MEPCO SCHLENK ENGINEERING COLLEGE (AUTONOMOUS), SIVAKASI

Affiliated to Anna University, Chennai 600 025.

BE COMPUTER SCIENCE ENGINEERING

MEPCO R2023 Choice Based Credit System

VISION	MISSION
To become the centre of excellence in computer education & research and to create the platform for industrial consultancy	To produce globally competent, quality computer professionals by educating computer concepts and techniques To facilitate the students to work with recent tools and technologies To mold the students by inculcating the spirit of ethical values contributing to the societal ethics

PROGRAM OUTCOMES (PO) and PROGRAM SPECIFIC OUTCOME (PSO)

PO1	Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems
PO2	Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
PO3	Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
PO4	Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions
PO5	Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations
PO6	The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice
PO7	Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO8	Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice
PO9	Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings
PO10	Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions
PO11	Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments
PO12	Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change
PSO1	Able to design a computer based system both at hardware and software level.
PSO2	Able to work on data related techniques and give solution focusing on industries.
PSO3	Able to analyse and give the solution for the given real world problem by writing effective program

BE COMPUTER SCIENCE ENGINEERING
Curriculum and Syllabus

Semester - 1

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	23HS101	TECHNICAL ENGLISH (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	3	**0**	**0**	**3**
2	23BS101	MATHEMATICS - I (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	3	**2**	**0**	**4**
3	23BS102	ENGINEERING PHYSICS (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	3	**0**	**0**	**3**
4	23BS103	ENGINEERING CHEMISTRY (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	3	**0**	**0**	**3**
5	23GE101	PROGRAMMING IN C (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	3	**0**	**0**	**3**
6	23GE103	BASIC CIVIL AND MECHANICAL ENGINEERING (Common to BAD, BBE, BCS, BEC, BEE, BIT)	3	**0**	**0**	**3**
Core Practical						
7	23BS151	ENGINEERING PHYSICS LABORATORY (Common to BAD, BBE, BCS, BEC, BEE, BIT)	0	**0**	**2**	**1**
8	23GE151	PROGRAMMING IN C LABORATORY (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	0	**0**	**3**	**1.5**
9	23GE152	ENGINEERING PRACTICES LABORATORY (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	0	**0**	**3**	**1.5**
Mandatory Course						
10	23GE153	தமிழர் மரபு (HERITAGE OF TAMILS) (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	1	**0**	**0**	**1#**
11	23GE154A	YOGA FOR YOUTH EMPOWERMENT - I (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	0	**0**	**2**	**-**
Total			19	**2**	**10**	**23**

 # - Grades shall not be considered for the computation of CGPA

Semester - 2

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	23BS201	MATHEMATICS - II (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	**2**	**0**	**3**
2	23BS203	MATERIALS SCIENCE (Common to BAD, BBE, BCS, BEC, BEE, BIT)	3	**0**	**0**	**3**
3	23BS205	ENVIRONMENTAL SCIENCE AND DISASTER MANAGEMENT (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	3	**0**	**0**	**3**
4	23CS201	OBJECT ORIENTED PROGRAMMING USING PYTHON	3	**0**	**0**	**3**
5	23GE204	ENGINEERING GRAPHICS AND BUILDING DRAWING (Common to BAD, BBE, BCS, BEC, BEE, BIT)	2	**2**	**0**	**3**
Theory Course with Lab Component						
6	23HS281	ENGLISH FOR PROFESSIONAL COMMUNICATION (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	**0**	**2**	**3**
Core Practical						
7	23BS252	ENVIRONMENTAL CHEMISTRY LABORATORY (Common to BAD, BBE, BCS, BEC, BEE, BIT)	0	**1**	**0**	**1**
8	23CS251	OBJECT ORIENTED PROGRAMMING USING PYTHON LABORATORY	0	**0**	**3**	**1.5**
9	23CS252	LINUX ADMINISTRATION AND SHELL PROGRAMMING LABORATORY	0	**0**	**3**	**1.5**
Mandatory Course						
10	23GE154	YOGA FOR YOUTH EMPOWERMENT - II (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	0	**0**	**2**	**1#**
11	23GE255	தமிழரும் தொழில்நுட்பமும் (TAMILS AND TECHNOLOGY) (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	1	**0**	**0**	**1#**
12	23GE256	NCC COURSE LEVEL - I** (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	1	**0**	**2**	**1#**
Total			17	**5**	**12**	**22**

**** - External Assessment Only # - Grades shall not be considered for the computation of CGPA**

Semester - 3

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	23MA303	MATHEMATICS - III : DISCRETE MATHEMATICS (Common to BCS, BIT)	2	**2**	**0**	**3**
2	23CS301	DATA STRUCTURES AND ALGORITHMS	3	**0**	**0**	**3**
3	23CS302	DIGITAL PRINCIPLES AND SYSTEM DESIGN	3	**0**	**0**	**3**
4	23CS303	COMPUTER ORGANIZATION AND ARCHITECTURE	3	**0**	**0**	**3**
5	23CS304	PROGRAMMING WITH JAVA	3	**0**	**0**	**3**
Core Practical						
6	23CS351	DATA STRUCTURES AND ALGORITHMS LABORATORY	0	**0**	**3**	**1.5**
7	23CS352	DIGITAL CIRCUITS LABORATORY	0	**0**	**3**	**1.5**
8	23CS353	JAVA LABORATORY	0	**0**	**3**	**1.5**
Project Work						
9	23CS354	MINI PROJECT - I	0	**0**	**2**	**1**
Employability Enhancement Courses						
10	23HSM01	PRESENTATION AND LANGUAGE SKILLS LABORATORY (Common to BAD, BBT, BCI, BCS, BEE, BIT)	0	**0**	**2**	**1**
Ability Enhancement Courses						
11	IAS30	INTEGRATED APTITUDE SKILLS - I (LOWER) (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	**0**	**0**	**1#**
12	USS30	UNDERSTANDING SOFT SKILLS - I (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	1	**0**	**0**	**1#**
Total			17	**2**	**13**	**21.5**

 # - Grades shall not be considered for the computation of CGPA

Semester - 4

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	23MA403	MATHEMATICS - IV : PROBABILITY, QUEUEING THEORY AND STATISTICS (Common to BCS, BIT)	2	**2**	**0**	**3**
2	23CS401	MICROPROCESSORS AND MICRO CONTROLLERS	3	**0**	**0**	**3**
3	23CS402	THEORY OF COMPUTATION	3	**0**	**0**	**3**
4	23CS403	OBJECT ORIENTED SOFTWARE ENGINEERING	3	**0**	**0**	**3**
5	23CS404	DATABASE SYSTEMS	3	**0**	**0**	**3**
Theory Course with Lab Component						
6	23CS481	DESIGN AND ANALYSIS OF ALGORITHMS	3	**0**	**2**	**4**
Core Practical						
7	23CS451	MICROPROCESSORS AND MICRO CONTROLLERS LABORATORY	0	**0**	**3**	**1.5**
8	23CS452	DBMS LABORATORY	0	**0**	**3**	**1.5**
Project Work						
9	23CS453	MINI PROJECT - II	0	**0**	**2**	**1**
Mandatory Course						
10	23GE451	NCC COURSE LEVEL - II** (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	1	**0**	**2**	**1#**
Ability Enhancement Courses						
11	IAS40	INTEGRATED APTITUDE SKILLS - II (LOWER) (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	**0**	**0**	**1#**
12	ITT40	ITT ON PYTHON PROGRAMMING (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	0	**0**	**2**	**1#**
13	USS40	UNDERSTANDING SOFT SKILLS - II (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	**0**	**0**	**1#**
Total			22	**2**	**14**	**23**

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Semester - 5

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	23CS501	OPERATING SYSTEMS	3	**0**	**0**	**3**
2	23CS502	COMPUTER NETWORKS AND APPLICATIONS	3	**0**	**0**	**3**
Theory Course with Lab Component						
3	23CS581	COMPILER DESIGN	3	**0**	**2**	**4**
Core Elective						
4		Core Elective-1 (BCS)	3	**0**	**0**	**3**
Open Elective						
5		UG Open Elective-1	3	**0**	**0**	**3**
Allied Elective						
6		UG Allied Elective-1	3	**0**	**0**	**3**
Core Practical						
7	23CS551	OPERATING SYSTEMS LABORATORY	0	**0**	**3**	**1.5**
8	23CS552	COMPUTER NETWORKS LABORATORY	0	**0**	**3**	**1.5**
Project Work						
9	23CS553	MINI PROJECT - III	0	**0**	**2**	**1**
Employability Enhancement Courses						
10	23HSM02	CAREER PLANNING AND PROFESSIONAL ESSENTIALS LABORATORY (Common to BAD, BBT, BCI, BCS, BEE, BIT)	0	**0**	**2**	**1**
Ability Enhancement Courses						
11	IAS50	INTEGRATED APTITUDE SKILLS - I (HIGHER) (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	**0**	**0**	**1#**
12	ITT50	ITT ON C PROGRAMMING (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	0	**0**	**2**	**1#**
13	USS50	SOFT SKILLS AND PERSONALITY DEVELOPMENT - I (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	1	**0**	**0**	**1#**
Total			21	**0**	**14**	**24**

 # - Grades shall not be considered for the computation of CGPA

Semester - 6

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	23CS601	HIGH PERFORMANCE COMPUTING	3	**0**	**0**	**3**
2	23CS602	COMPUTATIONAL INTELLIGENCE	3	**0**	**0**	**3**
Theory Course with Lab Component						
3	23CS681	CRYPTOGRAPHY ALGORITHMS AND NETWORK SECURITY	3	**0**	**2**	**4**
Core Elective						
4		Core Elective-2 (BCS)	3	**0**	**0**	**3**
Open Elective						
5		UG Open Elective-2	3	**0**	**0**	**3**
Allied Elective						
6		UG Allied Elective-2	3	**0**	**0**	**3**
Core Practical						
7	23CS651	HIGH PERFORMANCE COMPUTING LABORATORY	0	**0**	**3**	**1.5**
8	23CS652	COMPUTATIONAL INTELLIGENCE LABORATORY	0	**0**	**3**	**1.5**
Project Work						
9	23CS653	MINI PROJECT - IV	0	**0**	**2**	**1**
Mandatory Course						
10	23GE651	NCC COURSE LEVEL - III** (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	1	**0**	**2**	**1#**
Ability Enhancement Courses						
11	IAS60	INTEGRATED APTITUDE SKILLS - II (HIGHER) (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	**0**	**0**	**1#**
12	ITT63	ITT ON C++ / JAVA PROGRAMMING	0	**0**	**2**	**1#**
13	USS60	SOFT SKILLS AND PERSONALITY DEVELOPMENT - II (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	1	**0**	**0**	**1#**
Total			22	**0**	**14**	**23**

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Core Elective-1 (BCS)

S.No	Code	Name of the Course	Offered
1	23CSC01	DIGITAL IMAGING	CSE
2	23CSC02	COMPUTER GRAPHICS	CSE
3	23CSC03	WEB USER INTERFACE DESIGN	CSE
4	23CSC04	PARALLEL PROGRAMMING	CSE
5	23CSC05	SECURITY IN COMPUTING	CSE

Core Elective-2 (BCS)

S.No	Code	Name of the Course	Offered
1	23CSC06	SPEECH AND LANGUAGE PROCESSING	CSE
2	23CSC07	PATTERN RECOGNITION TECHNIQUES	CSE
3	23CSC08	J2EE TECHNOLOGIES	CSE
4	23CSC09	FULL STACK PROGRAMMING	CSE
5	23CSC10	PARALLEL ALGORITHMS	CSE
6	23CSC11	CRYPTOGRAPHIC ALGORITHMS AND ARCHITECTURE USING JAVA	CSE

UG Open Elective-1

S.No	Code	Name of the Course	Offered
1	23ADP01	DATA ANALYTICS IN BIOINFORMATICS	AID
2	23ADP02	TEXT ANALYTICS	AID
3	23ADP03	PRINCIPLES OF KNOWLEDGE REPRESENTATION AND REASONING	AID
4	23ADP04	ARTIFICIAL INTELLIGENCE IN FINANCE	AID
5	23ADP05	ETHICS AND VALUES IN INTELLIGENT COMPUTING	AID
6	23ADP06	PREDICTIVE ANALYTICS	AID
7	23ADP07	INFORMATION AND NETWORK SECURITY	AID
8	23BMP01	MEDICAL PHYSICS	BME
9	23BMP02	ENGINEERING OF NANOMATERIALS	BME
10	23BMP03	REGENERATIVE MEDICINE	BME
11	23BTP01	BIOSENSOR TECHNOLOGY	BT
12	23BTP02	IMAGING IN BIOLOGY AND MEDICINE	BT
13	23BTP03	CLINICAL TRIALS	BT
14	23CEP01	COMPOSITE MATERIALS	CIV
15	23CEP02	BASICS OF CLIMATIC SCIENCE AND POLICY	CIV
16	23CEP03	CONSTRUCTION SAFETY PRACTICES	CIV
17	23CEP04	INTRODUCTION TO GEOINFORMATICS	CIV
18	23CEP05	ARCHITECTURE	CIV
19	23CSP01	DIGITAL VIDEO PROCESSING	CSE
20	23CSP02	FREE OPEN SOURCE SOFTWARE	CSE
21	23CSP03	PRINCIPLES OF DISTRIBUTED SYSTEMS	CSE
22	23ECP01	MACHINE LEARNING TECHNIQUES AND ALGORITHMS	ECE
23	23ECP02	ATTACKS ON CYBER SECURITY AND DEFENSE STRATEGIES	ECE
24	23ECP03	SEMICONDUCTOR MEMORIES	ECE
25	23ECP04	WEARABLE DEVICES	ECE
26	23ECP05	CONSUMER ELECTRONICS	ECE
27	23ECP06	PCB DESIGN AND THERMAL MANAGEMENT	ECE
28	23EEP01	VIRTUAL INSTRUMENTATION	EEE
29	23EEP02	SOFT COMPUTING TECHNIQUES	EEE
30	23ITP01	SOCIAL NETWORK ANALYSIS	IT
31	23ITP02	DATA SCIENCE	IT
32	23ITP03	FUZZY SYSTEMS AND APPLICATIONS	IT
33	23ITP04	INTRODUCTION TO DEVOPS	IT
34	23ITP05	MATH FOR MACHINE LEARNING	IT
35	23MEP01	PROPERTIES AND SELECTION OF ENGINEERING MATERIALS	MECH
36	23MEP02	INNOVATION AND DESIGN THINKING	MECH
37	23MEP03	MECHATRONICS	MECH
38	23MEP04	METALLURGY OF STEEL	MECH
39	23MEP05	SURFACE COATING TECHNOLOGY	MECH
40	23MEP06	SOLAR ENERGY TECHNOLOGIES	MECH
41	23MEP07	AUTOMOTIVE INFOTRONICS	MECH

42	23MEP08	INDUSTRIAL REVOLUTION X	MECH
43	23UCP01	NANO MATERIALS AND THEIR APPLICATIONS	CHE
44	23UCP02	COMPUTER APPLICATIONS IN CHEMICAL SCIENCE	CHE
45	23UMP01	NUMBER THEORY AND GRAPH THEORY FOR CRYPTOGRAPHY	MAT
46	23UMP02	INTRODUCTION TO NUMBER THEORY FOR CRYPTOGRAPHY	MAT

UG Open Elective-2

S.No	Code	Name of the Course	Offered
1	23ADP08	GEO SPATIAL ANALYTICS	AID
2	23ADP09	DIGITAL ASSET MANAGEMENT SYSTEM	AID
3	23ADP10	EVOLUTIONARY COMPUTING ALGORITHMS	AID
4	23ADP11	DISTRIBUTED COMPUTING	AID
5	23ADP12	DATA SCIENCE USING PYTHON	AID
6	23ADP13	DATA VISUALIZATION	AID
7	23BMP04	BIOMEDICAL SENSOR TECHNOLOGY	BME
8	23BMP05	MEDICAL WASTE MANAGEMENT	BME
9	23BMP06	REGULATORY AFFAIRS FOR MEDICAL DEVICES	BME
10	23BTP04	PRINCIPLES AND APPLICATIONS OF RADIOISOTOPES IN BIOTECHNOLOGY	BT
11	23BTP05	BIOFUELS	BT
12	23BTP06	MOLECULAR PATHOGENESIS OF INFECTIOUS DISEASES	BT
13	23BTP07	IPR, BIOETHICS AND BIOSAFETY	BT
14	23CEP06	CONSTRUCTION PLANNING AND MANAGEMENT	CIV
15	23CEP07	HYDROPOWER ENGINEERING	CIV
16	23CEP08	FUNDAMENTALS OF SMART CITY PLANNING	CIV
17	23CEP09	BASICS OF DYNAMICS AND SEISMIC DESIGN OF STRUCTURES	CIV
18	23CSP04	PROGRAMMING WITH JULIA	CSE
19	23CSP05	PROGRAMMING MASSIVELY PARALLEL PROCESSORS	CSE
20	23CSP06	CYBER CRIME AND LAWS	CSE
21	23ECP07	MULTIMEDIA COMPRESSION TECHNIQUES	ECE
22	23ECP08	DATA HIDING TECHNIQUES	ECE
23	23ECP09	QUADCOPTER AND ITS APPLICATIONS	ECE
24	23ECP10	ESSENTIALS OF SEMICONDUCTOR IC TESTING	ECE
25	23ECP11	QUANTUM CIRCUIT DESIGN	ECE
26	23ECP12	TOTAL QUALITY MANAGEMENT	ECE
27	23EEP03	PLC AND INDUSTRIAL AUTOMATION	EEE
28	23EEP04	ADVANCED OPTIMIZATION TECHNIQUES	EEE
29	23EEP05	PRINCIPLES OF MANAGEMENT	EEE
30	23EEP06	PROFESSIONAL ETHICS AND HUMAN VALUES	EEE
31	23ITP06	INNOVATION AND ENTREPRENEURSHIP	IT
32	23ITP07	INTELLECTUAL PROPERTY RIGHTS	IT
33	23ITP08	ETHICS IN COMPUTING	IT
34	23ITP09	REINFORCEMENT LEARNING	IT
35	23MEP09	ENGINEERING ECONOMICS AND COST ANALYSIS	MECH
36	23MEP10	INDUSTRIAL MANAGEMENT AND PSYCHOLOGY	MECH
37	23MEP11	DESIGN OF EXPERIMENTS	MECH
38	23MEP12	LITHOGRAPHIC PROCESSES	MECH
39	23MEP13	THERMAL TURBOMACHINES	MECH
40	23MEP14	FUEL CELL AND HYDROGEN TECHNOLOGY	MECH
41	23MEP15	DESIGN FOR X	MECH
42	23MEP16	DESIGN OF MATERIAL HANDLING EQUIPMENTS	MECH
43	23MEP17	THERMAL AND FIRED EQUIPMENT DESIGN	MECH
44	23UEP01	BUSINESS COMMUNICATION	ENG
45	23UEP02	WRITING FOR MASS MEDIA	ENG
46	23UMP03	FUZZY SET AND ITS APPLICATIONS	MAT
47	23UMP04	GRAPH THEORY	MAT
48	23UMP05	LATTICE THEORY	MAT
49	23UMP06	OPTIMIZATION TECHNIQUES	MAT
50	23UPP01	THIN FILMS TECHNOLOGY	PHY
51	23UPP02	CRYSTAL GROWTH AND SPECTROSCOPY	PHY

52	23UPP03	PHOTONICS	PHY

UG Allied Elective-1

S.No	Code	Name of the Course	Offered
1	23ADA01	INTRODUCTION TO MACHINE LEARNING	AID
2	23ADA02	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE	AID
3	23ADA03	DATA VISUALIZATION WITH PYTHON	AID
4	23ADA04	WEB DEVELOPMENT USING NODE AND REACT JS	AID
5	23ADA05	PROBLEM SOLVING USING PYTHON	AID
6	23BMA01	BIOLOGICAL SCIENCE AND ENGINEERING	BME
7	23BMA02	HOSPITAL PLANNING AND EQUIPMENT MANAGEMENT	BME
8	23BTA01	BIOLOGY FOR ENGINEERS	BT
9	23BTA02	BASIC MICROBIOLOGY	BT
10	23BTA03	BASIC BIOCHEMISTRY	BT
11	23BTA04	FUNDAMENTALS OF IMMUNOLOGY	BT
12	23CEA01	BUILDING PLANNING AND DRAWING	CIV
13	23CEA02	INDUSTRIAL POLLUTION PREVENTION AND CONTROL	CIV
14	23CEA03	INTRODUCTION TO ENGINEERING SEISMOLOGY	CIV
15	23CEA04	PRINCIPLES OF GLOBAL POSITIONING SYSTEM	CIV
16	23ECA01	IMAGE PROCESSING	ECE
17	23ECA02	ARDUINO FOR ENGINEERS	ECE
18	23ECA03	EMBEDDED SYSTEMS FOR INDUSTRIAL APPLICATIONS	ECE
19	23ECA04	SMART SENSORS	ECE
20	23EEA01	PRINCIPLES OF ELECTRICAL SYSTEM	EEE
21	23EEA02	ELECTRICAL MACHINES AND DRIVES	EEE
22	23EEA03	FUNDAMENTALS OF ELECTRIC POWER UTILIZATION	EEE
23	23EEA04	GREEN ENERGY SOURCES	EEE
24	23ITA01	WEB DESIGN AND DEVELOPMENT	IT
25	23ITA02	INTRODUCTION TO JAVA	IT
26	23ITA03	PYTHON SCRIPTING	IT
27	23ITA04	E-WASTE MANAGEMENT	IT
28	23ITA05	DIGITAL ASSET MANAGEMENT	IT
29	23MEA01	AUTOMOTIVE MAINTENANCE AND POLLUTION CONTROL	MECH
30	23MEA02	ADDITIVE MANUFACTURING	MECH
31	23MEA03	DECISION SUPPORT AND INTELLIGENT SYSTEMS	MECH
32	23MEA04	ENERGY EFFICIENT BUILDINGS	MECH
33	23MEA05	ELECTRONICS PACKAGING TECHNOLOGY	MECH
34	23MEA06	FUNDAMENTALS OF ENERGY RESOURCES	MECH
35	23MEA07	FUNDAMENTALS OF FIRE SAFETY ENGINEERING	MECH
36	23MEA08	RELIABILITY ENGINEERING	MECH
37	23MEA09	STATISTICAL QUALITY CONTROL	MECH
38	23MEA10	COMPUTER AIDED DESIGN	MECH
39	23MEA11	DIGITAL MANUFACTURING	MECH
40	23MEA12	STRESS MANAGEMENT	MECH
41	23MEA13	ENERGY CONSERVATION TECHNOLOGIES	MECH
42	23MEA14	PRODUCT LIFE CYCLE MANAGEMENT	MECH

UG Allied Elective-2

S.No	Code	Name of the Course	Offered
1	23ADA06	INTRODUCTION TO DEEP LEARNING TECHNIQUES	AID
2	23ADA07	IOT AND ITS APPLICATIONS	AID
3	23ADA08	ESSENTIALS OF BIG DATA	AID
4	23ADA09	DATA ENGINEERING	AID
5	23ADA10	DESIGN THINKING IN ARTIFICIAL INTELLIGENCE	AID
6	23BMA03	BIOSENSORS AND ITS APPLICATIONS	BME
7	23BMA04	INTRODUCTION TO BIOMEDICAL DEVICES	BME
8	23BTA05	BIOLOGICAL WASTE MANAGEMENT	BT
9	23BTA06	NANOBIOTECHNOLOGY	BT
10	23BTA07	INTRODUCTION TO BIOINFORMATICS	BT
11	23CEA05	RESOURCES AND ENERGY RECOVERY FROM WASTE	CIV

12	23CEA06	GEOTECHNICAL FUNDAMENTALS OF EARTHQUAKE	CIV
13	23CEA07	ROAD AND RAIL TRANSPORT	CIV
14	23CEA08	GEOGRAPHICAL INFORMATION SYSTEM FOR DISASTER MANAGEMENT	CIV
15	23ECA05	VLSI CIRCUITS	ECE
16	23ECA06	ROBOTICS	ECE
17	23ECA07	MOBILE COMMUNICATION	ECE
18	23ECA08	BRAIN COMPUTER INTERFACE	ECE
19	23EEA05	POWER SUPPLY CIRCUITS	EEE
20	23EEA06	FUNDAMENTALS OF POWER QUALITY	EEE
21	23EEA07	CONTROL ENGINEERING (EXCEPT FOR ECE)	EEE
22	23EEA08	INDUSTRIAL MEASUREMENTS AND INSTRUMENTATION	EEE
23	23EEA09	INSTRUMENTS IN BIOENGINEERING RESEARCH	EEE
24	23ITA06	GRAPHICS PROGRAMMING	IT
25	23ITA07	BIG DATA AND APPLICATIONS	IT
26	23ITA08	INTELLIGENT DECISION MAKING METHODS	IT
27	23ITA09	PHP PROGRAMMING	IT
28	23ITA10	GO PROGRAMMING	IT
29	23MEA15	FUNDAMENTALS OF AIRCRAFT AND SPACE TECHNOLOGY	MECH
30	23MEA16	FUNDAMENTALS OF NANOMATERIALS	MECH
31	23MEA17	FUNDAMENTALS OF THERMAL SCIENCE	MECH
32	23MEA18	PROPELLANTS, EXPLOSIVES AND PYROTECHNICS	MECH
33	23MEA19	FUELS AND EMISSIONS	MECH
34	23MEA20	MODELING AND ANALYSIS OF ADVANCED MANUFACTURING SYSTEM	MECH
35	23MEA21	FACILITIES LOCATION AND DESIGN	MECH
36	23MEA22	CONCEPTS IN DESIGN	MECH
37	23MEA23	APPLICATIONS OF NANOFLUID	MECH
38	23MEA24	ENERGY ANALYSIS OF INDUSTRIAL SYSTEMS	MECH
39	23UBA01	ESSENTIALS OF ACCOUNTING AND FINANCE	MBA
40	23UBA02	ESSENTIALS OF HUMAN RESOURCE MANAGEMENT	MBA
41	23UBA03	ESSENTIALS OF MARKETING	MBA
42	23UBA04	ESSENTIALS OF ENTREPRENEURSHIP	MBA

Honours / Minor in Emerging Area Electives for BE COMPUTER SCIENCE ENGINEERING

Honours in Internet of Things

S.No	Sem.	Code	Name of the Course	Offered
1	4	23ECH01	SENSORS AND ACTUATORS	ECE
2	4	23ECH02	IOT ARCHITECTURE AND FRAMEWORK	ECE
3	5	23ECH03	COMMUNICATION PROTOCOLS FOR IOT	ECE
4	5	23ECH04	CLOUD SERVICES FOR IOT	ECE
5	6	23ECH05	BIG DATA ANALYTICS FOR IOT	ECE

Honours in Sensor Technology

S.No	Sem.	Code	Name of the Course	Offered
1	4	23ECH01	SENSORS AND ACTUATORS	ECE
2	4	23EEH41	DIGITAL MEASUREMENTS AND INSTRUMENTATION	EEE
3	5	23ECH21	ENERGY AWARE SENSORS	ECE
4	5	23ECH22	MULTIDISCIPLINARY SENSORS	ECE
5	6	23ECH23	ADVANCED SENSOR AND DETECTION MATERIALS	ECE

Honours in Artificial Intelligence and Machine Learning

S.No	Sem.	Code	Name of the Course	Offered
1	4	23CSH01	ARTIFICIAL INTELLIGENCE FOR ENGINEERS	CSE
2	4	23CSH02	MACHINE LEARNING USING PYTHON	CSE
3	5	23CSH03	NLP AND ITS APPLICATIONS	CSE
4	5	23CSH04	DEEP LEARNING USING TENSOR FLOW	CSE
5	6	23CSH05	METAHEURISTIC OPTIMIZATION TECHNIQUES	CSE

Honours in Cyber Security

S.No	Sem.	Code	Name of the Course	Offered
1	4	23MAH91	NUMBER THEORY FOR INFORMATION SECURITY	MAT
2	4	23CSH21	COMPUTER FORENSICS	CSE
3	5	23CSH22	INTRUSION DETECTION AND PREVENTION SYSTEM	CSE
4	5	23CSH23	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	CSE
5	6	23CSH24	ETHICAL HACKING	CSE

Honours in Data Science

S.No	Sem.	Code	Name of the Course	Offered
1	4	23MAH92	MATHEMATICS FOR DATA SCIENCE	MAT
2	4	23CSH41	DATA MINING AND ANALYTICS	CSE
3	5	23CSH42	DATA SCIENCE FOR ENGINEERS	CSE
4	5	23CSH43	PROGRAMMING FOR DATA SCIENCE	CSE
5	6	23CSH44	BIG DATA ANALYTICS USING SPARK	CSE

Honours in Blockchain

S.No	Sem.	Code	Name of the Course	Offered
1	4	23ITH01	CRYPTOGRAPHY AND HASHING	IT
2	4	23ITH02	INTRODUCTION TO DIGITAL CURRENCIES	IT
3	5	23ITH03	BLOCKCHAIN TECHNOLOGIES	IT
4	5	23ITH04	SMART CONTRACTS AND DECENTRALIZED APPLICATIONS	IT
5	6	23ITH05	BLOCKCHAIN PLATFORMS	IT

Honours in Virtual Reality & Augmented Reality

S.No	Sem.	Code	Name of the Course	Offered
1	4	23ITH21	INTRODUCTION TO COMPUTER GRAPHICS	IT
2	4	23ITH22	INTRODUCTION TO VIRTUAL REALITY	IT
3	5	23ITH23	GEOMETRIC MODELLING FOR XR	IT
4	5	23ITH24	INTERACTIVE 3D DESIGN	IT
5	6	23ITH25	XR APP DEVELOPMENT	IT

Honours in Advance Web development

S.No	Sem.	Code	Name of the Course	Offered
1	4	23ADH01	INTRODUCTION TO WEB DESIGN	AID
2	4	23ADH02	FRONT END DEVELOPMENT WITH REACT AND TYPESCRIPT	AID
3	5	23ADH03	WEB APPLICATION DEVELOPMENT	AID
4	5	23ADH04	DEVOPS	AID
5	6	23ADH05	MERN STACK	AID

Minor in Smart Cities

S.No	Sem.	Code	Name of the Course	Offered
1	4	23CEH01	URBAN AND REGIONAL PLANNING REGULATIONS	CIV
2	4	23CEH02	URBAN CLIMATE CHANGE AND ADAPTATION	CIV
3	5	23CEH03	IOT PLATFORM FOR SMART CITY PLANNING	CIV
4	5	23CEH04	INTELLIGENT TRANSPORT SYSTEMS	CIV
5	6	23CEH05	INTEGRATED URBAN WATER MANAGEMENT	CIV

Minor in Infrastructure Engineering

S.No	Sem.	Code	Name of the Course	Offered
1	4	23CEH21	MATERIAL PROCUREMENT AND MANAGEMENT	CIV
2	4	23CEH22	STRATEGIC PLANNING FOR INFRASTRUCTURE SECTORS	CIV
3	5	23CEH23	GEOTECHNIQUES FOR INFRASTRUCTURE	CIV
4	5	23CEH24	PROJECT FORMULATION AND IMPLEMENTATION	CIV
5	6	23CEH25	HIGH RISE BUILDINGS	CIV

Minor in Construction Technology

S.No	Sem.	Code	Name of the Course	Offered
1	4	23CEH41	MODERN CONSTRUCTION MATERIALS	CIV
2	4	23CEH42	CONSTRUCTION EQUIPMENT MANAGEMENT	CIV
3	5	23CEH43	ENERGY CONSERVATION METHODS IN CONSTRUCTION	CIV

4	5	23CEH44	INTELLIGENT BUILDING TECHNIQUES	CIV
5	6	23CEH45	QUALITY CONTROL IN CONSTRUCTION	CIV

Minor in Smart Grid Technologies

S.No	Sem.	Code	Name of the Course	Offered
1	4	23EEH01	CONVENTIONAL AND ALTERNATE ENERGY SOURCES	EEE
2	4	23EEH02	INTRODUCTION TO SMART GRID AND ELECTRIC VEHICLES	EEE
3	5	23EEH03	DATA MANAGEMENT FOR SMART GRID	EEE
4	5	23EEH04	IOT FOR SMART GRIDS	EEE
5	6	23EEH05	POWER ELECTRONIC INTERFACES FOR SMART GRID	EEE

Minor in Electrical & Computer Engineering

S.No	Sem.	Code	Name of the Course	Offered
1	4	23EEH21	OBJECT ORIENTED PROGRAMMING USING JAVA FOR ELECTRICAL ENGINEERS	EEE
2	4	23EEH22	DATA ANALYSIS USING PYTHON FOR ELECTRICAL ENGINEERS	EEE
3	5	23EEH03	DATA MANAGEMENT FOR SMART GRID	EEE
4	5	23EEH04	IOT FOR SMART GRIDS	EEE
5	6	23EEH23	COMMUNICATION AND DATA SECURITY IN ELECTRICAL ENGINEERING	EEE

Minor in Control Systems and Sensors Technology

S.No	Sem.	Code	Name of the Course	Offered
1	4	23ECH01	SENSORS AND ACTUATORS	ECE
2	4	23EEH41	DIGITAL MEASUREMENTS AND INSTRUMENTATION	EEE
3	5	23EEH42	INDUSTRIAL INSTRUMENTATION	EEE
4	5	23EEH43	PROCESS CONTROL	EEE
5	6	23EEH44	MEMS SENSORS AND ACTUATORS	EEE

Minor in 3D Printing

S.No	Sem.	Code	Name of the Course	Offered
1	4	23MEH01	INTRODUCTION TO PRODUCT DESIGN	MECH
2	4	23MEH02	ADDITIVE MANUFACTURING PROCESSES	MECH
3	5	23MEH03	DESIGN FOR ADDITIVE MANUFACTURING	MECH
4	5	23MEH04	REVERSE ENGINEERING	MECH
5	6	23MEH05	BUSINESS VALUE ENHANCEMENT WITH ADDITIVE MANUFACTURING	MECH

Minor in Robotics

S.No	Sem.	Code	Name of the Course	Offered
1	4	23MEH21	FUNDAMENTALS OF ROBOTICS	MECH
2	4	23EEH91	ROBOT MANIPULATOR CONTROL	EEE
3	5	23ECH91	ROBOT OPERATING SYSTEM AND PROGRAMMING	ECE
4	5	23ECH92	ARTIFICIAL INTELLIGENCE AND REINFORCEMENT LEARNING	ECE
5	6	23MEH22	AUTONOMOUS ROBOTS	MECH

Minor in Electric Vehicles

S.No	Sem.	Code	Name of the Course	Offered
1	4	23MEH41	FUNDAMENTALS OF ELECTRIC AND HYBRID VEHICLES	MECH
2	4	23EEH92	INTELLIGENT AND AUTONOMOUS VEHICLES	EEE
3	5	23MEH42	ENERGY STORAGE AND MANAGEMENT FOR ELECTRIC VEHICLES	MECH
4	5	23MEH43	VEHICLE DYNAMICS AND CONTROL	MECH
5	6	23MEH44	ELECTRIC VEHICLE DESIGN	MECH

Minor in Energy Engineering

S.No	Sem.	Code	Name of the Course	Offered
1	4	23MEH61	BIO ENERGY	MECH
2	4	23MEH62	ALTERNATE ENERGY FUELS	MECH
3	5	23MEH63	COMBUSTION ENGINEERING	MECH
4	5	23MEH64	ANALYSIS AND DESIGN OF AIR CONDITIONING SYSTEMS	MECH
5	6	23MEH65	ENERGY AUDIT AND ENVIRONMENT MANAGEMENT	MECH

Minor in Systems Engineering

S.No	Sem.	Code	Name of the Course	Offered
1	4	23MEH81	SCHEDULING ALGORITHMS	MECH
2	4	23MEH82	LEAN AND AGILE MANUFACTURING	MECH
3	5	23MEH83	SYSTEMS SCIENCE AND ENGINEERING	MECH
4	5	23MEH84	SERVICES OPERATIONS MANAGEMENT	MECH
5	6	23MEH85	QUALITY ENGINEERING	MECH

Minor in Genome Engineering & Technology

S.No	Sem.	Code	Name of the Course	Offered
1	4	23BTH01	HUMAN PHYSIOLOGY	BT
2	4	23BTH02	ENZYME - COENZYME CHEMISTRY	BT
3	5	23BTH03	INTRODUCTION TO ECOLOGY AND EVOLUTION	BT
4	5	23BTH04	REGULATORY ISSUES IN PRODUCTION OF BIOLOGICALS	BT
5	6	23BTH05	GENE EDITING TECHNOLOGIES	BT

Minor in Biosimilar Technology

S.No	Sem.	Code	Name of the Course	Offered
1	4	23BTH01	HUMAN PHYSIOLOGY	BT
2	4	23BTH02	ENZYME - COENZYME CHEMISTRY	BT
3	5	23BTH21	MOLECULAR TOXICOLOGY	BT
4	5	23BTH04	REGULATORY ISSUES IN PRODUCTION OF BIOLOGICALS	BT
5	6	23BTH22	BIO-TRANSPORT PHENOMENA	BT

Minor in Computational Biology

S.No	Sem.	Code	Name of the Course	Offered
1	4	23CSH91	COMPUTER FUNDAMENTALS FOR BIOLOGICAL DATA REPRESENTATION	CSE
2	4	23CSH92	PYTHON AND R PROGRAMMING FOR BIOTECHNOLOGISTS	CSE
3	5	23BTH03	INTRODUCTION TO ECOLOGY AND EVOLUTION	BT
4	5	23BTH41	COMPUTER-AIDED DRUG DESIGN	BT
5	6	23BTH42	MATHEMATICAL MODELING IN BIOLOGY	BT

Minor in Medical Robotics and Devices

S.No	Sem.	Code	Name of the Course	Offered
1	4	23MEH21	FUNDAMENTALS OF ROBOTICS	MECH
2	4	23BMH01	MEDICAL DEVICE DESIGN	BME
3	5	23BMH02	ROBOTIC SYSTEM PROGRAMMING	BME
4	5	23BMH03	MICRO AND NANO MEDICAL ROBOTICS	BME
5	6	23BMH04	ROBOTICS IN BIOPROSTHETICS	BME

Minor in VLSI Design and Technology

S.No	Sem.	Code	Name of the Course	Offered
1	4	23ECH41	ADVANCED DIGITAL SYSTEM DESIGN	ECE
2	4	23ECH42	PHYSICAL DESIGN OF VLSI CIRCUITS	ECE
3	5	23ECH43	LOW POWER VLSI DESIGN	ECE
4	5	23ECH44	ANALOG VLSI DESIGN	ECE
5	6	23ECH45	VLSI SIGNAL PROCESSING	ECE

Minor in 5G and Advanced Technologies

S.No	Sem.	Code	Name of the Course	Offered
1	4	23ECH61	MIMO AND MULTICARRIER SYSTEMS	ECE
2	4	23ECH02	IOT ARCHITECTURE AND FRAMEWORK	ECE
3	5	23ECH62	LONG TERM EVOLUTION TECHNOLOGIES	ECE
4	5	23ECH63	SIGNAL PROCESSING FOR 5G MILLIMETER WAVE COMMUNICATION	ECE
5	6	23ECH64	SOFTWARE DEFINED NETWORKING	ECE

Minor in Business Development, Marketing and Finance

S.No	Sem.	Code	Name of the Course	Offered
1	4	23BAH01	MANAGEMENT OF ORGANISATIONS	MBA
2	4	23BAH02	UNDERSTANDING BUSINESS ENVIRONMENT	MBA

3	5	23BAH03	ECONOMICS FOR BUSINESS DEVELOPMENT	MBA
4	5	23BAH04	MARKETING FOR BUSINESS DEVELOPMENT	MBA
5	6	23BAH05	CORPORATE FINANCE	MBA

Minor in Innovation, Entrepreneurship and Venture Development

S.No	Sem.	Code	Name of the Course	Offered
1	4	23MIH01	ENTREPRENEURIAL DYNAMICS AND OPPORTUNITIES	MIC
2	4	23MIH02	PROBLEM SOLVING AND INNOVATION MANAGEMENT	MIC
3	5	23MIH03	CREATIVE DESIGN APPROACH FOR PRODUCT DEVELOPMENT	MIC
4	5	23MIH04	ENTREPRENEURIAL FINANCE AND ACCOUNTING	MIC
5	6	23MIH05	SOCIAL ENTREPRENEURSHIP	MIC

23HS101 TECHNICAL ENGLISH

Offered by ENG (Core Theory offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Fine-tuning the speaking ability
- Communicating ideas fluently in English
- The application of grammar in speaking and writing
- Being assertive in their language
- Enhancing reading and listening skills.

Course Outcome:

At the end of the course, the students will be able to

- Construct lucid sentences for effective writing
- Write flawless sentences in their communication
- Speak precisely with right choice of diction
- Use wide range of vocabularies in speaking and writing
- Read and listen properly.

Unit I **9**

Listening: Listening to News (CNN, BBC, NDTV), Documentaries

Speaking: Individual Presentations - Greetings, Introducing oneself, One's family/friends; Describing Native places, festivals - Reporting / Summarising of lectures, Documentaries, Podcasts, News items and Interviews

Reading: News Reading-Skimming and Scanning – Reading Biographies, Travelogues, Technical events brochures, Online review for gadgets, Formal letters and e-mails

Writing: Free writing on any given topic (Trending news) - Informal letter – Its formats – Block, Modified Block and Semi- block

Grammar: Kinds of Sentences – Word Order – Framing Questions - Question Tags – Present Tense (Four forms), Modal Auxiliaries

Vocabulary : Affixes, Single line Definitions

Unit II **9**

Listening : Listening to Motivational Talks, News Comprehension

Speaking : Describing simple processes (filling forms, etc.), Seeking Clarifications/Explanations, Instructions to use a product / Presenting a Product / Marketing a Product

Reading : Excerpts from Literature – Comprehension Exercises, Technical Blogs

Writing : Letter to the Editor (Regarding Social Issues) – Instructions (Product service and code of conduct)- Developing Hints – Essay Writing – Narrative and Descriptive essays – Email writing – Formal and Informal

Grammar : Pronouns – Types and examples – Past Tense (Four Forms) - Regular and Irregular Verbs – Articles

Vocabulary : Expanding Compound words – Discourse Markers

Unit III **9**

Listening : Listening to Interviews with celebrities

Speaking : Describing Pictures, Events and Chit-chats

Reading : Cohesive Markers – Jumbled Sentences

Writing : Paragraph Writing (Compare and Contrast/ Analytical)

Grammar : Active and Passive Voice, Same word in a different parts of speech - Future Tense (Four Forms)

Vocabulary : Single word substitutes, Idioms

Unit IV **9**

Listening : Listening to videos of domain specific Product development / Process / Servicing videos - Debates / Analysing Technical Problems and Offering Solutions

Speaking : Expressing counterfeit opinions - Giving impromptu talks, Role-plays

Reading : Predicting Open ended stories - Technical documentaries – Editorial columns

Writing : Formal Letters – Invitations (Accepting/Declining), Seeking Permission (Industrial Visits) – Personal milestones (Goal setting)

Grammar : Prepositions – Determiners - Position of Adverbs - Degrees of Comparison - Punctuation and Capitalisation

Vocabulary : Standard Abbreviations & Acronyms – Content Vs Function words

Unit V **9**

Listening : Listen to Podcast, TEDx talks and Spell Bee contest to learn pronunciation

Speaking : Persuasive and content specific presentation, Mini Presentation – Making Suggestions & Recommendations

Reading : Product Advertisements

Writing : Note-making - Creating Posters/Notices, Creative Writing (Story Writing), Essay Writing – Analytical,

Compare and Contrast and Informal Essays
Grammar : Concord – Error Corrections (Paragraphs), - Fixed and Semi-fixed expressions
Vocabulary : Homophones and Homonyms – Domain specific Vocabulary – Phrasal Verbs

Text Book:

1. Gangalakshmi C, Rathika B, Saranraj L. Professional English for Engineers. New Delhi : CENGAGE, 2022

Reference Book:

1. Kumar, Sanjay and Pushp Lata. Communication Skills. New Delhi: OUP, 2018.
2. Wood F.T. A Remedial English Grammar For Foreign Students, Trinity, 2019.

Extensive Reading:

- Khera, Shiv. You can Win. Chennai: Macmillan India Press, 2010. Print.

23BS101 MATHEMATICS - I

Offered by MAT (Core Theory offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	2	0	4

Course Objective:

To impart knowledge on

- Examining the consistency of a linear system and analyzing characteristic polynomial of a square matrix.
- Introducing the matrix algebra theory for practical applications.
- Explaining the concept of functions of several variables and partial derivatives.
- Evaluating problems in multiple integrals and its application in engineering.
- Comparing types of infinite series and their convergence.

Course Outcome:

At the end of the course, the students will be able to

- Solve the linear system and estimate inverse and powers of a square matrix.
- Apply the matrix algebra for eigenvalue related applications.
- Describe concepts about functions of more than one variable.
- Explain about multiple integrals and its application in engineering.
- Examine the convergence for any infinite series.

Unit I MATRICES AND LINEAR SYSTEMS 12

Rank of a matrix - Solution of simultaneous equations by elementary transformation - Consistency and inconsistency of system of simultaneous linear equations - Evaluation of inverse of a matrix by elementary row operations - LU decomposition - Characteristic equation - Cayley-Hamilton theorem - Application of Cayley - Hamilton theorem.

Unit II REDUCTION OF MATRICES 12

Eigenvalues and eigenvectors of a real matrix - Properties of eigenvalues and eigenvectors - Diagonalization of matrices - Similarity transformation - Nature of quadratic forms - Reduction of a quadratic form to canonical form by orthogonal transformation.

Unit III FUNCTIONS OF SEVERAL VARIABLES 12

Partial derivatives - Homogeneous function and Euler's theorem - Total derivative - Differentiation of implicit functions - Jacobians - Taylor's series for functions of two variables - Maxima and minima of functions of two variables - Lagrange's method of undetermined multipliers.

Unit IV MULTIPLE INTEGRALS 12

Double integrals - Change of order of integration - Double integrals in polar coordinates - Area enclosed by plane curves - Triple integrals - Evaluation in cylindrical and spherical coordinates - Volume of solids.

Unit V INFINITE SERIES 12

Sequences - Convergence of series - General properties - Series of positive terms - Tests for convergence: Comparison test, Integral test and D'Alembert's ratio test (proofs excluded) - Alternating series - Series of positive and negative terms - Absolute and conditional convergence - Power Series - Convergence of Exponential, Logarithmic and Binomial Series.

Text Book:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2021.

Reference Book:

1. Anthony Croft, Robert Davison, Martin Hargreaves and James Flint, "Engineering Mathematics", Pearson Education, 5th Edition, 2017.
2. George B. Thomas, Joel Hass, Christopher Heil and Maurice D. Weir, "Thomas' Calculus", Pearson Education, 14th Edition, 2018.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, 2nd Edition, 2013.
4. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, 2020.
5. Peter O'Neil, "Advanced Engineering Mathematics", Cengage Learning, 8th Edition, 2017.
6. Ramana B.V., "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, 13th Edition, 2017.
7. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, 2015.

23BS102 ENGINEERING PHYSICS

Offered by PHY (Core Theory offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart sound knowledge about basic concepts of elasticity
- To introduce the basic physics concepts of acoustics of buildings and ultrasonics
- To comprehend and explain the fundamentals of quantum physics
- To impart knowledge on laser and fibre optics
- To give exposure on solid state physics

Course Outcome:

At the end of the course, the students will be able to

- Gain knowledge on the basics properties of matter and its applications
- Have adequate knowledge on the concepts of acoustics and ultrasonics
- Get knowledge on advanced physics concepts of quantum theory
- Acquire knowledge on the concepts of laser and their applications in fiber optics
- Comprehend the basics of crystals, their structures and different crystal growth techniques

Unit I PROPERTIES OF MATTER **9**

Elasticity – Poisson's ratio and relationship between moduli (qualitative) – Stress-strain diagram and its uses – Factors affecting tensile strength – Bending of beams – Cantilever - bending moment - theory and experiment of Young's modulus determination – Uniform and non-uniform bending – I shaped girders – Twisting couple - hollow cylinder - shaft – torsion pendulum - determination of rigidity modulus - moment of inertia of a body (regular and irregular).

Unit II ACOUSTICS AND ULTRASONICS **9**

Classification of sound – loudness and intensity – Weber-Fechner Law – Standard intensity and intensity level – decibel – reverberation – reverberation time – rate of growth and decay of sound intensity – derivation of Sabine's formula – absorption coefficient and its determination – factors affecting acoustics of buildings : focusing, interference, echo, Echelon effect, resonance – noise and their remedies. Ultrasonics – production – magnetostriction and piezoelectric methods – detection of ultrasound – acoustic grating – industrial applications – NDT – Ultrasonic method: scan modes and practice.

Unit III QUANTUM PHYSICS **9**

Inadequacy of classical mechanics – Black body radiation – Planck's theory (derivation) – Compton effect – Theory and experimental verification – de Broglie concept of matter waves – Schrodinger wave equation – Time dependent and time independent wave equation – Physical Significance of wave function – Particle confined in one and three dimensional infinite square well potential.

Unit IV LASER AND FIBER OPTICS **9**

Laser – Einstein's coefficients – CO2, Nd-YAG and semiconductor laser – homojunction and heterojunction laser – construction and working – applications – Optical fibers – classification (material, index & mode based) – principle and propagation of light in optical fibers – acceptance angle and numerical aperture – Losses in optical fibres – fiber optic communication system – pressure and displacement fiber optic sensors.

Unit V CRYSTAL PHYSICS **9**

Growth of single crystals – Czochralski method and Bridgman–Stockbarger method – unit cell, crystal systems, Bravais space lattices – crystal planes and directions – Miller indices - expressions for interplanar distance – coordination number and packing factor for simple structures: SC, BCC, FCC and HCP – structure and significance of NaCl, ZnS, diamond and graphite – Crystal imperfections: point defects, line defects–Burger vector, surface defects, volume defects.

Text Book:

1. Serway, R. A., Vuille, C., "College Physics", Cengage Learning, 11th Edition, 2017.
2. Avadhanulu, M. N. and Kshirsagar P.G. A Textbook of Engineering Physics, S.Chand, New Delhi, 2021
3. Marikani A, Engineering Physics, PHI, New Delhi, 2022.

Reference Book:

1. Bhattacharya, Bhaskaran, Engineering Physics , Oxford Publications , 2012
2. Sankar, B.N., Pillai.S.O., Engineering Physics I, New Age International (P) Ltd., 2015.
3. Palanisamy, P.K., Engineering Physics, Scitech Publications (P) Ltd, 2009.

23BS103 ENGINEERING CHEMISTRY

Offered by CHE (Core Theory offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Treatment of water for potable and industrial purposes.
- Principles of electrochemistry, the corrosion and its control.
- Principles of energy storing and extracting processes.
- Various types of Lubricants and liquid fuels
- Properties and characteristics of materials used in electronic industry.

Course Outcome:

At the end of the course, the students will be able to

- Understand the basic principles of water quality parameters, their analysis and various water treatment processes for domestic and industrial applications.
- Understand the basic principles of electrochemistry and corrosion.
- Know the method of working of energy storage devices.
- Have a thorough knowledge on lubricants and liquid fuels.
- Familiarize the knowledge about materials used in electronic industry.

Unit I WATER TECHNOLOGY **9**

Characteristics of water – Hardness – Types of hardness - Estimation by EDTA (problems on hardness) – Alkalinity – Determination – Boiler feed water – Requirements – Priming and foaming, Scales and sludges Caustic embrittlement and Boiler corrosion – External conditioning (Ion-exchange) – Internal conditioning – Domestic water treatment – Disinfection methods – Break point chlorination – Desalination by reverse osmosis.

Unit II ELECTROCHEMISTRY AND CORROSION **9**

Electrochemical cells – EMF – Single electrode potential – Nernst equation (problems)- electrochemical series.

Corrosion – Chemical corrosion – Electrochemical corrosion – Factors influencing corrosion – Different types of Corrosion – Corrosion control – Sacrificial anode and impressed current cathodic methods – Corrosion inhibitors – Protective coatings – Pretreatment of surface – Electroplating of Cu – Electroless nickel plating.

Unit III ELECTROCHEMICAL POWER SOURCES **9**

Batteries – Types of batteries – Working of dry cell, primary lithium cell, lead-acid battery, Ni–Cd and lithium ion batteries – Supercapacitors – EDLC and its applications – Fuel cells - Classification – Proton exchange membrane, Direct methanol, Solid oxide and Molten carbonate fuel cells. Hydrogen as a fuel, production and storage.

Unit IV LUBRICANTS AND FUELS **9**

Lubricants – Mechanism of lubrication - Types of lubricants: Solid lubricants: Graphite and MoS2 - Liquid lubricants: Mineral oil - Semisolid lubricants and Emulsions – Properties of Lubricants: Viscosity index, flash and fire point, cloud and pour point and oiliness.

Fuels – Calorific value (Problems using Dulong's formula) – Petroleum – processing and fractions – Cracking – catalytic cracking and methods – Synthetic petrol – Fischer-Tropsch and Bergius processes – Knocking – octane number and cetane number.

Unit V OPTOELECTRONIC MATERIALS **9**

Electroluminescence - Exciton, OLED materials – Emitters - Charge transfer complexes, metal chelates, polycyclic aromatic oligomers, conjugated polymers – polyphenylenes, polyfluorenes. Liquid crystalline polymers - Classification of liquid crystals, chemical constitution, stability and applications - Organic and dye sensitized photovoltaics – Working principle, materials, advantages and disadvantages.

Text Book:

1. P.C. Jain and Monika Jain, Engineering Chemistry, Dhanpat Rai Publishing Co.(P) Ltd., 16th Edition, New Delhi (2016).
2. S. S. Dara and S.S. Umare, A Text Book of Engineering Chemistry, S. Chand & Co. Ltd., New Delhi (2017).
3. Cowie J.M.G,Valeria Arrighi "Polymers: Chemistry and Physics of modern materials", CRC Press., London, third edition, 2007.

Reference Book:

1. Mars G. Fontana, Corrosion Engineering, Tata McGraw Hill Publishing Company (P) Ltd., New Delhi (2009).
2. B. K. Sharma, Engineering Chemistry, Krishna Prakasan Media (P) Ltd., Meerut (2006).
3. B. Sivasankar, Engineering Chemistry, Tata McGraw-Hill Pub. Co. Ltd, New Delhi (2008).
4. Stergios Logothetidis, Handbook of Flexible Organic Electronics Materials - Manufacturing and Applications, WoodHead Publishing, London, First edition (2015).

23GE101 PROGRAMMING IN C

Offered by CSE (Core Theory offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To gain knowledge on problem solving techniques
- To learn how to write simple and modular C programs
- To understand the usage of arrays and strings
- To learn the usage of pointers in accessing and manipulating memory
- To exploit the notion of derived data types and files

Course Outcome:

At the end of the course, the students will be able to

- Solve simple problems using C
- Control the sequence of the program using functions
- Store and manipulate homogeneous data using arrays and strings
- Develop programs using dynamic memory allocation
- Store and manipulate heterogeneous data using structures and files

Unit I FUNDAMENTALS OF C **9**

Basic Organization of a Computer -Introduction to Number System (Decimal, Binary, Octal, Hexadecimal) Problem Solving Techniques: Introduction to Algorithm, Pseudo code, Flow Chart, Structure of 'C' program, compilation and linking processes - C Tokens: Keywords, Data Types, Constants, Variables - Declaration - Qualifiers - typedef – Enumeration - Type Casting

Unit II BASIC CONSTRUCTS IN C **9**

Managing simple Input and Output operations - Operators and Expressions - Decision Making: Branching statements, Looping statements - Pre-processor directives (#define, #if, #else, #elif, #ifdef, #ifndef) - Function: Declaration, Definition - Passing arguments by value - Recursion - Storage classes

Unit III ARRAYS AND STRINGS IN C **8**

Arrays: Initialization - One dimensional, Two dimensional, and Multi-dimensional arrays - String: String operations, Manipulating Strings - Passing arrays and strings as arguments - Command Line Arguments

Unit IV POINTERS IN C **10**

Pointers - Passing arguments by address - Dynamic Memory Allocation - Pointer arithmetic - Pointers and one dimensional array - Pointers and Multi-Dimensional Array: Array of Pointers, Pointer to Pointer, Pointer to an array - void Pointer - Pointer to function

Unit V STRUCTURES, UNIONS AND FILE HANDLING IN C **9**

Structure: Declaration, Definition-Array of Structures - Pointer to Structure - Structure within a Structure - Bit fields in Structure - Union - Files: File Management functions, Random access in file- Working with Text Files and Binary Files

Text Book:

1. Pradip Dey, Manas Ghosh, "Programming in C", AICTE Edition, Oxford University Press, 2018
2. Behrouz A. Forouzan, Richard F.Gilberg, P.Golda Jeyasheeli, G.Priyanka,S.T.Veena "Problem solving Using C A Structured Programming Approach" Volume I &II.First Edition, Cengage Publication, 2022

Reference Book:

1. Yashavant P. Kanetkar, "Let Us C : Authentic guide to C programming language", Eighteenth Edition, BPB Publications, 2021.
2. Paul Deitel, Harvey Deitel, "C How to Program", Ninth Edition, Pearson, 2021.
3. Brian.W.Kernighan and Dennis.M.Ritchie, "C Programming language", Second Edition, Independently Published, 2021
4. Byron S Gottfried, "Programming with C", Fourth Edition, Schaum's Outlines, McGraw Hill Education, 2018
5. Ashok N. Kamthane, Amit A.Kamthane, "Programming in C", Third Edition, Pearson Education, 2015.

Extensive Reading:

- http://www.cprogramming.com/tutorial/c-tutorial.html
- http://www.tutorialspoint.com/cprogramming/index.htm
- https://www.geeksforgeeks.org/c-programming-language/
- http://www.w3schools.in/c
- http://fresh2refresh.com/c-tutorial-for-beginners

23GE103 BASIC CIVIL AND MECHANICAL ENGINEERING

Offered by MECH (Core Theory offered to BAD, BBE, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the essential principles of construction materials
- To make students understand the principles of to Building sciences.
- To introduce the essential principles of energy sciences.
- To make students to understand the functioning of fundamental prime movers & machines.
- To share the knowledge related to energy with emphasis on energy conversion and transmission to mechanical energy.

Course Outcome:

At the end of the course, the students will be able to

- Understand the civil engineering materials
- Acquire knowledge about building components and types of bridges and dams.
- Acquire knowledge on traditional & new energy sources and understand the functioning of basic energy conversion devices.
- Understand the construction and functioning of critical appliances like IC engines, refrigerator and air-conditioner.
- Acquire knowledge on basic power plant engineering.

Unit I CIVIL ENGINEERING MATERIALS **9**

Stones and Bricks – types, properties and uses - Materials for making concrete: cement - chemical compounds of portland cement, types and storage - Fine aggregate - functions - gradation and effect of impurities - Coarse aggregate – functions - Quality water for mixing.

Plain Cement Concrete (PCC) - functions of various ingredients , preparing placing and curing - Properties of fresh concrete and hardened concrete - Reinforced cement concrete (RCC) – uses and requirement of good RCC Steel-properties and uses

Unit II BUILDING COMPONENTS AND STRUCTURES **9**

Foundations – Types, bearing capacity, requirement of good foundations, causes of failure of foundations Superstructure – Brick masonry, stone masonry, beams, columns, lintels, roofing and flooring, plastering Bridges – Classification and components - Dams – Classification and purposes governing selection of site.

Unit III ENERGY SOURCES, BOILERS AND TURBINES **9**

Conventional and New & Renewable sources of energy, Indian and global energy scenario, Principle and operation of Boilers-fire tube and water tube (one example for each type), Steam, Hydraulic and Gas turbines.

Unit IV IC ENGINES, REFRIGERATOR AND AIR CONDITIONER **9**

Four stroke and two stroke IC engine cycles, functioning of petrol and Diesel Engines – Comparisons, simple vapour compression refrigerator and window air conditioner

Unit V POWER PLANTS **9**

Principle of operation, construction and working of : Steam, Hydel, Diesel, Gas and Nuclear power plants along with accessories – Selection, comparison, merits and demerits

Text Book:

1. Shanmugam G and Palanichamy M S, “Basic Civil and Mechanical Engineering”, 2nd edition,Tata McGraw Hill Publishing Co., New Delhi, 2000

Reference Book:

1. Ramamrutham.S, “Basic Civil Engineering”, DhanpatRai Publishing Co. (P) Ltd., 1999.
2. Seetharaman S. “Basic Civil Engineering”, Anuradha Agencies, 2005.
3. Venugopal K and Prahu Raja V, “Basic Mechanical Engineering” Anuradha Publishers, Kumbakonam, 2000.
4. Shantha Kumar S R J., “Basic Mechanical Engineering”, Hi- tech Publications, Mayiladuthurai, 2000.

23BS151 ENGINEERING PHYSICS LABORATORY

Offered by PHY (Core Practical offered to BAD, BBE, BCS, BEC, BEE, BIT)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- To apply different methods to calculate the modulus of elasticity
- To make use of ultrasonic interferometer to find the velocity of sound
- To inculcate experimental skills to test basic understanding of optics
- To analyze the lattice types of crystals
- To demonstrate the concept to determine the viscosity of liquids

Course Outcome:

At the end of the course, the students will be able to

- Acquire knowledge on the concepts of properties of matter and hence to find Young's modulus using Uniform and non-uniform bending and rigidity modulus measurement..
- Measure the Ultrasonic velocity in liquids
- Have adequate knowledge on the wavelength of Laser and to determine the numerical aperture of an optical fiber.
- Comprehend the Indexing of a cubic X-ray diffraction data
- Perform experiment on determination of band gap and specific resistance measurement characteristics

Practical Experiments:

(Any TEN Experiments)

1. Torsional pendulum – Determination of rigidity modulus of wire and moment of inertia of disc
2. Non-uniform bending – Young's modulus determination
3. Uniform bending – Young's modulus determination
4. Determination of velocity of ultrasonic waves and compressibility of liquid – Ultrasonic interferometer
5. Air-wedge – Determination of thickness of a thin sheet of paper
6. Spectrometer – Determination of wavelength of Hg spectrum using grating
7. Spectrometer – Dispersive power of the prism
8. Laser – (i) Particle size and wavelength determination (ii) Numerical aperture and acceptance angle measurement of an optical fibre
9. Indexing of Powder X-ray Diffraction Pattern
10. Viscosity of liquids – Determination of co-efficient of viscosity of a liquid by Poiseuille's method
11. Carey Foster Bridge – Specific resistance of the given coil of wire
12. Band gap determination – Post office box

Reference Book:

1. Physics Laboratory Manual, Department of Physics, Mepco Schlenk Engineering College, Sivakasi.
2. Palanisamy, P.K., Engineering Physics, Scitech Publications (P) Ltd, 2009.
3. Gaur R.K., and Gupta, S.L., Engineering Physics, Dhanpat Raj Publications, 2013

23GE151 PROGRAMMING IN C LABORATORY

Offered by CSE (Core Practical offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To develop C programs using conditional and looping statements
- To apply the principles of arrays and strings
- To access memory using pointers
- To group different kinds of information related to a single entity
- To manipulate data in permanent storage

Course Outcome:

At the end of the course, the students will be able to

- Implement programs using control statements
- Write programs using arrays and strings
- Access data in memory using pointers
- Use structures to manipulate heterogeneous data
- Manipulate data stored on permanent storage

Practical Course **45**

Practical Syllabus:

0. Study of simple Document Processing & Presentation Preparation
   Study of basic OS commands, Software Engineering Practices -2 sessions (Not for End Examination)
1. Programs using simple statements
2. Programs using decision making statements
3. Programs using looping statements
4. Programs using user defined functions and recursive functions
5. Programs using one dimensional and two dimensional arrays
6. Solving problems using string functions
7. Programs using pointers and dynamic memory allocation
8. Programs using structures and unions
9. Programs using pointers to structures and other data types
10. Programs using text files
11. Programs using binary files

Practical Experiments:

Sample Exercises

1. Varun has bought 40 kg of apple for Rs 140 per kg and 50 kg of pomegranate for Rs 120 per kg. Then she sold out all the stock with the selling price of Rs 150 per kg and Rs 140 per kg for apple and pomegranate respectively. Write a C program which computes the profit gained by her
2. A location in a map is represented by a pair of points as x co-ordinate and y co-ordinate. Person A wants to move towards person B which is residing in the points p1 and p2 respectively. Write C Program to find the distance between these two person .
3. If a number is 123 is entered through the keyboard, your program should print “ONE TWO THREE”. Write the program such that it does this for any positive integer. Use unconditional Jump
4. Write a function to find whether a given number is circular prime or not. For example, number 3779 is a circular prime because the rotation of numbers 3779, 7793, 7937, 9377 all are prime numbers
5. Find the greatest common divisor (GCD) of the given two numbers using recursion.
6. A set of five students attends a test with 4 objective questions. For each question they have to choose one correct answer from option A, option B and option C. Write an application which reads the students response (e.g. student 1‟s responses, student 2‟s responses etc.), evaluate and award marks for each student. The answer key is in an array which should be initialized while declaration itself. [Note: each right answer carries 10 marks]
7. Write a C program to check whether the given matrix is identity or not.
8. Write a C program which reads a paragraph and counts number of occurrence of the given substring
9. A class has strength of N students. The class has two advisors, one person for the odd roll numbers and the other for the rest. Write a C program which reads the roll numbers of all the students and gives two lists of roll numbers corresponding to each advisor
10. Write a program to create array of books. Collect various details of books such as topic, author, department. Collect details for N books and display the details of books based on department name or author
11. Write a C program to maintain the inventory details of items sold in a stationery shop such as item id, name, no of items available, price per item. Perform efficient data storage based on user‟s demand at runtime
12. Write a C program to merge two files into a third file. The names of the input and output files must be entered using the command line arguments
13. Write a C program to use binary files for maintaining a telephone directory which includes telephone no,

Owner name and address. Here address includes details such as door no, street name, locality, city and pincode. Update the door no of all people belonging to a particular street as follows: Increment the old door no by 10 to get the new door no. (Eg: If the old door no is 13, update it as 23)

Reference Book:

1. Pradip Dey, Manas Ghosh, "Programming in C", AICTE Edition, Oxford University Press, 2018
2. Behrouz A. Forouzan, Richard F.Gilberg, P.GoldaJeyasheeli, G.Priyanka,S.T.Veena "Problem solving Using C A Structured Programming Approach" Volume I &II.First Edition, Cengage Publication,2022
3. Brian.W.Kernighan and Dennis.M.Ritchie, "C Programming language", Second Edition, Independently Published, 2021.
4. Byron S Gottfried, "Programming with C", Fourth Edition, Schaum's Outlines, McGraw Hill Education, 2018
5. Paul Deitel, Harvey Deitel, "C How to Program", Ninth Edition, Pearson, 2021
6. Yashavant P. Kanetkar, "Let Us C : Authentic guide to C programming language", Eighteenth Edition, BPB Publications, 2021

Extensive Reading:

- http://www.cprogramming.com/tutorial/c-tutorial.html
- http://www.tutorialspoint.com/cprogramming/index.htm
- http://www.w3schools.in/c
- http://fresh2refresh.com/c-tutorial-for-beginners

23GE152 ENGINEERING PRACTICES LABORATORY

Offered by MECH (Core Practical offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To provide exposure to the students with hands-on-experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
- To perform hands-on-exercise in plumbing and carpentry
- To practice basic machining operations in drilling machine and lathe
- To carryout measurement of electrical quantities, energy and resistance to earth.
- To have a practice on soldering

Course Outcome:

At the end of the course, the students will be able to

- Perform pipe connections with different joining components.
- Make simple carpentry connections like T joint, Dove tail joint, etc.,
- Perform machining operations like drilling a hole, facing, turning and chamfering.
- Do residential house wiring
- Measure energy and resistance to earth of electrical equipment
- Make soldering joints

The Laboratory examination is to be conducted for Group A & Group B, allotting 90 minutes for each group, with a break of 15 minutes. Both the examinations are to be taken together in sequence, either in the FN session or in the AN session. The maximum marks for Group A and Group B lab examinations will be 50 each, totalling 100 for the Lab course. The candidates shall answer either I or II under Group A and either III or IV under Group B, based on lots.

Practical Syllabus:

List of Experiments:
GROUP A (CIVIL & MECHANICAL)
Civil Engineering Practice:
Study of Plumbing accessories
Pipe threading and Assembling
Practice of simple pipe layout joints
Study of layout of Suction and Delivery of Pump.
Study of Carpentry and its Tools
Planning practice and Middle Lap Joint
Tee Halving Joint
Dove Tail Joint
Mechanical Engineering Practice:
Study of Welding and its Tools
Butt Joint, Lap Joint and Tee Fillet Joint
Study of Gas Welding
Study of Basic Machining Operations
Facing and Turning in Lathe
Drilling

GROUP B (ELECTRICAL AND ELECTRONICS)
Electrical Engineering Practice:
Residential house wiring using switches, fuse, indicator, lamp and energy meter.
Fluorescent lamp wiring.
Stair case wiring
Measurement of electrical quantities – voltage, current, power & power factor in RLC circuit.
Measurement of energy using a single-phase energy meter.
Measurement of resistance to earth of electrical equipment.
Electronics Engineering Practice:
Study of Electronic Components and Equipments
Resistor Value using Colour coding
Generation of AC signal using Function Generator and Measurement of its parameter using CRO / DSO
Study of logic gates - AND, OR, NOT, NOR, NAND and EX-OR
Soldering simple electronic circuits and checking continuity.
Verification of KVL and KCL using series and parallel circuits
Study of assembly and dismantle of PC and LED TV.

Reference Book:

1. K.Jeyachandran, S.Natarajan& S, Balasubramanian, “A Primer on Engineering Practices Laboratory”, Anuradha

Publications, 2007.
2. T.Jeyapoovan, M.Saravanapandian & S.Pranitha, “Engineering Practices Lab Manual”, Vikas Publishing House Pvt. Ltd, 2006.
3. H.S. Bawa, “Workshop Practice”, Tata McGraw – Hill Publishing Company Limited, 2009.
4. A.Rajendra Prasad & P.M.M.S. Sarma, “Workshop Practice”, Sree Sai Publication, 2002.
5. P.Kannaiah & K.L.Narayana, “Manual on Workshop Practice”, Scitech Publications, 2004.

23GE153 தமிழர் மரபு (HERITAGE OF TAMILS)

Offered by ENG (Mandatory Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
1	0	0	1

Course Objective:

To impart knowledge on

-

Course Outcome:

At the end of the course, the students will be able to

-

Unit I *மொழி மற்றும் இலக்கியம்* **3**

இந்திய மொழிக் குடும்பங்கள் - திராவிட மொழிகள் - தமிழ் ஒரு செம்மொழி - தமிழ் செவ்விலக்கிங்கள் - சங்க இலக்கயத்தின் சமய சார்பற்ற தன்மை - சங்க இலக்கித்தில் பகிர்தல் அறம்-திருக்குறளில் மேலாண்மைக் கருத்துக்கள்- தமிழ்க் காப்பியங்கள், தமிழகத்தில் சமண பௌத்த சமயங்களின் தாக்கம்- பக்தி இலக்கியம், ஆழ்வார்கள் மற்றும் நாயன்மார்கள் - சிற்றிலக்கியங்கள் -தமிழில் நவீன இலக்கியத்தின் வளர்ச்சி - தமிழ் இலக்கிய வளர்ச்சியில் பாரதியார் மற்றும் பாரதிதாசன் ஆகியோரின் பங்களிப்பு.

Unit II *மரபு பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக்கலை* **3**

நடுகல் முதல் நவ்வேன சிற்பங்கள் வரை - ஐம்பொன் சிலைகள் - பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப்பொருட்கள், பொம்மைகள் - தேர் செய்யும் கலை- சுடுமண் சிற்பங்கள் - நாட்டுப்புறத் தெய்வங்கள் - குமரிமுனையில் திருவள்ளுவர் சிலை - இசைக்கருவிகள் - மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் - தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு

Unit III *நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்* **3**

தெருக்கூத்து, கரகாட்டம், வில்லுப்பாட்டு, கணியான் கூத்து, ஒயிலாட்டம், தோல்பாவைக் கூத்து, சிலம்பாட்டம், வளரி, புலியாட்டம், தமிழர்களின் விளையாட்டுகள்.

Unit IV *தமிழர்களின் திணைக் கோட்பாடுகள்* **3**

தமிழகத்தின் தாவரங்களும், விலங்குகளும் - தொல்காப்பியம் மற்றும் சங்க இலக்கியத்தில் அகம் மற்றும் புறக் கோட்பாடுகள் - தமிழர்கள் போற்றிய அறக்கோட்பாடு -சங்ககாலத்தில் தமிழகத்தில் எழுத்தறிவும், கல்வியும் - சங்ககால நகரங்களும் துறை முகங்களும் - சங்க காலத்தில் ஏற்றுமதி மற்றும் இறக்குமதி - கடல் கடந்த நாடுகளில் சோழர்களின் வெற்றி.

Unit V *இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு* **3**

இந்திய விடுதலைப் போரில் தமிழர்களின் பங்கு - இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் - சுய மரியாதை இயக்கம் - இந்திய மருத்துவத்தில் சித்த மருத்துவத்தின் பங்கு - கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப்புத்தகத்தின் அச்சு வரலாறு

Reference Book:

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ்- முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்க கால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை -ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by International Institute of Tamil Studies).
9. Keeladi-'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by the Author)
11. Porunai Civilization (Jointly Published by Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by RMRL) –Reference Book.

23GE154A YOGA FOR YOUTH EMPOWERMENT - I

Offered by GEN (Mandatory Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
0	0	2	0

Course Objective:

To impart knowledge on

-

Course Outcome:

At the end of the course, the students will be able to

-

23BS201 MATHEMATICS - II

Offered by MAT (Core Theory offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
2	2	0	3

Course Objective:

To impart knowledge on

- Solving ordinary differential equations involved in engineering problems.
- Applying the concepts of vector calculus to solve engineering problems.
- Analyzing complex functions and apply complex integration in engineering problems.
- Laplace transforms and its applications in their domains.
- Explaining about the importance of statistical methods in engineering.

Course Outcome:

At the end of the course, the students will be able to

- Apply various techniques to solve ordinary differential equations.
- Solve engineering problems using vector calculus.
- Use complex variable theory and apply complex integration in engineering problems.
- Solve linear ordinary differential equation using Laplace transform.
- Compute different measures of central tendency, dispersion and to interpret the data.

Unit I DIFFERENTIAL EQUATIONS **9**

Linear differential equations with constant coefficients - Rules for finding the complementary function - Rules for finding the particular integral - Equations reducible to linear equations with constant coefficients - Cauchy's and Legendre's linear differential equation.

Unit II VECTOR CALCULUS **9**

Gradient and directional derivative - Divergence and curl - Irrotational and solenoidal vector fields - Line integral over a plane curve - Surface integral and volume integral - Green's, Gauss divergence and Stokes' theorems (proofs excluded) - Verification and application in evaluating line, surface and volume integrals.

Unit III CALCULUS OF COMPLEX FUNCTIONS **9**

Analytic functions - Necessary and sufficient conditions for analyticity - Cauchy's theorem and Cauchy's integral formula - Laurent's series - Singularities - Residues - Residue theorem - Application of residue theorem for evaluation of real integrals - Use of semi-circular contour with no pole on real axis.

Unit IV LAPLACE TRANSFORMS **9**

Laplace transform - Transform of standard functions - Transform of periodic functions - Laplace transform properties - Inverse transforms - Method of partial fractions - Convolution - Application in solving linear differential equations with constant coefficients.

Unit V STATISTICS **9**

Measures of central tendency - Arithmetic mean - Geometric mean - Harmonic mean - Median - Mode - Measures of dispersion - Range - Standard deviation - Coefficient of variation - Correlation - Coefficient of correlation - Lines of regression.

Text Book:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, 44th Edition, 2021.

Reference Book:

1. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, 5th Edition, 2020.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons, 10th Edition, 2015.
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, 2nd Edition, 2013.
4. Srimanta Pal and Subodh C. Bhunia, "Engineering Mathematics", Oxford university Press, 1st Edition, 2015.
5. Roland E. Thomas , Albert J. Rosa and Gregory J. Toussaint, "The Analysis and Design of Linear Circuits", Wiley, 8th Edition, 2016.
6. Gupta S.C. and Kapoor V.K., "Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 12th Edition, 2020.

23BS203 MATERIALS SCIENCE

Offered by PHY (Core Theory offered to BAD, BBE, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart sound knowledge about conducting materials.
- To acquire knowledge about semiconducting materials.
- To understand the working of semiconductor devices.
- To introduce the basic concepts about magnetic materials.
- To introduce the fundamentals of nanoelectronic devices.

Course Outcome:

At the end of the course, the students will be able to

- Comprehend the properties of conducting materials.
- Have adequate knowledge on semiconductors.
- Acquire knowledge on the working of semiconductor devices.
- Get knowledge on magnetic materials.
- Understand the basics principles of nanoelectronic devices

Unit I CONDUCTING MATERIALS 9

Classical free electron theory - electrical and thermal conductivity – Wiedemann Franz law – Drawbacks of classical free electron theory – Quantum free electron theory (qualitative) – Fermi function – Density of energy states – Carrier concentration in metals – Expression for Fermi energy

Unit II SEMICONDUCTING MATERIALS 9

Semiconductors – Classifications – Carrier concentration of intrinsic semiconductors – Direct and indirect band gap – Determination of band gap energy – Extrinsic semiconductor – Carrier concentration in n type and p type semiconductors – Variation of Fermi energy level with temperature and impurity concentration – Drift and Diffusion currents – Continuity equation – Hall effect – Determination of Hall coefficient

Unit III SEMICONDUCTING DEVICES 9

Theory of PN junction diode – Energy band structure of open circuited PN junction – Quantitative theory of PN diode currents – Diode current equation – Diode resistance – Transition and diffusion capacitance – Effect of temperature – Breakdown in PN junction diodes – Diode switching characteristics – Principles, characteristics and applications of Zener Diode, tunnel diode, PIN diode, Varactor diode, SCR and photodiode.

Unit IV MAGNETIC PROPERTIES OF MATERIALS 9

Classification of magnetic materials – Quantum numbers – Origin of magnetic moments – Classical theory of diamagnetism (Langevin theory) –Quantum theory of paramagnetism – Ferromagnetism (Weiss theory) – Energy associated with domain theory – Hysteresis – Antiferromagnetic materials – Ferrites–applications – Soft and hard magnetic materials – Magnetic recording and readout hard disk drives.

Unit V NANOMATERIALS AND NANOELECTRONIC DEVICES 9

Introduction – Quantum Confinement – Quantum Structures – Density of states in Quantum well, Quantum wire and Quantum dot structures – Size dependence of properties – Mechanical properties, Optical Properties, Electrical Properties, Dielectric Properties, Magnetic properties – Classification of nanostructures – Metal nanoparticles, Oxide nanoparticles, Metal nanoclusters – Resonant Tunneling Diode – Coulomb blockade effects – Single electron phenomena and Single electron Transistor.

Text Book:

1. Pradeep Fulay, Jung-Kun Lee, Electronic, Magnetic, and Optical Materials, CRC Press, 2017
2. Salivahanan S, Suresh Kumar N, Vallavaraj A, Electronic devices and circuits, Tata McGraw Hill, 2008
3. Kasap, S.O., Principle of Electronic Materials and devices, Tata McGraw Hill, 2007

Reference Book:

1. Pierret, R.F. Semiconductor device fundamentals, Pearsons 1996
2. Garcia N and Damask A, Physics for Computer science students, Springer–Verlag, 1991
3. Todd D. Steiner, Semiconductor Nanostructure for Optoelectronic Applications, ArTech House Publishers, Boston, London, 2004

23BS205 ENVIRONMENTAL SCIENCE AND DISASTER MANAGEMENT

Offered by CHE (Core Theory offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Knowledge about the environment and its vulnerability.
- Precise information of various resources, exploitation and its environmental problems.
- Knowledge on structure of ecosystem, biodiversity and their conservation.
- Ideas about environmental pollution, sustainable development and social problems.
- The facts behind the various types of disaster and their impacts.
- The various steps of disaster management and the strategic plan to be adopted on the event of disaster.

Course Outcome:

At the end of the course, the students will be able to

- Understand the basic concepts of environmental studies and natural resources.
- Get thorough knowledge about ecosystem and biodiversity.
- Have an elaborate knowledge about different types of pollution, social issues and pollution related acts.
- Categorize the different types of disaster and its impacts.
- Identify and tackle the disastrous events with the help of Government and Non-Government agencies.

Unit I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES 9

Definition, scope, and importance of environment studies – Forest resources: Uses, deforestation, consequences – Water resources: Uses of surface and ground water, Environmental problems, conflicts over water & dams (benefits and problems) – Mineral resources: Uses, exploitation and environmental effects – Food resources: world food problems, agriculture and overgrazing, effects of modern agriculture, Fertilizer and pesticide – Energy resources: growing energy needs, renewable energy sources, use of alternate energy sources – Role of an individual in conservation of natural resources.

Unit II ECOSYSTEMS AND BIODIVERSITY 10

Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Food chains – Food webs – Ecological pyramids – Energy flow in ecosystem (single channel energy flow model) – Concept of nutrient cycling (Nitrogen cycle) – Primary and Secondary Production – Ecological succession – Introduction to Biodiversity – Genetic, species and ecosystem diversity – Values of biodiversity: Consumptive, productive, social, ethical, aesthetic and option values – India as a mega biodiversity nation – Hotspots of biodiversity – Threats to biodiversity: Habitat loss, poaching, man-wildlife conflicts – Endangered and endemic species in India – Conservation of biodiversity: In-situ and Ex-situ conservation.

Unit III ENVIRONMENTAL POLLUTION AND SUSTAINABILITY 12

Definition – Causes, effects, and control measures of: (a) Air pollution (b) Water pollution (c) Marine pollution – Consequences of pollution: Global warming, Acid rain, Ozone layer depletion and Photochemical smog – Solid waste Management: Causes, effects, and control measures – Role of an individual in prevention of pollution – Sustainable development – Environmental ethics – Environmental Acts: Wildlife Protection, Forest Conservation and Environment Protection Act – Enforcement of environmental legislation – Concept of carbon credit – Carbon footprint – Zero waste – Materials life cycle assessment – Green engineering.

Unit IV DISASTER AND ITS IMPACTS 7

Definition of Disaster, Hazard, Vulnerability, Risk – Types – Natural disasters: Earthquake, landslides, flood, cyclones, tsunami, and drought – Manmade disasters: Chemical, nuclear, and biological – Disaster impacts: Environmental, physical, social, ecological, and economical – Case studies.

Unit V DISASTER MANAGEMENT 7

Need and concept of Disaster management – Disaster Management cycle: Prevention, mitigation, preparedness, relief, and recovery – Post disaster environmental response: Water, sanitation, food safety, and human health – Disaster Management Plan – Disaster management Act – Role and responsibilities of government, community, local institutions, and NGOs.

Text Book:

1. K.Jeyasubramanian, D.Madhavan, A.Sakthivel, B.Thanga Giri, S.Malathi Devi, “The Textbook of Environmental Science and Disaster Management”, I Edition, Page No. 1-267, Cengage Learning India Private Limited, India, 2022.
2. VP Verma, Environmental Studies and Disaster Management, I Edition, S.K. Kataria & Sons Publishers, ISBN: 978-93-5014-689-7, 2019.
3. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age International (P) Ltd, Fourth Edition, ISBN: 978-81-224-3647-1, 2014.

Reference Book:

1. Gilbert M.Masters, Introduction to Environmental Engineering and Science, II Edition, Pearson Education, 2004.

2. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill, New Delhi, 2006.
3. Mukesh Dhunna, Disaster Management, Vayu Education of India, New Delhi, 2009.
4. D.R Khullar, Environment & Disaster Management, III Edition, ISBN: 9354601049 & 9789354601040 Mc Graw Hill Publications, 2021.
5. Management and Mitigation of Natural Disaster, I Edition, Regal Publication by Rajan Kumar Sahoo, 2014.

23CS201 OBJECT ORIENTED PROGRAMMING USING PYTHON

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basics of Python programming such as operators and control structures
- To learn different functions and modules with various data structures
- To study Object-Oriented programming and exception handling with Python
- To work on advanced OOP concepts
- To perform file handling and work with packages

Course Outcome:

At the end of the course, the students will be able to

- Explore the basics of Python programming such as operators and control structures
- Construct functions and modules with various data structures
- Create Classes and Objects using Python and handle exceptions
- Apply advanced OOP concepts in solving real-world problems
- Work on files and packages

Unit I INTRODUCTION TO PYTHON 9

Introduction: Importance – limitations - Python impressions - Internal working – comments. Basics: Identifiers - reserved keywords – literals - fundamental data types - base conversion - type casting -escape characters - eval(), input(), and print() functions - command line arguments - delete statement. Operators - operator precedence – conditional, iterative and transfer statements - loops with else block. Strings: multiline string literal - accessing characters of string - operators for string - string operations – formatting.

Unit II DATA STRUCTURES, FUNCTIONS AND MODULES 9

Data structures: list, tuple, set, dictionary - Types of Functions - Return Statement - arguments in a function - scope of variables - global keyword - recursive, Lambda - filter(), map(), and reduce() function - function aliasing - nested, decorator, and generator functions. Modules: Module Aliasing - Member Aliasing - Reloading a Module - Dir() Function - Math Module - Random Module - Packages.

Unit III OBJECT ORIENTED PROGRAMMING AND EXCEPTION HANDLING 9

Class – object – self variable – constructor – types of variables and methods – setter and getter methods – passing members of one class to another class. Types of Error – Exception - Default Exception Handling - Customized Exception Handling: Using Try- Except - Multiple Except Blocks – finally block - Nested Try- Except- Finally Block - Types of Exception - Raise User- Defined Exception – Assertion.

Unit IV ADVANCED OOPS CONCEPTS 9

Inner class - Garbage collection – destructor - Finding the number of references of an object – Encapsulation – Inheritance – Aggregation vs Composition – Inheritance types – method resolution order – super() method – polymorphism – abstract class and method – interface - __str__() method

Unit V FILE HANDLING AND PACKAGES 9

Introduction to file – With statement – seek() and tell() methods – Testing the existence of a file – Handling binary data and CSV files – Zipping and unzipping files – Directory – Get information about a file – Pickling and unpickling of objects, using Packages: Math – Numpy - Matplotlib

Practical Course -6

Text Book:

1. Vijay Kumar Sharma, Vimal Kumar, Swati Sharma, Shashwat Pathak, “Python Programming – A Practical Approach”, CRC Press, First Edition, 2022

Reference Book:

1. Urban, Michael., Murach, Joel. “Murach's Python Programming”, United States: Mike Murach & Associates, Incorporated, Second Edition, 2021.
2. Alex Martelli, Anna Ravenscroft, and Steve Holden, “Python in a nutshell”, O’REILLY Publisher, Third Edition, 2022.

Extensive Reading:

- http://www.python.org
- https://www.digitalocean.com/community/tutorials/python-data-types
- https://www.edureka.co/blog/data-structures-in-python/#:~:text=Python%20allows%20its%20users%20to,you%20in%20other%20programming%20languages.
- https://www.geeksforgeeks.org/python-oops-concepts/

23GE204 ENGINEERING GRAPHICS AND BUILDING DRAWING

Offered by MECH (Core Theory offered to BAD, BBE, BCS, BEC, BEE, BIT)

L	T	P	C
2	2	0	3

Course Objective:

To impart knowledge on

- To gain knowledge on the basics of Engineering Drawing construction procedures.
- To understand the principles involved in graphic skill for communication of concepts, ideas and design of Engineering products.
- To draw various projections of solids.
- To gain knowledge about building drawings.
- To expose the existing national standards related to technical drawings.

Course Outcome:

At the end of the course, the students will be able to

- Sketch multiple views of engineering components
- Create the projection of point, straight line and plane
- Project the solid objects
- Apply sectioning and isometric projections of solids
- Create plan, section and elevation of buildings

Unit I PLANE CURVES AND PICTORIAL VIEWS TO ORTHOGRAPHIC VIEWS 19

Geometrical Constructions like bisection of a straight line, division of a straight line into n equal parts, bisection of angles, Curves used in engineering practices: Conics – Construction of ellipse, parabola and hyperbola by eccentricity method – Construction of cycloid – Construction of involutes of square and circle – Drawing of tangents and normal to the above curves.

Orthographic projection – Principles – Principal planes - Representation of Three-Dimensional objects – Layout of views – Sketching of multiple views (Front, Top and Side views) from pictorial views of simple objects and Engineering Components.

Unit II PROJECTION OF POINTS, LINES AND PLANE SURFACES 14

First Angle projection – Projection of points in four quadrants. Projection of straight lines (only First angle projection) inclined to both the principal planes – Determination of true lengths and true inclinations by rotating line method and traces.

Projection of planes (polygonal and circular surfaces) inclined to both the principal planes by change of position method.

Unit III PROJECTION OF SOLIDS 14

Projection of simple solids like prisms, pyramids, cylinder and cone when the axis is inclined to one of the principal planes by change of position method.

Unit IV SECTIONING AND ISOMETRIC PROJECTION OF SIMPLE SOLIDS 14

Sectioning of above solids in simple vertical position when the cutting plane is inclined to one of the principal planes and perpendicular to the other – Obtaining true shape of the section. Principles of isometric projection – Isometric scale – Isometric View – Isometric projections of simple solids– Prisms, pyramids, cylinders and cones.

Unit V GEOMETRICAL AND BUILDING DRAWING 14

Component parts of the residential building – Development plan, foundation plan, cross section, elevation of residential buildings (line diagram only) – labelling, dimensioning and position of doors and windows.

CONCEPTS AND CONVENTIONS (NOT FOR EXAMINATION)

Importance of graphics in engineering applications – Use of drafting instruments – BIS conventions and specifications – Lettering and Dimensioning - Size, layout and folding of drawing sheets.

Publication of Bureau of Indian Standards:

1. IS 10711 – 2001: Technical products Documentation – Size and lay out of drawing sheets.
2. IS 9609 (Parts 0 & 1) – 2001: Technical products Documentation – Lettering.
3. IS 10714 (Part 20) – 2001 & SP 46 – 2003: Lines for technical drawings.
4. IS 11669 – 1986 & SP 46 – 2003: Dimensioning of Technical Drawings.
5. IS 15021 (Parts 1 to 4) – 2001: Technical drawings – Projection Methods.

Special points applicable to End Semester Examinations on Engineering Graphics and Building Drawing:

1. There will be five questions, each of either-or type covering all units of the syllabus.
2. All questions will carry equal marks of 20 each making a total of 100.

3. The answer paper shall consist of drawing sheets of A3 size only. The students will be permitted to use appropriate scale to fit solution within A3 size.

4. The examination will be conducted in appropriate sessions on the same day.

Text Book:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2018.
2. Sikka V.B., "A Course in Civil Engineering Drawing", 11th edition, S.K.Kataria& Sons, New Delhi, 2022.

Reference Book:

1. Natrajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2017.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2017.
3. Luzzader, Warren.J. and Duff,John M., "Fundamentals of Engineering Drawing with an introduction to Interactive Computer Graphics for Design and Production", Eastern Economy Edition, Prentice Hall of India Pvt. Ltd, New Delhi, 2005.
4. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House, 54th Edition, 2023.
5. Kumaraswamy N., Kameswara Rao A., "Building planning & Drawing", 9th edition, Charotar Publishing, 2019.

23HS281 ENGLISH FOR PROFESSIONAL COMMUNICATION

Offered by ENG (Theory Course with Lab Component offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
2	0	2	3

Course Objective:

To impart knowledge on

- Inculcating LSRW skills in English
- Graphical data in logical writing using discourse markers
- Formal writings for internal and external communication
- Effective communication in terms of academic requirements
- Developing the ability to present and modify concepts according to the target audience

Course Outcome:

At the end of the course, the students will be able to

- Apply LSRW skills in English
- Decode graphical data coherently
- Draft professional correspondences confidently
- Use English independently and effectively for academic requirements
- Present ideas as per the understanding of the audience and situation

Unit I **9**

Listening: Listening to native speaker's Telephone Conversations–Analyzing a Product
Speaking: Sharing Childhood Experiences- Talking about Favourite Personalities
Reading: Job Advertisements – Manual for Product/Service – Telephone Phrases
Writing: Cover letter – Resume Preparation- Product Description - Checklist
Grammar: Compound Words - Conditional Clauses – Simple Sentences
Vocabulary: -Misspelt Words

Unit II **9**

Listening: Listening to Technical Talks, Scientific Lectures and Short Conversations
Speaking: Career Choice, Describing Recent Innovation in Technology
Reading: Speed Reading –Journal Reviews
Writing: Essay Writing -Interpretation of Charts - Short Articles on everyday life
Grammar: Connectives - Purpose Expressions – Compound Sentences
Vocabulary: American and British English -Use of Sequence Words or Conjunctions

Unit III **9**

Listening: Job Interviews - Sports Commentaries / Animated stories / Anecdotes / Event narration
Speaking: Interviewing Celebrities and Entrepreneurs
Reading: Short Stories - Critical Reading
Writing: Precis writing - Letter of Enquiry, Quotation, Order, Claim and Adjustment Letters- Response to complaints
Grammar: Subject-Verb agreement – Complex Sentences - Gerund and Infinitive
Vocabulary: Vocabulary used in Formal Letters, Emails and Reports

Unit IV **9**

Listening: Listening to Statistical Information and Follow-up Exercises. - Form Filling Exercises
Speaking: Situational Conversations (Meeting a friend in a cafe) - Narrating Personal Experience
Reading :Developing Analytical Skills – Company Profiles
Writing: Biography Writing - Writing Statement of Purpose (SoP)-Emails, Memos, Notices and Circulars - Minutes of the Meeting – Internship Application Letters
Grammar: Numerical Expressions – Relative Clauses
Vocabulary: Adjectives – Verbal Reasoning

Unit V **9**

Listening: Model Debate and Reviewing the performance of each participant - Panel Discussion
Speaking: Group Communication- Discussing Social Issues, Current Affairs and Debate
Reading: Fitting Sentences in a Paragraph – Cause and Effect Essays, Technical Papers and Case Studies
Writing: Itinerary – Accident Report and Feasibility Report- Recommendations – Brochures and Tourist Pamphlets
Grammar: Cause and Effect Expressions - Reported Speech
Vocabulary: Verbal Analogies – Collocations

Practical Course **15**

Practical Syllabus:

Intra personal, Interpersonal, Organizational and Mass Communication
Listening: Listening to Audio (Podcasts, Audiobooks, Radio Program) and Practice Exercises-Making a Critical Appreciation of Audio Content-Answering Cloze Test Based on Listening
Speaking: Self-Introduction-Introducing Resource Persons and Chief Guests - Developing Stories Using Picture Prompts –Language Etiquette in Different Situations-Expressing Agreement and Conflict Management and Seeking

Information – Expressing Feelings - Affection, Anger, Regret etc. – Team Reviewing and Appraisal on any Social Event / Issue-Data Decoding - Short Talk on Technical Topics

Reading: Making Inference in Reading - SQ3R Method of Reading – Reading Longer Texts with Time Frame – Reading Data using different types of Texts, Magazines and Internet Materials - Editing/Proofreading - Reading Research Papers

Writing: Abstract Writing - Mind Mapping and Brainstorming on any Social Event/Issue – Creating a Product Review Blog.

IEEE – English for Technical Professional Course

Text Book:

1. Gangalakshmi, C, Rathika, B, Saranraj, L. Professional English for Engineers. New Delhi: Cengage, 2022.

Reference Book:

1. Raman, Meenakshi and Sangeetha Sharma. Communication Skills. New Delhi: OUP, 2018
2. R. C. Sharma_ Krishna Mohan - Business Correspondence and Report Writing _ a Practical Approach to Business _ Technical Communication-Mc Graw Hill India (2017)

23BS252 ENVIRONMENTAL CHEMISTRY LABORATORY

Offered by CHE (Core Practical offered to BAD, BBE, BCS, BEC, BEE, BIT)

L	T	P	C
0	1	0	1

Course Objective:

To impart knowledge on

- The principles of the estimation of hardness and alkalinity present in a water sample.
- The knowledge regarding the conductivity and its use in estimating acidity, alkalinity, etc.,
- Estimating the quantity of dissolved oxygen in fresh water, industrial waste water and their significances.
- The water quality parameter like COD in assessing the extent of pollution.
- The permissible levels of heavy metals like Pb, Cr, Cd etc., in the industrial effluents.

Course Outcome:

At the end of the course, the students will be able to

- Estimate the quantity of hardness, alkalinity of a sample water and their implications.
- Quantify the amounts of acidic, basic and other salts presents in a sample water through conductometric titration.
- Know the consequences of dissolved oxygen present in fresh water, polluted water, etc.,
- Evaluate the quantity of COD and its implications in a polluted water.
- Interpret the water quality parameters relevant to potable water, polluted water and raw water used in industries.

Practical Experiments:

Any TEN Experiments in the given list

1. Preparation of standard solution and estimation of HCl
2. Estimation of oxalic acid by KMnO4
3. Determination of alkalinity in a water sample
4. Estimation of hardness of water by EDTA method
5. Determination of chloride content of a water sample by Argentometry
6. Determination of dissolved oxygen in water by Winkler's method
7. Estimation of chromium in tannery wastes
8. Estimation of copper in brass by Iodometry
9. Determination of COD in an industrial effluent
10. Estimation of strong acid by conductometric titration
11. Estimation of mixture of acids by conductometric titration
12. Estimation of hydrochloric acid by pHmetric method
13. Estimation of iron by potentiometric titration

Text Book:

1. J. Mendham, R.C. Denney, J. D. Barnes, M.J.K. Thomas, Vogel's Quantitative Chemical Analysis, Prentice Hall, India, 2000.
2. D.P. Shoemaker and C.W. Garland, Experiments in Physical Chemistry, McGraw Hill, London, 2001.
3. A. I. Vogel, A Text Book of Quantitative Inorganic Analysis, ELBS London, 1995.
4. N. Manivasakam, Industrial Effluents – Origin, Characteristics, Effects Analysis & Treatment, Sakthi Publications, Coimbatore, 2003.

23CS251 OBJECT ORIENTED PROGRAMMING USING PYTHON LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To practice conditional and loop statements using python
- To learn about functions and modules with various data structures
- To work with Object-Oriented programming principles and error handling using Python
- To practice with operator overloading, inner class and garbage collector
- To know about persistent storage and the use of packages

Course Outcome:

At the end of the course, the students will be able to

- Write Python programs with conditionals and loops
- Construct functions and modules with various data structures
- Use Object-Oriented programming principles to solve real world problem and handle errors
- Develop application using operator overloading method for user defined types, inner class and garbage collector
- Exploit file handling and use the packages

Practical Course **45**

Practical Syllabus:

0. Python naming convention, programming indentation guidelines
1. Python programs using conditional statements, Loops
2. Python program using List, tuple, and dictionary
3. Python programs using String and String handling functions
4. Python programs using functions, modules
5. Python programs using Classes, object, member data and method, initialize and handling errors
6. Inheritance and polymorphism using Python
7. Operator overloading using python
8. Inner class and garbage collection, and finding the number of references of an object using Python
9. Method Resolution Order (MRO) tracing using python
10. Python program using File I/O, random access file handling methods and Zipping and Unzipping of files
11. Python programs using packages

Practical Experiments:

Sample exercises:

1. Write a python program to determine whether the seller has made profit or loss. Also find how much profit he made or loss. Read product price and selling price from user
2. Write a Python program to check the given number is prime or not.
3. Write a Python program to compute the GCD of two numbers
4. Write a Python program to find the sum of ‘n’ numbers using function?
5. Write a Python program to generate the Fibonacci Series?
6. Write a Python program to find the following:
   (i) 2rd highest number from a set of numbers using LIST
   (ii) Find the length of the list
   (iii) Find the Max value in the List
7. Write a python program to create a telephone directory using dictionary.
8. Write a python program to create a hotel menu card using dictionary.
9. Design a simple python module for arithmetic calculator. Also develop a application to use that modules
10. Develop Rational number class in Python. Your implementation should use efficient representation for a rational number, i.e. (500 / 1000) should be represented as (½).
11. Develop a Complex number class in Python with private data members as real and imaginary components and necessary member methods. Write program that adds and subtracts two complex numbers
12. Design a Vehicle class hierarchy in Python. Write a test program to demonstrate polymorphism.
13. Write a python program to show the use of overload ‘+’ operator for class Complex.
14. Write a program that randomly generates a number and raises a user defined excep¬tion if the number is smaller than 0.1
15. Write a program that opens a file and writes data to it. Handle exceptions that can be generated during the I/O operations.
16. Write a python program to copy the file content
17. Write a python program to find the occurrence of each word in a file
18. Write a python program to zip and unzip the files
19. Write a Python program using the packages such as math, NumPy, and matplotlib.

Reference Book:

1. Vijay Kumar Sharma, Vimal Kumar, Swati Sharma, Shashwat Pathak, “Python Programming – A Practical Approach”, CRC Press, First Edition, 2022
2. Urban, Michael., Murach, Joel. “Murach's Python Programming”, United States: Mike Murach & Associates, Incorporated, Second Edition, 2021.
3. Alex Martelli, Anna Ravenscro, and Steve Holden, “Python in a nutshell”, O’REILLY Publisher, Third edition, 2022.

Extensive Reading:

- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-096-introduction-to-c-january- iap-2011/index.htm
- https://developers.google.com/edu/c++/
- https://www.coursera.org/course/cplusplus4c
- http://www.greenteapress.com/thinkpython/thinkpython.html
- https://www.tutorialspoint.com/python/
- https://www.hackerrank.com/domains/python

23CS252 LINUX ADMINISTRATION AND SHELL PROGRAMMING LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To practice the LINUX installation and basic Linux, System, File and Directory Management Commands
- To learn the Pipes & Filters, Process management, Networking commands
- To explore the user & system services commands and installation of packages
- To write Linux shell programs with shell programming constructs
- To know command line arguments usage in shell programming

Course Outcome:

At the end of the course, the students will be able to

- Install LINUX operating system and work with system, file and directory management commands
- Work with pipes & filters, process and networking commands
- Install packages and web server configuration
- Develop shell programs for conditional and looping statements
- Write shell scripts using command line arguments

Practical Course **45**

Practical Syllabus:

1) Install Linux operating system on Virtual Box
2) Work with basic Linux Commands: ls, cd, mkdir, pwd, clear, man, cat, who, passwd, chmod, wc, grep, pipe, redirection operators
3) Use System Bootup and Shutting Commands to restart and shutdown computer
4) Creation and management of files and directories
5) Apply filters on file contents and redirects the results using pipes in Linux
6) Perform the process and network management using Linux commands
7) Create and manage permissions of users, groups in Linux
8) Control the status of the services using system service commands
9) Install and uninstall packages using package management commands in Linux
10) Install and configure web server on Linux
11) Write a shell program with variables, operators, conditional and looping statements
12) Write a shell program with command line arguments

Practical Experiments:

1. Install the Linux operating system and write the steps for installation.
2. Write the Linux commands and do the following operation:
   a. Display current date and time and display only month name for the current date
   b. Display the list of current users and your own user name and display your own user name
   c. Display manual pages for date command page by page
   d. Print your name on the terminal using echo
   e. Display available disk space and disk usage
   f. Display your name of your system in the network using hostname command
   g. Create a compressed file archive using tar command and extract files from tar archive
3. Working File Contents Commands: which, head, tail, cat, tac, more, less, strings and print
4. Create a file consisting of countries and corresponding continents Display the countries which are in the continent India. Sort the generated list and convert them into lowercase.
5. Create a directory “LINUXLAB”, change your working directory to ‘LINUXLAB’ and display where you are working now? Create files named “date”, “user”. Store the calendar and current date information in the file named “date” and store the login details of all users in the file “user”. Also, store the details of all active users in the same file (“user”). Finally merge the two files into a single file called “merge” and delete both the files.
6. Create a user group called “csestudent” and rename it as “engineers”. Add 10 users to the group and rename the usernames for at least 5 students. Delete an user from the group and finally delete the group
7. Create a file named file list and store the list of files present in the current working directory and change the name of the file as filelistupdated. Compress the file to archive.
8. Create a file named student with at least four student details such as name rollno age and dept. Display the details of student belong to ‘CSE’. Also display the number of students who do not belong to ‘CSE’. And make the file read only to group and others.
9. Display the process id of bash. Delete a process by using the process id. Display the CPU utilization of particular process. Display the IP address (just IP address nothing else) of your system
10. Send 10 packets to a website and check for healthy connection. Trace the number of hops that is needed to connect to google.com. How will you check the status of Network Manager service and restart it in your system?
11. Perform the following system administration tasks

- Print network connections, routing tables, interface statistics, masquerade connections, and multicast memberships
- System Load statistics
- Report a snapshot of the current processes.
- Report virtual memory statistics
- Display system tasks

12. Write a shell script which will accepts login name from the user as command line argument and display the message whether the user having that login name is currently logged in or not. Also enable the user to view the long list of files that end with 'ca' along with the count.

13. Write a shell program to read the marks of five subjects through keyboard. Find out the aggregate and percentage of marks obtained by the student. Assume maximum marks that can be obtained by a student in each subject as 100.

14. A company XYZ pays their employers monthly. It pays their employers with DA=50% of BP, HRA=10% of BP, allowance=Rs.1000. The company needs to automate the salary computation based on the basic pay. Develop an application to compute the gross salary of an employee given their basic pay.

15. Write nested if statements to print the appropriate message depending on the value of the variables temperature and humidity as given as below. Assume that the temperature can only be warm and cold and the humidity can only be dry and humid.

temperature	humidity	activity
Warm	Dry	Play Basketball
Warm	Humid	Play Tennis
Cold	Dry	Play Cricket
Cold	Humid	Swim

16. Write a shell program to construct the following pattern, using a nested for loop.

```
*
* *
* * *
* * * *
* * * * *
* * * *
* * *
* *
*
```

17. Write a shell script to copy the contents of one file to another. Read the source and destination file name as a command line arguments.

Reference Book:

1. Mark G. Sobell, "A Practical Guide to Linux Commands, Editors, and Shell Programming", Pearson Education, 4th Edition, 2017.
2. Wale Soyinka, "Linux Administration A Beginner's Guide", The McGrawHill, Eighth Edition, 2020
3. Richard Petersen, "Linux: The Complete Reference", The McGrawHill, Sixth Edition, 2017

Extensive Reading:

- http://www.tutorialspoint.com/unix/index.htm
- https://www.guru99.com/must-know-linux-commands.html#7
- https://www.tutorialspoint.com/linux_admin/linux_admin_tutorial.pdf
- http://www.greenstechnologys.com/unix-course-content.html
- https://vegibit.com/command-types-in-linux/
- https://www.javatpoint.com/linux-commands-list

23GE154 YOGA FOR YOUTH EMPOWERMENT - II

Offered by GEN (Mandatory Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

-

Course Outcome:

At the end of the course, the students will be able to

-

23GE255 தமிழரும் தொழில்நுட்பமும் (TAMILS AND TECHNOLOGY)

Offered by ENG (Mandatory Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
1	0	0	1

Course Objective:

To impart knowledge on

-

Course Outcome:

At the end of the course, the students will be able to

-

Unit I **நெசவு மற்றும் பானைத் தொழில்நுட்பம்** **3**

சங்க காலத்தில் நெசவுத் தொழில் -பானைத் தொழில்நுட்பம் - கருப்பு சிவப்பு பாண்டங்கள்- பாண்டங்களில் கீறல் குறியீடுகள்

Unit II **வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்** **3**

சங்க காலத்தில் வடிவமைப்பு மற்றும் கட்டுமானங்கள் & சங்க காலத்தில் வீட்டுப் பொருட்களில் வடிவமைப்பு- சங்க காலத்தில் கட்டுமான பொருட்களும் நடுகல்லும் - சிலப்பதிகாரத்தில் மேடை அமைப்பு பற்றிய விவரங்கள்- மாமல்லபுரச் சிற்பங்களும், கோவில்களும் - சோழர் காலத்துப் பெருங்கோவில்கள் மற்றும் பிற வழிபாட்டுத் தலங்கள் - நாயக்கர் காலக் கோயில்கள் - மாதிரி கட்டமைப்புகள் பற்றி அறிதல், மதுரை மீனாட்சி அம்மன் ஆலயம் மற்றும் திருமலை நாயக்கர் மஹால் - செட்டிநாட்டு வீடுகள் - பிரிட்டிஷ் காலத்தில் சென்னையில் இந்தோ-சாரோசெனிக் கட்டிடக் கலை

Unit III **உற்பத்தித் தொழில்நுட்பம்** **3**

கப்பல் கட்டும் கலை - உலோகவியல் - இரும்புத் தொழிற்சாலை -இரும்பை உருக்குதல், எஃகு -வரலாற்றுச் சான்றுகளாக செம்பு மற்றும் தங்க நாணயங்கள் - நாணயங்கள் அச்சடித்தல்- மணி உருவாக்கும் தொழிற்சாலைகள் - கல்மணிகள் , கண்ணாடி மணிகள் - சுடுமண் மணிகள் -எலும்புத்துண்டுகள்- தொல்லியல் சான்றுகள்- சிலப்பதிகாரத்தில் மணிகளின் வகைகள்.

Unit IV **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில்நுட்பம்** **3**

அணை, ஏரி, குளங்கள், மதகு - சோழர்காலக் குமிழித் தூம்பின் முக்கியத்துவம்- கால்நடை பராமரிப்பு - கால்நடைகளுக்காக வடிவமைக்கப்பட்ட கிணறுகள் - வேளாண்மை மற்றும் வேளாண்மைச் சார்ந்த செயல்பாடுகள்- கடல்சார் அறிவு- மீன்வளம்- முத்து மற்றும் முத்துக்குளித்தல் - பெருங்கடல் குறித்த பண்டைய அறிவு - அறிவுசார் சமூகம்.

Unit V **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்** **3**

அறிவியல் தமிழின் வளர்ச்சி - கணித்தமிழ் வளர்ச்சி - தமிழ் நூல்களை மின்பதிப்பு செய்தல் - தமிழ் மென்பொருட்கள் உருவாக்கம் - தமிழ் இணையக் கல்விக்கழகம் - தமிழ் மின்நூலகம்- இணையத்தில் தமிழ் அகராதிகள் – சொற்குவைத் திட்டம்

Reference Book:

1. தமிழக வரலாறு - மக்களும் பண்பாடும் - கே. கே. பிள்ளை (வெளியீடு : தமிழ்நாடு பாடநூல் மற்றும் கல்வியியல் பணிகள் கழகம்)
2. கணினித் தமிழ்- முனைவர் இல. சுந்தரம் (விகடன் பிரசுரம்)
3. கீழடி - வைகை நதிக்கரையில் சங்ககால நகர நாகரிகம் (தொல்லியல் துறை வெளியீடு)
4. பொருநை -ஆற்றங்கரை நாகரிகம் (தொல்லியல் துறை வெளியீடு)
5. Social Life of Tamils (Dr.K.K.Pillay) A joint publication of TNTB & ESC and RMRL – (in print).
6. Social Life of the Tamils – The Classical Period (Dr.S.Singaravelu) (Published by International Institute of Tamil Studies).
7. Historical Heritage of the Tamils (Dr.S.V.Subatamanian, Dr.K.D.Thirunavukkarasu) (Published by International Institute of Tamil Studies).
8. The Contributions of the Tamils to Indian Culture (Dr.M.Valarmathi) (Published by International Institute of Tamil Studies).
9. Keeladi-'Sangam City Civilization on the banks of river Vaigai' (Jointly Published by Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
10. Studies in the History of India with Special Reference to Tamil Nadu (Dr.K.K.Pillay) (Published by the Author)
11. Porunai Civilization (Jointly Published by Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu)
12. Journey of Civilization Indus to Vaigai (R.Balakrishnan) (Published by: RMRL) –Reference Book.

23GE256 NCC COURSE LEVEL - I

Offered by GEN (Mandatory Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
1	0	2	1

Course Objective:

To impart knowledge on

- To groom the youth of the country responsible and patrioticcitizens
- To enhance the knowledge of armed forces
- To inculcate value of integrity social responsibility
- To know the service of the great people

Course Outcome:

At the end of the course, the students will be able to

- Raise awareness to live with principles and values
- Gain a glimpse and overview of armed forces
- Develop a sense of national integration
- Create awareness about social causes and community development

Unit I NCC GENERAL **6**

NCC1 Aims, Objectives & Organization of NCC
NCC2 Incentives
NCC3 Duties of NCC Cadet
NCC4 NCC Camps: Types & Conduct

Unit II NATIONAL INTEGRATION AND AWARENESS **4**

NI1 National Integration: Importance &Necessity
NI2 Factors Affecting NationalIntegration
NI3 Unity in Diversity & Role of NCC in Nation Building
NI4 Threats to National Security

Unit III PERSONALITY DEVELOPMENT **7**

PD1 Self-Awareness, Empathy, Critical & Creative Thinking, Decision Making and, Problem Solving
PD2 Communication Skills
PD3 Group Discussion: Stress &Emotions

Unit IV LEADERSHIP **5**

L1 Leadership Capsule: Traits, Indicators, Motivation, Moral Values, Honour Code
L2 Case Studies: Shivaji, Jhasi Ki Rani

Unit V SOCIAL SERVICE ANDCOMMUNITYDEVELOPMENT **8**

SS 1 Basics, Rural Development Programmes, NGOs,Contribution of Youth
SS 2 Protection of Children and Women Safety
SS 3 Road / Rail Travel Safety
SS 4 New Initiatives
SS 5 Cyber and Mobile Security Awareness

23MA303 MATHEMATICS - III : DISCRETE MATHEMATICS

Offered by MAT (Core Theory offered to BCS, BIT)

L	T	P	C
2	2	0	3

Course Objective:

To impart knowledge on

- Describing propositional and predicate calculus.
- Explaining the basic enumeration of graphs and combinatorics.
- Using group theory and its relevance in computer science.
- Discussing about various kinds of lattices and its properties.
- Introducing the basic concepts of probability and random variables.

Course Outcome:

At the end of the course, the students will be able to

- Construct mathematical arguments using logical connectives and quantifiers.
- Solve applied problems related to graphs and combinatorics in their domain.
- Apply the concept of group theory in networks.
- Employ the concept of lattices to solve problems in data mining.
- Relate the real life problems with the concept of probability and random variables.

Unit I LOGIC AND PROOFS **9**

Basic connectives and truth tables - Logical equivalences and implications - Propositional logic - First order logic - Laws of logic - Rules of inference - Inference theory - Statement calculus - Quantifiers - Predicate calculus.

Unit II GRAPHS AND COMBINATORICS **9**

Planar graphs - Euler's formula - Graph coloring - Chromatic number and its applications - Basics of counting - Permutations and combinations - Recurrence relations - Solving linear recurrence relations.

Unit III ALGEBRAIC STRUCTURE **9**

Semi groups and monoids - Groups - Subgroup - Normal subgroup - Homomorphisms - Cosets and Lagrange's theorem - Rings and Fields (Definitions and examples).

Unit IV LATTICES AND BOOLEAN ALGEBRA **9**

Partial ordering - Posets - Lattices as posets - Properties of lattices - Sub-lattices - Distributive lattices - Modular lattices - Complete lattices - Complemented lattices - Boolean algebra.

Unit V PROBABILITY AND RANDOM VARIABLE **9**

Axiomatic definition of probability - Addition theorem of probability - Conditional probability - Baye's theorem - Multiplication theorem of probability - Discrete and continuous random variables - Moments - Moment generating function.

Text Book:

1. Kenneth H. Rosen, "Discrete Mathematics and its Applications", McGraw Hill Education, 8th Edition, 2021.
2. Oliver C. Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier, 2nd Edition, 2019.

Reference Book:

1. Thomas Koshy, "Discrete Mathematics with Applications", Elsevier Academic Press, 1st Edition, 2006.
2. Richard A. Brualdi, " Introductory Combinatorics", Pearson Education, 5th Edition, 2019.
3. Jean-Paul Trembley and Manohar R., "Discrete Mathematical Structures with Application to Computer Science", McGraw Hill Education, 1st Edition, 2017.
4. Gupta S.C. and Kapoor V.K., " Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 12th Edition Reprint, 2020.

23CS301 DATA STRUCTURES AND ALGORITHMS

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn algorithm analysis frame work for recursive and non-recursive algorithms
- To acquire knowledge on ADTs such as List, Stack and Queue
- To explore the binary trees and the priority queues with their applications
- To learn the various hashing techniques and Set ADT
- To get exposure on graphs, its representation, traversal and applications

Course Outcome:

At the end of the course, the students will be able to

- Design and analyse recursive and non-recursive algorithms
- Design List, Stack and Queue with appropriate data structures
- Construct balanced search trees and heap-based priority queue
- Work with Set and hash table for effective searching
- Apply the BFS and DFS traversal techniques and find MST, Shortest path and connected components in graphs

Unit I INTRODUCTION TO ANALYSIS OF ALGORITHMS 9

Introduction to algorithms - Algorithm Analysis framework - Performance of algorithms: Space and Time Complexity - Asymptotic Notations: Big-Oh, Big-Omega and Big-Theta - Best, Worst and Average case analysis of algorithms. Mathematical analysis of Non recursive Algorithms - Sequential Search. Mathematical analysis of Recursive Algorithms - Recurrence relation - Binary search.

Unit II LINEAR DATA STRUCTURES 9

Abstract Data Types (ADT) - List ADT - Array-based implementation - Linked list implementation - doubly-linked lists - Applications of Lists - Polynomial Operations. Stack ADT - Array based and linked List based implementation - Postfix expression evaluation. Queue ADT - Circular queue and linked List based implementation.

Unit III TREES AND ITS APPLICATIONS 10

Trees - Binary trees - Binary tree representation and traversals - Binary Search Tree - Balanced trees: AVL trees - Splay tree - Tree Applications: B-Tree – TRIE.

Unit IV PRIORITY QUEUES AND HASHING 8

Priority queue - Binary heap - Heap operations - Applications of heap. Hashing - Open hashing: Separate chaining - Open addressing/Closed hashing: Linear and quadratic probing - double hashing - rehashing - Extendible hashing.

Unit V GRAPHS 9

Graph: Definitions - Representations - Topological sort - Breadth first traversal - Depth first traversal - Connected components – Biconnectivity – Euler circuit - Shortest path algorithms: Single source shortest path - Minimum spanning tree - Prim's and Kruskal's algorithms.

Text Book:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C++", Pearson Education, Fourth Edition, 2013.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education Asia, 2013.

Reference Book:

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", The MIT Press, Fourth Edition, 2022.
2. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, "Data Structures and Algorithms", Pearson Education, New Delhi, Fourteenth Impression, 2013.
3. Ellis Horowitz and Sartaj Sahni, "Fundamentals of Data Structures", Galgotia Book Source, Gurgaon, Second Edition, 2007.
4. Jean-Paul Tremblay and Paul G. Sorenson, "An Introduction to Data Structures with Applications", Tata McGraw-Hill, New Delhi, Second Edition, 2004.

Extensive Reading:

- www.nptel.ac.in
- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-851-advanced-data-structures-spring-2012/
- http://courses.cs.vt.edu/~csonline/DataStructures
- http://cslibrary.stanford.edu/103/LinkedListBasics.pdf
- www.cs.cornell.edu/courses/cs312/2005sp/lectures/rec19.html

23CS302 DIGITAL PRINCIPLES AND SYSTEM DESIGN

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce different methods to simplify Boolean function and realize the logic circuits
- To acquire knowledge for the design of the combinational circuit and simulation using HDL
- To understand the principles of memory and programmable logic circuits
- To learn the working of the synchronous sequential circuits and their simulation using HDL / Verilog HDL.
- To get exposure of asynchronous sequential circuits.

Course Outcome:

At the end of the course, the students will be able to

- Simplify Boolean function and realize the logic circuits
- Design combinational circuits and simulate using HDL
- Design memory and programmable logic circuits
- Design synchronous sequential circuits and simulate using HDL / Verilog HDL.
- Design asynchronous sequential circuits.

Unit I BOOLEAN ALGEBRA AND LOGIC GATES 10

Number Systems and Codes - Boolean algebra and theorems - Simplifications of Boolean functions using Karnaugh map and Tabulation methods - Implementation of Boolean functions using logic gates - Introduction to Hardware Description Language (HDL).

Unit II COMBINATIONAL CIRCUITS 9

Combinational circuits - Analysis and Design procedure - Circuits for arithmetic operations: Adder, Subtractor, Multiplier - Code Converters - Magnitude Comparator – Parity Generator / Checker - Decoders and Encoders - Multiplexers and Demultiplexers - HDL for combinational circuits

Unit III MEMORY AND PROGRAMMABLE LOGIC 9

Classification of memories - ROM- RAM – Memory decoding – Memory Expansion – Programmable Logic Devices : PLA , PAL - Implementation of combinational logic circuits using ROM, PLA, PAL

Unit IV SYNCHRONOUS SEQUENTIAL LOGIC 8

Sequential circuits - Flip-Flops - Counters - Registers – Analysis and design procedures - State reduction and state assignment – Design of Counters, Sequence detector - HDL for Sequential Circuits.

Unit V ASYNCHRONOUS SEQUENTIAL LOGIC 9

Analysis and design of fundamental mode asynchronous sequential circuits - Reduction of state and flow tables - Race-free state assignment - Hazards.

Text Book:

1. S.Salivahanan and S. Arivazhagan, “Digital Circuits and Design”, Fifth Edition, Oxford University Press, 2018
2. M.Morris Mano and Michael D. Ciletti, “Digital Design : With an Introduction to the Verilog HDL, VHDL, and System Verilog”, Sixth Edition, Pearson Education, 2018.

Reference Book:

1. John F. Wakerly, “Digital Design Principles and Practices”, Pearson Education, Fifth Edition, 2018.
2. Donald D.Givone, “Digital Principles and Design”, McGraw Hill Education, 2017.
3. Charles H.Roth, Jr. “Fundamentals of Logic Design”, Cengage Learning, Seventh edition, 2013.

Extensive Reading:

- http://www.doe.carleton.ca/~shams/ELEC3500/hazards.pdf
- https://ocw.mit.edu/courses/6-004-computation-structures-spring-2017/pages/c4/

23CS303 COMPUTER ORGANIZATION AND ARCHITECTURE

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the basic structure and operation of a digital computer.
- To understand the basics of processing unit and control signals.
- To interpret the pipelining architecture and its issues.
- To practice hierarchical memory system.
- To recognize different interfaces for I/O devices.

Course Outcome:

At the end of the course, the students will be able to

- Identify the parameters that affect the performance of digital computers.
- Design the components of arithmetic unit.
- Address the various issues of pipeline organization.
- Analyze the performance of types of memory.
- Design I/O interface circuits.

Unit I BASIC STRUCTURE OF COMPUTERS 10

Functional units - Basic operational concepts - Performance - Instructions and instruction sequencing - Addressing modes - Arithmetic: Design of fast adders - Multiplication of unsigned and signed numbers - Fast Multiplication - Integer division - Floating point numbers and operations.

Unit II BASIC PROCESSING UNIT 9

Fundamental concepts - Instruction Execution - Hardware Components - Instruction Fetch and Execution Steps - Control Signals - Hardwired control - RISC and CISC Styles Processors.

Unit III PIPELINING 9

Basic concepts - Pipeline organization and issues - Data dependencies - Memory and branch delays - Performance evaluation - Pipelining in CISC processors – Introduction to Parallel architectures: Flynn Classification.

Unit IV MEMORY SYSTEM 8

Basic concepts - Memory hierarchy - Semiconductor RAM - Read-only Memories - Direct Memory Access - Cache memory - Performance considerations - Virtual memory - Secondary storage.

Unit V I/O ORGANIZATION 9

Bus structure - Bus operation - Arbitration - Interface circuits - Interconnection standards: PCI, SCSI, SATA, USB, SAS, HDMI, NVMe - Accessing I/O Devices: I/O Device Interface - Program-Controlled I/O - Interrupts.

Text Book:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, and Naraig Manjikian, “Computer Organization and Embedded Systems”, McGraw Hill Higher Education, Sixth Edition, 2011.

Reference Book:

1. David A. Patterson and John L. Hennessy, “Computer Organization and Design: The Hardware / Software interface”, Elsevier, Sixth Edition, 2020.
2. William Stallings, “Computer Organization and Architecture”, Pearson Education, Eleventh Edition, 2022.

Extensive Reading:

- http://www.ics.p.lodz.pl/~dpuchala/CompArch/Lecture_6.pdf
- http://www.dauniv.ac.in/downloads/CArch_PPTs/
- http://cse.iitk.ac.in/users/karkare/courses/2011/cs220/html/notes.html
- http://nptel.ac.in/courses/106102062/
- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-823-computer-system-architecture-fall-2005/
- https://blogs.vmware.com/virtualblocks/2018/08/20/nvm-express-part-one/#:~:text=The%20NVMe%20SSD%20consists%20of,was%20architected%20to%20reduce%20costs

23CS304 PROGRAMMING WITH JAVA

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basic concepts of Java
- To know the concepts of inheritance, polymorphism and exceptions
- To practice event-driven programming using AWT and swings
- To work with generics, collection classes and native methods
- To learn the basics of concurrent programming in Java

Course Outcome:

At the end of the course, the students will be able to

- Write object-oriented programs using Java
- Derive and invoke methods in classes with inheritance and polymorphism
- Develop GUI-based applications using event-driven GUI programming
- Write Java programs using generics and collections
- Write concurrent programs in Java using Threads

Unit I INTRODUCTION TO JAVA 10

Java features - Objects and classes in Java - Defining classes and methods - Access specifiers - Static Fields –Methods Parameters - Object Constructors – Overloading - Arrays - Strings - StringBuffer - StringTokenizer - String Object in Switch Statement – I/O stream classes - Packages – JAR File Creation -JavaDoc comments - Class Design Hints - Exceptions - Dealing with errors – Catching exceptions

Unit II INHERITANCE AND POLYMORPHISM 8

Inheritance – Super classes method/Constructor calling - Polymorphism - Dynamic binding - final Keyword - Object Cosmic Super Class Methods- Object Wrappers and Autoboxing - Abstract classes - Reflection - Interfaces - Lambda expressions- Inner classes – Object Serialization - Saving and loading Serializable Objects.

Unit III GRAPHICAL USER INTERFACE PROGRAMMING 9

Java UI Toolkits - AWT event hierarchy – Displaying Frames – Displaying information in Components – Event Handling – UI components with Swing - Model-View-Controller Design Pattern – Layout Management - Text Input - Choice components - Menus - Dialog boxes - JDBC statements – Query Execution

Unit IV GENERIC PROGRAMMING, COLLECTION AND NATIVE METHODS 9

Motivation for generic programming - Generic classes - Generic methods - Bounds for Type Variables Inheritance Rules for Generic Types - Wildcard Types - Collections Framework - Concrete Collections - Maps – Sets - Native methods - Calling a C function - numeric, string parameters and return values

Unit V CONCURRENT PROGRAMMING 9

Thread states – Thread life cycle - Thread properties - Thread synchronization - Inter thread Communication - Suspending, Resuming, and Stopping Threads – Tasks and Thread pools - Executors –Synchronizers.

Text Book:

1. Cay S. Horstmann, “Core Java: Volume I – Fundamentals”, Twelfth Edition, Pearson Education Inc, 2021

Reference Book:

1. Cay S. Horstmann, “Core Java: Volume II – Advanced Features”, Twelfth Edition, Pearson Education Inc, 2022
2. Herbert Schildt, “Java: The Complete Reference”, Twelfth Edition, McGraw Hill Education, 2021
3. P.J. Deitel & H.M. Deitel, “Java: How to Program”, Eleventh Edition, Pearson Education Inc,2017

Extensive Reading:

- https://docs.oracle.com/javase/tutorial/java/index.html
- http://www.java2s.com/Tutorial/Java/CatalogJava.htm
- https://www.javatpoint.com/java-swing
- https://docs.oracle.com/javase/tutorial/collections/intro/index.html
- https://jenkov.com/tutorials/java-concurrency/index.html

23CS351 DATA STRUCTURES AND ALGORITHMS LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To develop programming skills in design and implementation of linear data structures.
- To experiment with nonlinear data structures for set data type.
- To practice the different hash searching and binary search techniques.
- To work with different types of heaps.
- To work with graph and solve some of the applications using graph.

Course Outcome:

At the end of the course, the students will be able to

- Implement the various linear data structures such as List, Stack and Queue ADTs.
- Design and implement non-linear data structures.
- Develop the collision resolution strategy using open and closed hashing techniques.
- Design and build the various heap structures.
- Implement graph-based applications for real-world problems.

Practical Course **45**

Practical Syllabus:

1. Implementation of List ADT using arrays and Linked List
2. Implementation of Stack ADT and its applications
3. Implementation of Queue ADT and its applications
4. Construction of Binary Search tree and perform the various operations
5. Implementation of AVL tree / Splay Tree
6. Implementation of B-Tree
7. Implementation of Priority Queue using Binary Heap
8. Implementation of Open and Closed Hashing techniques
9. Implementation of graph traversal algorithms
10. Implementation of minimum spanning tree algorithms

Practical Experiments:

Sample exercises:

1. Implement the following List operations using arrays and Linked List storage structure: Insert at front, Insert at middle, Insert end, Delete first, Delete last, Delete an element, Traversal, Find by position, Find by an element, Make empty.
2. Implementation of stacks using array and linked list
3. Implement queues using array and linked list and perform CPU scheduling
4. Perform polynomial operations by representing the polynomials using linked list
5. Using search tree construct a Telephone directory with the information such as Phone Number, Name and address and perform the following:
   - Search for a phone number and print the customer's name and address
   - Remove a phone number from the directory
   - Change the address of the customer whose phone number is given.
   - Print the content of the directory
6. Implement AVL / Splay tree with insert, search, delete and traversal operations.
7. Construct binary min / max heap and perform the following:
   - Find 3rd minimum / maximum
   - Delete an item (with random priority)
   - Delete minimum / maximum element
   - Sort Heap
8. Implement B-Tree with insert, search, delete and traversal operations.
9. Graph Traversals – Depth First and Breadth First search
   - Given an XY board containing obstacles and a knight that can only move like the chess piece, Find the minimum number of moves necessary to reach a certain destination on that board
   - Bessie is caught at the lower left corner of an X Y grid forest with various obstacles in her way. Given that she wants to reach the upper right corner, and that she never goes back to a point she has already visited, how many paths can she take?
10. For the given route map with cost of transportation between different cities, find the shortest route from a source to all the other cities.
11. Locate a particular word in a dictionary.
12. Implement a dictionary which contains the meaning of different words. Both the word and the meaning can be in the same language. Your program should read a word and should give the meaning. If the word is a new one (not

available in the dictionary) then include the word into its correct position with its meaning. Use Hashing techniques.

Reference Book:

1. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Pearson Education, Fourth Edition, 2013.
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, “Introduction to Algorithms”, The MIT Press, Fourth Edition, 2022.
3. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, “Data Structures and Algorithms”, Pearson Education, New Delhi, Fourteenth Impression, 2013.
4. Ellis Horowitz and Sartaj Sahni, “Fundamentals of Data Structures”, Galgotia Book Source, Gurgaon, Second Edition, 2007.
5. Jean-Paul Tremblay and Paul G. Sorenson, “An Introduction to Data Structures with Applications”, Tata McGraw-Hill, New Delhi, Second Edition, 2004.

Extensive Reading:

- www.nptel.ac.in
- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-851-advanced-data-structures-spring-2012/
- http://courses.cs.vt.edu/~csonline/DataStructures
- http://cslibrary.stanford.edu/103/LinkedListBasics.pdf
- www.cs.cornell.edu/courses/cs312/2005sp/lectures/rec19.html

23CS352 DIGITAL CIRCUITS LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To implement adders, subtractors
- To exercise code convertors, multiplexers, de-multiplexers
- To construct counters and shift registers
- To be familiar with any one digital circuits simulation software.

Course Outcome:

At the end of the course, the students will be able to

- Design and implement adders, subtractors, code convertors, multiplexers, de-multiplexers
- Design and implement magnitude comparator, parity checker circuit
- Design and implement LED display and traffic light signal controller
- Construct counters, shift registers using flip flops
- Construct and simulate digital circuit using VHDL software

Practical Course **45**

Practical Syllabus:

1. Verification of Boolean theorems using digital logic gates
2. Design and implementation of combinational circuits using basic gates for arbitrary functions, code converters, etc.
3. Design and implementation of binary adder / subtractor using basic gates and MSI devices
4. Design and implementation of parity generator / checker using basic gates and MSI devices
5. Design and implementation of magnitude comparator
6. Design of decoder for LED display control
7. Design and implementation of application using multiplexers/ De-multiplexers
8. Simulation of combinational circuits using Hardware Description Language (VHDL/ Verilog HDL software required)
9. Design and implementation of Shift registers
10. Design and implementation of Synchronous and Asynchronous counters
11. Simulation of sequential circuits using HDL (VHDL/ Verilog HDL software required)

Reference Book:

1. S.Salivahanan and S. Arivazhagan, “Digital Circuits and Design”, Fifth Edition, Oxford University Press, 2018
2. M.Morris Mano and Michael D. Ciletti, “Digital Design : With an Introduction to the Verilog HDL, VHDL, and System Verilog”, Sixth Edition, Pearson Education, 2018..
3. John F. Wakerly, “Digital Design Principles and Practices”, Pearson Education, Fifth Edition, 2018.
4. Donald D.Givone, “Digital Principles and Design”, McGraw Hill Education, 2017.

Extensive Reading:

- http://www.doe.carleton.ca/~shams/ELEC3500/hazards.pdf
- https://ocw.mit.edu/courses/6-004-computation-structures-spring-2017/pages/c4/

23CS353 JAVA LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To develop software development skills to solve real-world problems using java programming
- To understand and implement object programming concepts
- To design/develop GUI and concurrent applications in Java

Course Outcome:

At the end of the course, the students will be able to

- Develop simple java programs using object oriented features
- Write java programs to evaluate object class and reflection with exception handling
- Design GUI applications using AWT and swings event handling with database
- Simulate collection types using generic programming
- Implement java concurrency to solve scientific problems

Practical Course **45**

Practical Syllabus:

- Basic Java Programs with classes, objects, and methods
- Arrays and strings
- Inheritance types
- Abstract classes and Object Class
- Interfaces and Lambda expressions
- Native methods
- GUI programming
- Event Handling
- JDBC
- Generic programming
- Collections
- Concurrent Programming

Practical Experiments:

1. Develop a java application with an Employee class with Emp_name, Emp_id, Address, Mail_id, Mobile_no, basic pay as members. Write a method to calculate salary given 97% of BP as DA, 10 % of BP as HRA will be added while 12% of BP as PF and 0.1% of BP for staff club funds will be deducted from salary. Generate pay slips for the employees with their gross (without deductions) and net salary
2. Write a java program to multiply two matrices
3. Create two classes named Mammals and MarineAnimals. Create another class named BlueWhale which inherits both the above classes. Now, create a function in each of these classes which prints "I am mammal", "I am a marine animal" and "I belong to both the categories: Mammals as well as Marine Animals" respectively. Now, create an object for each of the above class and try calling
    - function of Mammals by the object of Mammal
    - function of MarineAnimal by the object of MarineAnimal
    - function of BlueWhale by the object of BlueWhale
    - function of each of its parent by the object of BlueWhale
4. Write a user defined java exception to eligibility for voting (age is user given)
5. Implement the given class diagram
6. Design a notepad application using awt program
7. Design a swing application that displays x and y coordinates with a coloured dot when mouse is clicked
8. Write a Java swing application to store and retrieve student database using JDBC
9. Write a Java program to explain various forms of writing Lambda Expression
10. Write a native C method to add two integers and invoke in Java program
11. Write generic code to store and display integer/string elements in an array
12. Write a Java program to evaluate properties of hash sets
13. Write a java program that creates a thread (let's call it Thread 1). Thread 1 creates another thread (Thread 2); Thread 2 creates Thread 3; and so on, up to Thread 50. Each thread should print "Hello from Thread num!"

Reference Book:

1. Cay S. Horstmann, “Core Java: Volume II – Advanced Features”, Twelfth Edition, Pearson Education Inc, 2022
2. Cay S. Horstmann, “Core Java: Volume I – Fundamentals”, Twelfth Edition, Pearson Education Inc, 2021
3. Herbert Schildt, “Java: The Complete Reference”, Twelfth Edition, McGraw Hill Education, 2021
4. P.J. Deitel& H.M. Deitel, “Java: How to Program”, Eleventh Edition, Pearson Education Inc,2017

Extensive Reading:

- https://docs.oracle.com/javase/tutorial/java/index.html
- http://www.java2s.com/Tutorial/Java/CatalogJava.htm
- https://www.javatpoint.com/java-swing
- https://docs.oracle.com/javase/tutorial/collections/intro/index.html
- https://jenkov.com/tutorials/java-concurrency/index.html

23CS354 MINI PROJECT - I

Offered by CSE (Project Work)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- To develop software development skills to solve real-world problems
- To create their own innovative idea prototype and work in team
- To impart students with effective communication and writing skills
- To inculcate self-learning and research

Course Outcome:

At the end of the course, the students will be able to

- Identify the societal/research needs and formulate the problem
- Collect, interpret and analyse project related information as a team
- Identify appropriate programming tool and techniques to implement project
- Excel in idea presentation and writing comprehensive reports

Practical Course **30**

Practical Syllabus:

Mini project guidelines:

- The students can work in a group of 2 to 3 on a current topic approved by the faculty supervisor and head of the department
- The student team should conduct survey and identify problem and submit implementation plan as Gannt/PERT/CPM chart that covers weekly activities
- The student should develop GUI based projects using JAVA and database concepts.
- The students should evaluate different methods to solve problems and select best among them.
- The student prepares and submit a comprehensive mini project report at the end of the semester.
- The review committee may be constituted by the Head of the Department.
- The project progress is evaluated based on a minimum of two reviews.
- The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.
- The mini project will be assessed based on quality of survey, clarity in problem definition, innovativeness in solution, cost effectiveness, societal impact, functionalities of the working model/solution, contribution as individual/member in team, clarity in oral/written communication

SOFTWARE / TOOLS TO BE USED:

- JDK
- Netbeans / Eclipse IDE
- Backend Database (MySQL, Oracle, …)

Practical Experiments:

Sample mini projects:

1. QuizUp – A Quiz Application
2. Chatbot Recommender System
3. House Price Prediction
4. Forecasting Stocks
5. Resume Builder Application
6. Library Management System
7. Face detection System
8. E-Authentication System
9. Student IQ Evaluation based on cursor movements (during MCQ exam)
10. Symbol/Sign recognition
11. Finding Cabs Nearby
12. Job Portal

Reference Book:

1. Tom Clark, Liam Foster, Alan Bryman, “How to Do Your Social Research Project Or Dissertation”, First Edition, Oxford University Press, 2019
2. Colin Robson, “How to Do a Research Project A Guide for Undergraduate Students”, First Edition, Wiley Publications, 2014

Extensive Reading:

- https://www.skyfilabs.com/blog/6-steps-to-do-successful-mini-project
- https://www.linkedin.com/pulse/tips-developing-your-first-mini-project-neavil-porus-a/?trk=public_profile_article_view

- https://greatresearch.org/exercises/mini-project/
- https://academy.araiindia.com/index.php/academics/research/academic-research/mini-projects
- https://www.elprocus.com/engineering-students-give-importance-to-mini-projects/

23HSM01 PRESENTATION AND LANGUAGE SKILLS LABORATORY

Offered by ENG (Employability Enhancement Courses offered to BAD, BBT, BCI, BCS, BEE, BIT)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- The strategies of presentation skills.
- Improving the proper usage of Vocabularies.
- Developing proficiency in application of language skills.
- Learning the nuances to interact with technical audience.
- Using English accurately in research papers.

Course Outcome:

At the end of the course, the students will be able to

- Implement the strategies of presentation skills.
- Use vocabularies properly.
- Speak English confidently on any topic.
- Interact with a technical audience.
- Use English properly in research papers.

Practical Course **30**

Practical Syllabus:

UNIT I

Importance and Significance of Presentation – Presentation Techniques – PPT Preparations Strategy – Do's and Don'ts of Presentation – Presentation Tools –7Cs of Effective Communication - Differences between Reading and Presenting – Formal Phrases for Presentation –Preparing Outline – Organizing Content - Documentaries and Educational Video Clips - Oration of Great Leaders - Live News - Listening Technical Presentations - Reviewing Technical News from Media & Webinar

UNIT II

Speaking Activities Using Discourse Markers:

Impromptu: Just A Minute (JAM) – Turncoat - Role-Play – One Minute Technical Presentation - Prepared Talks: Giving Reasons, Future Plans, Comparing & Contrasting, Making Suggestions – Poster/Project Presentation – Presentation of Data (Charts/Graphs) – Digital Presentation – Presenting a Product

UNIT III

Defining Purpose - Audience & Locale -Audio-Visual Aids - Nuances of Delivery - Body Language - Voice Dynamics – Stage dynamics – Handling questions – 4Ps of Presentation – Phonetics- British and American Accent – Intonation – Eliminating Gap Fillers – Storytelling Techniques – Humor in Presentation – Word Choice – Evaluating Form – Personal Appearance – Handouts

UNIT IV

Importance of Journal Articles/Paper– Writing Research Article/Paper - Elements of Technical papers (Abstract, Introduction, Methodology, Results, Discussion, Conclusion, Appendices, Writing Bibliography and References as well as using Software for Data Interpretation) - Preparation of Scholarly Papers in IEEE and APA Formats- Plagiarism and its Software's - Quiz on Presentation - Reviews and Feedback

UNIT V

Awareness on IEEE, Springer, MDPI, WoS, SCOPUS and SCI indexed journals – Predatory Journals – Copyrights – Patent drafting for beginners – Creating research profiles

Reference Book:

1. 1.Charles W.Knisely and Karin I.Knisely. Engineering Communication, Cengage, 2019.
2. 2.Meenakshi Raman and Sangeeta Sharma. Technical Communications Principle and Practice, Oxford University Press, 2021.

Extensive Reading:

- Any Novel

IAS30 INTEGRATED APTITUDE SKILLS - I (LOWER)

Offered by MECH (Ability Enhancement Courses offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
2	0	0	1

Course Objective:

To impart knowledge on

- The basic concepts of quantitative ability
- The basic concepts of logical reasoning Skills
- Satisfactory competency in use of verbal reasoning

Course Outcome:

At the end of the course, the students will be able to

- Solve aptitude, logical and verbal reasoning questions

Unit I QUANTITATIVE APTITUDE **10**

1. Numbers – Number Systems, Types of Numbers, Series (Arithmetic Progression, Geometric Progression)
2. Problem on Ages
3. HCF & LCM
4. Profit & Loss
5. Problems on Trains, Boats & Stream
6. Calendar & Clocks
7. Time & Work
8. Speed & Distance (Or) Time & Distance
9. Decimal Fractions, Simplification (Including Expression & Evaluation)
10. Square Root, Cubic Root
11. Average
12. Surds & Indices
13. Odd Man Out & Series

Unit II LOGICAL REASONING **10**

1. Series completion
2. Analogy
3. Classification
4. Coding-Decoding
5. Blood Relation
6. Puzzle test
7. Sequential Output Tracing
8. Direction sense test
9. Logical Venn Diagram
10. Alphabet Test
11. Alpha-numeric sequence Puzzle
12. Number, Ranking and Time sequence Test
13. Mathematical Operations
14. Logical Sequence of words
15. Arithmetical Reasoning
16. Inserting the mission character
17. Data Sufficiency
18. Eligibility test
19. Assertions and Reasoning
20. Situation Reaction Test
21. Verification of truth of the statement

Unit III VERBAL ABILITY **10**

1. Vocabulary Based - Synonyms
2. Vocabulary Based - Antonyms
3. Spotting Errors
4. Spelling
5. Jumbled words
6. One word substitution
7. Sentence Correction
8. Idioms & Phrases.
9. Commonly confusing words
10. Statement and Conclusion
11. Change of Voice
12. Facts/Inferences and Judgment

Text Book:

1. Agarwal R.S, “Quantitative Aptitude,” S.Chand and Company Pvt. Ltd., New Delhi, First Edition 1989, Reprint, 2016
2. Agarwal R.S, “A Modern Approach to Verbal and Non-Verbal Reasoning,” S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1994, Reprint, 2016
3. Agarwal R.S, “Objective General English,” S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1997, Reprint, 2016

Reference Book:

1. Anand P A, “Quantitative Aptitude,” Wiley India Pvt. Ltd., New Delhi, Edition, 2016
2. Arun Sharma, “How to Prepare for Logical Reasoning,” Tata-McGraw Hill Education Series. New Delhi, First Edition 2016
3. Sharon Weiner Green, Ira K Wolf, “Barron’s GRE,” Barron Publishers. First Edition 1995, Reprint, 2016
4. The Princeton Review, “Cracking the GRE”, Random House Publisher, Premium Edition 2016.
5. Mark Alan Steward, J D,”30 days to the GMAT CAT”, Arco Publishers, 2nd Edition 2016.

Extensive Reading:

- www.indiabix.com
- http://www.practiceaptitudetests.com

USS30 UNDERSTANDING SOFT SKILLS - I

Offered by ENG (Ability Enhancement Courses offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
1	0	0	1

Course Objective:

To impart knowledge on

- Characteristics of personal attributes
- Holistic development with a focus on soft skills
- Importance of Soft skills
- Inculcating positive mindset, right attitudinal and motivational aspects with nuances of communication
- Motivational and lateral thinking skills

Course Outcome:

At the end of the course, the students will be able to

- Develop their personality by understanding themselves
- Prepare themselves confidently for professional environment
- Have positive attitude in their future altitudes
- Have good attitude and behavior with polite expressions
- Become a highly self-motivated individual with problem solving techniques

Unit I

Definition of Soft Skills- Difference between Soft Skills and Hard Skills-Value Systems –Case study-SWOT Analysis-Who am I attribute &Self-Development

Unit II

Importance of Self confidence, Self Esteem- Art of Greetings, Self-Introduction- Business Etiquette

Unit III

Factors influencing Attitude-Pros and cons of Positive thinking- Positive thinking challenges

Unit IV

Conversational English-Real-life scenario-Challenges in acquiring fluency-Fluency: Tips and tricks

Unit V

Factors of Motivation, Self-talk, Intrinsic & Extrinsic Motivators- Creativity & Out of box thinking- Problem solving skills & Lateral thinking

Practical Course **4**

23MA403 MATHEMATICS - IV : PROBABILITY, QUEUEING THEORY AND STATISTICS

Offered by MAT

(Core Theory offered to BCS, BIT)

L	T	P	C
2	2	0	3

Course Objective:

To impart knowledge on

- Finding solutions for probabilistic models using various distributions.
- Association between the multi variables and the concept of Markov processes.
- Designing queuing models and its applications.
- Various methods in estimation theory.
- Categorizing various statistical techniques useful in making rational decision in engineering problems.

Course Outcome:

At the end of the course, the students will be able to

- Apply the concepts of probability distributions in solving engineering problems.
- Define the concepts of two dimensional random variables and study the transient behavior of stochastic systems.
- Examine the basic characteristic features of a queuing system in analyzing models.
- Use the concept of estimation theory.
- Derive the inference about samples using testing of hypothesis.

Unit I PROBABILITY DISTRIBUTION **9**

Discrete distributions: Binomial, Poisson and Geometric distributions - Continuous distributions: Uniform, Exponential and Normal distributions.

Unit II TWO DIMENSIONAL RANDOM VARIABLES AND MARKOV CHAINS **9**

Joint probability distributions - Marginal and conditional probability distributions - Classification of random process - Markov processes - Transition probability matrix - Classification of states.

Unit III QUEUEING THEORY **9**

Characteristics of queueing model - Markovian models: Single and multiple server queueing models - Queues with infinite size - Non Markovian models: M/G/1 queue - Pollaczek-Khinchine formula.

Unit IV ESTIMATION THEORY **9**

Unbiased estimators - Efficiency - Consistency - Sufficiency - Method of moments - Method of maximum likelihood - Method of least squares.

Unit V PARAMETRIC AND NON-PARAMERTIC METHODS **9**

Sampling distributions - Tests of significance - Errors in sampling - One sample and two sample tests for means of large samples (z-test) - F-test - Rank sum test: Mann-Whitney U test and Kruskal Wallis test.

Text Book:

1. Oliver C. Ibe, “Fundamentals of Applied Probability and Random Processes”, Elsevier, 2nd Edition, 2019.
2. Taha H.A., “Operations Research”, Pearson Education, 10th Edition, 2019.
3. Richard I. Levin, Masood H. Siddiqui, David S. Rubin and Sanjay Rastogi, “Statistics for Management”, Pearson Education, 8th Edition, 2017.

Reference Book:

1. Gupta S.C. and Kapoor V.K., “ Fundamentals of Mathematical Statistics”, Sultan Chand & Sons, 12th Edition, 2020.
2. Gross D. and Harris C.M., “Fundamentals of Queueing Theory”, Wiley, 4th Edition, 2012.
3. Allen A.O., “Probability, Statistics and Queueing Theory with Computer Science Applications”, CBS Publishers & Distributors Pvt. Ltd., 1st Edition, 2010.
4. Trivedi K.S., “Probability and Statistics with Reliability, Queueing and Computer Science Applications”, John Wiley and Sons, 2nd Edition, 2016.
5. Sheldon M. Ross, “ Introduction to Probability Models”, Academic Press, 11th Edition, 2014.

Extensive Reading:

- http://stattrek.com/probability-distributions/discrete-continuous.aspx
- http://people.brunel.ac.uk/~mastjjb/jeb/or/queue.html
- https://www.ibm.com/docs/en/db2woc?topic=procedures-statistics-parametric-nonparametric

23CS401 MICROPROCESSORS AND MICRO CONTROLLERS

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study the hardware architecture and programming model of 8086 processor
- To learn about use coprocessor with 8086
- To study the serial and parallel interfacing techniques
- To study the hardware architecture and programming model of 8051 microcontroller
- To learn the evolution of processors and its features

Course Outcome:

At the end of the course, the students will be able to

- Write Intel 8086 Assembly Language Programs
- Write modular programming and interrupts handlers
- Interface the microprocessors with various input output devices
- Develop programs using 8051 microcontroller
- Perform Floating Point Computations using co-processors and compare the features of recent processors

Unit I 8086 ARCHITECTURE AND PROGRAMMING 9

Intel 8086 Processor signals - Architecture - Addressing modes - Instruction set and assembler directives – Data transfer instructions - Arithmetic Instructions – Logical instructions – Branching instructions – Machine control instructions - Assembly language programming

Unit II 8086 AND MULTIPROCESSORS SYSTEM CONFIGURATION 9

Procedures - Macros - Interrupts and interrupt service routines. Minimum and Maximum mode configurations - Clock Generator - Bus controller - System bus timing.

Unit III INTERFACING 9

Memory interfacing and I/O interfacing - Parallel communication interface - Serial communication interface - Timer - Interrupt controller - Keyboard / Display interfacing - ADC and DAC Interfacing

Unit IV 8051 MICROCONTROLLER 9

Architecture of 8051 - Signals - Operational features - Instruction set - Memory and I/O addressing – Parallel Ports - Timer - Interrupts - Stepper motor interfacing - Serial Port.

Unit V EVOLUTION OF PROCESSORS AND COPROCESSORS (INTRODUCTORY LEVEL ONLY) 9

Coprocessors: 8087 Architecture-Data types -Instruction set.

Evolution of Processors: Architecture of Pentium Processors –Salient features of Pentium processors II,III, IV – Multicore processors: Salient features of Core i5, core i7 and core i9 - ARM 7 architecture.

Text Book:

1. Barry B. Brey, “The Intel Microprocessors - Architecture, Programming & Interfacing, 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4 and Core2 with 64-bit Extensions”, Pearson Prentice Hall, Eighth Edition, 2011.
2. N.Senthilkumar, M.Saravanan, S.Jeevananthan, S.K.Shah “Microprocessors & Interfacing”, Oxford University Press, 2012.

Reference Book:

1. Kenneth J.Ayala, “The 8051 Microcontroller Architecture, Programming and Applications”, Penram international, 2008.
2. A. K. Ray & K. M. Bhurchandi, “Advanced Microprocessors and Peripherals- Architectures, Programming and Interfacing”, Tata McGraw Hill, Second Edition, 2006.
3. Peter Abel, “IBM PC Assembly language and programming”, Prentice Hall of India Pvt. Ltd., Fifth Edition, 2007.
4. Mohamed Ali Mazidi, Janice Gillispie Mazidi, Rolin McKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Pearson education, Second Edition, 2011.

Extensive Reading:

- www.intel.com
- www.nptel.ac.in

23CS402 THEORY OF COMPUTATION

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To know the different types of finite automata and regular languages
- To familiarize with regular expression
- To learn the context free grammar and push down automata
- To understand grammar normalization and the working of Turing machines
- To study undecidable problems

Course Outcome:

At the end of the course, the students will be able to

- Design finite state automata for a language specification and convert one form to another form
- Write regular expression for a language specification and convert to Finite automata
- Design context free grammar (CFG) and push down automata (PDA) for languages and convert CFG to PDA and vice versa
- Normalize the CFG and Construct Turing machine by applying different techniques
- Find undecidability in languages

Unit I FINITE AUTOMATA AND REGULAR LANGUAGE 9

Automata theory - Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Equivalence between NFA and DFA – Finite Automata with Epsilon transitions – Equivalence of NFA and DFA- Equivalence of NFAs with and without ε-moves- Conversion of NFA into DFA – Minimization of DFAs.

Unit II REGULAR EXPRESSIONS AND LANGUAGES 8

Regular expression – Regular Languages- Equivalence of Finite Automata and regular expressions – Proving languages to be not regular (Pumping Lemma) – Closure properties of regular languages.

Unit III CONTEXT FREE GRAMMAR AND PUSH DOWN AUTOMATA 10

Types of Grammar - Chomsky's hierarchy of languages -Context-Free Grammar (CFG) and Languages – Derivations and Parse trees – Ambiguity in grammars and languages – Push Down Automata (PDA): Definition – Moves - Instantaneous descriptions -Languages of pushdown automata – Equivalence of pushdown automata and CFG-CFG to PDA-PDA to CFG – Deterministic Pushdown Automata - Pumping lemma for CFL – Closure properties of Context Free Languages

Unit IV NORMAL FORMS AND TURING MACHINES 9

Normal forms for CFG – Simplification of CFG- Chomsky Normal Form (CNF) and Greibach Normal Form (GNF) Turing Machine : Basic model – definition and representation – Instantaneous Description – Language acceptance by TM – TM as Computer of Integer functions – Programming techniques for Turing machines

Unit V UNDECIDABILITY 9

Unsolvable Problems and Computable Functions –PCP-MPCP- Recursive and recursively enumerable languages – Properties - Universal Turing machine -Tractable and Intractable problems - P and NP completeness – Kruskal's algorithm – Travelling Salesman Problem

Text Book:

1. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Pearson Education, Third Edition, 2011.

Reference Book:

1. Mishra K L P and Chandrasekaran N, "Theory of Computer Science-Automata, Languages and Computation", Prentice Hall of India, Third Edition, 2010.
2. Harry R. Lewis and Christos H. Papadimitriou, "Elements of the theory of Computation", Prentice-Hall of India Pvt. Ltd, Second Edition, 2009.
3. J. Martin, "Introduction to Languages and the Theory of Computation", Tata Mc Graw Hill, New Delhi, Third Edition, 2007.
4. Micheal Sipser, "Introduction to the Theory and Computation", Cengage Learning India, 2012.

Extensive Reading:

- http://ocw.mit.edu/courses/mathematics/18-404j-theory-of-computation-fall-2006/
- http://infolab.stanford.edu/~ullman/ialc.html
- http://www.cs.duke.edu/csed/jflap/tutorial/
- http://www.turing.org.uk/turing/scrapbook/machine.html

23CS403 OBJECT ORIENTED SOFTWARE ENGINEERING

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To know the fundamental concepts of software engineering
- To explore and practice the UML modeling
- To study requirements elicitation, analysis and modeling
- To understand the software design concepts and principles
- To learn the different testing strategies and quality assurance

Course Outcome:

At the end of the course, the students will be able to

- Use Software Process models for developing applications
- Apply UML diagrams for a software system
- Formulate software requirement specification
- Design software according to the specification
- Test and measure the software performance using software testing and quality assurance techniques

Unit I SOFTWARE PROCESS MODELS AND AGILE DEVELOPMENT 9

The nature of software - Software engineering practice - Software myths – Generic process models framework - Prescriptive process models - Specialized process models - The unified process - Personal and team process models – Overview of agile process – Extreme Programming – Scrum model – Other agile process models

Unit II REQUIREMENT ENGINEERING & MODELING 9

Functional and non-functional requirements – Software requirements document – Requirement specification – Requirement engineering process – Requirement's elicitation and analysis – Requirement's validation – Scenario-Based modelling – Class-Based modeling - Flow-Oriented modeling – Behavior modeling

Unit III MODELLING WITH CLASSES, INTERACTIONS AND BEHAVIOR 9

Basics of object-oriented concepts – UML – Class diagrams - Use case diagrams – Interaction diagrams – State diagrams - Activity diagrams – Sequence diagrams – Communication diagram – Package diagram

Unit IV DESIGN CONCEPTS 9

Design process and concepts - Architectural design: Software architecture - Architectural styles - Architectural design - Architectural mapping using data flow - User interface design: The golden rules, User interface analysis and design steps – Design patterns – Pattern-based software design – Architectural patterns

Unit V SOFTWARE TESTING AND QUALITY MANAGEMENT 9

Test strategies for conventional and object-oriented software -Validation testing - System testing – Debugging – White-box testing - Basis path testing - Control structure testing- Black-box testing – Object-oriented testing methods. Software Quality: Concepts – Review techniques – Quality assurance

Text Book:

1. Roger S. Pressman, "Software Engineering – A practitioner's approach", Eighth Edition, McGraw Hill Publications, 2019.
2. Craig Larman, "Applying UML and Patterns: An Introduction to object- oriented Analysis and Design and iterative development", Third Edition, Pearson Education, 2016.

Reference Book:

1. Bernd Bruegge & Allen H. Dutoit, "Object-Oriented Software Engineering Using UML, Patterns, and Java", Third Edition, Prentice Hall, 2013.
2. Timothy C. Lethbridge and Robert Laganière, "Object-Oriented Software Engineering Practical Software Development Using UML and Java", Second Edition, McGraw Hill Publications, 2005.
3. Ian Sommerville, "Software engineering", Tenth Edition Pearson Education, 2017.

Extensive Reading:

- https://www.mheducation.co.in/software-engineering-a-practitioner-s-approach-9789353165710-india
- https://www.tutorialspoint.com/software_engineering/index.htm
- http://www.agilemodeling.com/
- http://www.uml.org/
- https://www.oodesign.com/
- http://www.agilemodeling.com/essays/umlDiagrams.htm

23CS404 DATABASE SYSTEMS

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the role of Entity Relationship modeling in enterprise applications
- To examine data modeling and data retrieval
- To learn the logical database design methods
- To understand the relationship between Transaction Processing and Databases
- To study query processing and optimization

Course Outcome:

At the end of the course, the students will be able to

- Design database for enterprise applications using Entity Relationship Diagrams
- Create database with appropriate constraints and query the database
- Normalize databases to reduce cost due to data redundancy
- Analyze different types of scheduling and recovery techniques for concurrent transactions
- Validate the query evaluation plan and optimize the query to reduce complexity

Unit I DATABASE FUNDAMENTALS 9

Purpose of Database Systems – View of Data - Database System Architecture – Data Models – Structure of Network Model – Structure of Hierarchical Model - Entity Relationship Model – Constraints - Entity Sets – Attributes – Keys - E-R Diagrams - Design Issues - Extended E-R Features.

Introduction of Relational Model – E-R Reduction to Relational Schemas - Structure of Relational Databases – Schema Diagrams – Relational Query Languages - Relational Algebra.

Unit II RELATIONAL DATABASE MODELS 9

Data Definition Language - Integrity Constraints – Data Manipulation Language - Basic Queries in SQL – Set Operations – Aggregate Operations – Sub Queries - Joins – Views – Authorization.

Advanced SQL – Anonymous PL/SQL - Cursor - Triggers – Functions and Procedures– Embedded SQL – Dynamic SQL

Unit III LOGICAL DATABASE DESIGN 9

Need for good database design – Functional Dependencies and Keys – Closure of Functional Dependencies Set – Closure of attributes - Dependency Preservation - Decomposition using functional dependencies – Canonical Cover.

Atomic domains and First Normal Form – Second Normal Form – Third Normal Form – Boyce Codd Normal Form – Multivalued Dependencies - Decomposition using Multivalued dependencies – Fourth Normal Form – Introduction to Higher Normal Forms.

Unit IV TRANSACTIONS AND CONCURRENCY CONTROL 9

Transaction Model– ACID properties – Transaction States - Serializability - Conflict serializability – View Serializability – Testing Serializability - Concurrency Control – Lock Based Protocols – Deadlocks – Multiple Granularity – Time Stamp Based Protocols – Validation Based Protocols.

Recovery System – Failure Classification – Recovery and Atomicity – Recovery Algorithm.

Unit V QUERY PROCESSING & OPTIMIZATION AND CASE STUDIES 9

Indexing: B+ tree. Query Processing - Measures of Query Cost - Selection– Sorting - Join Operation.

Evaluation of Expressions – Query Tuning - Query Optimization - Transformation of Relational Expressions - Estimating Statistics of Expression Results - Choice of Evaluation Plans – Materialized Views.

Case Studies: PostgreSQL

Text Book:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, McGraw Hill, Seventh Edition, 2020.H.A. Taha, “Operations Research”, Pearson Education, Asia, 8th edition, 2016.

Reference Book:

1. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Pearson Education/Addison Wesley, Sixth Edition, 2010.
2. Thomas Cannolly and Carolyn Begg, "Database Systems, A Practical Approach to Design, Implementation and Management", Pearson Education, Fifth Edition, 2009.
3. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Pearson Education, Eighth Edition, 2006.
4. Raghu Ramakrishnan, Johannes Gehrke, "Database Management Systems", McGraw Hill, Third Edition, 2004.

Extensive Reading:

- http://www.1keydata.com/datawarehousing/data-modeling-levels.html
- http://www.cs.uwaterloo.ca/~gweddell/cs448/Arch.pdf
- http://www.sql-tutorial.net/SQL-tutorial.asp
- http://sqlzoo.net/

- https://beginnersbook.com/2017/09/mongodb-tutorial/
- http://www.orafaq.com/wiki/Oracle_database_Performance_Tuning_FAQ

23CS481 DESIGN AND ANALYSIS OF ALGORITHMS

Offered by CSE (Theory Course with Lab Component)

L	T	P	C
3	0	2	4

Course Objective:

To impart knowledge on

- To learn algorithmic solutions using brute force technique
- To study decrease and conquer and divide & conquer techniques.
- To understand dynamic programming techniques.
- To explore greedy algorithms and iterative improvement methods to solve optimization problems.
- To study the limitations of algorithmic power and handle using backtracking and branch and bound algorithms.

Course Outcome:

At the end of the course, the students will be able to

- Analyze the efficiency of non-recursive algorithmic solutions using brute force technique.
- Solve problems using decrease and conquer and divide & conquer techniques.
- Use Space, Time Tradeoffs and Dynamic Programming Techniques for solving real-world problems.
- Solve problems using greedy and iterative improvement techniques for optimization.
- Compute the limitations of algorithmic power and solve the problems using backtracking and branch and bound techniques.

Unit I ALGORITHM ANALYSIS AND BRUTE FORCE TECHNIQUE 12

Algorithm of analysis: Analysis of Recursive and Non-recursive algorithms Recap. Algorithm design techniques, Brute Force: Computing an, Selection sort, Bubble sort, String searching, Closest-Pair and Convex-Hull Problems. Exhaustive Search: Travelling Salesman Problem, Knapsack Problem, Assignment problem.

Unit II DIVIDE & CONQUER AND DECREASE & CONQUER TECHNIQUES 12

Divide and Conquer Methodology: Finding the maximum and minimum, Merge sort, Quick sort, Strassen's matrix multiplication - Closest-Pair and Convex Hull Problems. Transform-and-Conquer: Presorting-Gaussian Elimination-Heap sort.

Decrease-and-Conquer: Insertion sort, Topological sort, Fake-Coin problem, Computing a median, Selection problem.

Unit III SPACE, TIME TRADEOFFS AND DYNAMIC PROGRAMMING TECHNIQUE 12

Space and Time Trade-Offs – Sorting by counting-Comparison counting Sort. Input Enhancement in string matching-Horspool's Algorithm, Boyer-Moore Algorithm.

Dynamic programming: Knapsack Problem, Optimal Binary Search Trees, Floyd's algorithm, Traveling Salesperson problem.

Unit IV GREEDY TECHNIQUE AND ITERATIVE IMPROVEMENT 12

Greedy Technique: Container loading problem, Knapsack Problem, Huffman Trees, Optimal storage on tapes.

Iterative Improvement: The Simplex Method, The Maximum-Flow Problem, Stable Marriage Problem.

Unit V BACKTRACKING AND BRANCH & BOUND 12

Backtracking: n-Queen problem, Hamiltonian Circuit Problem, Sum of Subset Problem, Graph Coloring. Branch and Bound: Assignment problem, Knapsack Problem, Traveling Salesman Problem. Limitations of Algorithm Power - Tractable and Intractable Problems. Class complexity: P, NP classes, NP-Complete and NP-Hard Problems, Approximation algorithms for Traveling Salesman Problem.

Practical Experiments:

LIST OF SAMPLE PRACTICAL EXERCISES:

- Implementation of Finding closest pair problem and Selection sort
- Performance comparison of sorting algorithms such as Heap Sort and Quick sort.
- Horspool's string matching Algorithm, Implementation of Floyd's algorithm using Dynamic programming.
- Implementation of Huffman Trees and Maximum flow problem
- Implementation of n-Queen problem and Knapsack problem

Text Book:

1. Anany Levitin, "Introduction to the Design and Analysis of Algorithm", Pearson Education, Second Edition, 2013.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, Computer Algorithms/ C++, Second Edition, Universities Press, 2019.

Reference Book:

1. Thomas H.Cormen, Charles E.Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Third Edition, PHI Learning Private Limited, 2012.
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press, Hyderabad, Second Edition, 2012.
3. S.Sridhar, "Design and Analysis of Algorithms", Oxford Higher education, 2015.
4. Harsh Bhasin, "Algorithms Design and Analysis", Oxford university press, 2016.

5. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, “Data Structures and Algorithms”, Pearson Education, Reprint 2006.

Extensive Reading:

- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-ofalgorithms-spring-2012/
- http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html
- https://www.coursera.org/specializations/algorithms

23CS451 MICROPROCESSORS AND MICRO CONTROLLERS LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To acquire expertise in assembly language programming using 8086
- To develop programming skills on microcontroller programming using 8051
- To apply the assembly language programming for interfacing with various peripherals

Course Outcome:

At the end of the course, the students will be able to

- Write assembly language programs using 8086
- Design applications using MASM assembler and cross assemblers
- Write programs to perform I/O using handshaking and interrupts
- Develop different interfacing applications
- Write assembly language programs using microcontroller to perform different arithmetic operations.

Practical Course **45**

Practical Syllabus:

1. Simple programming exercises on 8086.
2. Code conversion, decimal arithmetic and Matrix operations.
3. Simple programming with BIOS Interrupts
4. String manipulation - search, find and replace, copy operations, sorting and searching.
5. Interfacing with 8086 - 8255 and 8253.
6. Interfacing with 8086 - 8279 and 8251.
7. 8 / 16 bit arithmetic operations using 8051.
8. Interfacing stepper motor with 8086/8051.
9. Interfacing ADC and DAC with 8086/8051.
10. Interfacing traffic light controller with 8086/8051.

Practical Experiments:

Sample exercises:

1. Write an 8086 program to perform arithmetic operations like addition, subtraction, multiplication and division.
2. Write an 8086 ALP to find the median of n 8 bit numbers
3. Write an 8086 ALP to find the sum of n 8 bit numbers.
4. Write an ALP using 8086 to find the mean of n 16 bit numbers.
5. Write an 8086 program to perform sorting, searching and matrix operations.
6. Write an 8086 program to perform string manipulations like string search, string compare, string copy, find and replace.
7. Write an ALP to perform string encryption.
8. Write an 8086 program to implement BIOS and DOS Interrupts.
9. Write an 8086 ALP for file manipulation using DOS interrupts.
10. Write an 8086 program to perform interfacing and programming with 8255.
11. Write an 8086 program to perform interfacing and programming with 8253 and 8251.
12. Write an 8086 program to perform interfacing and programming with 8279.
13. Write an 8086 program to perform interfacing and programming with ADC and DAC.
14. Write an 8086 program to perform interfacing and programming with stepper motor control.
15. Write an 8051 program to perform arithmetic operations and code conversion.
16. Write an ALP using 8051 to perform arithmetic operations on BCD numbers.
17. Write an 8051 program to perform interfacing and programming with traffic light controller.

Reference Book:

1. Barry B. Brey, “The Intel Microprocessors - Architecture, Programming & Interfacing, 8086/8088, 80186/80188, 80286, 80386, 80486, Pentium, Pentium Pro Processor, Pentium II, Pentium III, Pentium 4 and Core2 with 64-bit Extensions”, Pearson Prentice Hall, Eighth Edition, 2011.
2. N.Senthilkumar, M.Saravanan, S.Jeevananthan, S.K.Shah “Microprocessors & Interfacing”, Oxford University Press, 2012.Kenneth J.Ayala, “The 8051 Microcontroller Architecture, Programming and Applications”, Penram international, 2012.
3. A. K. Ray & K. M. Bhurchandi, “Advanced Microprocessors and Peripherals- Architectures, Programming and Interfacing”, Tata McGraw Hill, Second Edition, 2006.
4. Peter Abel, “IBM PC Assembly language and programming”, Prentice Hall of India Pvt. Ltd., Fifth Edition, 2007.
5. Mohamed Ali Mazidi, Janice GillispieMazidi, RolinMcKinlay, “The 8051 Microcontroller and Embedded Systems: Using Assembly and C”, Pearson Education, Second Edition, 2011

Extensive Reading:

- https://nptel.ac.in/courses/Webcourse-contents/IISc-BANG/Microprocessors and Microcontrollers/pdf/Teacher_Slides/mod2/M2L1.pdf
- http://www.keil.com/dd/docs/datashts/atmel/at_c51ism.pdf
- http://www.keil.com/dd/docs/datashts/atmel/at_c51ism.pdf

23CS452 DBMS LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To design and implement database system for real time applications
- To identify exact queries to extract information from the database
- To work with PL/SQL features
- To develop applications using database connectivity

Course Outcome:

At the end of the course, the students will be able to

- Declare and enforce integrity constraints on a database
- Design a database schema with appropriate constraints using DDL statements
- Populate and query a database using SQL DML statements
- Develop PL/SQL blocks such as stored procedures, stored functions, cursors
- Design and develop any application with permanent data storage and retrieval

Practical Course **45**

Practical Syllabus:

1. Schema Design using ER Diagram
2. Data Definition Language Commands
3. Data Manipulation Language Commands
4. Nested Queries
5. Joins and Set Operators
6. Views and Indexes
7. Anonymous PL/SQL & Cursor
8. PL/SQL – Triggers
9. PL/SQL – Functions and Procedures
10. Database Connectivity using ODBC

Practical Experiments:

Sample exercises:

1. City Taxi Call Service Centre Management
2. Material Management for a medium-sized organization
3. Front-office management for a Large Luxury Hotel
4. Sales Management System for a retail outlet
5. Library Management for a Large, Modern Public (or University) Library
6. Front-office management for a Large Bank
7. Patient and Services Management for a Large Hospital
8. Admissions Management for a Large University
9. Online enquiry service for products/services in a city (e.g. Ask Me or Yellow Pages)
10. Automation of a Regional Transport Office
11. Subscription Management System for a Subscription Agency
12. Course Administration for a typical college
13. Database of Software Professionals and Skill-Set Requirements
14. Peripheral Management System for a Large Organization
15. Payroll Processing System for a Large Corporate Organization
16. Financial Accounting System for a medium-size organization
17. Class timetable management system.
18. STTP/Workshop/Seminar registration system
19. Visiting cards details maintenance system.
20. Students leave management system
21. Online Shopping
22. Main-library management system using RFID.
23. Alumni details maintenance system
24. Department placement details management system
25. Automation of graduation day events.
26. Question Bank Creation (Part A, Part B, Objective with pictures and equations)
27. Administrator mode
28. Author Mode

Reference Book:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", McGraw Hill, Seventh Edition, 2020.

2. R. Elmasri, S.B. Navathe, "Fundamentals of Database Systems", Pearson Education/Addison Wesley, Sixth Edition, 2010.
3. C.J.Date, A.Kannan and S.Swamynathan, "An Introduction to Database Systems", Pearson Education, Eighth Edition, 2006.

Extensive Reading:

- http://www.sql-tutorial.net/SQL-tutorial.asp
- http://sqlzoo.net/
- http://www.orafaq.com/wiki/Oracle_12c

23CS453 MINI PROJECT - II

Offered by CSE (Project Work)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- To identify the problem of interest and apply software engineering principles
- To design look–and-feel GUI for client interactions
- To collect information and store them in backends
- To prepare documentation by adapting standards

Course Outcome:

At the end of the course, the students will be able to

- Formulate the problem through extensive requirements engineering
- Build UI models and perform model / UI validation
- Perform data validation and testing
- Evaluate system performance using standard metrics
- Write comprehensive project closure report and present the results

Practical Course **30**

Practical Syllabus:

MINIPROJECT GUIDELINES:

- The students can do either hardware or software based applications by forming a group of 2 to 3 members approved by the faculty supervisor and head of the department
- The students should identify the problem statement, collect requirements and identify the constraints
- The students must select an appropriate process model for the selected problem implementation
- The students should design by developing architecture diagram / class diagram / ER diagram / Use case diagram using UML notations
- The student should develop GUI based projects using C# / JAVA based on their own interest or innovative idea they have.
- The students should design interfacing circuits and develop hardware working prototypes.
- The student should evaluate different methods to solve problem and select the best among them.
- The progress of the project is evaluated based on a minimum of two reviews.
- The review committee may be constituted by the Head of the Department.
- The student prepares a comprehensive mini project report at the end of the semester after completing the work to the satisfaction.
- The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.
- The mini project will be assessed based on quality of survey, clarity in problem definition, innovativeness in solution, cost effectiveness, societal impact, functionalities of the working model/solution, contribution as individual/member in team, clarity in oral/written communication

HARDWARE / SOFTWARE TOOLS TO BE USED:

- Arduino / Raspberry Pi / ESP Based Boards /ARM Cortex based Boards / Equivalent Boards (Hardware projects)
- .Net / MVC Framework with Backend Database (MySQL, Oracle, Cassandra,…)
- Language: JAVA, Python, C#
- IDE : Visual Studio, Netbeans / Eclipse

Practical Experiments:

Sample list of Software Projects:

1. Front-office management for a Large Luxury Hotel
2. Sales Management System for a retail outlet
3. Library Management for a Large, Modern Public (or University) Library
4. Admissions Management for a Large University
5. Course Administration for a typical college
6. Payroll Processing System for a Large Corporate Organization
7. Financial Accounting System for a medium-size organization
8. Class timetable management system.
9. Students leave management system
10. Online Shopping
11. Department placement details management system

Sample list of Hardware Projects:

1. Design a smart room
2. Design an application to implement automation of attendance
3. Design an application for object detection

4. Design an application for smart healthcare
5. Build an application for smart agriculture
6. Develop an application for driver assistance
7. Design an application for smart electricity di
8. stribution
9. Design an application for smart metering
10. Build an application for driverless car
11. Create an application for smart inventory applications

Reference Book:

1. Arshdeep Bahga and Vijay Madisetti, “Internet of Things: A Hands-On Approach”, VPT Publisher, 2014.
2. Charalampos Doukas, “Building Internet of Things with the Arduino”, Create space, April 2002.
3. John C. Shovic, “Raspberry Pi IoT Projects Prototyping Experiments for Makers”, Apress, 2016.
4. Adeel Javed, “Building Arduino Projects for the Internet of Things Experiments with Real-World Applications”,Apress, 2016
5. Jan HÖller, Vlasios Tsiatsis, Catherine Mulligan, Stamatis Karnouskos, Stefan Avesand and David Boyle, “From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence”, Academic Press, 2014.
6. Massimo Banzi, “Getting Started with Arduino” O'Reilly,2011
7. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, McGraw Hill, Seventh Edition, 2020.
8. Herbert Schildt, “C# 4.0: The Complete Reference”, McGraw Hill Education, Indian Edition, 2010, Reprint 2017.
9. Andrew Troelsen, Philip Japikse, “C# 6.0 and the .NET 4.6 Framework”, Apress, 7th Edition, 2015

Extensive Reading:

- http://www.sql-tutorial.net/SQL-tutorial.asp
- http://sqlzoo.net/
- http://www.orafaq.com/wiki/Oracle_12c

23GE451 NCC COURSE LEVEL - II

Offered by GEN (Mandatory Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
1	0	2	1

Course Objective:

To impart knowledge on

- To inculcate a sense of obedience to orders , smartness and turnout
- To develop an all-round dynamic personality with adequate leadership traits
- To acquaint cadets with the Armed Forces
- To provide knowledge about Military

Course Outcome:

At the end of the course, the students will be able to

- Raise the quality of personal and professional life
- Improve the potential of the students.
- Make students responsible individual willing to serve society
- Enhance the knowledge of armed force and service

Unit I DRILL **6**

D-1 General and words of command
D-2 Attention, stand at ease and stand easy, turning and inclining at the halt
D-3 Sizing, forming up in three ranks and numbering, open and close order march and dressing
D-4 Squad Drill (With or without arms)
D-5 Gen Salute, Salami Shastra

Unit II PERSONALITY DEVELOPMENT AND LEADERSHIP **4**

P-Self confidence, courage & self conviction
P-Effects of leadership with historical examples
P-Problem solving skills
P-Interview skills

Unit III CIVIL AFFAIRS **7**

CA-1 Civil Defence Organisation and Essential services and their maintenance
CA-2 Types of Emergencies/Natural Hazards
CA-3 Role of NCC during Natural Hazards/Calamities and Fire fighting
CA-1 Civil Defence Organisation and Essential services and their maintenance

Unit IV MILITARY HISTORY **5**

MH-1 Biographies of renowned Generals (Carriapa /Sam Manekshaw)
MH-2 Indian Army War Heroes -PVCs
MH-3 Study of Battles of Indo Pak war 1965,1971 & Kargil
MH - 4 War Movies

Unit V ARMED FORCE **8**

AF-1 Basic organisation of Armed Forces
AF-2 Organisation of Army
AF-3 Task & Role of Fighting Arms
AF-4 Modes of Entry to Army

IAS40 INTEGRATED APTITUDE SKILLS - II (LOWER)

Offered by MECH (Ability Enhancement Courses offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
2	0	0	1

Course Objective:

To impart knowledge on

- To understand the basic concepts of quantitative ability
- To understand the basic concepts of logical reasoning Skills
- To acquire satisfactory competency in use of verbal reasoning

Course Outcome:

At the end of the course, the students will be able to

- Students at the end of the course will be able to solve aptitude, logical and verbal reasoning questions.

Unit I QUANTITATIVE APTITUDE **10**

1. Percentage
2. Ratio & Proportions
3. Pipes & Cisterns
4. Permutations & Combinations
5. Partnership
6. Alligation (Or) Mixture
7. Races & Games
8. Stocks & Shares
9. Height & Distance
10. True Discount & Banker's Discount
11. Probability
12. Mensuration (Area, Volume & Surface Area)
13. Interest (Simple Interest, Compound Interest)
14. Logarithm
15. Chain Rule
16. Data Interpretation (Tabulation, Bar Chart, Pie Chart, Line Graphs)

Unit II LOGICAL REASONING **10**

VERBAL REASONING:

Logical Deduction

1. Logic
2. Statement – Argument
3. Statement – Assumptions
4. Statement –Courses of action
5. Statement –Conclusion
6. Deriving Conclusion from passages
7. Theme Detection
8. Cause and Effect reasoning

NON-VERBAL REASONING

1. Series
2. Analogy
3. Classification
4. Analytical Reasoning
5. Mirror – Images
6. Water – Images
7. Spotting out the embedded figures
8. Completion of incomplete patterns
9. Figure Matrix
10. Paper Folding
11. Paper Cutting
12. Rule Detection
13. Grouping of identical figures
14. Cubes and Dice
15. Dot Situation
16. Construction of squares and triangles
17. Figure formation and analysis

Unit III VERBAL ABILITY **10**

1. Concord
2. Cloze Passage
3. Analogies or Reverse Analogies

4. Jumbled Sentences.
5. Error Deduction.
6. Reading Comprehension
7. Paragraph Formation
8. Completing Statements
9. Usage of Prepositions
10. Inference(Theme Detection)
11. Verification of Truth from the Statements
12. Change of Speech

Text Book:

1. Agarwal R.S, "Quantitative Aptitude," S.Chand and Company Pvt. Ltd., New Delhi, First Edition 1989, Reprint, 2016
2. Agarwal R.S, "A Modern Approach to Verbal and Non-Verbal Reasoning," S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1994, Reprint, 2016
3. Agarwal R.S, "Objective General English," S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1997, Reprint, 2016

Reference Book:

1. Anand P A, "Quantitative Aptitude," Wiley India Pvt. Ltd., New Delhi, Edition, 2016
2. Arun Sharma, "How to Prepare for Logical Reasoning," Tata-McGraw Hill Education Series. New Delhi, First Edition 2016
3. Sharon Weiner Green, Ira K Wolf, "Barron's GRE," Barron Publishers. First Edition 1995, Reprint, 2016
4. The Princeton Review, "Cracking the GRE", Random House Publisher, Premium Edition 2016.
5. Mark Alan Steward, J D,"30 days to the GMAT CAT", Arco Publishers, 2nd Edition 2016.

Extensive Reading:

- www.indiabix.com
- http://www.practiceaptitudetests.com/

ITT40 ITT ON PYTHON PROGRAMMING

Offered by IT (Ability Enhancement Courses offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

-

Course Outcome:

At the end of the course, the students will be able to

-

Practical Experiments:

1. Introduction
2. Data types
3. Strings
4. Sets
5. Math
6. Itertools
7. Collections
8. Date and Time
9. Errors and Exceptions
10. Classes
11. Built-Ins
12. Files
13. Regular Expression
14. Modules and Packages

USS40 UNDERSTANDING SOFT SKILLS - II

Offered by ENG (Ability Enhancement Courses offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
2	0	0	1

Course Objective:

To impart knowledge on

- Corporate communicationand Etiquette
- Nuances of presentation skills
- Self-development skills for personal and professional growth
- Corporate grooming technique for a professional outlook
- Required vocabulary and skills to deal in various situations.

Course Outcome:

At the end of the course, the students will be able to

- Effectively communicate verbally.
- Understand the requisite skills for presentation
- Exhibit their confident personality
- Build a consistent professional image in all workplace
- Express their ideas in any social situations.

Unit I

Corporate communication- Situational Conversations-Verbal Reasoning- E-mail communication/Etiquette-Critical thinking-picture/Audio/Video synthesizing, Transcoding Visual into Oral-simulation.

Unit II

How to face people during a presentation- Handling questions- Body Language

Unit III

Personality Development-Confidence building-How to keep yourself fit in business

Unit IV

Corporate dressing- Corporate Grooming- Communication Media Etiquette

Unit V

Cultural Ambience- Role-play activities- Dramatizing situations-Business Idioms and Phrases.

23CS501 OPERATING SYSTEMS

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To acquire basic knowledge on computer operating system structures and functioning
- To study the concept of process management
- To learn the basics of memory management
- To understand the structure of file and I/O systems
- To be familiar with various operating systems

Course Outcome:

At the end of the course, the students will be able to

- Identify the components of operating system and their functionalities
- Use the various process management algorithms
- Evaluate the performance of various memory management techniques
- Design a simple file system
- Work with popular operating systems like Linux, Windows

Unit I OPERATING SYSTEMS OVERVIEW 9

Operating system definitions, operations – Resource management - Virtualization – Kernel data structures - OS services – System calls - System services – Linkers and Loaders - Operating system structure – Building and Booting an Operating system - Process concept – Process scheduling - Operations on processes - Inter process communication - IPC in Shared-Memory and Message passing systems

Unit II PROCESS MANAGEMENT 10

Scheduling criteria - Scheduling algorithms – Multiple-processor scheduling – Thread Scheduling - Algorithm evaluation. The critical-section problem - Hardware support for Synchronization - Semaphores - Classic problems of synchronization – Monitors - Deadlock characterization - Methods for handling deadlocks - Deadlock prevention - Deadlock avoidance - Deadlock detection and Recovery

Unit III MEMORY MANAGEMENT 9

Contiguous memory allocation – Paging - Structure of page table - Swapping – Segmentation - Virtual memory: Background – Demand paging – Copy on write – Page replacement – Allocation of frames – Thrashing

Unit IV FILE AND I/O SYSTEMS 9

File concept - Access methods - Directory structure – File-system mounting - Protection - Directory implementation - Allocation methods - Free space management - HDD Scheduling – Error Detection and Correction - Storage Device Management – Swap Space Management. I/O Systems: I/O Hardware - Application I/O Interface - Kernel I/O subsystem

Unit V CASE STUDY 8

The Linux system: Design principles - Kernel modules - Process management - Scheduling - Memory management - File systems - Input and output - Inter Process Communication - Network structure – Security.

Windows 10: Design principles - architecture. Android OS: Design Principles - architecture.

Text Book:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, “Operating System Concepts Essentials”, John Wiley & Sons Inc., 10th Edition, 2018

Reference Book:

1. Andrew S. Tanenbaum, “Modern Operating Systems”, Addison Wesley, Second Edition, 2001.
2. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, Tata McGraw Hill Education, 1996.
3. D M Dhamdhere, “Operating Systems: A Concept-based Approach”, Tata McGraw-Hill Education, Second Edition, 2007.
4. William Stallings, “Operating Systems: Internals and Design Principles”, Prentice Hall, Seventh Edition,2011.
5. Maurice J.Bach, “The Design of the UNIX Operating System”, Prentice Hall, 2004

Extensive Reading:

- http://www.cs.kent.edu/~farrell/osf03/oldnotes/
- http://cseweb.ucsd.edu/classes/fa06/cse120/lectures/120-fa06-l13.pdf
- https://web.cs.wpi.edu/~cs3013/c07/lectures/Section08-Memory_Management.pdf
- https://web.cs.wpi.edu/~cs3013/c07/lectures/Section03-Processes.pdf

23CS502 COMPUTER NETWORKS AND APPLICATIONS

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study layered architecture of computer network and enumerate the functionalities of Physical layer
- To learn the functionalities of data link layer.
- To learn the routing algorithms and the use of IP addressing in the network layer.
- To study, analyse and implement the design of a network using TCP and UDP
- To be familiar with the protocols of various layers and how they can assist in network design and implementation

Course Outcome:

At the end of the course, the students will be able to

- Gain a comprehensive understanding of the foundational principles of computer networking.
- Explore the functionalities of datalink layer.
- Expertise knowledge in internet protocol and routing protocols.
- Discover the working principle of transport layer protocols and develop network applications using TCP and UDP sockets.
- Bring out the issues and protocols involved in application layer of TCP/IP architecture.

Unit I PHYSICAL LAYER **9**

Data Communication – Networks – Network Types – Protocol Layering - TCP/IP protocol suite – OSI model –Physical layer: Signals – Signal Impairment – Digital Transmission – Multiplexing - Transmission media: Guided and Unguided media.

Unit II DATALINK LAYER **9**

Data Link Layer: Introduction – framing – error control – HDLC – PPP – Media Access Control: Random Access: ALOHA – CSMA/CD – CSMA/CA - Controlled Access - Channelization - Link Layer Addressing - Ethernet – Wifi – Bluetooth – connecting devices

Unit III NETWORK LAYER **10**

Network layer services - Switching: Circuit switched network – Packet switched network – IPV4 addressing: Classful addressing – classless addressing – DHCP - NAT – ARP - Internet Protocol – ICMPv4 – Routing algorithms: Distance Vector Routing – Link State Routing – Unicast routing protocols – RIP – OSPF – IPV6 addressing – IPV6 protocol - Transition from IPv4 to IPv6

Unit IV TRANSPORT LAYER **9**

Transport layer services - Transport layer protocols - UDP – TCP: services and features - segment format – TCP connection - TCP Congestion control and avoidance – TCP Timers – Socket Interface Programming – SCTP - Iterative communication using UDP – Communications using TCP.

Unit V APPLICATION LAYER **8**

World Wide Web and HTTP - File Transfer Protocol – Secure FTP - E-mail – SMTP – IMAP – POP3 – Telnet –Putty - Secure Shell - Domain Name System – Peer to Peer paradigm.

Text Book:

1. Behrouz A. Forouzan, “Data communication and Networking with TCP/IP Protocol Suite”, McGraw-Hill, Sixth Edition, 2022.

Reference Book:

1. Larry L. Peterson, Bruce S. Davie, “Computer Networks: A Systems Approach”, Morgan Kauffmann Publishers Inc., Sixth Edition, 2022.
2. William Stallings, “Data and Computer Communication”, Pearson Education, 2015.
3. Andrew S. Tanenbaum, Nick Feamster, David J. Wetherall, “Computer Networks”, Pearson Education, Sixth Edition, 2021
4. D.E. Comer, “Internetworking with TCP/IP Vol- III”, (BSD Sockets Version), Pearson Education, Second Edition, 2003.

Extensive Reading:

- https://nptel.ac.in/courses/106105183/
- https://www.lifewire.com/lans-wans-and-other-area-networks-817376
- https://inl.info.ucl.ac.be/cnp3.html
- https://oer.uclouvain.be/jspui/handle/20.500.12279/37
- https://booksite.elsevier.com/9780123850591/
- http://www.unix-ag.uni-siegen.de/docs/unix/unix.html

23CS581 COMPILER DESIGN

Offered by CSE (Theory Course with Lab Component)

L	T	P	C
3	0	2	4

Course Objective:

To impart knowledge on

- To learn to design a lexical analyzer
- To learn to design and implement a parser
- To study the various intermediate code representations
- To understand storage management
- To understand the code optimization techniques
- To learn to generate the machine code

Course Outcome:

At the end of the course, the students will be able to

- Design a lexical analyzer
- Design a parser
- Select the appropriate intermediate code
- Choose the right storage structure for the language constructs
- Apply the suitable optimization techniques
- Generate the machine code for simple language constructs

Unit I INTRODUCTION AND LEXICAL ANALYSIS 12

Introduction: process of compilation - phases of compiler - grouping of phases - cousins of compiler –assemblers-linkers-loaders- compiler construction tools

Lexical Analyzer: role of the lexical analyzer - Input buffering - specification of tokens - recognition of tokens - language for specifying lexical analyzer: LEX tool

Lab Exercise :Lexical Analyzer using DFA, Lexical Analyzer using LEX

Unit II SYNTAX ANALYSIS 12

Need and role of the parser - Context Free Grammars –Writing Grammars- top down parsing - Recursive descent parser - Predictive parser - bottom up parsing - shift reduce parser - LR parsers - Construction of SLR parsing table – Introduction to LALR Parser - Error Recovery in Parsers - syntax analyzer generator: YACC tool

Lab Exercise :Parser using YACC

Unit III INTERMEDIATE CODE GENERATION 12

Syntax directed definitions - construction of syntax tree - intermediate languages - declarations - assignment statements - type systems- specification of a simple type checker - arithmetic expression evaluation in assignment statements - Boolean expressions - back patching

Lab Exercise :Generate Quadruples using YACC

Unit IV RUN-TIME ENVIRONMENT AND CODE OPTIMIZATION 12

Run-time environments: Source language issues-Storage organization - Stack allocation space - Access to non-local data on the stack - Heap management

Code Optimization: Principal sources of optimization – Basic Blocks and Flow Graph - optimization of basic blocks - global data flow analysis

Lab Exercise : Implement simple optimization techniques

Unit V CODE GENERATION 12

Code Generation: issues in design of a code generator – a simple code generator algorithm - register allocation and assignment –Peephole Optimization - DAG Construction - generating code from DAGs

Lab Exercise : Generate 8086 assembly code from Quadruples

Text Book:

1. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, “Compilers: Principles, Techniques and Tools”, Pearson Education, 2013.
2. K.Muneeswaran, “Compiler Design”, Oxford University Press, 2013

Reference Book:

1. David Galles, “Modern Compiler Design”, Pearson Education Asia, 2007
2. Steven S. Muchnick, “Advanced Compiler Design and Implementation”, Morgan Kaufmann Publishers, 2000.
3. C. N. Fisher and R. J. LeBlanc, “Crafting a Compiler with C”, Pearson Education, 2000.
4. V. Raghavan, “Principles of Compiler Design”, McGraw Hill Education Publishers, 2017.

Extensive Reading:

- www.nptel.ac.in
- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-035-computer-language-engineering-spring-2010/
- http://infolab.stanford.edu/~ullman/dragon.html

23CS551 OPERATING SYSTEMS LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To learn process related system calls
- To practice on the process scheduling algorithms
- To learn to write programs for process synchronization using semaphores.
- To experiment with IPC system calls
- To practice memory allocation and disk scheduling algorithms

Course Outcome:

At the end of the course, the students will be able to

- Create and manage processes
- Use various CPU scheduling algorithms appropriately
- Write code for IPC with synchronization
- Implement memory allocation, file allocation algorithms
- Work with page replacement and disk scheduling algorithms

Practical Course **45**

Practical Syllabus:

Process creation and inter-process communication using pipe
Simulation of CPU scheduling algorithms
Perform inter-process communication using shared memory
Perform inter-process communication using message queue
Solving critical problems using semaphores.
Implementation of deadlock avoidance algorithms
Simulate memory management technique
Implementation of Page replacement algorithms
Implementation of file allocation algorithms
Simulation of disk scheduling algorithms

Practical Experiments:

- Create new processes and do communicate using pipe
- Make communication between the processes using shared memory
- Make communication between the processes using message queue
- Simulate the following CPU scheduling algorithms

a) FIFO b) SJF c) Priority d) Round Robin

- Implement Producer-Consumer problem using Semaphore
- Simulate Bankers Algorithm for Dead Lock Avoidance and Resource Request Algorithm
- Simulate Paging Technique of memory management
- Simulate all page replacement algorithms

a) FIFO b) LRU c) Optimal

- Simulate all file allocation strategies

a) Sequential b) Indexed c) Linked

- Simulate the following disk scheduling algorithms

a) FCFS b) SSTF c) LOOK d) C-LOOK e) SCAN f) C-SCAN

Reference Book:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, “Operating System Concepts Essentials”, John Wiley & Sons Inc., 10th Edition, 2018
2. Andrew S. Tanenbaum, “Modern Operating Systems”, Addison Wesley, Second Edition, 2001.
3. Charles Crowley, “Operating Systems: A Design-Oriented Approach”, Tata McGraw Hill Education, 1996.
4. D M Dhamdhere, “Operating Systems: A Concept-based Approach”, Tata McGraw-Hill Education, Second Edition, 2007.
5. William Stallings, “Operating Systems: Internals and Design Principles”, Prentice Hall, Seventh Edition,2011.

Extensive Reading:

- http://www.cs.kent.edu/~farrell/osf03/oldnotes/
- http://cseweb.ucsd.edu/classes/fa06/cse120/lectures/120-fa06-l13.pdf

23CS552 COMPUTER NETWORKS LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To learn framing and error control protocols
- To work with different routing techniques
- To develop socket programming skill to build network applications
- To demonstrate the usage of various networking tools

Course Outcome:

At the end of the course, the students will be able to

- Implement various framing and error control techniques
- Solve different routing algorithms
- Build network-based applications using socket programming
- Simulate networking functionalities using simulation tools

Practical Course **45**

Practical Syllabus:

Implementation of Framing Protocols
Implementation of Error Detection Techniques
Implementation of Error Correction Technique
Implementation of Routing algorithms
Implementation of Sliding Window Protocol
Implementation of client - server application using TCP Socket
Implementation of client - server application using UDP Socket
Implementation of Iterative Server using Socket Programming
Implementation of Concurrent Server using Socket Programming
Simulate TCP congestion control using NS3 / QualNet
Explore network essentials using Packet Tracer

Practical Experiments:

- Write a C program to implement bit stuffing and byte stuffing techniques.
- Write a C program to implement following error control techniques:

a. Checksum
b. Cyclic Redundancy Check (CRC)

- Write a C program to implement hamming code for error correction.
- Write a C program to find shortest path using following Algorithms:

a. Dijikstra algorithm
b. Bellman Ford algorithm

- Write a socket program in C to implement Echo server using TCP Socket.
- Write a socket program in C to simulate DNS using UDP socket.
- Create the iterative server for chat application using TCP socket in C.
- Create the concurrent server for FTP application using TCP socket in C.
- Create a network topology using NS3 / QualNet to simulate TCP congestion control.
- Configure a wireless network (Personal and enterprise) in Packet Tracer
- Create a network scenario to issue IP address using DHCP protocol in Packet Tracer

Reference Book:

1. Behrouz A. Forouzan, “Data communication and Networking with TCP/IP Protocol Suite”, McGraw-Hill, Sixth Edition, 2022.
2. Michael J. Donahoo, Kenneth L. Calvert, “TCP/IP Sockets in C: Practical Guide for Programmers”, Morgan Kauffmann Publishers, Second Edition, 2009.
3. Wendell Odom, “CCNA 200-301 Official Cert Guide Library”, CISCO Press, 2020

Extensive Reading:

- https://www.ibm.com/docs/en/i/7.1?topic=programming-basic-socket-design
- https://skillsforall.com/learningcollections/cisco-packet-tracer

23CS553 MINI PROJECT - III

Offered by CSE (Project Work)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- To identify the problem statement and develop a system model / Algorithm
- To design a user friendly interface for end user interaction
- To test and evaluate the model / algorithm
- To prepare documentation with findings and outcomes

Course Outcome:

At the end of the course, the students will be able to

- Formulate the algorithm or model for the problem through extensive requirements engineering
- Build UI models, perform validation and testing
- Evaluate system performance using standard metrics
- Write comprehensive project closure report and present the results

Practical Course **30**

Practical Syllabus:

GUIDELINES:

- The students can do either hardware or software - based applications by forming a group of 2 to 3 members approved by the faculty supervisor and head of the department
- The students should identify the problem statement, collect requirements and identify the constraints
- The students must select an appropriate process model / algorithm for the selected problem implementation
- The student should develop GUI based projects using recent tools and techniques based on verticals.
- The student should evaluate different methods to solve problem and select the best among them.
- The students should use GIT repository for source code management.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- The student should prepares a comprehensive mini project report at the end of the semester after completing the work to the satisfaction.
- The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.
- The mini project will be assessed based on quality of survey, clarity in problem definition, innovativeness in solution, cost effectiveness, societal impact, functionalities of the working model/solution, contribution as individual/member in team, clarity in oral/written communication
- Outcome of the mini project must be a deliverable product

23HSM02 CAREER PLANNING AND PROFESSIONAL ESSENTIALS LABORATORY

Offered by ENG (Employability Enhancement Courses offered to BAD, BBT, BCI, BCS, BEE, BIT)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- Developing effective communication in group discussion
- Offering insights into interview techniques and developing professional resumes
- Equipping to apply soft skills in the work place
- Applying constructive use of vocabulary in research writing and competitive examinations
- Appearing for language proficiency test and competitive examinations

Course Outcome:

At the end of the course, the students will be able to

- Attain effective professional communication skills
- Inculcate the interview strategies
- Enhance employability and soft skills
- Improve the ability to use vocabulary appropriately in research papers and competitive examinations
- Appear for language proficiency test to pursue higher studies

Unit I GROUP DISCUSSION **10**

Group Discussion -GD Etiquette - Sample Videos on GD - Participation in Group discussion - Writing minutes and Notes of observation for Group Discussion - Leadership quality - Team work - Persuasive skills – Negotiation

Unit II INTERVIEW **10**

Resume Designing- Submitting offline/online Resume – Resume E-template

Successful Interview Skills - Types of Interviews – Sample Interview questions (Technical, non-technical, stress questions and current affairs) - Searching job using online/offline resources - Body Language - Dress Code and Power Dressing - Moral Conduct and Social Behavior

Business correspondence: Emails -Memos - Meeting and Minutes of the Meeting

Unit III CAREER PLANNING **6**

Goal Setting and Career Planning -Career Awareness - Adaptability - Attitude Building - Corporate Etiquette - Time and Stress Management - Health Awareness - Netiquette - Entrepreneurial Development

Report Writing: Report Format –Preparation of Technical report (domain specific) -Non-technical report (survey/case study/unstructured interview) – Review paper (literature survey) writing

Unit IV VOCABULARY BUILDING **2**

Synonyms - Antonyms - Affixes - Business Idioms- Phrasal Verbs - Listening and Reading Comprehension Exercises to hone word power - Verbal Ability – Newspaper Reading

Unit V LANGUAGE PROFICIENCY TESTS **2**

An Introduction to International English Language Testing System (IELTS) - Test of English as a Foreign Language (TOEFL) -Cambridge Advanced English(CAE) - Graduate Record Examination (GRE) - Civil Service Examinations (Verbal)- Graduate Aptitude Test in Engineering (GATE)

Reference Book:

1. Courtland L. Bovee and John V. Thill. Business Communication Essentials: Fundamental Skills for the Mobile-Digital-Social Workplace. Pearson, 2021
2. Mc Lean, Pamela. Self as Coach, Self as Leader: Developing the Best in You to Develop the Best in Others, Wiley Publication, 2019.
3. Jeff Butterfield. Soft Skills for Everyone, 2e. India. Cengage, 2020

IAS50 INTEGRATED APTITUDE SKILLS - I (HIGHER)

Offered by MECH (Ability Enhancement Courses offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
2	0	0	1

Course Objective:

To impart knowledge on

- To understand the basic concepts of quantitative ability
- To understand the basic concepts of logical reasoning Skills
- To acquire satisfactory competency in use of verbal reasoning

Course Outcome:

At the end of the course, the students will be able to

- Solve aptitude, logical and verbal reasoning questions.

Unit I QUANTITATIVE APTITUDE **10**

1. Numbers – Number Systems, Types of Numbers, Series (Arithmetic Progression, Geometric Progression)
2. Problem on Ages
3. HCF & LCM
4. Profit & Loss
5. Problems on Trains, Boats & Stream
6. Calendar & Clocks
7. Time & Work
8. Speed & Distance (Or) Time & Distance
9. Decimal Fractions, Simplification (Including Expression & Evaluation)
10. Square Root, Cubic Root
11. Average
12. Surds & Indices
13. Odd Man Out & Series

Unit II LOGICAL REASONING **10**

General Mental Ability

1. Series completion
2. Analogy
3. Classification
4. Coding-Decoding
5. Blood Relation
6. Puzzle test
7. Sequential Output Tracing
8. Direction sense test
9. Logical Venn Diagram
10. Alphabet Test
11. Alpha-numeric sequence Puzzle
12. Number, Ranking and Time sequence Test
13. Mathematical Operations
14. Logical Sequence of words
15. Arithmetical Reasoning
16. Inserting the mission character
17. Data Sufficiency
18. Eligibility test
19. Assertions and Reasoning
20. Situation Reaction Test
21. Verification of truth of the statement

Unit III VERBAL ABILITY **10**

1. Vocabulary Based - Synonyms
2. Vocabulary Based - Antonyms
3. Spotting Errors
4. Spelling
5. Jumbled words
6. One word substitution
7. Sentence Correction
8. Idioms & Phrases.
9. Commonly confusing words
10. Statement and Conclusion
11. Change of Voice
12. Facts/Inferences and Judgment.

Text Book:

1. Agarwal R.S, “Quantitative Aptitude,” S.Chand and Company Pvt. Ltd., New Delhi, First Edition 1989, Reprint, 2017
2. Agarwal R.S, “A Modern Approach to Verbal and Non-Verbal Reasoning,” S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1994, Reprint, 2016
3. Agarwal R.S, “Objective General English,” S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1997, Reprint, 2016

Reference Book:

1. Anand P A, “Quantitative Aptitude,” Wiley India Pvt. Ltd., New Delhi, Edition, 2016
2. Arun Sharma, “How to Prepare for Logical Reasoning,” Tata-McGraw Hill Education Series. New Delhi, First Edition 2016
3. Sharon Weiner Green, Ira K Wolf, “Barron’s GRE,” Barron Publishers. First Edition 1995, Reprint, 2016
4. The Princeton Review, “Cracking the GRE”, Random House Publisher, Premium Edition 2016.
5. Mark Alan Steward, J D,”30 days to the GMAT CAT”, Arco Publishers, 2nd Edition 2016.

Extensive Reading:

- www.indiabix.com
- http://www.practiceaptitudetests.com/

ITT50 ITT ON C PROGRAMMING

Offered by IT (Ability Enhancement Courses offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- To explore algorithmic approaches to problem solving.
- To develop modular programs using control structures
- To apply the principles of arrays and strings
- To access memory using pointers
- To manipulate data in permanent storage like files

Course Outcome:

At the end of the course, the students will be able to

- Develop modular C programs for a given problem
- Implement programs using control statements
- Store and manipulate homogeneous data using arrays and strings
- Access data in memory using pointers
- Store and manipulate heterogeneous data using structures and union

Practical Experiments:

1. Programs using simple statements
2. Programs using decision making statements
3. Programs using looping statements
4. Programs using user defined functions
5. Programs using recursive functions
6. Programs using arrays
7. Programs using string functions
8. Programs using pointers and dynamic memory allocation
9. Programs using structures and unions
10. Programs using files

USS50 SOFT SKILLS AND PERSONALITY DEVELOPMENT - I

Offered by ENG (Ability Enhancement Courses offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
1	0	0	1

Course Objective:

To impart knowledge on

- Effective and confident communication
- Work place dynamics and work place competence
- Emotional Intelligence and the difference between Emotional quotient and intelligence quotient
- Leadership qualities and group dynamics
- Self management and stress management with current affairs

Course Outcome:

At the end of the course, the students will be able to

- Make confident use of effective communication techniques
- Understand the requisite skills of work place management
- Make emotionally balanced decisions personally and professionally
- Willingly take up leadership roles & to employ strategies of group dynamics effectively
- To become well informed citizens of national and international affairs with realistic goals and better levels of stress management

Unit I UNIT 1 **7**

Components of Effective Communication - Conviction, Confidence & Enthusiasm, Listening- its Importance, Active and Passive Listening - Composing Effective Messages in Situations, Deadline extension, Saying No, Expressing Inability- Barriers of Communication- Verbal Communication- its Importance and Nuances

Unit II UNIT II **7**

Workplace Competence- Handling Critics- Unspoken Rules of Workplace-Synergy & Its Importance- Choosing a Mentor- Being Relevant-Updating Lifestyle Emotional Intelligence, Emotional Quotient-Why Emotional Intelligence Matters? Emotion Scales, Managing Emotions

Unit III UNIT III **6**

Team Building Practices through Group Exercises-Concepts of Group Dynamics and Discussion- Ability to Mix and Accommodate, Ability to Work Together, Role-play

Unit IV UNIT IV **6**

Blue Print for Success - Self- Discipline- Self-Criticism- Goal Setting - Short Term Goals, SMART Goals, Life Time Goals - Self-Management- Recognition of One's Own Limits and Deficiencies. Independency etc., Self-Valuation - Emotions, Ego, Pride, Attitude and Behavior

Unit V UNIT V **6**

Stress Management, Causes of Stress and its Impact, How to Manage & Distress, Circle of Control, Stress Busters. News Snippets & Interactions, Current affairs –News – National & International Sports- News Reading Activity- Situational Awareness

Reference Book:

1. Covey, Stephen R., and Sean Covey. The 7 habits of highly effective people. Simon & Schuster, 2020.
2. Klaus, Peggy, Jane Rohman, and Molly Hamaker. The hard truth about soft skills. Harper Collins Publishers, 2007.
3. Pease, Barbara, and Allan Pease. The definitive book of body language: The hidden meaning behind people's gestures and expressions. Bantam, 2008.
4. Tulgan, Bruce. Bridging the soft skills gap: How to teach the missing basics to todays young talent. John Wiley & Sons, 2015

Extensive Reading:

- Peterson, Jordan B. 12 rules for life: An antidote to chaos. Random House Canada, 2018.
- Gangwar, Swetab. The Rudest Book Ever.2019
- De Bono, Edward. "Serious creativity." The Journal for Quality and Participation 18.5 (1995): 12

23CS601 HIGH PERFORMANCE COMPUTING

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the different ways of exploiting Instruction Level Parallelism
- To understand message passing paradigm using MPI
- To learn shared memory programming paradigm with Pthreads and OpenMP.
- To study the various SIMD architectures
- To understand the different multiprocessor architectures and warehouse scale computers.

Course Outcome:

At the end of the course, the students will be able to

- Explore Instruction Level Parallelism in a code.
- Write parallel programs using MPI framework
- Write shared memory parallel programs using Pthreads and OpenMP.
- Analyze the architecture of Vector, SIMD and GPU architecture.
- Analyze the issues in warehouse scale computing and maintain coherence in different multiprocessor architectures

Unit I HIGH PERFORMANCE COMPUTING 10

Classes of computers - Classes of parallelism - Dependability - Quantitative principles of computer design - - ILP: Concepts and challenges - Basic compiler techniques for exposing ILP - Branch prediction - Dynamic scheduling - Hardware based Speculation - Multiple issue, static and dynamic scheduling - Limitations of ILP-- Case Study: Intel Core i7, ARM Cortex-A53.

Unit II MESSAGE PASSING PARADIGM 9

Basic MPI programming - MPI_Init and MPI_Finalize - MPI communicators - SPMD programs - Message passing - MPI_Send and MPI_Recv - Message matching - The Trapezoidal Rule in MPI - MPI I/O - Collective communication: MPI_Reduce - MPI_Allreduce - Broadcast – Scatter - Gather - Allgather - Derived Datatypes– Performance evaluation of MPI programs - Parallel Sorting.

Unit III SHARED MEMORY PARADIGM: PTHREADS AND OPENMP 9

Basics of Pthreads - Matrix-Vector Multiplication - Critical section - Busy waiting - Mutexes - Semaphores - Barriers and Condition variables. OpenMP: Basic OpenMP constructs - Trapezoidal Rule - Scope of variables - Reduction clause - Parallel For directive – Sorting - Scheduling loops - Synchronization in OpenMP: Atomic and Critical Directive, Locks.

Unit IV VECTOR, SIMD AND GPU ARCHITECTURES 8

Vector architecture: Vector Execution Time - Multiple Lanes - Vector-Length Registers - Vector Mask Registers - Vector Mask Register - Memory Banks – Stride – Gather and Scatter - Programming Vector Architecture. SIMD instruction set extensions for multimedia. Graphics processing units: Programming the GPU-NVIDIA GPU Computational Structures - NVIDA GPU Instruction Set Architecture-NVIDIA GPU Memory Structures - Similarities and Differences between Vector Architectures, SIMD Computers and GPUs - Detecting and Enhancing Loop Level Parallelism.

Unit V MULTIPROCESSOR AND WAREHOUSE-SCALE ARCHITECTURE 9

Multiprocessor architecture: Issues and approaches - Centralized shared memory architecture - Multiprocessor cache coherence - Snooping cache coherence protocol - Directory based cache coherence protocols. Warehouse-Scale Architectures: Programming models and workloads for Warehouse-Scale computers - Architecture for Warehouse-Scale computers – Efficiency and costs - Cloud computing - Case studies.

Text Book:

1. John L. Hennessey and David A. Patterson, “Computer architecture - A quantitative approach”, Morgan Kaufmann / Elsevier Publishers, 6th edition, 2017.
2. Peter S. Pacheco, “An introduction to parallel programming”, Morgan Kaufmann, 2011.

Reference Book:

1. David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture: A hardware/software approach”, Morgan Kaufmann /Elsevier Publishers, 1999.
2. Kai Hwang and Zhi Wei Xu, “Scalable Parallel Computing”, Tata McGraw Hill, New Delhi, 2003.
3. Kai Hwang, “Advanced Computer Architecture”, Tata McGraw-Hill Education, 2003
4. Richard Y. Kain, “Advanced Computer Architecture a Systems Design Approach”, Prentice Hall, 2011.
5. M. J. Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.
6. W. Gropp, E. Lusk, and A. Skjellum, “Using MPI: Portable parallel programming with the message passing interface”, MIT Press, Second Edition, 1999.
7. B. Chapman, G. Jost, and Ruud van der Pas, “Using OpenMP”, MIT Press, 2008.
8. B. Lewis and D. J. Berg, “Multithreaded programming with Pthreads”, Sun Microsystems Press, 1998

9. Ananth Grama, Anshul Gupta, George Karypis, VipinKumar, ”Introduction to Parallel Computing:, second edition, Pearson Education,2003

Extensive Reading:

- http://docs.nvidia.com/cuda/cuda-c-programming-guide/
- http://web.cs.iastate.edu/~prabhu/Tutorial/PIPELINE/instrLevParal.html
- https://www.sciencedirect.com/science/article/pii/S0065245808604970
- https://www.nvidia.com/en-us/about-nvidia/ai-computing/
- https://computing.llnl.gov/tutorials/dataheroes/GPUParallelProgramming.pdf

23CS602 COMPUTATIONAL INTELLIGENCE

Offered by CSE (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the basic concepts of computational intelligence
- To understand the problem solving search algorithms
- To study the representation of knowledge and the reasoning process
- To explore models used to solve uncertainty problems
- To introduce models that learn from samples of data

Course Outcome:

At the end of the course, the students will be able to

- Exploit the structure of agents
- Apply searching and optimization algorithms for real world problems
- Represent knowledge using logic
- Construct network models to represent knowledge in uncertain domain
- Apply learning algorithms to solve real world problems

Unit I INTRODUCTION **9**

Introduction – Foundations of AI - History of AI - Intelligent agents – Agents and Environments - Concepts of Rationality - Nature of Environments - Structure of Agents

Unit II PROBLEM SOLVING **9**

Solving problems by searching - Problem solving Agents - Example Problems - Searching for solutions - Uninformed search strategies - Informed search strategies: Greedy best first search, A* search - Memory bounded Heuristic search - Heuristic functions-Local search algorithms and optimization problems-Local search in continuous spaces.

Unit III KNOWLEDGE AND REASONING **9**

Logic Agents: Knowledge based agents - Wumpus world - Logic - Propositional logic - Syntax and Semantic of FOL - Using FOL - Propositional vs First order inference - Unification and Lifting - Forward chaining - Backward chaining - Resolution

Unit IV UNCERTAIN KNOWLEDGE AND REASONING **9**

Quantifying Uncertainty - Acting under Uncertainty - Basic probability notation – Axioms of Probability- Inference using Full joint distribution - Independence - Bayes rule - Probabilistic Reasoning - Semantics of Bayesian networks - Bayesian nets with continuous variable – Inference by enumeration- Variable elimination algorithm-Approximate Inference in Bayesian networks

Unit V LEARNING **9**

Forms of learning - Supervised learning - Learning decision trees – Theory of learning-Regression and Classification with Linear models-Artificial Neural networks-Nonparametric models-Support Vector Machines-Ensemble learning.

Text Book:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson education, Fourth edition, 2022

Reference Book:

1. Nils.J.Nilsson, "Artificial Intelligence: A new synthesis", Elsevier, July 2003
2. AndriesP.Engelbrecht, "Computational Intelligence: An Introduction", John Wiley & Sons, 2nd edition, 2007
3. Kevin Knight, Elaine Rich, Shivashankar B. Nair, “Artificial Intelligence”, Third Edition, McGraw-Hill Education, 2017.
4. John Fulcher, L.C. Jain, “Computational Intelligence: A Compendium, Studies in Computational Intelligence”, Vol.115, Springer,2008

Extensive Reading:

- https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/
- https://ocw.mit.edu/courses/6-867-machine-learning-fall-2006/
- https://www.cse.iitk.ac.in/users/piyush/courses/ml_autumn16/ML.html
- https://redirect.cs.umbc.edu/portal/help/prolog/index.shtml

23CS681 CRYPTOGRAPHY ALGORITHMS AND NETWORK SECURITY

Offered by CSE (Theory Course with Lab Component)

L	T	P	C
3	0	2	4

Course Objective:

To impart knowledge on

- To learn about OSI security architecture and classical encryption techniques.
- To understand various block cipher and stream cipher models.
- To describe the principles of public key cryptosystems
- To know about the need of authentication using hash and digital signature
- To familiarise security protocols for various applications.

Course Outcome:

At the end of the course, the students will be able to

- Explore the OSI security architecture and Classical Encryption Schemes
- Analyse different block cipher algorithms
- Implement public key encryption algorithms to provide various security services
- Apply hash functions to provide message authentication and integrity
- Explore various security protocols for different applications

Unit I INTRODUCTION & MATHEMATICAL FOUNDATION 12

Definitions – Cryptography, cryptanalysis, cryptology, classical cryptosystem- shift cipher, affine cipher, Vigenere cipher, substitution, transposition techniques, Types of attacks in OSI security architecture - Number Theory concepts – Modular Arithmetic, Properties, Euclidean algorithm, Fermat's and Euler's theorem, Chinese Remainder Theorem, Legendre and Jacobi symbols ,Primitive roots, Discrete Logarithms

Lab Component: Implement Substitution Cipher, primality testing algorithm, Primitive root, Euclidean algorithm

Unit II BLOCK CIPHERS AND MODES OF OPERATIONS 12

Simplified DES -Data Encryption Standard-Block cipher principles-block cipher modes of operation – AES – Triple DES – Blowfish-RC4

Lab Component: Implement DES, AES

Unit III PUBLIC KEY CRYPTOGRAPHY 12

Principles and characteristics -Need for public key cryptography -Primality Testing -Miller Rabin Test -Diffie Hellman Key Exchange – Man in the middle attack - RSA, Fast Modular Exponentiation Algorithms, Random Number Generation – Finite Fields–Polynomial Arithmetic – ECC–Key Management

Lab Component: Implement Diffie Hellman, RSA

Unit IV HASH FUNCTIONS AND DIGITAL SIGNATURES 12

Authentication requirement –Authentication function –MAC –Hash function –Security of hash function and MAC –MD5 -SHA -HMAC –CMAC -Digital signature andauthentication protocols –DSS – EI Gamal

Lab Component: Implement SHA, CMAC

Unit V NETWORK AND APPLICATION SECURITY 12

Authentication – Kerberos, System Security - Firewalls, Types, Design considerations, Intrusion Detection Systems, IP Security - IPSec, Web Security - SSL, TLS, Secure Electronic Transaction, Email Security - PGP

Lab Component: Network Traffic debugging using Snort IDS

Text Book:

1. William Stallings, "Cryptography and Network Security", 8thEdition, Pearson Education,2023.

Reference Book:

1. Michael Gregg, Omar Santos, "CEH Certified Ethical Hacker CERT Guide", Fourth Edition, Pearson Publication, 2022.
2. Charlie Kaufman, Radia Perlman, Mike Speciner and Ray Perlner, "Network Security - Private Communication in a Public World", Addison Wesley,2022.
3. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", 3rdedition, Pearson, 2020.
4. Jamie White, "Practical Cryptography", Murphy & Moore Pub, 2022.
5. Jonathan Katz, Yehuda Lindell, "Introduction to Modern Cryptography", CRC Press, 2020.
6. William Stallings, "Network Security Essentials – Applications and Standards", Sixth Edition, Pearson Publication, 2021.

Extensive Reading:

- https://onlinecourses.nptel.ac.in/noc21_cs16/preview
- https://onlinecourses.nptel.ac.in/noc22_cs13/preview
- https://archive.nptel.ac.in/noc/courses/noc15/SEM1/noc15-cs03/
- http://resources.infosecinstitute.com/13-popular-wireless-hacking-tools/
- https://cert.eccouncil.org/images/doc/CEH-Handbook-v2.0.pdf

- https://www.ibm.com/docs/en/streams/4.2.0?topic=authentication-introduction-kerberos

23CS651 HIGH PERFORMANCE COMPUTING LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To learn the design of message passing paradigm using MPI
- To explore the shared memory paradigm with Pthreads
- To learn the implementation of shared memory paradigm with OpenMP.
- To learn synchronisation mechanisms in Pthreads and OpenMP.

Course Outcome:

At the end of the course, the students will be able to

- Implement message passing parallel programs using MPI framework
- Implement shared memory parallel programs using Pthreads
- Work with shared memory parallel programs using OpenMP
- Synchronise the threads using various synchronisation mechanisms.

Practical Course **45**

Practical Syllabus:

Data parallelism and Task parallelism using fork and IPC.
MPI programs using Point to Point communication.
MPI programs using collective communication
Working with MPI derived data types.
Pthreads - Data parallelism using multiple threads.
Pthreads- synchronization using busy waiting, mutex, and condition variables.
Pthreads- synchronization using semaphores.
Programs using parallel for directive in OpenMP
Reduction clause in OpenMP
Synchronization in OpenMP using Atomic, Critical directives and Locks.

Practical Experiments:

- Write a C program using fork and IPC mechanisms to multiply two matrices of order m X n and n X p using concurrent processing. Create m processes and generate one row of the resultant matrix in each process. Compare the time taken for serial and parallel implementation.
- Write an MPI program to create n processes and print a hello message with rank from each process.
- Write an MPI program to create n processes . Let Odd ranked process send a string to master process with message type 1 . Let even ranked process send a string to master process with message type 2. Master process will convert the string to uppercase if it is a Type 1 message. It checks if the string is palindrome for a Type 2 message. Prints the result along with rank of the process.
- Write an MPI program using collective communication primitives to find the frequency of a number in a list of numbers. In detail, the program does the following:

1.Receives a number from the program user.
2.Creates an array of random numbers.
3.Creates a number of processes.
4.Let the master process splits the array into parts and distributes them among all worker processes.
5.Let the master process Passes the user input to all worker processes.
6.Let each worker process finds the frequency of the user input in its part of the array and sends the result to the master process.
7.Let the master process collects the results from all worker processes and print it out.

- Write an MPI program to create a student data type with members Name, Roll No, Total Marks, Grade. Create a file with student data. Read the data into an array of student in master process. Divide the array among n processes and find the grade and write the result into a grade file.
- Write an MPI program to implement the Trapezoidal rule with n processes.
- Write an MPI program that implements multiplication of a vector by a scalar product. The user should enter two vectors and a scalar, all of which are read in by process 0 and distributed among the processes. The results are calculated and collected onto process 0, which prints them. You can assume that n, the order of the vectors, is evenly divisible by comm sz.
- Find the speedups and efficiencies of the parallel odd-even sort using MPI.
- Write a PThreads program to do matrix addition and matrix multiplication using two threads. Main thread will get the input matrices from the user. One thread will do matrix addition. Another thread will do matrix multiplication.
- Write a spellcheck server using Pthreads that creates multiple spell_check threads to do the spell checking. The master creates a buffer and places the words ro be checked in the buffer. The spell_check threads take a word from the buffer and do the spell check and the word and result in another result_buffer. In the end the content of

result buffer is printed by the server thread. A dictionary of words is maintained by the server. The spell_check thread check if the word is in the buffer, then the result is correct else it is incorrect. Use locks and condition variables to provide synchronised access to the shared data.

- Implement a calculator server using Pthreads with 4 computing threads each for addition, subtraction, multiplication and division. The server randomly generates two integers and the operation and places it in the work_buffer. The computing threads constanly monitor the queue for work and do the operation and writes the result to a result_file. Use semaphores for synchronisation.
- Write a multithreaded program for calculating the pi value.
- Write a Pthreads program that finds the average time required by your system to create and terminate a thread.
- Use OpenMP to implement the parallel histogram .
- Write an OpenMP program to add two large arrays using parallel for loop.
- Write an OpenMP program to implement the trapezoidal program using parallel for, reduction and critical directive.
- Use OpenMP to implement a producer-consumer program in which some of the threads are producers and others are consumers. The producers read text from a collection of files, one per producer. They insert lines of text into a single shared queue. The consumers take the lines of text and tokenize them. Tokens are “words” separated by white space. When a consumer finds a token, it writes it to stdout.

Reference Book:

1. Peter S. Pacheco, “An introduction to parallel programming”, Morgan Kaufmann, 2011.
2. Michael J. Quinn, “Parallel Computing: Theory & Practice”, Tata McGraw Hill Edition, 2003.
3. A. Munshi, B. Gaster, T. G. Mattson, J. Fung, and D. Ginsburg, “OpenCL programming guide”, Addison Wesley, 2011
4. M. J. Quinn, “Parallel programming in C with MPI and OpenMP”, Tata McGraw Hill, 2003.
5. W. Gropp, E. Lusk, and R. Thakur, “Using MPI-2: Advanced features of the message passing interface”, MIT Press, 1999.
6. W. Gropp, E. Lusk, and A. Skjellum, “Using MPI: Portable parallel programming with the message passing interface”, Second Edition, MIT Press, 1999.
7. B. Chapman, G. Jost, and Ruud van der Pas, “Using OpenMP”, MIT Press, 2008.
8. D. R. Butenhof, “Programming with POSIX Threads”, Addison Wesley, 1997.
9. B. Lewis and D. J. Berg, “Multithreaded programming with Pthreads”, Sun Microsystems Press, 1998.

Extensive Reading:

- https://www.tutorialspoint.com/parallel_algorithm/parallel_algorithm_tutorial.pdf
- http://www.hpcc.unn.ru/mskurs/ENG/DOC/pp09.pdf
- https://www.openmp.org/
- http://condor.cc.ku.edu/~grobe/docs/intro-MPI-C.shtml
- https://www.cs.cmu.edu/afs/cs/academic/class/15492-f07/www/pthreads.html
- http://i.stanford.edu/pub/cstr/reports/cs/tr/84/1028/CS-TR-84-1028.pdf
- http://www.dcc.fc.up.pt/~fds/aulas/PPD/1112/sorting.pdf

23CS652 COMPUTATIONAL INTELLIGENCE LABORATORY

Offered by CSE (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To formulate and solve real world problems
- To implement basic programs using PROLOG and LISP programming
- To use probability to solve uncertainty problems
- To construct supervised learning models using python

Course Outcome:

At the end of the course, the students will be able to

- Identify suitable searching algorithms for real world problems
- Design agent programming that implement agent functions
- Apply Bayes Rule for solving uncertainty in real world problems
- Design supervised learning models to solve real world problems

Practical Course **45**

Practical Syllabus:

Write a program to solve real world problems using Uninformed search algorithms
Implement real world problems using Informed search algorithms
Implement Wumpus world
Simple programs using PROLOG
Simple programs using Common LISP / JESS programming
Apply Bayes Rule, Conditional and Marginal Probabilities
Build decision tree for real world data using python
Construct Nearest neighbour model for training data using python
Build ensemble classifier for high dimensional data using python
Design Neural network architecture to compute real world problems

Practical Experiments:

- Implement the DFS algorithm for the given figure. Here A-Start state and L-Goal State.
- Write a program to implement the 8 puzzle problem using BFS search. The initial state can be fed as input
- Write a program to perform A* search for route finding problem in Romania. Start state – Arad and Goal state – Bucharest.. Record the stages in an A* search for Bucharest. Figure Romania Map and Straight line distances to Bucharest
- Implement Wumbus world problem by considering a given scenario.
- Write a program to implement Wumpus world problem for both success and failing scenario. Formulate PEAS description, If players moves rite direction give reward, if player moves wrong direction give penalty. Note: The number of moves has been restricted to nxn, where n is the size of the maze
- Write a PROLOG program to implement kinship relation knowledge based agent.
- Write a simple PROLOG program to solve Towers of Hanoi problem.
- Write a LISP programs to work with data types and Lists. The table shows the distribution of Democratic and Republican U.S. Senators by gender in the 114th Congress as of January 2015.

	Male (M)	Female (F)	Total
Democrats (D)	30	14	44
Republicans(R)	48	6	54
Other (T)	2	0	2
Total	80	20	100

- Write a program to find P(M,D), P(F,D), P(D,R), P(M|D), P(D|M), P(F|R).
- Consider a Buys_Computer[Class Label: Yes,No] dataset

age	income	student	credit_rating	buys_computer
Youth	high	no	fair	no
Youth	high	no	excellent	no
middle_aged	high	no	fair	yes
Senior	medium	no	fair	yes
Senior	low	yes	fair	yes
Senior	low	yes	excellent	no
middle_aged	low	yes	excellent	yes
Youth	medium	no	fair	no
Youth	low	yes	fair	yes
Senior	medium	yes	fair	yes

- Write a program to find the best feature at the root of the decision tree by applying Entropy measure.
- Write a program to bulid a nearest neighbor binary classifier for a given set of data points.

- Construct a random forest for the Winconsin dataset with 20 decision trees. Use impurity measure as entropy. Perform training using 80% of the given data and tabulate the performance metrics(such as precision, recall and F-score).
- The following is a training set for a 2-classification problem. Iterate the perceptron through the training set and obtain the weights.

Inputs Class Label

X1 X2 0/1

([0.25, 0.353, 0], [0.26,0.25,1], [0.27,0.5, 0], [0.5, 0.647,1], [0.75,0.705,0], [0.75,0.882,1],[1,0.705,0], [1,1,1])

(Get the initial weights, bias maximum number of iterations for training)

Reference Book:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson education, Fourth edition, 2022.
2. Nils. J.Nilsson, "Artificial Intelligence: A new synthesis", Elsevier, July 2003.
3. Andries P.Engelbrecht, "Computational Intelligence: An Introduction", John Wiley & Sons, 2nd edition, 2007.
4. Kevin Knight, Elaine Rich, Shivashankar B. Nair, “Artificial Intelligence”, Third Edition, McGraw-Hill Education, 2017.
5. John Fulcher, L.C. Jain, “Computational Intelligence: A Compendium, Studies in Computational Intelligence”, Vol.115, Springer,2008.

Extensive Reading:

- https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/
- https://ocw.mit.edu/courses/6-867-machine-learning-fall-2006/
- https://www.cse.iitk.ac.in/users/piyush/courses/ml_autumn16/ML.html
- https://redirect.cs.umbc.edu/portal/help/prolog/index.shtml

23CS653 MINI PROJECT - IV

Offered by CSE (Project Work)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- To explore various research domains.
- To conduct a review of the literature on the chosen problem.
- To apply the techniques for solving the problem.
- To prepare the report with findings and outcomes.

Course Outcome:

At the end of the course, the students will be able to

- Determine a problem that pertains to a newly emerging research issue.
- Examine related publications to learn about current approaches.
- Design a proposed system to address the identified research problem.
- Document the findings and outcomes.

Practical Syllabus:

LIST OF RESEARCH DOMAINS (Not limited to given domains)

- Artificial Intelligence/ Machine Learning/ Deep Learning
- Bio-medical Engineering
- Bigdata and Cloud Computing
- Computer Vision
- Network Security and Cryptography
- Data Mining and Analytics
- High Performance Computing
- Wireless Networks
- Internet of Things
- Natural Language Processing

GUIDELINES:

- The students should do research based project by forming a group of 2 to 3 members approved by the faculty supervisor and head of the department.
- The students should identify the problem statement, collect literature from peer reviewed journals such as IEEE Transactions, Elsevier, Springer, ACM, and identify the research gaps.
- The students must select an appropriate design model for the identified problem statement.
- The students should choose the appropriate benchmarked dataset for the identified problem statement.
- The students should design an architecture / system design for the proposed model.
- The student should develop algorithms based on an innovative idea they have proposed.
- The student should experiment different methods to solve the problem and select the best among them in terms of performance.
- The students should compare the proposed methodology with recent research works to justify the novelty and performance superiority.
- The progress of the project is evaluated based on a minimum of three reviews.
- The review committee may be constituted by the Head of the Department.
- The student prepares a comprehensive mini project report at the end of the semester after completing the work to the satisfaction.
- The student should present their findings in reputed National / International Conferences.
- The mini project work is evaluated based on oral presentation and the mini project report jointly by external and internal examiners constituted by the Head of the Department.
- The mini project will be assessed based on quality of survey, clarity in problem definition, innovativeness in solution, cost effectiveness, societal impact, functionalities of the working model/solution, contribution as individual/member in team, clarity in oral/written communication.

23GE651 NCC COURSE LEVEL - III

Offered by GEN (Mandatory Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

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Course Outcome:

At the end of the course, the students will be able to

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IAS60 INTEGRATED APTITUDE SKILLS - II (HIGHER)

Offered by MECH (Ability Enhancement Courses offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
2	0	0	1

Course Objective:

To impart knowledge on

- Understand the basic concepts of quantitative ability
- Understand the basic concepts of logical reasoning Skills
- Acquire satisfactory competency in use of verbal reasoning

Course Outcome:

At the end of the course, the students will be able to

- Solve aptitude, logical and verbal reasoning questions.

Unit I QUANTITATIVE APTITUDE **10**

1. Percentage
2. Ratio & Proportions
3. Pipes & Cisterns
4. Permutations & Combinations
5. Partnership
6. Allegation (Or) Mixture
7. Races & Games
8. Stocks & Shares
9. Height & Distance
10. True Discount & Banker's Discount
11. Probability
12. Mensuration (Area, Volume & Surface Area)
13. Interest (Simple Interest, Compound Interest)
14. Logarithm
15. Chain Rule
16. Data Interpretation (Tabulation, Bar Chart, Pie Chart, Line Graphs)

Unit II LOGICAL REASONING **10**

VERBAL REASONING:

Logical Deduction

1. Logic
2. Statement – Argument
3. Statement – Assumptions
4. Statement –Courses of action
5. Statement –Conclusion
6. Deriving Conclusion from passages
7. Theme Detection
8. Cause and Effect reasoning

NON-VERBAL REASONING

1. Series
2. Analogy
3. Classification
4. Analytical Reasoning
5. Mirror – Images
6. Water – Images
7. Spotting out the embedded figures
8. Completion of incomplete patterns
9. Figure Matrix
10. Paper Folding
11. Paper Cutting
12. Rule Detection
13. Grouping of identical figures
14. Cubes and Dice
15. Dot Situation
16. Construction of squares and triangles
17. Figure formation and analysis

Unit III VERBAL ABILITY **10**

1. Concord
2. Cloze Passage

3. Analogies or Reverse Analogies
4. Jumbled Sentences.
5. Error Deduction.
6. Reading Comprehension
7. Paragraph Formation
8. Completing Statements
9. Usage of Prepositions
10. Inference(Theme Detection)
11. Verification of Truth from the Statements
12. Change of Speech

Text Book:

1. Agarwal R.S, “Quantitative Aptitude,” S.Chand and Company Pvt. Ltd., New Delhi, First Edition 1989, Reprint, 2017
2. Agarwal R.S, “A Modern Approach to Verbal and Non-Verbal Reasoning,” S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1994, Reprint, 2016
3. Agarwal R.S, “Objective General English,” S.Chand and Company Pvt. Ltd.,New Delhi, First Edition 1997, Reprint, 2016

Reference Book:

1. Anand P A, “Quantitative Aptitude,” Wiley India Pvt. Ltd., New Delhi, Edition, 2016
2. Arun Sharma, “How to Prepare for Logical Reasoning,” Tata-McGraw Hill Education Series. New Delhi, First Edition 2016
3. Sharon Weiner Green, Ira K Wolf, “Barron’s GRE,” Barron Publishers. First Edition 1995, Reprint, 2016
4. The Princeton Review, “Cracking the GRE”, Random House Publisher, Premium Edition 2016.
5. Mark Alan Steward, J D,”30 days to the GMAT CAT”, Arco Publishers, 2nd Edition 2016.

Extensive Reading:

- www.indiabix.com
- http://www.practiceaptitudetests.com/

ITT63 ITT ON C++ / JAVA PROGRAMMING

Offered by CSE (Ability Enhancement Courses)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- To learn the essential concepts of creating Classes and Objects
- To explore the Object-Oriented Concepts of C++/Java programming for solving problems with exception handling
- To apply the OOPs concepts in solving real-world problems

Course Outcome:

At the end of the course, the students will be able to

- Develop simple C++/Java programs
- Design applications involving Object Oriented Programming concepts such as inheritance, polymorphism, abstract classes, and interfaces to solve a problem
- Derive solutions to various real-world problems

Practical Experiments:

1. Classes and objects
2. Constructors and destructors
3. C++ Templates
4. Abstraction, Encapsulation
5. Method Overloading
6. Polymorphism
7. Nested and Inner Classes
8. Exploring the String Class in Java
9. Inheritance
10. Super Classes and Abstract Classes
11. Method Overriding
12. Packages and Interfaces
13. Exception handling
14. Lambda Expressions in Java

Text Book:

1. Nicolai M. Josuttis. 2012. The C++ Standard Library: A Tutorial and Reference (2nd. ed.). Addison-Wesley Professional.
2. Herbert Schildt, “Java: The Complete Reference”, Twelfth Edition, McGraw Hill Education, 2021

USS60 SOFT SKILLS AND PERSONALITY DEVELOPMENT - II

Offered by ENG (Ability Enhancement Courses offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
1	0	0	1

Course Objective:

To impart knowledge on

- The Technicalities of Business Communication
- Interpersonal and Intrapersonal Skills
- Public speaking skills
- Email etiquette and its urgent need in the virtually growing world
- Decision making skills

Course Outcome:

At the end of the course, the students will be able to

- Tackle communication challenges in different Business situations
- Build and maintain positive relationships with friends, family members and professional
- Adhere to the nuances of public speaking by overcoming fear
- Compose formal and informal Emails suitable for Corporate and Casual correspondence
- Have greater insight into decision-making processes.

Unit I UNIT 1 **7**

Business Communication Skills – Voice and Accent, Voice Clarity, Voice Modulation & Intonation, Word Stress etc., Feedback & Questioning Development Techniques, Etiquette in Non-Verbal Communication- Facial Expression, Posture, Gesture, Eye Contact, Appearance, Dress code – Flow of Communication

Unit II UNIT II **7**

Interpersonal and Intrapersonal skills Positive Relationship-Positive Attitudes-Empathy: Comprehend other Opinions, Points of Views, and Face them with Understanding- Mutuality, Trust, Emotional Bonding- Handling Situations (Interview, Holding a Meeting etc.,) Recognizing Cultural Norms-Understanding how Gender Differences Influence Nonverbal Communication-Self-Talk and its Advantages

Unit III UNIT III **6**

Public Speaking-Nonverbal Communication-Giving Seminars and Presentations, Nuances of Addressing a Gathering - One to one, One to Many- Extempore

Unit IV UNIT IV **6**

Email Etiquette-Do’s and Don’ts of E-mail Writing, Desirable drafting of E-mails, Types of E-mails-personal E-mails, Professional E-mails, Demi-official Emails, Business Mails, Unknown Ad mails

Unit V UNIT V **6**

What is Leadership? Leadership skills- Leadership and Productivity Importance and necessity of decision making, process and practical way of decision-making, Weighing Positives & Negatives-Strategic decision making- Case studies of Efficient and Inefficient Leaders

Reference Book:

1. Covey, Stephen R., and Sean Covey. The 7 habits of highly effective people. Simon & Schuster, 2020.
2. Klaus, Peggy, Jane Rohman, and Molly Hamaker. The hard truth about soft skills. Harper Collins Publishers, 2007.
3. Pease, Barbara, and Allan Pease. The definitive book of body language: The hidden meaning behind people's gestures and expressions. Bantam, 2008.
4. Tulgan, Bruce. Bridging the soft skills gap: How to teach the missing basics to todays young talent. John Wiley & Sons, 2015

Extensive Reading:

- Peterson, Jordan B. 12 rules for life: An antidote to chaos. Random House Canada, 2018.
- Gangwar, Swetab. The Rudest Book Ever.2019
- De Bono, Edward. "Serious creativity." The Journal for Quality and Participation 18.5 (1995): 12

23CSC01 DIGITAL IMAGING

Offered by CSE (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the components of image processing system
- To know about various transformations and filters
- To study various compression methods and morphological operations
- To learn the image segmentation techniques
- To acquire knowledge on image classification and representation methods

Course Outcome:

At the end of the course, the students will be able to

- Work with the mathematical tools used for image processing
- Perform transformation techniques and filtering
- Implement various compression algorithms
- Apply various segmentation methods
- Represent the outcome of image classification

Unit I DIGITAL IMAGE FUNDAMENTALS 8

Fundamental steps in digital image processing – Components of an image processing system - Image sensing and acquisition– Image sampling and quantization – Some basic relationships between pixels

Unit II INTENSITY TRANSFORMATIONS AND FILTERING 10

Intensity transformation functions – Histogram processing – Fundamentals of spatial filtering – Smoothing (lowpass) spatial filters - Sharpening (high pass) spatial filters – Basics of filtering in frequency domain – Image smoothing, sharpening using frequency domain filters - Image restoration – Degradation model - Noise models- Spatial filtering - Frequency domain filtering

Unit III IMAGE COMPRESSION AND MORPHOLOGICAL IMAGE PROCESSING 9

Image compression: Fundamentals – Basic compression methods: Huffman coding – Arithmetic coding – LZW coding – Run-Length coding – Bit-Plane coding – Digital image water marking – Morphological image processing: Erosion and dilation – Opening and closing

Unit IV IMAGE SEGMENTATION 9

Point, line, and edge detection – Thresholding – Region based segmentation – Region growing – Region splitting and Merging – Region Segmentation Using Clustering and Super pixels - Segmentation using morphological watersheds

Unit V FEATURE EXTRACTION AND PATTERN CLASSIFICATION 9

Boundary preprocessing- Boundary feature and Region feature descriptors - Principal components descriptors- Whole image features – Scale invariant feature transform- Patterns and pattern classes – Pattern Classification by Prototype Matching - Optimum (Bayes) Statistical Classifiers

Text Book:

1. R. C. Gonzalez and R. E. Woods, “Digital Image Processing,” Fourth Edition, Pearson, 2018.

Reference Book:

1. E. R. Davies, “Computer & Machine Vision,” Fourth Edition, Academic Press, 2012.
2. W. Burger and M. Burge, “Digital Image Processing: An Algorithmic Introduction using Java,” Springer, 2016.
3. John C. Russ, “The Image Processing Handbook,” Sixth Edition, CRC Press, 2011.
4. Mark Nixon and Alberto S. Aguado, “Feature Extraction & Image Processing for Computer Vision,” Third Edition, Academic Press, 2012.
5. D. L. Baggio et al., “Mastering OpenCV with Practical Computer Vision Projects,” Packt Publishing, 2012.
6. Jan Erik Solem, “Programming Computer Vision with Python: Tools and algorithms for analyzing images,” O'Reilly Media, First Edition, 2012.

Extensive Reading:

- http://inst.eecs.berkeley.edu/~ee225b/fa12/lectures/
- https://sisu.ut.ee/imageprocessing/
- https://www.tutorialspoint.com/dip/
- https://faculty.ucmerced.edu/mhyang/papers/object-recognition-chapter.pdf

23CSC02 COMPUTER GRAPHICS

Offered by CSE (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the output primitives like line, circle and ellipse using algorithms.
- To study the 2-D transformations and clipping.
- To explore 3-D object representations and transformations.
- To learn 3-D viewing and detect visible surfaces
- To explore various rendering methods and understand various 3-D modeling and animation tools.

Course Outcome:

At the end of the course, the students will be able to

- Develop the line, circle and ellipse drawing algorithms
- Apply the two dimensional geometric transformations and 2-D clipping
- Represent 2-D objects and do geometric transformations
- Perform clipping and Detecting the visible surfaces in 3-D objects
- Apply various rendering methods and create simple model and animation using 3-D studio max, Maya and Blender tools

Unit I OUTPUT PRIMITIVES AND THEIR ATTRIBUTES 9

Applications of Computer Graphics - Overview of Graphics Systems - Input Devices - Output Primitives: Points and Lines - Line Drawing Algorithms - Mid-Point Circle and Ellipse Algorithms - Attributes of Output Primitives: Line, Curve, Color, Area-Fill, Character, Bundled Attributes - Antialiasing.

Unit II TWO-DIMENSIONAL CONCEPTS 9

Two-Dimensional Geometric Transformations - Two-Dimensional Viewing - Two-Dimensional Point clipping – Cohen Sutherland Line Clipping - Sutherland-Hodgeman Polygon Clipping - Weiler-Atherton Polygon Clipping - Text Clipping - Exterior Clipping.

Unit III THREE-DIMENSIONAL CONCEPTS 8

Three-Dimensional Display Methods - Three-Dimensional Object Representations: Polygon - Quadric Surfaces – Splines – Bezier curves and surfaces – Octree – BSP trees – Visualization of Datasets. Three-Dimensional Transformations: Translation – Rotation – Scaling – Reflection - Shearing - Composite transformation

Unit IV THREE-DIMENSIONAL VIEWING AND VISIBLE SURFACE DETECTION 9

Three-Dimensional Viewing and Clipping: Viewing Pipeline - Viewing coordinates – Projections – Clipping. Visible Surface Detection: Classification - Back-Face Detection - Depth-Buffer - Scan-Line - Depth Sorting – BSP - Tree Methods - Area Sub-Division - Octree Method – Ray casting – wireframe methods.

Unit V RENDERING METHODS 10

Drawing 3D Scenes – Perform Transformations - Colors And Light - Adding Texture and Shadows - Using Shading Models. Understanding 3D Modeling and Animation Tools like 3D Studio Max, Maya, Blender.

Text Book:

1. Donald Hearn and M. Pauline Baker, “Computer Graphics C Version”, Pearson Education, Second Edition, Reprint, 2023.

Reference Book:

1. Edward Angel and Dave Shreiner, “Interactive Computer Graphics: A Top-Down Approach with WebGL”, Pearson Education, Seventh Edition, 2015.

Extensive Reading:

- https://area.autodesk.com/all/tutorials/3ds-max/
- https://area.autodesk.com/all/tutorials/maya/
- https://www.blender.org/support/tutorials/

23CSC03 WEB USER INTERFACE DESIGN

Offered by CSE (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To design web pages with good look and feel using HTML5
- To understand the concept of CSS
- To validate and manipulate the contents of the webpage using JavaScript and DOM
- To learn and realize features of JQuery fundamentals
- To Gain knowledge on Bootstrap

Course Outcome:

At the end of the course, the students will be able to

- Design increasingly appealing web pages using HTML5
- Create different styles in webpage with CSS3
- Create valid and interactive web pages using JavaScript and DOM
- Implement real time applications using Jquery
- Develop interactive web design using Bootstrap

Unit I HTML5 **9**

Review of HTML - Lists - Tables - Forms - Internal linking - Meta elements - New HTML5 Form input types - Input and datalist elements and auto complete attribute – Page Structure Elements

Unit II CSS3 **9**

Types of CSS – Inline Styles- Embedded Stylesheets - Conflicting style sheets – Linking External Style sheets- Positioning Elements - Element Dimension - Box model and Text Flow – Media Types and Media Queries- Drop down menus – Text Shadows –Rounded Corners – Box Shadows.

Unit III JAVASCRIPT AND DOM **9**

JavaScript - Syntax - Variables and data types - JavaScript Control Statements - Operators - Literals - Functions - Objects - Arrays - Built in objects - JavaScript Event Handling - Form processing with focus, blur, submit, reset - Event Bubbling - Document Object Model - The Document Tree - DOM Collections – Dynamic Style - Using Timer and Dynamic Styles to Create Animated Effects.

Unit IV JQUERY **9**

Jquery Fundamentals - Selecting elements for manipulation - managing the wrapped element set - Manipulating Element Properties and attributes - Changing element Styling - Setting Element Content - Dealing with form element value

Unit V BOOTSTRAP **9**

Bootstrap Scaffolding - Bootstrap file Structure – Global styles – Default grid system – Container layout - Typography – Tables – Forms – Buttons –Images –Icons – Dropdown menu – Button groups – Button with dropdown – Navigation elements – Labels – Badges – Thumbnail- Progress bar

Text Book:

1. P.J. Deitel, H.M. Deitel, “Internet and World Wide Web – How to program”, Fifth Edition, Pearson Education Publishers, 2011 (Unit 1 to 3)
2. Bibeault, Bear, Aurelio De Rosa, and Yehuda Katz, “jQuery in Action”, Manning Publisher, 2015. (Unit 4)
3. Spurlock, Jake,”Bootstrap: responsive web development" ,O'Reilly Media, Inc.", 2013. (Unit 5)

Reference Book:

1. Jeffrey C. Jackson, "Web Technologies - A Computer Science Perspective", Pearson Education, 2011
2. Shenoy, Aravind, and Ulrich Sossou. Learning Bootstrap. Packt Publishing Ltd, 2014.
3. Chernick, Michael R., and Robert A. LaBudde. An introduction to bootstrap methods with applications to R. John Wiley & Sons, 2014.
4. Chaffer, Jonathan, and Karl Swedberg. Learning jQuery. Packt Publishing Ltd, 2011.
5. Chaffer, Jonathan, and Karl Swedberg. Learning jQuery 1.3. Packt publishing, 2009.

Extensive Reading:

- https://www.w3schools.com/html/html5_intro.asp
- https://www.javascript.com/
- https://www.w3schools.com/css/

23CSC04 PARALLEL PROGRAMMING

Offered by CSE (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce models and issues in parallel programming
- To acquire knowledge about basics of parallel algorithm design and communication
- To understand the Parallel Algorithm for Matrix Multiplication, sorting and graph-based applications
- To study the Basic constructs of the GO language.
- To learn the various constructs on GO for synchronization

Course Outcome:

At the end of the course, the students will be able to

- Identify the need and issues in parallel programming
- Comprehend the design and communication of parallel programming
- Develop Parallel Programs for Matrix Multiplication, sorting and graph-based applications
- Write parallel programs using GO language using basic constructs
- Develop parallel programs using GO language with synchronization

Unit I FOUNDATIONS OF PARALLEL PROGRAMMING 9

Motivation for parallel programming - Concurrency in computing – Basics of processes, multiprocessing and threads – cache – cache mappings – caches and programs –Instruction level parallelism – SIMD – MIMD – Interconnection networks – cache coherence – shared memory model – Issues in shared memory model – distributed memory model – Issues in distributed memory model – hybrid model – Performance of parallel programs – parallel program design- Flynn's taxonomy.

Unit II PARALLEL ALGORITHM DESIGN AND COMMUNICATION 9

Principles of parallel algorithm Design-Preliminaries, Decomposition techniques, Characteristics of Tasks and Interaction, Mapping techniques for load balancing, Parallel algorithm Models.

Basic Communication Operations-One to All and All to one reduction, All to All Broadcast, Scatter and gather.

Unit III PARALLEL ALGORITHMS 9

Dense Matrix Algorithms- Matrix-Vector Multiplication, Matrix-Matrix Multiplication: Cannon's algorithm, Sorting, Issues in Sorting on Parallel Computers, Bubble Sort and its Variants, Bucket and Sample sort, Radix sort. Graph Algorithms- Minimum Spanning Tree: Prim's Algorithm, All pair shortest path: Floyd's algorithm

Unit IV GO PROGRAMMING BASICS 9

Introduction to Go, Keywords, Identifiers, Variables, Data Types, Constants, Operators, Types of operators, Control Structures-Branching statements, Looping statements. Functions, Declarations, Function calls, Arrays & Slices, Declarations, Initializations.

Unit V GO PROGRAMMING - II 9

Pointers, Need, Declarations, Initializations, dereferencing pointers. Structures, Declaration of struct, Initialization. Concurrency- Goroutines, Mutex and Channels, Decorations of Channel, Channel operations, Deadlock, Mutex.

Text Book:

1. Peter S. Pacheco, "An introduction to parallel programming", Morgan Kaufmann, 2021 (Unit 1)
2. Ananth Grame, George Karpis, Vipin Kumar and Anshul Gupta, "Introduction to Parallel Computing", 2nd Edition, Addison Wesley, 2003 (Unit 2 and 3)
3. Shubhangi Agarwal, Learning Go Programming, First edition, BPB Publications,2021. (Unit 4 and 5)

Reference Book:

1. Michael J. Quinn, "Parallel Computing: Theory & Practice", Tata McGraw Hill, Second Edition, 2017.
2. M. J. Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, 2017.
3. V Rajaraman, C Siva Ram Murthy, " Parallel computers- Architecture and Programming ", PHI learning, 2016.

Extensive Reading:

- http://i.stanford.edu/pub/cstr/reports/cs/tr/84/1028/CS-TR-84-1028.pdf
- http://www.dcc.fc.up.pt/~fds/aulas/PPD/1112/sorting.pdf
- http://www.hpcc.unn.ru/mskurs/ENG/DOC/pp09.pdf
- https://www.tutorialspoint.com/parallel_algorithm/parallel_algorithm_tutorial.pdf

23CSC05 SECURITY IN COMPUTING

Offered by CSE (Core Elective)

L	T	P	C
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Course Objective:

To impart knowledge on

- To understand the basics of computer security
- To identify the vulnerabilities in programs and to overcome them
- To know about the Operating System (OS) protection mechanism and trusted OS
- To explore the different kinds of security threats and control measures in networks
- To study the security threats in web applications

Course Outcome:

At the end of the course, the students will be able to

- Apply cryptography techniques to secure information.
- Secure programs and system from malicious code.
- Discover the working principle of operating system protection and trusted operating system.
- Bring out the mechanisms involved in protecting network.
- Identify security issues and counter measures for web applications.

Unit I INTRODUCTION TO COMPUTER SECURITY 9

Threats – Harms – Vulnerabilities – Controls – Authentication – Access Control – Terminologies - Data Encryption Standard – AES encryption algorithm – Public key encryption: RSA – Key Exchange – Cryptographic hash functions – Digital signatures – Certificates

Unit II PROGRAM SECURITY 9

Non-malicious program errors – Malicious Code – Countermeasures – Internet Attacks: Browser Attacks – Attacks targeting users – Obtaining user data – Mobile App Security – Email Attacks

Unit III NETWORK SECURITY 9

Threats in networks – Wireless Network Security – Denial of Service – Distributed Denial of Service – Security Countermeasures: Cryptography in Network Security – Firewalls – Intrusion Detection System – Intrusion Prevention System

Unit IV DATABASE SECURITY 9

Introduction to Databases - Security requirements of database systems – Access Control List - Reliability and integrity in databases – Two phase update – Redundancy / internal consistency– Recovery– Concurrency / consistency – Database Disclosure: Sensitive data – Types of disclosures – Preventing Disclosure

Unit V WEB APPLICATION SECURITY 9

Network Security vs Application Security – Top Web application Vulnerability introduction: Injection – Cross-Site scripting – Broken Authentication and Session Management – Insecure Direct Object Reference – Cross-Site Request Forgery – Security Misconfiguration – Insecure Cryptographic Storage – Failure to Restrict URL Access – Insufficient Transport Layer Protection – Unvalidated Redirects and Forwards – Secure Development Methodologies

Text Book:

1. Charles Pfleeger, Shari Lawrence Pfleeger, Lizzie Coles-Kemp, “Security in Computing”, Sixth Edition, Pearson Education, 2023.
2. Bryan Sullivan, Vincent Liu., “Web Application Security – A Beginner’s Guide”, McGrawHill, 2011

Reference Book:

1. Joachim Biskup,” Security in Computing Systems: Challenges, Approaches and Solutions”, Springer-Verlag, 2009.
2. William Stallings, Cryptography and Network Security, 8th Edition, Pearson Education, 2023.
3. Matt Bishop, “Introduction to Computer Security”, Addison-Wesley, 2004.
4. Wade Trappe, Lawrence C Washington, “Introduction to Cryptography with coding theory”, 3rd edition, Pearson Education, 2020.

Extensive Reading:

- https://owasp.org/www-project-top-ten/
- https://cwe.mitre.org/top25/archive/2023/2023_top25_list.html
- https://insecure.org/
- https://www.intechopen.com/books/1778
- https://archive.nptel.ac.in/courses/106/106/106106129/
- https://archive.nptel.ac.in/courses/106/106/106106199/
- https://archive.nptel.ac.in/noc/courses/noc15/SEM1/noc15-cs03/

23CSC06 SPEECH AND LANGUAGE PROCESSING

Offered by CSE (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explore the fundamental concepts of Speech and Natural Language Processing
- To learn the different grammars of language modelling and lexical analysis techniques
- To know the working of syntactic, semantic analysis and lexical resources
- To understand the pragmatic analysis and natural language generation systems
- To study about speech recognition, dialogue acts, machine translation and information retrieval

Course Outcome:

At the end of the course, the students will be able to

- Familiarize Speech and Natural Language Processing concepts
- Construct various language models and analyse word level of natural language using lexical analysis
- Perform syntactic and semantic analysis for natural languages
- Apply the reference resolution technique for pragmatic analysis and develop NLG systems
- Apply NLP techniques in Speech Recognition, Dialogue Acts, Machine Translation and Information Retrieval

Unit I INTRODUCTION TO SPEECH AND NLP 9

Phonetics: Phonetic Transcription - Articulatory Phonetics – Prosody - Acoustic Phonetics and Signals - Phonetic Resources.

Natural language processing: History of NLP – Early NLP systems – Phases of natural language processing – Evaluation of NLP systems - Origins and challenges of NLP – Speech processing - Basic English concepts - Language and Grammar - Processing Indian languages - NLP tools.

Unit II LANGUAGE MODELLING AND LEXICAL ANALYSIS 9

Language modelling: Various grammar-based language models – Government and binding grammar – Lexical functional grammar – Paninian framework - Statistical language model – Lexical analysis: Regular expressions - Finite-state automata - Morphological parsing - Spelling error detection and correction - Words and word classes - Part-of Speech tagging

Unit III SYNTACTIC AND SEMANTIC ANALYSIS 9

Syntactic analysis: Context-free grammar – Constituency – Parsing - Probabilistic parsing - Semantic analysis: Meaning representation - Lexical semantics – Ambiguity - Word sense disambiguation - Lexical resources: WordNet – FrameNet.

Unit IV PRAGMATIC ANALYSIS AND NATURAL LANGUAGE GENERATION 9

Discourse processing: Cohesion - Reference resolution - Reference phenomena - Pronoun interpretation – Pronoun resolution algorithm – Discourse coherence – Discourse structure – Natural language generation: Architecture of NLG systems – Generation tasks and representations - Application of NLG

Unit V APPLICATIONS 9

Speech Recognition: Automatic Speech Recognition Task – Feature Extraction of ASR - Text to Speech Systems - Dialogue Acts: Types of Interpretation of dialogue acts - Dialogue structure and coherence – Dialogue managers - Machine Translation: Problems and Approaches of Machine Translation – Information Retrieval: Design Features of Information Retrieval Systems - Models and Evaluation of IR Systems

Text Book:

1. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, 2nd Edition, Pearson Education, 2008.
2. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.

Reference Book:

1. Ela Kumar, “Natural Language Processing”, I.K International, New Delhi 2013.
2. James Allen, “Natural Language Understanding”, 2nd edition, Pearson Education, 1995.
3. Christopher D. Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 1999.

Extensive Reading:

- http://nptel.ac.in/courses/106101007/
- http://nlp.stanford.edu/
- https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-863j-natural-language-and-the-computer-representation-of-knowledge-spring-2003/index.htm
- https://www.nltk.org/
- https://www.deeplearning.ai/resources/natural-language-processing/
- https://www.ibm.com/topics/natural-language-processing

23CSC07 PATTERN RECOGNITION TECHNIQUES

Offered by CSE (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basics of Pattern recognition concepts
- To learn the concepts of linear models
- To study nonlinear classifiers to solve pattern recognition problems
- To know about context dependent classifiers
- To be familiar with clustering concepts and algorithms

Course Outcome:

At the end of the course, the students will be able to

- Familiarize Pattern recognition concepts
- Solve pattern recognition problems using liner classifiers
- Apply Nonlinear classifier algorithms to solve problems.
- Identify suitable context dependent classifiers to solve real world problems
- Recognize patterns using clustering algorithms

Unit I INTRODUCTION **9**

Pattern recognition importance – Feature vectors – Supervised, Unsupervised and Semi supervised learning – Classifiers based on Bayes Decision theory: Bayes decision theory – Discriminant functions and Decision surfaces – Bayesian classification for normal distributions – Estimation of Unknown probability density functions – Nearest neighbor rule – Bayesian networks

Unit II LINEAR MODELS **8**

Introduction – Linear Discriminant functions and decision hyperplanes – Perceptron algorithm – Least square methods – Mean square estimation – Logistic Discrimination – Support vector machines. Feature Selection: Introduction – Preprocessing – The peaking phenomenon – Statistical hypothesis testing – ROC curve – class separability measures – Feature subset selection – Optimal feature generation – Neural networks for generation

Unit III NONLINEAR MODELS **9**

Introduction – XOR problem – Two layer and Three layer perceptron – Algorithms based on training set – BPN and variations – Simulation – Generalization – Polynomial classifiers – RBF networks – Approximators – PNN – SVM Kernel functions – Decision trees

Unit IV COMBINING MODELS AND CONTEXT-DEPENDENT CLASSIFICATION **9**

Combining classifiers – Approaches – Class imbalance problem – Template matching: Introduction – Optimal Path searching techniques - Context Dependent classification: Introduction - Bayes classifier – Markov chaining models – Viterbi algorithm – HMM – Training – Markov random fields

Unit V CLUSTERING ALGORITHMS AND REINFORCEMENT LEARNING **10**

Introduction – Proximity measures – Sequential Algorithms: Introduction – Categories – Basic sequential algorithmic scheme – Modification – Refinement – Implementation – Hierarchical Algorithms: Agglomerative, Divisive algorithms– Determining best clustering

Reinforcement Learning: Learning from Rewards – Passive and Active Reinforcement Learning – Policy search – Apprenticeship and Inverse Reinforcement Learning.

Text Book:

1. Theodoridis, S. and K. Koutroumbas, “Pattern Recognition”, Fourth Edition, Elsevier, Academic Press, 2009

Reference Book:

1. Theodoridis, Sergios & Pikrakis, Aggelos & Koutroumbas, Konstantinos & Cavouras, Dionisis, “Introduction to Pattern Recognition : A MATLAB approach”, Elsevier, Academic Press, 2010
2. Stuart J. Russell and Pete, Norvig “Artificial Intelligence – A Modern Approach”, Fourth edition, Pearson, 2022
3. Rajjan Shinghal, “Pattern Recognition Techniques and Application”, Oxford University Press, Reprint 2016
4. Christopher M.Bishop, “ Pattern Recognition and Machine Learning”, Springer, Reprint, 2009

Extensive Reading:

- http://kdd.ics.uci.edu/
- https://onlinecourses.nptel.ac.in/

23CSC08 J2EE TECHNOLOGIES

Offered by CSE (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the server-side technologies such as Java servlets, JSP and EJB
- To learn the various design patterns and frameworks
- To examine the notion of creating databases and its relevant operations
- To familiarize the interconnectivity using JavaMail and Java Message Service
- To understand the usage of J2EE web services

Course Outcome:

At the end of the course, the students will be able to

- Develop web-based applications using Java servlet / JSP /EJB
- Examine the different design patterns and frameworks of J2EE
- Embed J2EE applications with database
- Develop GUI-based applications with interconnectivity
- Deploy J2EE web services for real time applications

Unit I J2EE FOUNDATION **9**

J2EE and J2SE– Java and XML – Java Servlets - JSP: Java Server Pages - JSP Tags – Tomcat – Request String - User Session – Cookies – Session Objects. EJB: Container – Classes – Interfaces - Deployment Descriptors – Session Java Bean – Entity Java Bean – Message Driven Bean – JAR File.

Unit II J2EE DATABASES **9**

J2EE Database Concepts – Database Schema – Creating Tables – Indexing – Inserting Data – Selecting Data – Metadata – Updating Data – Deleting Data – Joining Tables – Calculating Data – Grouping and Ordering Data – Sub Queries - View

Unit III J2EE INTERCONNECTIVITY **9**

Java Mail API - Java Activation Framework - Protocols - Send Email Message - Retrieving Email Messages - Deleting Email Messages - Replying to and Forwarding an Email Message – Sending/Receiving - Searching an Email Folder. Java Message service: Components of a JMS Program - Message Selector – Sending/ Receiving Messages to/from a Queue - Creating a Publisher/Subscriber - Creating a Message Listener - Compiling and Running the Publisher and Subscriber.

Unit IV J2EE WEB SERVICES **9**

SOAP: Basics - Java API for XML Messaging - Create, Send, and Receive a Point-to-Point SOAP Message - Using a Messaging Provider - Creating a SOAP Attachment–UDDI: UDDI API – Inquiry API – Publishing API - Electronic Business XML - Java API for XML Registries - Web Services Description Language (WSDL)

Unit V J2EE DESIGN PATTERNS AND FRAMEWORKS **9**

J2EE Multi-Tier Architecture - J2EE Best Practices -Enterprise Application Strategy – The Enterprise Application – Clients - Sessions Management - Web Tier and JSP – EJB Tier –MVC - Struts framework: overview – architecture – Struts Action class– Using Struts HTML tags – Struts validation framework – Developing application with Struts. Introduction to Spring – Introduction to Hibernate.

Text Book:

1. Jim Keogh, “J2EE The Complete Reference”, McGraw Hill, 2017.

Reference Book:

1. Antonio Goncalves, “Beginning Java™ EE 6 Platform with GlassFish™ 3”, Second Edition, Apress, 2009.
2. Jeffrey C. Jackson, "Web Technologies – A Computer Science Perspective", Pearson Education, 2011.

Extensive Reading:

- http://docs.oracle.com/javaee/6/tutorial/doc/bnafd.html
- http://www.javatpoint.com/servlet-tutorial
- http://www.javatpoint.com/jms-tutorial
- http://www.tutorialspoint.com
- http://www.w3schools.com

23CSC09 FULL STACK PROGRAMMING

Offered by CSE (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about web development framework and Javascript
- To understand the concept of server side Java Script Framework Node JS
- To learn and realize features of MongoDB
- To Gain knowledge on Express and Angular
- To study the React applications

Course Outcome:

At the end of the course, the students will be able to

- Create valid and interactive web pages using JavaScript
- Write programs of Node JS in server side
- Design simple application with MongoDB and Node.js
- Develop single page application using Angular and Express
- Design web applications with React

Unit I BASICS OF WEB DEVELOPMENT FRAMEWORK AND JAVA SCRIPT 8

Understanding the Basic Web Development Framework – User – Browser – Webserver -JavaScript overview - Error Handling – Web page with dynamic styles using JavaScript timers-JavaScript engine:V8-JavaScriptCore-SpiderMonkey-Chakra - MVC Architecture – Understanding the different stacks –The role of Express – Angular– Node – Mongo DB – React

Unit II NODEJS 9

Basics of Node JS – Installation – Working with Node packages – Using Node package manager – Creating a simple Node.js application – Understanding the Node.js Event Model-Adding Work to the Event Queue-Implementing Callbacks - Handling Data I/O – Implementing HTTP services in Node.js

Unit III MONGODB 8

Understanding NoSQL and MongoDB – Building MongoDB Environment – User accounts – Access control – Administering databases – Managing collections – Connecting to MongoDB from Node.js – simple applications

Unit IV EXPRESS AND ANGULAR 10

Implementing Express in Node.js – Configuring routes – Using Request and Response objects – Angular – Typescript – Angular Components-Component Configuration-Building a Template-Using External Templates- Injecting Directives – Expressions – Data binding – Built-in directives

Unit V REACT 10

MERN STACK – Basic React applications – React Components - React Classes - Composing Components- Passing Data Using Properties - Passing Data Using Children - Dynamic Composition – React State – Express REST- APIs – Routing with React Router – React Forms

Text Book:

1. Brad Dayley, Brendan Dayley, Caleb Dayley, 'Node.js, MongoDB and Angular Web Development', Addison-Wesley, Second Edition, 2018
2. Vasan Subramanian, 'Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node', Second Edition, Apress, 2019.

Reference Book:

1. Chris Northwood, 'The Full Stack Developer: Your Essential Guide to the Everyday Skills Expected of a Modern Full Stack Web Developer', Apress; 1st edition, 2018
2. Kirupa Chinnathambi, 'Learning React: A Hands-On Guide to Building Web Applications Using React and Redux', Addison-Wesley Professional, 2nd edition, 2018
3. Cyrus Dasadia, AmolNayak, "MongoDB Cookbook" , Packt Publishing , 2016
4. KrasimirTsonev, "Node.js by Example", Packt Publishing , 2015

Extensive Reading:

- https://www.javascript.com/
- https://angular.io/
- https://www.mongodb.com/
- https://nodejs.org/en
- https://www.coursera.org/specializations/full-stack-react
- https://www.udemy.com/course/the-full-stack-web-development/

23CSC10 PARALLEL ALGORITHMS

Offered by CSE (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To acquire knowledge about parallel processing architectures
- To understand mapping and scheduling on multiprocessors
- To solve matrix multiplication and linear systems using parallel algorithms
- To understand PRAM algorithms, graph algorithms and dictionary operations
- To study sorting and combinatorial search algorithms

Course Outcome:

At the end of the course, the students will be able to

- Identify issues in parallel programming
- Analyze mapping and scheduling algorithms running on multiple processors
- Compare parallel algorithms used for solving matrix multiplication and linear systems
- Comprehend PRAM algorithm, parallel graph and dictionary searching algorithms
- Apply parallel algorithms for sorting and combinatorial search

Unit I PARALLEL PROCESSING ARCHITECTURES 9

Introduction-Computational demands of modern science-Advent of practical parallel processing-parallel processing terminology-The Steve of Eratosthenes-Processor Organizations-Processor Arrays-Multiprocessors – Multicomputers - Flynn's taxonomy - Speedup, scaled speedup and paralizability.

Unit II MAPPING AND ELEMENTARY PARALLEL ALGORITHMS 9

Mapping data to Processors on Processor Arrays and Multicomputers - Dynamic Load balancing on Multicomputers - Static Scheduling on UMA Multiprocessors - Deadlock - SIMD algorithms:Reduction-Broadcast-Graph coloring, Prefix sums, List ranking.

Unit III MATRIX MULTIPLICATION AND SOLVING LINEAR SYSTEMS 9

Sequential Matrix Multiplication-Algorithms for Processor arrays: Matrix Multiplication on 2-D mesh, Hypercube, Shuffle-exchange SIMD models-Algorithms for Multiprocessors - Algorithms for Multicomputers: Row-Column oriented and block oriented algorithms. Solving Linear systems: Terminology - Back substitution - Odd-even reduction - Gaussian Elimination.

Unit IV PRAM ALGORITHMS 9

A model of serial computation-The PRAM model of parallel computation - PRAM algorithms-List Ranking, Merging two sorted list, Graph coloring - Searching a graph- All-pairs shortest path-Single- Source shortest path-Minimum cost spanning tree-Dictionary operations: complexity of parallel search-searching on multiprocessors: Ellis's algorithm, Menber and Ladner's algorithms.

Unit V SORTING AND COMBINATORIAL SEARCH 9

Enumeration sort-lower bounds on parallel sorting-odd-even transposition sort - Bitonic Merge - Quick-sort based algorithms: Parallel Quick sort, HyperQuick sort- Parallel sorting by regular sampling. Combinatorial Search: Introduction - Divide and Conquer-Branch and bound-Parallel branch-and-bound algorithms.

Text Book:

1. Michael J. Quinn, "Parallel Computing: Theory & Practice", Tata McGraw Hill, Second Edition, Reprint 2017.

Reference Book:

1. AnanthGrama, Anshul Gupta, George Karypis, Vipin Kumar, "Introduction to Parallel Computing,second edition, Pearson Education,2003
2. M. J. Quinn, "Parallel programming in C with MPI and OpenMP", Tata McGraw Hill, Reprint 2017.
3. Peter S. Pacheco, "An introduction to parallel programming", Morgan Kaufmann, 2021.
4. Joseph Jaja, "An Introduction to Parallel algorithms",Addison Wesley Publishing Company,1992.

Extensive Reading:

- http://i.stanford.edu/pub/cstr/reports/cs/tr/84/1028/CS-TR-84-1028.pdf
- http://www.dcc.fc.up.pt/~fds/aulas/PPD/1112/sorting.pdf
- http://www.hpcc.unn.ru/mskurs/ENG/DOC/pp09.pdf
- https://www.tutorialspoint.com/parallel_algorithm/parallel_algorithm_tutorial.pdf

23CSC11 CRYPTOGRAPHIC ALGORITHMS AND ARCHITECTURE USING JAVA

Offered by CSE (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the concepts of security services, security mechanisms and security components in java.
- To implement the key management techniques using Java.
- To Implement the Digital Signature Algorithm using Java
- To study the principles of symmetric key and Asymmetric key encryption
- To acquire fundamental knowledge on resource access management using Java

Course Outcome:

At the end of the course, the students will be able to

- Able to map the security features to the digital world
- Implement various key management techniques in Java
- Implement digital signature algorithm in Java
- Apply encryption techniques for hiding the data
- Use JAAS and GSS to authenticate and authorize the enterprise resources

Unit I INTRODUCTION TO SECURITY **9**

Security Basics – Protecting the information, Security Services, Mapping security features to the digital world, Hackers tool – different types of hacks, Understanding Network Attacks, protecting against hackers, Java Security Components – Categorizing security elements, categorizing security components in Java

Unit II IDENTITY AND AUTHENTICATION **9**

Key Management Algorithms – Understanding the purpose of keys, Symmetric vs Asymmetric Keys, Diffie-Hellman Key Exchange, RSA Key Exchange, Elliptic Curve Cryptography, Key Management through Internet Protocol – IP Security Protocol, Simple Authentication and Security Layer, Implementing Keys with Java, Key Management using Java.

Unit III DATA INTEGRITY **9**

Data Integrity – Hash Function, Message Digest Algorithms – Concepts, Implementation in Java, Message Authentication – Message Authentication Code algorithm – Concepts, Implementation in Java, Signature Security – Digital Signature Algorithm (DSA), RSA digital Signature Algorithm, Elliptic Curve Digital Signature Algorithm, Implementation of Digital Signature Algorithm using Java – Applications of security algorithms: Block chain technology

Unit IV DATA HIDING **9**

Understanding Symmetric Cipher, Implementation of RSA public Key Encryption, Extending New Ciphers with the Java – Implementation of CipherSpi, Implementation of RC4 Stream Cipher using Java, Applying Ciphers - Password based Encryption, Blowfish Encryption, Java Smart Card

Unit V RESOURCE ACCESS USING JAVA **9**

Securing Enterprise Resources – Criteria for security systems, Security needs, security requirements, Authentication and Authorization through Kerberos, Securing Messages with Java General Security Services (GSS) API – implementing the GSS, Authentication using Java Authentication and Authorization Service (JAAS), Java Access – Class Loader, Security Manager, Access Controller, Policy, Permission Collection. JASS Authorization

Text Book:

1. Rich Helton, Johennie Helton, “Mastering Java Security: Cryptography, Algorithms and Architecture”, 1st Edition, Wiley Dreamtech India Pvt. Ltd, 2002.

Reference Book:

1. Wade Trappe, Lawrence C Washington, “Introduction to Cryptography with coding theory”, 2nd edition, Pearson, 2007
2. William Stallings, “Cryptography and Network Security”, 6th Edition, Pearson Education, March 2013.
3. Bruce Schneier and Neils Ferguson, “Practical Cryptography -‖”, First Edition, Wiley Dreamtech India Pvt Ltd, 2003.
4. W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, Second Edition, 2007.
5. Douglas R Simson, “Cryptography –Theory and practice ‖”, First Edition, CRC Press,1995.
6. David Hook,“Beginning Cryptography with Java”, Wiley, November 2005.
7. Jonathan Knudsen, “Java Cryptography”, O’Reily Media, May 2010.

Extensive Reading:

- http://tutorials.jenkov.com/java-cryptography/index.html
- https://docs.oracle.com/javase/8/docs/technotes/guides/security/crypto/CryptoSpec.html

23ADP01 DATA ANALYTICS IN BIOINFORMATICS

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Exposed to the need for Bioinformatics technologies
- To Data warehousing and datamining techniques in bioinformatics
- To Familiar with the modeling techniques
- To Different Pattern Matching and Visualization techniques
- To Use of microarray analysis on various benchmark datasets

Course Outcome:

At the end of the course, the students will be able to

- Use the concept of bioinformatics technologies
- Analyse biomedical data using machine learning techniques
- Develop models for biological data
- Apply pattern matching techniques to bioinformatics, protein and genomic data
- Implement micro array technologies for evaluation of biological data

Unit I INTRODUCTION **9**

Fundamentals of Genes and Genomes – Need for Bioinformatics technologies – Overview of Bioinformatics technologies Structural bioinformatics – Data format and processing – Secondary resources and applications – Role of Structural bioinformatics – Biological Data Integration System

Unit II DATAWAREHOUSING AND DATA MINING IN BIOINFORMATICS **9**

Bioinformatics data – database –Primary and Secondary database – Data Retrieval – Data warehousing architecture – data quality – Biomedical data analysis – DNA data analysis – Protein data analysis – Machine learning – Neural network architecture and applications in bioinformatics

Unit III MODELLING FOR BIOINFORMATICS **9**

Hidden Markov modeling for biological data analysis – Sequence identification –Sequence classification – multiple alignment generation – Comparative modeling –Protein modeling – genomic modeling – Probabilistic modeling – Bayesian networks – Boolean networks – Molecular modeling – Computer programs for molecular modelling

Unit IV PATTERN MATCHING AND VISUALIZATION **9**

Gene regulation – motif recognition – motif detection – strategies for motif detection – Visualization – Fractal analysis – DNA walk models – one dimension – two dimension – higher dimension – Game representation of Biological sequences – DNA, Protein, Amino acid sequences

Unit V MICROARRAY ANALYSIS **9**

Microarray technology for genome expression study – image analysis for data extraction – preprocessing – segmentation – gridding – spot extraction – normalization, filtering – cluster analysis – gene network analysis – Compared Evaluation of Scientific Data Management Systems – Cost Matrix – Evaluation model – Benchmark – Tradeoffs

Text Book:

1. Yi-Ping Phoebe Chen (Ed), “Bioinformatics Technologies”, Springer Verlag, 2007
2. Supratim Choudhuri, “Bioinformatics for Beginners”,Elsevier,2014

Reference Book:

1. Bryan Bergeron, “Bio Informatics Computing”, Second Edition, Pearson Education, 2003
2. Arthur M Lesk, “Introduction to Bioinformatics”, Fourth Edition, Oxford University Press, 2005

Extensive Reading:

- https://towardsdatascience.com/hidden-markov-model-applied-to-biological-sequence-373d2b5a24c
- https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/bioinformatics
- https://www.ebi.ac.uk/training/online/courses/functional-genomics-ii-common-technologies-and-dataanalysis-methods/microarrays/analysis-of-microarray-data/

23ADP02 TEXT ANALYTICS

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Study about natural language processing
- To Study about text categorization using classification
- To Study about clustering text document
- To Understand about Topic modeling and summarization
- To how to effectively apply document summarization on various cases

Course Outcome:

At the end of the course, the students will be able to

- Apply natural language processing algorithms for text processing
- Implement classification algorithms for text classification
- Apply clustering algorithms for document grouping
- Perform modeling based on LSI and LDH algorithms
- Perform summarization of text document

Unit I NATURAL LANGUAGE PROCESSING **9**

Basic techniques in natural language processing – Tokenization Part-of-Speech tagging – chunking – syntaxparsing named entity recognition – N– gram language model – estimating parameters and smoothing – evaluating language model; Sequence Labelling – Lexical syntax and Hidden Markov Models

Unit II TEXT CATEGORIZATION **9**

Basic supervised text categorization algorithms – Naive Bayes – k Nearest Neighbour (kNN) – Logistic Regression– Support Vector Machines – Decision Trees

Unit III TEXT CLUSTERING **9**

Clustering structure of a corpus of text documents – assigning documents to cluster; Clustering algorithms – connectivity – based clustering – hierarchical clustering –centroid-based clustering – k– means clustering

Unit IV TOPIC MODELLING **9**

Topic modelling basics – Probabilistic Latent Semantic Indexing (pLSI) – Latent Dirichlet Allocation (LDA) – their variants for different application scenarios – imagine annotation – collaborative filtering – Hierarchical topical structure modelling

Unit V DOCUMENT SUMMARIZATION AND CASE STUDIES **9**

Extraction based document summarization methods; Case study – Social Media and Network analysis – unique characteristic of social network – inter-connectivity –PageRank algorithm –Case Stud – Sentiment analysis – sentiment polarity prediction – review mining –aspect identification; Case Study – Text Visualization – Visual representations of abstract data to reinforce human cognition

Text Book:

1. Charu C. Aggarwal and ChengXiangZhai, “Mining Text Data”, Springer, 2012

Reference Book:

1. DanJurafsky and James H Martin, “Speech and Language Processing”. Pearson Education India, 2000
2. Christopher D. Manning, PrabhakarRaghavan, and HinrichSchuetze, “Introduction to Information Retrieval”, Cambridge University Press, 2007

Extensive Reading:

- https://monkeylearn.com/blog/what-is-text-analytics/
- https://www.lexalytics.com/technology/text-analytics
- https://www.linguamatics.com/what-text-mining-text-analytics-and-natural-language-processing

23ADP03 PRINCIPLES OF KNOWLEDGE REPRESENTATION AND REASONING

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- basic concepts of knowledge and its role
- representation of knowledge & associated methods for automated reasoning
- Identifying knowledge-based techniques which are appropriate for specific tasks
- representation of knowledge using object oriented and it structural description
- design and apply knowledge-based systems

Course Outcome:

At the end of the course, the students will be able to

- Illustrate the basic concept of KRR and how the knowledge can be used to represent commonsense worlds and key reasoning technique of Resolution theorem-proving
- Design the Rule based system
- Represent the knowledge using Object oriented approach
- Generate the plans using knowledge about actions and assess the tradeoff between representation and reasoning
- Apply KRR systems for challenging real-world problems

Unit I INTRODUCTION **9**

The Key Concepts : Knowledge Representation and Reasoning – Why Knowledge Representation and Reasoning – Role of Logic – First Order Logic : Syntax and Semantics – Pragmatics – Explicit and Implicit Belief – Expressing Knowledge – Resolution.

Unit II REASONING WITH HORN CLAUSE AND PROCEDURAL CONTROL **9**

Horn Clauses – SLD Resolution – Computing SLD Derivations – Facts and Rules – Rule Formation and Search Strategy – Algorithm Design – Specifying Goal Order – Committing to Proof Methods – Controlling Backtracking – Negation as Failure – Dynamic Databases – Rules in Production Systems.

Unit III OBJECT ORIENTED REPRESENTATIO AND STRUCTURAL DESCRIPTIONS **9**

Objects and Frames – A Basic Frame Formalism – Using frames to Plan – Other uses of frames – Extension to the frame formalism – Object-Driven Programming with frames – Description and Description Language – Meaning and Entailment – Computing Entailments – Taxonomies and Classifications – Extensions to the Language – Applications of Description Logics.

Unit IV INHERITANCE AND DEFAULT REASONING **9**

Inheritance Networks – Strategies for Defeasible Inheritance – A formal account of Inheritance Networks – Generics and Universals – Default Reasoning – Monotonicity and Nonmonotonicity – Closed World Reasoning – Circumscription -Default Logic – Autoepistemic Logic.

Unit V ACTIONS AND PLANNING **9**

The Situation Calculus – A Simple Solution to the Frame Problem – Complex Actions – Planning – Planning in the Situation Calculus - STRIPS Representation – Planning as a Reasoning Task – Hierarchical Planning – Conditional Planning – The Trade-off between expressiveness and Tractability.

Text Book:

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. Deepak Khemani. A First Course in Artificial Intelligence, McGraw Hill Education (India), 2013

Reference Book:

1. Sowa, John F., ed., "Principles of semantic networks: Explorations in the representation of knowledge", Morgan Kaufmann, 2014.
2. Murray Shanahan: A Circumscriptive Calculus of Events. Artificial Intelligence 77(2), pp. 249-284, 1995.

Extensive Reading:

- https://www.javatpoint.com/knowledge-representation-in-ai
- https://www.edureka.co/blog/knowledge-representation-in-ai/

23ADP04 ARTIFICIAL INTELLIGENCE IN FINANCE

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explore the concepts of machine intelligence
- To understand the types of Finance, and Concepts of AI in Finance
- To discuss the neural networks and reinforcement learning
- To learn algorithmic trading and test it in python environment
- To understand the role of AI in finance and its applications

Course Outcome:

At the end of the course, the students will be able to

- Explore the main concepts of AI and machine learning
- Use financial types, metrics and machine learning techniques in AI
- Apply neural networks in Finance
- Explore algorithmic trading that AI and machine learning techniques can add to various portfolio and risk management strategies
- Apply the concepts of AI in financial applications

Unit I MACHINE INTELLIGENCE 7

Artificial Intelligence: Algorithms, Neural Networks - Importance of Data. Super Intelligence : Forms of Intelligence - Paths to Superintelligence - Intelligence Explosion.

Unit II FINANCE AND MACHINE LEARNING 11

Normative Finance: Uncertainty and Risk - Expected Utility Theory - Mean-Variance Portfolio Theory - Capital Asset Pricing Model - Arbitrage Pricing Theory. Data-Driven Finance: Scientific Method - Financial Econometrics and Regression - Data Availability, Normative Theories Revisited - Debunking Central Assumptions. Machine Learning. AI-First Finance.

Unit III STATISTICAL INEFFICIENCIES 9

Dense Neural Networks: Baseline prediction – Normalization-Dropout-Regularization-Bagging-Optimizers .Recurrent Neural Networks: Second Example - Financial Price Series - Financial Return Series - Financial Features. Reinforcement Learning : Fundamental Notations - OpenAI Gym - Monte Carlo Agent - Neural Network Agent - DQL Agent - Simple Finance Gym - Better Finance Gym - FQL Agent

Unit IV ALGORITHMIC TRADING 9

Vectorized Backtesting : Backtesting an SMA-Based Strategy - Backtesting a Daily DNN-Based Strategy - Backtesting an Intraday DNN-Based Strategy. Risk Management : Trading Bot, Vectorized Backtesting Event-Based Backtesting - Assessing Risk - Backtesting Risk Measures. Execution and Deployment : Oanda Account - Data Retrieval - Order Execution - Trading Bot.

Unit V OUTLOOK 9

AI-Based Competition: AI and Finance - Lack of Standardization - Education and Training Fight for Resources - Market Impact - Competitive Scenarios – Risks - Regulation and Oversight. Financial Singularity.

Text Book:

1. Yves Hilpisch “Artificial Intelligence in Finance - A Python-Based Guide”, O’Reilly Media, Inc. First Edition, 2020

Reference Book:

1. Oliver Wyman "Artificial Intelligence Applications in Financial Services” Marsh & McLennan, First Edition, 2019

Extensive Reading:

- https://rb.gy/9d2bu7
- https://www.coursera.org/learn/ai-for-everyone
- https://www.henryharvin.com/ai-in-finance-course

23ADP05 ETHICS AND VALUES IN INTELLIGENT COMPUTING

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand, identify, and apply different ethical philosophies, frameworks, and methodologies
- To identify and interpret the codes of professional conduct relating to the disciplines of computer science and software engineering
- To analyze the local and global impact of computing on individuals, organizations, and society
- To understand and apply the concepts and principles of moral thinking to problems relating to computing and digital technologies
- To learn the professional, ethical, legal, security, social issues and responsibilities

Course Outcome:

At the end of the course, the students will be able to

- Identify the ethical issues in information technology
- Apply privacy related laws and regulation to enlighten the legal constraints
- Identify the legalities to avoid plagiarism and intellectual property related crimes
- Apply the code of ethics for software development
- Exhibit ethics while working as teams in IT organizations

Unit I INTRODUCTION TO ETHICS **9**

Ethics in Business World - Ethics in Information Technology - Ethics for IT Workers and IT users - Computer and Internet Crime - Information Technology Security Incidents - Implementing Trustworthy Computing

Unit II PRIVACY **9**

Privacy Protection and the Law - Key Privacy and Anonymity issues - Identity Theft - Electronic Discovery – Consumer Profiling - Treating Consumer Data Responsibility - Workplace Monitoring - Advanced Surveillance TechnologyFreedom of Expression-First Amendment rights-Freedom of Expression - Key issues

Unit III INTELLECTUAL PROPERTY **9**

Definition-Copyrights-Copyright Term-Eligible works-Software copyright protection - PRO-IP-GATT- WTO and WTO TRIPS Agreement- WIPO - Digital Millennium Copyright-patents-Software Patents-Cross Licensing Agreements-Trade Secrets-Key Intellectual Property Issues – Plagiarism - Reverse Engineering - Open Source Code – Competitive Intelligence - Trademark Infringement - Cyber Squatting

Unit IV SOFTWARE DEVELOPMENT **9**

Strategies for engineering Quality Software-Software Product Liability-Key issues in software development-Impact of IT on productivity and quality of life-Social Networking-Business Application- Ethical Issues-Online Virtual worlds

Unit V ETHICS OF IT ORGANIZATIONS **9**

Key Ethical Issues for Organizations-Contingent Workers-H-1B Workers-Application Process - outsourcing-offshore outsourcing-pros and cons-strategies-Whistle Blowing-Protection for whistle blowers and Private sector WorkersGreen Computing

Text Book:

1. George_Reynolds," Ethics in Information Technology", Cengage Learning, Fifth edition 2014

Reference Book:

1. Michael J. Quinn ,"Ethics for the Information Age", Pearson Edu, Fifth Edition, 2012
2. Deborah G.Johnson ,"Computer Ethics",Pearson,4th Edition ,2009
3. Kallman, E.A. & Grillo, J.P," Ethical Decision Making and Information Technology", McGraw-Hill, Second Edition,2006
4. Lee, Wanbil W., Information Security Management: Semi-intelligent Risk-analytic Audit, Verlag Dr Muller, 2010

Extensive Reading:

- http://www.cengage.com/resource_uploads/downloads/1111138214_259148
- http://users.jyu.fi/~riesta/Green_Computing
- https://www.aat.org.uk/about-aat/professional-ethics
- http://ethics.iit.edu/publication/WhistleBlowing_Peterson1

23ADP06 PREDICTIVE ANALYTICS

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To know about various regression learning techniques
- To understand about various Model Assessments
- To learn about Models like decision tree and ensemble
- To understand various classification learning Models such as SVM
- To understand and learn various clustering learning Models

Course Outcome:

At the end of the course, the students will be able to

- Apply various regression learning techniques
- Assess various Models performances with various metrics
- Apply basic learning Models like decision tree and ensemble in Model Building
- Apply SVM and Neighborhood based algorithms in Model Building
- Apply clustering algorithms in respective Model building domains

Unit I REGRESSION MODELS **9**

Linear Methods for Regression and Classification: Overview of supervised learning – Linear regression models and least squares – Multiple regression – Multiple outputs – Subset selection– Ridge regression – Lasso regression – Linear Discriminant Analysis – Logistic regression – Perceptron learning algorithm.

Unit II MODEL ASSESSMENT **9**

Model Assessment and Selection: Bias – Variance – model complexity – Bias-variance trade off – Optimise training error rate – Estimate of In-sample prediction error – Effective number of parameters – Bayesian approach and BIC – Cross- validation – Boot strap methods – conditional or expected test error.

Unit III PRELIMINARY CLASSIFICATOIN MODELS **9**

Additive Models–Trees and Boosting: Generalized additive models – Regression and classification trees – Boosting methods-exponential loss and AdaBoost – Numerical Optimization via gradient boosting – Random forests: Association rules –– Principal Components –Random forests and analysis

Unit IV ADVANCED CLASSIFICATOIN MODELS **9**

Neural Networks (NN) – Support Vector Machines (SVM) – and K-nearest Neighbour: Fitting neural networks – Back propagation – Issues in training NN – SVM for classification – Reproducing Kernels – SVM for regression – K-nearest –Neighbour classifiers:Image Scene Classification

Unit V CLUSTERING **9**

Time Series Data Analytics – Autoregressive Integrated Moving Average (ARIMA) – Exponential Smoothing – Seasonal Trend Decomposition – Unsupervised Learning – K Means – K Means++ -- parameter tuning – Density based clustering – DBSCAN – Hierarchical clustering – Cluster analysis – Kohonen SOM clustering

Text Book:

1. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning-Data Mining, Inference, and Prediction”, Second Edition, Springer, 2017.
2. E.Alpaydin, “Introduction to Machine Learning”, Prentice Hall Of India, Third Editoin, 2015

Reference Book:

1. Jiawei Han,Micheline Kamber, Jian Pei Professor, “Data Mining: Concepts and Techniques”,Morgan Kaufmann,2011
2. Christopher.M.Bishop, “Pattern Recognition and Machine Learning”,Springer,2016
3. McCarthy, Richard V., Mary M. McCarthy, Wendy Ceccucci, Leila Halawi, R. V. McCarthy, M. M. McCarthy, W. Ceccucci, and L. Halawi, “Applying predictive analytics”, Springer International Publishing, 2022.
4. Larry Wasserman, “All of statistics: a concise course in statistical inference”, Springer, 2010.
5. G.James,D.Witten,T.Hastie,R.Tibshirani, “An introduction to statistical learning with applications in R”, Springer,2017

Extensive Reading:

- https://www.ibm.com/topics/predictive-analytics
- https://online.hbs.edu/blog/post/predictive-analytics
- https://www.sas.com/en_in/insights/analytics/predictive-analytics.html

23ADP07 INFORMATION AND NETWORK SECURITY

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand various types of classical cryptographic algorithms
- To learn Symmetric and asymmetric key encryption techniques
- To learn about Authentication measures and digital signatures
- To study the Program based security threats
- To understand the various Network security threats

Course Outcome:

At the end of the course, the students will be able to

- Apply concepts of classical cryptographic techniques for applications
- Implement and use advanced cryptographic algorithms such as AES and DES
- Apply various authentication and hashing techniques
- Design and detect various attacks that happen in networks
- Detect vulnerability and apply various measures to secure the devices in network.

Unit I INTRODUCTION **9**

Attacks Vulnerability – Security Goals –Security Services and mechanisms Conventional Cryptographic Techniques: Conventional substitution and transposition ciphers – One-time Pad – Block cipherandStreamCipher – Steganography

Unit II CRYPTOGRAPHY **9**

Key management – Session and Interchange keys – Key exchange andgeneration – Cryptographic Key Infrastructure–Storing and Revoking Keys –Digital Signatures –CipherTechniques – Symmetric and Asymmetric Cryptographic Techniques: DES – AES – RSA algorithms

Unit III AUTHENTICATION AND DIGITAL SIGNATURES **9**

Message Authentication and Hash Function: Authentication requirements – authentication functions – message authentication code – hash functions – Birthday attacks – security of hash functions and MACS – MD5 message digest algorithm – Secure hash algorithm (SHA) Digital Signatures: Digital Signatures – authentication protocols – Digital Signature Standards (DSS) – Proof of digital signature algorithm – Authentication Applications: Kerberos and X.509 – directory authentication

Unit IV PROGRAM SECURITY **9**

Malicious Logic – Viruses – Worms & Trojans – Vulnerability Analysis –Auditing and Intrusion Detection Systems – Real Time Systems Intrusion Detection Systems – Signature Based Detection Systems Non-malicious Program errors – Bufferoverflow – Incomplete mediation – Time-of-check to Time-of-use Errors –Viruses –Trapdoors –Salami attack – Man-in-the-middleattacks – Covert channels

Unit V SECURITY IN NETWORK **9**

Threats in networks – Network Security Controls – Architecture – Encryption – Content Integrity – Strong Authentication–AccessControls – WirelessSecurity – Honeypots –Trafficflowsecurity – Firewalls – Design and Types of Firewalls –PersonalFirewalls – IDS – EmailSecurity – PGP,S/MIME

Text Book:

1. William Stallings, “Cryptography And Network Security Principles And Practice”,Seventh Edition, Pearson,2017
2. Shari Lawrence Pfleeger, Charles P. Pfleeger, Jonathan Margulies, “Security in Computing”, Fifth Edition,PearsonEducation,2015

Reference Book:

1. MattBishop,“Computer Security art and science”, Addison-Wesley Professional,2003
2. WenboMao , “Modern Cryptography:Theory and Practice”,HP Professional books,2003
3. WilliamStallings , “Network Security Essentials:Applications and Standards”, Sixth Edition,Pearson,2018
4. Mark Merkow,James Breithaupt, “Information Security:Principles and Practices” ,Second Edition, Pearson Education, 2014.
5. Mark S. Merkow, James Breithaupt“Information Security: Principles and Practices”, Pearson,2005

Extensive Reading:

- https://page.math.tu-berlin.de/~kant/teaching/hess/krypto-ws2006/des.htm
- https://www.tutorialspoint.com/cryptography/data_encryption_standard.htm
- https://www.techtarget.com/searchsecurity/definition/Advanced-Encryption-Standard
- https://engineering.purdue.edu/kak/compsec/NewLectures/Lecture8.pdf
- https://www.javatpoint.com/computer-network-security
- https://www.w3schools.com/cybersecurity/index.php

23BMP01 MEDICAL PHYSICS

Offered by BME (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study principles of atomic physics and effects of ionizing and non-ionizing radiation in human body
- To discuss the physics of the senses
- To explore the effects of radiation and interaction of radiation with matter
- To understand various detectors for detecting the presence of ionizing radiation

Course Outcome:

At the end of the course, the students will be able to

- Elucidate the atomic physics and non-ionizing radiation, interaction with tissue and its effects.
- Explore the physics of the senses
- Demonstrate the fundamentals of radioactive nuclides.
- Summarize the interaction of radiation with the human body.
- Illustrate the types of radiation detectors.

Unit I NON-IONIZING RADIATION AND ITS MEDICAL APPLICATIONS 9

Introduction to atomic physics - emission of light and its frequencies. Tissue as a leaky dielectric - Relaxation processes, Debye model, Cole–Cole model, Overview of non-ionizing radiation effects-Low Frequency Effects-Higher frequency effects. Physics of light, Measurement of light and its unit- limits of vision and color vision.

Unit II PHYSICS OF THE SENSES 9

Introduction and objectives - Cutaneous sensation - The chemical senses – Audition –physics of sound, Normal sound level, theories of hearing, –Vision – physics of light, Intensity of light and limit of vision – Psychophysics

Unit III PRINCIPLES OF RADIOACTIVE NUCLIDES 9

Radioactive Decay Types- Decay Law- Decay series -Units of Radiation Measurement-Attenuation of Gamma-Rays-Sources of Radioisotopes-Production of Radioisotopes- Natural and Artificial radioactivity- Radionuclide used in Medicine and Technology. Cyclotron, Reactor produced Radionuclide- nuclide-fission and electron Capture reaction, radionuclide Generator-Technetium generator.

Unit IV INTERACTION OF RADIATION WITH MATTER 9

Spontaneous Fission- Isomeric Transition-Alpha -Beta -Positron Decay- Interaction of charged particles with matter – Specific ionization, Linear energy transfer range, Bremsstrahlung, Annihilation, Interaction of X and Gamma radiation with matter- Photoelectric effect, Compton Scattering , Pair production, Attenuation of Gamma Radiation, Interaction of neutron with matter and their clinical significance.

Unit V RADIATION DETECTORS 9

Scintillation Detectors - Solid Scintillation Counters - Gamma-Ray Spectrometry-Liquid Scintillation Counters-Characteristics of Counting Systems-Gamma Well Counters-Thyroid Probe-Principles of Gas-Filled Detectors - Ionization Chambers-Geiger–Müller Counters

Text Book:

1. B.H Brown, R.H Smallwood, D.C. Barber, P.V Lawford, D.R Hose, "Medical Physics and Biomedical Engineering", Institute of Physics Publishing, 1999.
2. 2Gopal B. Saha, “Physics and Radiobiology of Nuclear Medicine”, 4th Edition, Springer, 2013.

Reference Book:

1. John R Cameran, James G Skotfronick, “Medical Physics”, John- Wiley & Sons, 1978
2. W. J. Meredith and J. B. Massey, “Fundamental Physics of Radiology”, Varghese Publishing house, 1992.
3. S. Webb, “The Physics of Medical Imaging”, Taylor and Francis, 1988.
4. J. P. Woodcock, "Ultrasonics Medical Physics Handbook-1”, Adam Hilger Ltd, Bristol, 2002.
5. Agarwal R.S., “Advanced Biophysics”, APH Publishing Corporation, New Delhi, 2005.

Extensive Reading:

- https://www.gatech.edu/academics/degrees/masters/medical-physics-online-degree-ms
- https://elearning.iaea.org/m2/course/index.php?categoryid=127
- https://onlinecourses.nptel.ac.in/noc21_bt50/preview

23BMP02 ENGINEERING OF NANOMATERIALS

Offered by BME (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explore the basic concepts and ideas involved in the synthesis and types of nanomaterials.
- To implement different strategies for synthesizing 0D, 1D, 2D nanomaterials.
- To identify the role and application of nanomaterials in various fields.

Course Outcome:

At the end of the course, the students will be able to

- Identify various types of nanomaterial synthesis.
- Elucidate various optical and thermal properties.
- Paraphrase various chemical approaches for nanomaterial synthesis.
- Comprehend various physical approaches for nanomaterial synthesis.
- Explore knowledge on the application of nanomaterials to solve the societal problems.

Unit I TYPES OF NANOMATERIALS **9**

Nanoclusters, Solid solutions, Thin film, Nanocomposites (Metal Oxide and Polymer based), Core Shell Nanostructure, Buckyballs, Carbon nanotubes, graphene, Zeolites minerals, Dendrimers, Micelles, Liposomes, mesoporous materials. Block Copolymers, Porous Materials, Metal Nanocrystals, Semiconductor nanomaterials.

Unit II OPTICAL & THERMAL PROPERTIES **9**

Photo-conductivity, Photovoltaic effect, optical absorption & transmission, photoluminescence, fluorescence, phosphorescence, electroluminescence, LED, Concept of phonon, thermal conductivity, specific heat, exothermic & endothermic heat, Thermoelectric effect, Thermoelectric material(TEM) properties.

Unit III CHEMICAL APPROACHES **9**

Top down and bottom up approaches–Mechanical alloying and mechanical ball milling, Mechano chemical process, Inert gas condensation technique – Arc plasma and laser ablation. Sol gel processing - Solvo thermal, hydrothermal, precipitation, Spray pyrolysis, Electro spraying and spin coating routes, Self-assembly, self-assembled monolayers (SAMs). Langmuir - Blodgett (LB) films, micro emulsion polymerization - templated synthesis, pulsed electrochemical deposition.

Unit IV PHYSICAL APPROACHES **9**

Vapor deposition and different types of epitaxial growth techniques (CVD,MOCVD,MBE,ALD) - pulsed laser deposition, Magnetron sputtering - lithography :Photo/UV/EB/FIB techniques, Dip pen nanolithography, Etching process :Dry and Wet etching, micro contact printing.

Unit V APPLICATION OF NANOMATERIALS **9**

Overview of nano materials properties and their applications, Molecular Electronics and Nano electronics – Nanobots - Biological Applications – Quantum Devices – Nanomechanics - Photonics - Nano structures as single electron transistor – principle and design.

Text Book:

1. W.Gaddand, D.Brenner, S.Lysherski and G.J.Infrate, “Handbook of NanoScience, Engineering and Technology”, CRC Press, 3rd Edition, 2012.
2. Tai Ran Hsu, “MEMS and Microsystems design and manufacture”, Tata McGraw Hill Publishing Company, New Delhi, 2017.

Reference Book:

1. G.A. Ozin and A.C. Arsenault, “Nanochemistry: A chemical approach to nanomaterials”, Royal Society of Chemistry, 2nd Edition, 2009.
2. K. Barriham, D.D. Vvedensky, “Low dimensional semiconductor structures: fundamental and device applications”, Cambridge University Press, 2010.
3. G. Cao, Y. Wang. “Nanostructures & Nanomaterials: Synthesis, Properties & Applications”, Imperial College Press, 2nd Edition, 2011.

Extensive Reading:

- https://www.manchester.ac.uk/study/undergraduate/courses/2022/12661/meng-materials- science-andengineering-with-nanomaterials/
- https://www.edx.org/course/fundamentals-of-nanomaterials-and-nanotechnology
- https://www.classcentral.com/course/swayam-surface-engineering-of-nanomaterials-7914
- https://www.coursera.org/courses?query=nanotechnology
- https://nptel.ac.in/courses/118104008
- https://onlinecourses.nptel.ac.in/noc21_mm38/preview

23BMP03 REGENERATIVE MEDICINE

Offered by BME (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the fundamental principles of regenerative medicine, developmental biology, stem cell biology.
- To understand the bioprinting, biomaterials used in regenerative medicine.
- To illustrate the various applications of regenerative medicines.
- To understand the regulations and standardisation involved in regenerative medicine.

Course Outcome:

At the end of the course, the students will be able to

- Illustrate the principles of regeneration and their types.
- Elucidate different types of bioprinting used for regeneration.
- Evaluate the biomaterials used for different applications of regenerative medicine.
- Comprehend the potential applications of regenerative medicine.
- Explore the regulations and standardisation of regenerative medicine.

Unit I INTRODUCTION TO REGENERATION **9**

An over view, Evolutionary perspective and origin of regeneration, Wound healing process, Repair Vs Regeneration, Tissue specificity, Types of regeneration - Regeneration by instrument, Regeneration by drug, Regeneration by materials, Regeneration by Bio printing, Regeneration and aging, Developmental clues in regeneration.

Unit II 3D BIOPRINTING TECHNIQUES **9**

Definition and Principle, Technologies, Types of Bio printing - Ink Jet, Laser, Pressure Assisted, Laser Assisted, Solenoid valve, Acousting, Applications - Cell Printing, Microvasculature Printing, Muscle Printing, Cartilage and Bone printing.

Unit III BIOMATERIALS FOR REGENERATIVE MEDICINE **9**

Design principles in biomaterials and scaffolds, Naturally occurring scaffolds materials - Collagen, Chitosan, synthetic polymers - Biodegradable, non-biodegradable, Surface modifications of biomaterials, Biocompatibility and bio response, Essential elements for wound for wound healing.

Unit IV THERAPEUTIC APPLICATIONS **9**

Biomineralisation and Bone regeneration - scaffolds; Blood substitutes - biomaterials, cardiovascular biomechanics, Bioartificial liver - bioreactors, modelling, Tissue engineered vascular graft, Bioartificial kidney - Ultrafiltration membrane.

Unit V REGULATIONS AND STANDARDISATION **9**

Overview of FDA Regulatory Process, The development and licensure process for biologics, Advancements in regenerative medicine, Challenges and Policy Options for Regenerative Medicine Technologies and Therapies - Challenges related to standardization, Challenges related to regulation, Challenges related to manufacturing.

Text Book:

1. Nishant Chakravorty, Praphulla Chandra Shukla, “Regenerative Medicine: Emerging Techniques to Translation”, Springer Verlag, Singapore, 2023.
2. Birru Bhaskar, Naresh Kasoju, Parcha Sreenivasa Rao, “Biomaterials in Tissue Engineering and Regenerative Medicine: From Basic Concepts to State of the Art Approaches”, Springer Verlag, Singapore, 2021.

Reference Book:

1. Anthony Atala, Robert Lanza, James A. Thomson, Robert M. Nerem, “Principles of Regenerative Medicine”, Elsevier, 3rd Edition - August 9, 2018.
2. Elisa Lottor, “The Miracles of Regenerative Medicine”, Healing Arts Press, 2017.
3. Ancreas Lendlein, Antonios Mikos, LinShu Liu , Samir Mitragotri, “Advances in Material Design for Regenerative Medicine, Drug Delivery and Targeting/Imaging”, Cambridge University Press; 1st edition, 2014.

Extensive Reading:

- https://www.gao.gov/products/gao-23-105430
- https://onlinecourses.nptel.ac.in/noc19_bt33/preview
- https://www.studeersnel.nl/nl/document/technische-universiteit-delft/regenerative-medicine/regenerative-medicine-lecture-notes-of-lecture-1-and-2/26501601
- https://www.ncabr.org/wp-content/uploads/2015/12/chapter_regenerativeMedicine.pdf

23BTP01 BIOSENSOR TECHNOLOGY

Offered by BT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Basic components of biosensor
- Principle and working of Enzymatic sensors.
- Principle and working of immunosensors
- Principle and working of nucleic acid-based sensors
- Application of nanotechnology in biosensor

Course Outcome:

At the end of the course, the students will be able to

- Illustrate and explain the components and characteristics of biosensor.
- Acquire knowledge on transduction systems used in Enzymatic Sensors.
- Explain the role of affinity interactions in biosensors.
- Analyze the application of DNA in biosensors.
- Apply nano constructs in design of Biosensors

Unit I FUNDAMENTALS OF BIOSENSOR 9

Definition- Historical development- Important aspects of sensors- Considerations in Biosensor Development- Biological Recognition elements and Transduction: Electrochemical, Optical, Piezoelectric and Thermal. Methods of Immobilization of the Biological recognition elements in Biosensors, Choice of bioreceptor, Choice of transducer. Performance factors: calibration, selectivity, sensitivity, reproducibility, detection limits and time factors- response time- Recovery Time-Lifetime.

Unit II ENZYMATIC SENSORS 9

Enzymes with relevance to Biosensors - Transduction Methods in Enzymatic Biosensors - Potentiometric enzyme electrodes: Urea, glucose and aminoacid electrodes -Inhibitor-sensitive enzyme electrodes- Amperometric enzyme electrodes: Glucose sensitive electrodes - Semiconductor enzyme sensors: Field effect Transistors (FET)- ENFET, ISFET, MOSFET, Immuno- FET - Optical enzyme sensors based on Absorption, fluorescence - Thermal enzyme sensors: Thermopile and Thermistor based sensors, Multienzyme thermal sensors- Piezoelectric enzyme sensors

Unit III IMMUNOLOGICAL SENSORS 9

General Principles: Antibodies structure and function, Antigen- Antibody Interactions - Immobilization Methods in Immunosensors: Magnetic on-bead antibody conjugation, Avidin–biotin system- Immunoassay Formats: Direct, Indirect - Membrane Immunosensors: Inorganic, organic, composite and hybrid - Piezoelectric Systems - Optical Immunosensors: Ellipsometry, Surface plasmon resonance - Biosensors Using Intact Biological Receptors- Immunosensors for Food Allergens

Unit IV NUCLEIC ACID BASED BIOSENSORS 9

Nucleic Acid Structure and Properties- Stability, Principles of Nucleic acid hybridization, Nucleic Acid Analogs, Nucleic Acids as Receptors in Recognition Processes, Immobilization of Nucleic Acids, Transduction Methods in Nucleic Acids Sensors: Nucleic Acid Enzyme (NAE) Based Sensors, Fluorescent NAE Sensors, Colorimetric NAE Sensors, Electrochemical NAE Sensors- Aptamer-Based Sensors- DNA dendrimers- DNA biosensor miniaturization: DNA Microarrays.

Unit V NANOTECHNOLOGY BASED BIOSENSORS 9

Nanomaterials for Sensing Applications - Signal Amplification Using Nanomaterials for Biosensing - Nanomaterial-Based Electroanalytical Biosensors for Cancer and Bone Disease - Gold Nanostructure LSPR- based Biosensors for Biomedical Diagnosis - DNA Sensors Employing Nanomaterials for Diagnostic Applications

Text Book:

1. Eiggns B. R., “Chemical sensors and Biosensors”, John Wiley & Sons Ltd,1st Edition, 2004.
2. Banica F. G., “Chemical sensors and Biosensors Fundamentals and Applications” John Wiley & Sons Ltd, 1st Edition, 2012.
3. Scheller F. and Schubert F., “Biosensors”, Elsevier Science Publishers, 1992.
4. Cahn T. M., “Biosensors”, Chapman and Hall, 1st Edition, 1993

Reference Book:

1. Serra P.A., “Biosensors”, Intech Publishers, 1st Edition, 2010.
2. Tuantranont A, “Applications of Nanomaterials in Sensors and Diagnostics”, Springer, 1st Edition, 2013
3. Ahmed M. U, Zourob M, Tamiya E., “Immunosensors”., Royal Society of Chemistry, 1st Edition, 2019.

23BTP02 IMAGING IN BIOLOGY AND MEDICINE

Offered by BT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Historical development and significance of medical imaging in healthcare.
- Microscopy and optical imaging techniques in biological research
- medical imaging techniques like X-Ray, MRI, CT and nuclear medicine imaging
- To expose students to infectious microbiology and pathology
- To impart knowledge on the immune system and related disorders

Course Outcome:

At the end of the course, the students will be able to

- explain the history, principles, and significance of medical imaging, as well as ensuring they are aware of the safety measures associated with radiation in healthcare settings.
- Comprehend the applications and significance of optical imaging
- Critically assess and select appropriate imaging techniques and biomarkers for specific clinical scenarios and research objectives.
- Identify bacteria, fungi and virus, their pathogenesis and use sterilization and disinfection methods
- Synthesize information from multiple sources, such as medical history, diagnostic tests, and patient interviews, to arrive at accurate clinical diagnoses

Unit I INTRODUCTION **9**

Historical Development of Medical Imaging, Role and Significance of Imaging in Healthcare, Basic Principles of Image Formation, Overview of Imaging Modalities - Non-invasive methods of imaging, Physics of Medical Imaging, Image Formation and Interpretation, Radiation types, Radiation Safety and Protection in Medical Imaging.

Unit II OPTICAL MICROSCOPY **9**

Microscopy Techniques in Biological Research, Confocal Microscopy and Multiphoton Microscopy, Endoscopy and In Vivo Optical Imaging, Fluorescence Imaging and Spectroscopy, applications - Fluorescence, fluorescent molecules and dye

Unit III MEDICAL IMAGING **9**

Radiographic imaging – Principles of X-ray, Fluoroscopy , Computed Tomography, Ultrasonic imaging - principles of ultrasound generation and detection, Medical applications of ultrasound, Doppler ultrasound and other advanced techniques, Magnetic Resonance Imaging - Magnetic Resonance Spectroscopy, clinical applications. Nuclear Medicine Imaging- principles of radioactive tracers, Positron Emission Tomography, Radiopharmaceuticals and clinical applications

Unit IV IMAGING AND BIOMARKERS **9**

Imaging: digital image processing fundamentals - Image enhancement and filtering principles of 3d image formation, Techniques for 3D image reconstruction, Applications in surgery and research, Biomarkers: Role of imaging in biomarker discovery, Imaging biomarkers in disease characterization Imaging in drug development and precision medicine

Unit V CLINICAL APPLICATIONS AND CASE STUDIES **9**

Imaging for disease diagnosis and management, Radiological differential diagnosis, Imaging in oncology and cardiology, Role of imaging in surgery and interventional procedures, Real-life scenarios and case studies in medical imaging

Text Book:

1. Jerrold T, Bushberg J, Anthony S, Edwin ML, John MB, “The Essential Physics of Medical Imaging”, 3rd Edition, LWW, 2011
2. Nadine BS and Andrew W, "Introduction to Medical Imaging: Physics, Engineering, and Clinical Applications," Cambridge University Press, 2nd Edition, 2010.
3. David S, "Textbook of Radiology and Imaging," Churchill Livingstone, 7th Edition, 2002
4. Nadine BS, and Andrew W, "Introduction to Medical Imaging: Physics, Engineering, and Clinical Applications," Cambridge University Press, 2nd Edition, 2010
5. Ronald LE, "Clinical Imaging: An Atlas of Differential Diagnosis," Lippincott Williams & Wilkins, 5th Edition, 2014

Reference Book:

1. Ahuja AT, Lui LT,, "Case Studies in Medical Imaging: Radiology for Students and Trainees," Springer, 1st Edition, 2012
2. Gopi S, Bevin PE, and John ME, "Imaging in Biological Research," CRC Press, 1st Edition, 2005
3. Mary Alice SS, Paula JV, and Russell ER, "Radiation Protection in Medical Radiography," Mosby, 8th Edition, 2019

23BTP03 CLINICAL TRIALS

Offered by BT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- fundamentals of drug discovery and development
- ethical considerations of preclinical and clinical research
- regulatory guidelines and responsibilities of stakeholders
- essential documents for conducting clinical trials
- clinical trial management and post marketing surveillance

Course Outcome:

At the end of the course, the students will be able to

- describe principles of drug discovery and development process
- practice principles of animal and human research ethics
- comprehend the regulatory guidelines in clinical trials
- prepare essential documents for clinical trials
- summarize the principles of clinical trial project management and pharmacovigilance

Unit I FUNDAMENTALS OF DRUG DISCOVERY AND DEVELOPMENT 9

Origin and History of Clinical Research, Principles of Drug Discovery: conventional – ligand-based and structure-based screening, modern: introduction to high throughput, in silico screening and combinatorial chemistry approach– IPR in drug discovery: patentable subject matter - Pre clinical research - Stages in Drug Development: Phase 0, I, II, III, IV - Principles of sampling - Inclusion and exclusion criteria – Principles of randomization and blinding - Termination of trial - Investigational New Drug application and New Drug Application – Clinical trials in India: Timelines, roles of CDSCO

Unit II ETHICAL CONSIDERATIONS IN CLINICAL RESEARCH 9

Use of animals in scientific research - laboratory animal models - opposition to animal research – responsibilities of scientists – alternatives to animal research - Legislation on animal experiments in India: INSA Guidelines for care and use of animals in scientific research, ICMR Guidelines for use of laboratory animals in medical colleges, CPCSEA guidelines for laboratory animal facility, Institutional Animal Ethics Committee - Use of humans in Scientific Experiments - Historical guidelines in Clinical Research - Nuremberg code, Declaration of Helsinki, Belmont report, ICMR guidelines for research involving human subjects – Institutional Ethics Committee

Unit III GUIDELINES IN CLINICAL RESEARCH 9

International Conference on Harmonization (ICH) - Brief history of ICH, Structure of ICH, Working groups, ICH Harmonization Process, ICH products: Quality, Safety, Efficacy and multidisciplinary guidelines –Principles of Good Clinical Practice: ICH E6, FDA, Drugs & Cosmetics Act - Responsibilities of Stakeholders: Sponsors, Investigators, Clinical Research Organization, Monitors, Institutional Ethics Committee

Unit IV ESSENTIAL DOCUMENTS 9

Essential Documents in Clinical Trials: before, during and after the conduct of clinical trial - Standard Operating Protocols, Clinical Trial Protocol and Protocol Amendment(s), Investigator Brochure, Master Files, Informed Consent Form, Case Record Form, Trial report - CONSORT

Unit V TRIAL MANAGEMENT 9

Project management in clinical trials – principles, application in clinical trial management - Risk assessment in clinical trials – Risk management principles – Project Auditing, Inspection, common pitfalls – Data management in clinical trials - Pharmacovigilance: principles, strategies, challenges and opportunities – Pharmacovigilance program in India (PVPI): Structure and function, case studies on drug toxicity reported during post marketing surveillance

Reference Book:

1. Benjamin E Blass, “Basic Principles of Drug Discovery and Development” Academic Press, 2015
2. Lawrence M. Friedman, Curt D. Furberg, David L. DeMets, David M. Reboussin, Christopher B. Granger, “Fundamentals of Clinical Trials” 5th edition, Springer, 2015
3. Ezekiel J. Emanuel, Christine C. Grady, Robert A. Crouch, Reidar K. Lie, Franklin G. Miller, David D. Wendler, “Clinical Research Ethics” OUP USA, Reprint edition (17 February 2011)
4. Richard Chamberlain, “Project Management of Clinical Trials” Xlibris Us, 2019
5. David Machin, Simon Day, Sylvan Green, “Clinical Trials” Wiley India, 2nd edition, 2010
6. Patrick Waller, “An Introduction to Pharmacovigilance” John Wiley, 2nd edition, 2017

Extensive Reading:

- https://database.ich.org/sites/default/files/E6_R2_Addendum.pdf
- https://database.ich.org/sites/default/files/ICH_E6-R3_GCP-Principles_Draft_2021_0419.pdf
- https://main.icmr.nic.in/sites/default/files/guidelines/ICMR_Ethical_Guidelines_2017.pdf
- https://main.icmr.nic.in/sites/default/files/guidelines/National_Ethical_Guidelines_for_BioMedical_Research_I

nvolving_Children_0.pdf

- http://www.cvsccauaizawl.edu.in/sites/default/files/files/iaec/cpcsea_laboratory.pdf
- https://www.insaindia.res.in/pdf/FINAL_DOCUMENT_ON_MAN_ANIMAL_SCIENCE.pdf
- https://medicaleducationunit.yolasite.com/resources/ICMR-animal%20use%20guidelines.pdf
- https://apps.who.int/iris/handle/10665/43392
- https://drugs.kar.nic.in/sites/drugs.kar.nic.in/files/topimages/Schedule_Y.pdf
- http://www.ipc.gov.in/PvPI/pub/Guidance%20Document%20for%20Marketing%20Authorization%20Holders.pdf

23CEP01 COMPOSITE MATERIALS

Offered by CIV (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The fundamentals of composite materials and their applications
- The constituent materials of polymer matrix composites
- The comparison of metal matrix composites with other types
- The ceramic matrix composites
- The application of concepts of mechanics of composites in their analysis

Course Outcome:

At the end of the course, the students will be able to

- Choose a composite based on the required application
- Describe the fabrication of polymer matrix composites
- Proportion the metal matrix composites
- Use ceramic and other special composites over traditional materials
- Analyze a composite lamina

Unit I INTRODUCTION TO COMPOSITES

Fundamentals, Need and Classification of Composites - Lamina Assumptions - Macroscopic Viewpoint - Generalized Hooke's Law - Reduction to Homogeneous Orthotropic Lamina - Isotropic Limit Case, Orthotropic Stiffness Matrix (Qij) - Strain Displacement Relations - Basic Assumptions of Laminated Anisotropic Plates - Laminate Constitutive Equations.

Unit II POLYMER MATRIX COMPOSITES

Polymer Resins - Thermosetting Resins, Thermoplastic Resins - Reinforcement Fibres - Rovings - Woven Fabrics - Non-Woven Random Mats - Various Types of Fibres - PMC fabrication Processes - Fibre Reinforced Plastics (FRP), Laminates-)- Applications -Volume Fraction-Design using Rule of Mixtures.

Unit III METAL MATRIX COMPOSITES

Characteristics of MMC, Various Types of Metal Matrix Composites Alloy Vs. MMC, Advantages of MMC, Limitations of MMC-Applications and Case study of MMC

Unit IV CERAMIC MATRIX COMPOSITES AND SPECIAL COMPOSITES

Engineering Ceramic Materials - Properties - Advantages - Limitations - Monolithic Ceramics - Need for CMC - Ceramic Matrix - Various Types of Ceramic Matrix Composites- Oxide Ceramics - Non Oxide Ceramics - Aluminum Oxide - Silicon Nitride - Reinforcements - Particles - Fibers - Whiskers.

Unit V STRUCTURAL AND NON-STRUCTURAL APPLICATIONS

Carbon-Carbon Composites (CCCs): Fabrication, Properties, Applications and limitations - Processing of CCC- Solid, Liquid and Gas phase pyrolysis processes -Design of Cement Composite Structural Elements – Ferro-cement, SIFCON and Fibre Reinforced Concrete – FRP Composites for Structural Strengthening

Text Book:

1. Krishan K .Chawla, "Composite Materials", Springer Publications 4th edition, 2019.
2. Mathews F. L. and Rawlings R. D., "Composite Materials: Engineering And Science", 1st Edition, Chapman And Hall, London, England, 1994.

Reference Book:

1. G.Piatti, " Advances in composite materials", Applied Science Publishers Ltd., London, 1978.
2. Clyne, T. W. And Withers, P. J., "Introduction To Metal Matrix Composites", Cambridge University Press, 2003.
3. Strong, A.B., "Fundamentals of Composite Manufacturing", SME, 2008.
4. Sharma, S.C., "Composite Materials", Narosa Publications, 2000.
5. Broutman, L.J. And Krock,R.M., " Modern Composite Materials", Addison-Wesley, 1967.
6. ASM Hand Book, "Composites", Vol.21, ASM International, 2001.

23CEP02 BASICS OF CLIMATIC SCIENCE AND POLICY

Offered by CIV (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- The future scenarios of climate change and likely risks and impacts.
- The earth's climate system and its components.
- The concept of paleoclimatology
- The impacts and mitigation of climate change
- Clean development mechanism and governance

Course Outcome:

At the end of the course, the students will be able to

- At the end of the course, the students will be able to
- Apply the concepts of climate science and the role of policy for transitioning to a low carbon energy supply.
- Realize the earth's change in climate, causes for the climate change and basics of atmosphere
- Apply the paleoclimatology concepts
- Categorize the effect of climate change in national and global level.
- Apply the clean development mechanism to their cities

Unit I CLIMATE SCIENCE **9**

Understanding climate science - Fundamentals of meteorology - Atmospheric vertical profile of temperature and pressure - Microphysical processes in the atmosphere.

Unit II COMPONENTS OF CLIMATE SCIENCE **9**

Earth Climate System - Interaction among components of climate system and feedback mechanisms- Atmospheric thermodynamics - Radiation in the atmosphere - Greenhouse gases and climate forcing.

Unit III PALEOCLIMATOLOGY **9**

Introduction of the concept - Measurement techniques. Aerosol science: Introduction and overview of aerosols, properties of atmospheric aerosols - Carbonaceous aerosols - Radioactive effects of Atmospheric aerosols - Direct and indirect effects of aerosol particles.

Unit IV IMPACTS AND MITIGATION **9**

Time series trends of important climate variables temperature and precipitation - Mitigation of GHGs and stabilization scenario - Long term and short term mitigation options - Linkages between mitigation and adaptation of climate change - Mitigation from cross sector perspective and its linkages with sustainable development - Case study based approach.

Unit V GOVERNANCE AND REGULATORY APPROACHES **9**

Market based approaches (CDM, REDD, REDD plus) - Co-operatives arrangements for implementation - National Action Plan on Climate change (Mitigation specific Missions) - Nationwide policies for alternate energy programme - Alternate energy crops programmes and afforestation - Regulatory approaches – Macro and Micro level initiatives - Conventions and Protocols.

Text Book:

1. Gupta M., "Restricting Greenhouse Gas Emissions: Economic Implications for India", New Delhi, 2017.
2. Ruddiman W.F, freeman W.H. and Company, "Earth's Climate Past and Future," 2014
3. Velma. I. Grover "Global Warming and Climate" Change. Vol I and II. Science Publishers, 2008.

Reference Book:

1. Oliver J.E. and Hidore J.J., "Climatology: An Atmospheric Science", Pearson educational, 2009.
2. Seinfeld J.H. and Pandis S.N., "Atmospheric Chemistry and Physics-from Air Pollution to Climate Change", John Wiley and Sons, Inc, 2016.
3. Hardy J., "Climate Change: Causes, Effects and Solutions", John Wily & Sons, 2003.

Extensive Reading:

- https://www.ncdc.noaa.gov/news/what-have-we-learned-paleoclimatology
- https://cdm.unfccc.int/

23CEP03 CONSTRUCTION SAFETY PRACTICES

Offered by CIV (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- Accidents & hazards occurring during construction.
- Various methods of safety against construction accidents.
- The contractual obligations in safety implementation.
- The design safety plan and technology for the protection of workers.
- Different occupational health practices.

Course Outcome:

At the end of the course, the students will be able to

- At the end of the course, the students will be able to
- Identify the correct and proper method of managing accidents by analyzing the actual situations.
- Implement appropriate safety programmes at the site to make accident free construction.
- Adopt the contractual obligations which are essential for construction safety.
- Monitor safety precaution using various technologies with the help of managerial level.
- Realize the occupational hazards and to take remedial actions.

Unit I CONSTRUCTION ACCIDENTS **9**

Accidents and causes - Accident prevention - Definition and principles - Potential hazards/risks associated with construction sites - High risk activities - Use of hoists - Working at height & in confined space - Equipment safety - Costs of construction injuries - Accident management.

Unit II CONSTRUCTION SAFETY PROGRAMME **9**

Elements of effective safety program - Job safety analysis - Fault tree analysis - Job-site safety assessment - Safety regulations at construction sites - Human factors in construction safety - Safety meetings - Safety incentives - Safety training - Safety policy - Safety committees - Safety inspection - Safety audit.

Unit III CONTRACTUAL OBLIGATIONS **9**

Government's policy in industrial safety - Safety & health legislation in India - The Factories Act, 1948 - Equipment Safety - Safety provisions in construction contracts - Sub contractual obligation - Workers compensation - Substance abuse - Safety record keeping.

Unit IV DESIGNING FOR SAFETY **9**

Project coordination and safety procedures - Safety culture - Safe workers - Company activities on safety - Principles of risk and loss control - Machinery safety - Machine guarding - Workplace ergonomics - Personal protective equipment - First aid and emergency preparedness - Fire safety - Electrical hazards.

Unit V OCCUPATIONAL HEALTH PRACTICE **9**

Statutory requirements and regulations related to health hazards - Legal Implications - Dust hazards and control - Occupational and safety hazard assessment - Noise assessment and control measures - Impact and vibration - ISO 18001 & ISO 14001 codal provisions - Case Studies.

Text Book:

1. Richard J. Coble, Jimmie Hinze and Theo C. Haupt, "Construction Safety and Health Management", Prentice Hall Inc., 2019.
2. Tim Howarth and Paul Watson, "Construction Safety management", Wiley – Blawel, 2016.

Reference Book:

1. Jimmy W. Hinze, "Construction Safety", Prentice Hall Inc., 2021.
2. Tamilnadu Factory Act, Department of Inspectorate of factories, Tamilnadu.

Extensive Reading:

- https://nptel.ac.in/courses/105/103/105103093/
- https://theconstructor.org/practical-guide/safety-practical-guide/job-safety-analysis/44673/
- http://www.dconc.gov/home/showdocument?id=9246

23CEP04 INTRODUCTION TO GEOINFORMATICS

Offered by CIV (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- The basics of classification and map preparation.
- The basics of GPS techniques.
- The EMR and its interactions.
- Basic concepts of GIS.
- The process of storage and analysis of various data's.

Course Outcome:

At the end of the course, the students will be able to

- At the end of the course, the students will be able to
- Read different types of maps using cartography principles.
- Prepare geospatial database using principles of GPS.
- Map different kinds of resources using principles of remote sensing.
- Identify the methodology for solving a the given engineering problem in geospatial environment
- Analyze data models for different studies.

Unit I GEODESY AND CARTOGRAPHY **9**

Modern surveying instruments - Projection systems - Heights and geoids - Local and global datum's - Map classification - Topographic and thematic - Map reading.

Unit II GLOBAL POSITIONING SYSTEMS **9**

Global positioning systems - GPS signal and segments - GPS errors - Technical characteristics - Measurement techniques - Other positioning systems.

Unit III REMOTE SENSING **9**

Electromagnetic spectrum - Electromagnetic radiation - Atmospheric interaction - Resolutions - Platforms - IRS - LANDSAT.

Unit IV GEOGRAPHIC INFORMATION SYSTEM **9**

Introduction - Maps - Map projections - Types of map projections - Map analysis - GIS definition - Basic components of GIS - Data type - Spatial and non-spatial (attribute) data - Measurement scales - Data Base Management Systems (DBMS).

Unit V DATA ENTRY, STORAGE AND ANALYSIS **9**

Data models - Vector and raster data - Data compression - Data input by digitization and scanning - Attribute data analysis - Integrated data analysis - Routing through GIS.

Text Book:

1. Satheesh Gopi, "Advanced Surveying", Pearson Education, 2017.
2. Burrough, P.A. and McDonnell, R.A., "Principles of Geographic Information System", Oxford University Press, 2016.

Reference Book:

1. Duggal R.K, "Surveying" Vol. I and II, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.
2. Anji Reddy M. , "Remote Sensing and Geographical Information Systems" IV Edition, BS Publications, 2012
3. Anderson, J.M. and Mikhail, E.M., "Surveying: Theory and Practice", McGraw Hill, 1998
4. Bossler, J.D., "Manual of Geospatial Science and Technology", II edition, Taylor and Francis, 2010.
5. Ian Heywood, "An Introduction to GIS", Pearson Education Asia, 2011
6. Kang Tsung Chang., Introduction to Geographic Information Systems, IV edition, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2017.

23CEP05 ARCHITECTURE

Offered by CIV (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The fundamentals of visual perception and principles.
- The architectural principles in the design of buildings.
- The National traditions and the local regional heritage in architecture, landscape design including the vernacular tradition.
- The basic principles, appropriate application, performance of building envelope materials and assemblies.
- The technical, practical skills of landscape architecture and their role in investigating complex and innovative ideas.

Course Outcome:

At the end of the course, the students will be able to

- Apply the fundamentals of visual perception in two and three dimensional design.
- Utilize the architectural principles in the design of buildings and interior spaces.
- Plan the buildings by considering our Indian climatic conditions.
- Choose the various building material as per the interior design aspects.
- Perform landscape architecture according to the environmental conditions.

Unit I INTRODUCTION **9**

Definition - Architecture - classification - influencing factors - region, culture, climate, topography, building materials, economic and technology - historic structure - prominent world architecture - Anthropometrics – Human scale - Space requirements in architecture.

Unit II PRINCIPLES & ELEMENTS OF ARCHITECTURE **9**

Architectural design principles - Proportion, scale, balance, symmetry, rhythm and axis - Contrast in form – Harmony - Application of design principles at various levels - site level, building level and detail level – Architectural Elements - Mass and space visual emotional effects of geometric forms and their derivatives - sphere, cube, pyramid, cylinder and cone Evolution of architectural form - Basic 3d forms, Transformation of form - Space, spatial relationships and spatial organization - Relevant examples from modern and traditional architecture. Case studies of relevant modern and traditional architectural examples.

Unit III ORIENTATION AND PLANNING OF BUILDINGS **9**

General - Factors affecting orientation - Sun, Wind and Rain - Orientation criteria for Indian conditions – Planning Specifications and standards - Planning of buildings - Green building - Carbon rating - Case studies.

Unit IV INTERIOR ARCHITECTURE **9**

Materials and methods of interior design - Decorative materials - Cement bonded boards, Water proof cement - Paint - Industrial glazing and roofing - Masonry - Plaster and dry wall - Wall surface materials - Effect of colour - Home furnishing - Cultural particularities, changing trends and lifestyles, innovations and design ideas - Case studies of representative examples.

Unit V LANDSCAPE ARCHITECTURE **9**

Principles - Site planning - Design - Styles - Organisation of spaces in the outdoor environment - Role of circulation and built form in shaping the environment – Landscaping Elements and materials - Different types of hard landscape elements - Plant materials, water and landform – Landscape planning - Case studies.

Text Book:

1. Francis D.K.Ching, “Architecture: Form, Space and Order”, John Wiley & Sons, Inc. 2007.
2. Mohmohan, Muthu Shoba G, “Principles of Architecture” Oxford University Press, New Delhi, 2009.

Reference Book:

1. Arvind Krishnan,”Climate Responsive Architecture: A Design Handbook for Energy Efficient Buildings”, McGraw Hill Education, New Delhi, 2013.
2. Leland M. Roth, Amanda C. Roth Clark “Understanding Architecture: Its Elements, History, and Meaning”, Westview Press, 2013.
3. V.S.Pramar, "Design fundamentals in Architecture", Somaiya Publications Pvt., Ltd, 2003.
4. Simon Unwin, “Analysing Architecture”, Routledge, London, 2003.
5. McCarter & Pallasmaa; Understating Architecture - A Prime on Architecture as Experience; Phaidon Press; 2012.
6. Motloch, J.L., 'An Introduction to Landscape Design', US: John Wiley and Sons, 2001.
7. John F. Pile, 'Interior Design', Pearson Prentice Hall, 2007.

Extensive Reading:

- https://theconstructor.org/building/green-building-materials/7028/
- https://nptel.ac.in/courses/124/107/124107011/

23CSP01 DIGITAL VIDEO PROCESSING

Offered by CSE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the fundamentals of video processing
- To learn how to estimate motion in video images
- To gain knowledge on the different video coding standards
- To get a clear view of video error control and streaming

Course Outcome:

At the end of the course, the students will be able to

- Enhance the knowledge in video processing
- Articulate the various motion estimation techniques
- Explore various video coding techniques
- Investigate semantic based video coding technique
- Work with error control and video streaming

Unit I VIDEO PROCESSING FUNDAMENTALS **9**

Digital Video - Digital Video Formats and Applications - Digital Video Recording - Video Quality Measure - Video sampling - Sampling over Lattices - Sampling of Video Signals - Filtering Operations - Video sampling rate conversion - Conversion of Signals - Sampling Rate Conversion - Video modelling – Different Models

Unit II MOTION ESTIMATION **9**

2D Motion Models. 2D Motion Estimation: Optical flow - General methodologies - Pixel-based motion estimation - Block-Matching Algorithm - Deformable block-matching algorithm - Mesh-based motion estimation - Global motion estimation. 3D Motion Estimation: Feature based motion estimation

Unit III VIDEO CODING BASICS **9**

Coding Systems - Probability and Information Theory - Information Theory for Source Coding - Binary Encoding - Scalar Quantization - Vector Quantization. Waveform based Video Coding: Block-Based Transform Coding - Predictive Coding – Transform Coding

Unit IV SEMANTIC BASED VIDEO CODING **9**

Content-Dependent Video Coding: 2D Shape Coding - Texture Coding - Joint Shape and Texture Coding - Region-Based Video Coding - Object-Based Video Coding -Knowledge-Based Video Coding -Semantic Video Coding - Layered Coding - Scalable Video Coding: Scalability Modes - Object-Based Scalability - Wavelet-Transform-Based Coding

Unit V ERROR CONTROL AND STREAMING **9**

Error Control:Video Applications and Communication Networks - Transport-Level Error Control - Error-Resilient Encoding - Decoder Error Concealment - Encoder–Decoder Interactive Error Control – Streaming: Video Streaming Architecture - Application-Layer QoS Control - Continuous Media Distribution Services - Streaming Servers - Streaming Video Protocols - Streaming Video over Wireless IP Network

Text Book:

1. Yao wang, Jorn Ostermann and Ya-Qin Zhang, “Video Processing and Communications”, Prentice Hall, 2002.

Reference Book:

1. Alan C. Bovik, “The Essential Guide to Video Processing”, Elsevier Science, Second Edition, 2009.
2. Alan C. Bovik, “Handbook of Image and Video processing”, Academic Press, Second Edition, 2005.

Extensive Reading:

- https://www.mathworks.com/solutions/image-video-processing/video-processing.html
- https://www.sciencedirect.com/topics/engineering/video-processing
- https://processing.org/tutorials/video

23CSP02 FREE OPEN SOURCE SOFTWARE

Offered by CSE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the context and operation of free and open source software (FOSS) communities and associated software projects.
- To study about Gawk and Linux portable devices.
- To learn Package management systems and source code management systems
- To be familiar with Web servers.
- To study the cloud platform

Course Outcome:

At the end of the course, the students will be able to

- Able to select appropriate open source licenses.
- Explore the use of gawk.
- Able to manage the packages using different package managers in Linux and to manage source code using versioning systems
- Work with Web servers.
- Explore the open source cloud platform

Unit I PHILOSOPHY **9**

IntroductiontoOpensources–Needofopensources-Advantagesofopensources–Applicationofopensources - open source operating system – Linux: Introduction- General Overview – Kernel Mode and User Mode – Advancedconcepts – Scheduling – Personalities – Cloning – Signals – Development with Linux – OSS Installation - Four degreesoffreedom-FOSSLicensingModels-FOSSLicenses–GPL- AGPL-LGPL-FDL-Implications– Copyright vs. Copyleft - FOSSexamples – Free Software vs Open Source Software. Case Study – LibreOffice

Unit II LINUXUTILITIES **10**

Gawk -ConceptualOverview-Command-LineSyntax-PatternsandProcedures-Built-inVariables–Operators- Variable and Array Assignment - User-Defined Functions - Group Listing of awk Functions and Commands - Boot Process - The Linux Loader (LILO) - The Grand Unified Boot loader (GRUB) - Boot Time Kernel Options - Specificfeatures-df-env-grep-ifconfig-locate,slocate-ln-netconfig,netcfg-netstat-ping-Snort–traceroute,LinuxforportableDevices,Creation ofBootableCDandUSB from commandline,CaseStudies–Samba,CUPS

Unit III PACKAGE MANAGEMENT AND SOURCE CODE MANAGEMENT **9**

Package Management – YUM, RPM, APT. Source Code Management – Usage Models and Systems, Sub Version Control Systems – Command Line Client, Repository Administration, Examining the repository, Providing Remote Access, GIT – Overview, Git Repository Format, Git Commit, Creating and Sharing a New Repository, Git Command Line Client.

Unit IV WEB SERVER AND DEVELOPMENT PLATFORMS **9**

Web server: ApacheHTTPServeranditsflavors–Lighttpd-TornadoHTTPstaticFileServer-WAMPserver,MySQL,PHP, PYTHON -PERLas a developmentplatform.

Unit V OPEN SOURCE CLOUD **8**

IntroductiontoCloud,FOSSCloudSoftwareEnvironment,Eucalyptus–History,OverviewandGoalsofEucalyptus, Architectureandcomponents,CompatibilitywithAmazonEC2,OpenStack–Historyandoverview,Characteristics,Features,Architecture, Components,Open Stack CloudOperatingSystem

Text Book:

1. RAO M N, Fundamentals of Open source software, PHI New Delhi, 2015
2. Mark G. Sobell, A Practical Guide to Linux Commands, Editors, and Shell Programming 3rd Edition, Pearson Publishers, 2017

Reference Book:

1. “Perspectives on Free and Open-Source Software”, Clay Shirky and Michael Cusumano, MIT Press.
2. “Understanding Open Source and Free Software Licensing”, Andrew M. St. Laurent, O’Reilly Media.
3. Martin C. Brown, “Perl: The Complete Reference”, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.
4. Steven Holzner, “PHP: The Complete Reference”, 2nd Edition, Tata McGraw-Hill Publishing Company Limited, Indian Reprint 2009.

Extensive Reading:

- Libre office: http://www.libreoffice.org/.
- Philosophy of GNU URL: http://www.gnu.org/philosophy/.
- Linux Administration URL: http://www.tldp.org/LDP/lame/LAME/linux-admin-made-easy/
- Samba: URL : http://www.samba.org/

- Version control system URL: http://git-scm.com/
- Perl Programming book at http://www.perl.org/books/beginning-perl/.

23CSP03 PRINCIPLES OF DISTRIBUTED SYSTEMS

Offered by CSE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study the distributed system principles and various communication models.
- To gain knowledge about peer-to-peer services.
- To understand distributed file systems.
- To study synchronization and replication techniques.
- To study the resource management techniques.

Course Outcome:

At the end of the course, the students will be able to

- Compare the pros and cons of various communication models.
- Address the issues in peer-to-peer services.
- Explore distributed file systems.
- Analyze synchronization and replication algorithms.
- Explore distributed scheduling algorithms

Unit I INTRODUCTION **9**

Introduction – Examples of distributed systems–Trends in distributed systems – Focus on resource sharing – Challenges - World Wide Web - System models – Physical models - Architectural models - Fundamental models

Unit II COMMUNICATION IN DISTRIBUTED SYSTEM **9**

Inter Process Communication – the API for the Internet protocols – External data representation – Multicast communication - Network virtualization: Overlay networks. MPI - Request-reply protocols – Remote procedure call. Distributed Objects: Java RMI – Group communication – Publish-subscribe systems – Message queues – Shared memory approaches- From Objects to Components: Enterprise Java Beans

Unit III PEER TO PEER SYSTEMS AND DISTRIBUTED FILE SYSTEMS **9**

Introduction – Napster and its legacy – Peer-to-peer Middleware – Routing overlays - Overlay case studies: Pastry, Tapestry. Distributed File Systems – File service architecture – Sun Network File System – Google File System – Name Services and Domain Name System – Directory services – Case studies: The Global Name System, X.500 Directory Service

Unit IV SYNCHRONIZATION AND FAULT TOLERANCE **9**

Introduction – Clocks, events and process states – Synchronizing physical clocks - Logical time and logical clocks – Global states – Coordination and Agreement – Distributed mutual exclusion – Elections –Transactions - Locks – Optimistic concurrency control – Timestamp ordering – Atomic commit protocols – Concurrency control in distributed systems - Distributed deadlocks

Unit V RESOURCE AND PROCESS MANAGEMENT **9**

Resource management: Desirable features of a good global scheduling algorithm –Task assignment approach – Load balancing approach – Load sharing approach – Process management: Process migration – Threads

Text Book:

1. George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2017.
2. Pradeep K Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2012.

Reference Book:

1. Tanenbaum A.S., Van Steen M., “Distributed Systems: Principles and Paradigms”, Pearson Education, second edition, 2016.
2. Liu M.L., “Distributed Computing, Principles and Applications”, Pearson Education, 2004.
3. Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufman Publishers, USA, 2003.
4. Mukesh Singhal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw-Hill, 2017.

Extensive Reading:

- http://www.coda.cs.cmu.edu/ljpaper/lj.html
- http://techgenix.com/windows2003-distributed-file-system/
- https://www.ntfs.com/index.html
- https://ai.google/research/pubs/pub51

23ECP01 MACHINE LEARNING TECHNIQUES AND ALGORITHMS

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To develop a good understanding of the foundations of Machine Learning.
- To achieve proficiency in supervised learning algorithms for classification and regression.
- To acquire knowledge and practical skills in ensemble techniques and explore unsupervised learning algorithms.

Course Outcome:

At the end of the course, the students will be able to

- Apply the fundamental concepts and mathematical foundations of machine learning.
- Implement and interpret the results of supervised learning models for classification.
- Apply regression models to real-world scenarios and interpret the outcomes effectively.
- Use ensemble techniques to enhance model performance in practical applications.
- Apply unsupervised learning methods to analyze and interpret the patterns in unlabeled data.

Unit I PRINCIPLES OF MACHINE LEARNING **9**

Machine Learning: Need –History – Definitions – Applications - Advantages, Disadvantages & Challenges, Types of Machine Learning Problems – Training, Testing, Validation Sets, Mathematical Foundations: Vapnik-Chervonenkis (VC) dimension, Probably Approximately Correct (PAC) learning, Hypothesis spaces, Inductive bias, Generalization, Bias variance trade-off, Different Performance Measures: Accuracy, Confusion Matrix, ROC

Unit II SUPERVISED LEARNING: CLASSIFICATION **9**

Probability and Bayes learning - Naive Bayes - Bayesian Network - Perceptron – Multi-layer Perceptron - Support Vector Machines K-Nearest Neighbours

Unit III SUPERVISED LEARNING: REGRESSION AND TREE BASED MODELS **9**

Linear Regression - Multivariate Regression- Logistic Regression- Principal Component Regression- Decision Trees, Regression Trees

Unit IV ENSEMBLE TECHNIQUES **9**

Combining multiple learners: Model combination schemes, Voting, Ensemble Learning – Bagging: Random Forest, Boosting: AdaBoost, Gradient Boost, Stacking

Unit V UNSUPERVISED LEARNING **9**

Introduction - Clustering Algorithms: Partitional Clustering - Hierarchical Clustering – Density based Clustering - Cluster Validity, Dimensionality Reduction: Principal Component Analysis – Expectation Maximization algorithm

Text Book:

1. Ethem Alpaydin, “Introduction to machine learning” 4th Edition, The MIT Press, 2020
2. Stephen Marsland, “Machine Learning - An Algorithmic Perspective” 2nd Edition, CRC Press, 2015

Reference Book:

1. Andreas Christian Müller & Sarah Guido “Introduction to machine learning with python: A guide for data scientists” O’Reilly Media, 2018
2. Christopher M. Bishop, “Pattern recognition and machine learning” Springer, 2016
3. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", Cambridge English, 2015
4. Tom M. Mitchell, “Machine Learning”, McGraw Hill Education, 2017

Extensive Reading:

- https://github.com/mdnoorit/letslearnai
- https://archive.nptel.ac.in/courses/106/105/106105152/
- https://archive.nptel.ac.in/courses/106/106/106106139/

23ECP02 ATTACKS ON CYBER SECURITY AND DEFENSE STRATEGIES

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the current threat landscape in cyber security.
- To learn the attack mechanisms and post-incident activities.
- To identify and explore defence security strategies.

Course Outcome:

At the end of the course, the students will be able to

- Describe the current cyber security challenges faced by organizations.
- Apply various external and internal reconnaissance techniques.
- Demonstrate proficiency in cyber tactics and techniques through knowledge graphs.
- Develop strategies to mitigate specific attack vectors.
- Explore and assess the security policy of an organization.

Unit I CYBERSECURITY CURRENT TRENDS **9**

Security Posture-The current threat landscape-Cybersecurity challenges-Incident response process-Handling an incident-Incident response in the cloud-Post-incident activity.

Unit II CYBERSECURITY ATTACK CHAIN **9**

External reconnaissance - Dumpster diving - Social engineering - Diversion theft - Spear phishing - Internal reconnaissance - Sniffing and scanning – Wardriving - Extortion attacks - Data manipulation attacks - IoT device attacks - Zero-day.

Unit III TACTICS AND TECHNIQUES **9**

Understanding attack and knowledge graphs - Graph database basics - Building the homefield graph using Neo4j - Creating and querying information - Adding more data to the knowledge graph - Hunting for ciphertext and hashes.

Unit IV DEFENSE STRATEGIES **9**

Lateral Movement - Port scans - Central administrator consoles - Email pillaging- Privilege Escalation – Infiltration - Avoiding alerts - Performing privilege escalation.

Unit V SECURITY POLICY **9**

Policy enforcement - Reviewing your security policy - Monitoring for compliance - Introduction to threat intelligence - Open source tools for threat intelligence - Leveraging threat intelligence to investigate suspicious activity.

Text Book:

1. Johann Rehberger, “Cybersecurity Attacks - Red Team Strategies_ A practical guide to building a penetration testing program having homefield advantage”,Packt Publishing,2020
2. Yuri Diogenes and Erdal Ozkaya, “Cybersecurity – Attack and Defense Strategies_ Infrastructure security with Red Team and Blue Team tactics”, Packt Publishing, 2018

Reference Book:

1. Rajneesh Gupta, “Hands-On Cybersecurity with Blockchain Implement DDoS protection, PKI-based identity, 2FA, and DNS security using Blockchain”, Packt Publishing, 2018.
2. Sunit Belapure and Nina Godbole, “Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives”, Wiley India Pvt. Ltd, 2011.

Extensive Reading:

- https://nptel.ac.in/courses/106106248
- https://www.priv.gc.ca/en/opc-actions-and-decisions/research/explore-privacy-research/2014/cs_201412/

23ECP03 SEMICONDUCTOR MEMORIES

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To acquire knowledge about different types of semiconductor memories.
- To analyze the Architectures of Static and Random Access, Non-volatile memories.
- To evaluate the fault modelling and testing procedures for the memory circuit.

Course Outcome:

At the end of the course, the students will be able to

- Synthesize Static and Dynamic Memory structures.
- Decide the type of memory for a specific application.
- Analyze the modelling for memory fault and testing
- Analyze the reliability issues of memory.
- Understanding the radiation effects on memory.

Unit I RANDOM ACCESS MEMORY TECHNOLOGIES 9

STATIC RANDOM ACCESS MEMORIES (SRAMs) SRAM Cell Structures – MOS SRAM Architecture – MOS SRAM Cell and Peripheral Circuit Operation – Bipolar SRAM Technologies – Silicon On Insulator (SOI) Technology – Advanced SRAM Architectures and Technologies – Application Specific SRAMs.

DYNAMIC RANDOM ACCESS MEMORIES (DRAMs) DRAM Technology Development – CMOS DRAMs – DRAMs Cell Theory and Advanced Cell Structures – BiCMOS – DRAMs – soft error failures in DRAMs – Advanced DRAM Designs and Architecture.

Unit II NON VOLATILE MEMORIES 9

Masked Read–Only Memories (ROMs) – High Density ROMs – Programmable Read –Only Memories (PROMs) – Bipolar PROMs – CMOS PROMs – Erasable (UV) – Programmable Read– Only Memories (EPROMs) – Floating – Gate EPROM Cell–One Time Programmable (OTP) EPROM – Electrically Erasable PROMs (EEPROMs) –EEPROM Technology and Architecture – Non-volatile SRAM – Flash Memories (EPROMs or EEPROM) – Advanced Flash Memory Architecture.

Unit III MEMORY FAULT MODELLING & TESTING 9

RAM Fault Modelling – Electrical Testing – Pseudo Random Testing – Megabit DRAM Testing – Non-volatile Memory Modelling and Testing – IDDQ Fault Modelling and Testing – Application Specific Memory Testing

Unit IV SEMICONDUCTOR MEMORY RELIABILITY 9

General Reliability Issues – RAM Failure Modes and Mechanism – Non-volatile Memory Reliability– Reliability Modelling and Failure Rate Prediction – Design for Reliability – Reliability Test Structures – Reliability Screening and Qualification

Unit V SEMICONDUCTOR MEMORY RADIATION EFFECTS 9

Radiation effects- Space radiation environments- total dose effects- single event phenomenon-non-volatile memory radiation characteristics- Radiation hardening techniques-radiation hardening process issues-design issues-radiation hardness assurance and testing.

Text Book:

1. Ashok K. Sharma, “Semiconductor Memories: Technology Testing and Reliability”, Prentice-Hall of India”, 2002.
2. Ashok K. Sharma, “Advanced Semiconductor Memories: Architecture, Designs and Applications”, Wiley Interscience, IEEE Press, 2009.

Reference Book:

1. Kiyoo Itoh, “VLSI memory chip design”, Springer Berlin, Heidelberg, 2013.
2. Chenming C Hu, “Modern Semiconductor Devices for Integrated Circuits”, Pearson/Prentice Hall, New Jersey, 2010
3. Andrea Redaelli, Fabio Pellizzer, “Semiconductor Memories and Systems”, Elsevier, Woodhead Publishing 2022

Extensive Reading:

- http://te.inakassel.de/index.php/semiconductormemories_en.html
- http://www.pti-inc.com/Courses/memories101.html
- http://electronicdesign.com/cypress-semiconductor-1

23ECP04 WEARABLE DEVICES

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To know the hardware requirement of wearable systems.
- To be familiar with the communication and security aspects in the wearable devices.
- To relate the applications of wearable devices in the field of medicine.

Course Outcome:

At the end of the course, the students will be able to

- Describe the concepts of wearable system.
- Explain the energy harvestings in wearable device.
- Utilize the concepts of BAN in health care.
- Illustrate the concept of smart textile.
- Compare the various wearable devices in healthcare system.

Unit I WEARABLE SYSTEMS AND SENSORS 9

Wearable Systems- Introduction, Need for Wearable Systems, Drawbacks of Conventional Systems for Wearable Monitoring, Applications of Wearable Systems, Types of Wearable Systems, Components of wearable Systems. Sensors for wearable systems - Inertia movement sensors, Respiration activity sensor, Inductive plethysmography, Impedance plethysmography, pneumography, Wearable ground reaction force sensor.

Unit II SIGNAL PROCESSING AND ENERGY HARVESTING 9

Wearability issues - physical shape and placement of sensor, Technical challenges - sensor design, signal acquisition, sampling frequency for reduced energy consumption, Rejection of irrelevant information. Power Requirements- Solar cell, Vibration based, Thermal based, Human body as a heat source for power generation, Hybrid thermoelectric photovoltaic energy harvests, Thermopiles.

Unit III WIRELESS HEALTH SYSTEMS 9

Need for wireless monitoring, Body Area Network Architecture, BAN and Healthcare, Technical Challenges: Sensor nodes, Wireless transmission, Safety , Energy efficiency - System security and reliability

Unit IV SMART TEXTILES 9

Introduction to smart textile- Passive smart textile, active smart textile. Fabrication Techniques - Conductive Fibres, Treated Conductive Fibres, Conductive Fabrics, Conductive Inks. Case study - smart fabric for monitoring biological parameters – ECG and respiration

Unit V APPLICATIONS OF WEARABLE SYSTEMS 9

Medical Diagnostics, Medical Monitoring-Patients with chronic disease, Hospital patients, Elderly patients, neural recording, Gait analysis, Sports Medicine.

Text Book:

1. Annalisa Bonfiglo and Danilo De Rossi, Wearable Monitoring Systems, Springer, 2011
2. Zhang and Yuan-Ting, Wearable Medical Sensors and Systems, Springer, 2013

Reference Book:

1. Edward Sazonov and Micheal R Neuman, Wearable Sensors: Fundamentals, Implementation and Applications, Elsevier, 2014
2. Mehmet R. Yuce and JamilY.Khan, Wireless Body Area Networks Technology,Implementation applications,Pan Stanford Publishing Pte.Ltd, Singapore, 2012
3. Sandeep K.S, Gupta, Tridib Mukherjee and Krishna Kumar Venkatasubramanian, Body Area Networks Safety, Security, and Sustainability, Cambridge University Press, 2013.
4. Guang-Zhong Yang, Body Sensor Networks, Springer, 2006.

Extensive Reading:

- https://www.sciencedirect.com/topics/computer-science/wearable-systems
- https://www.sciencedirect.com/topics/medicine-and-dentistry/wearable-sensor
- https://www.sciencedirect.com/science/article/pii/S2405896315008289
- https://www.sciencedirect.com/topics/engineering/smart-textile
- https://www.geeksforgeeks.org/7-cool-applications-of-wearable-technology/

23ECP05 CONSUMER ELECTRONICS

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the principles of operation of Audio System and VCR.
- To understand the operating principles of Television.
- To understand the working principles and troubleshooting of Home appliances.

Course Outcome:

At the end of the course, the students will be able to

- Narrate the working principles of operation of audio system.
- Explain the concepts of CD audio and video recordings and playback.
- Narrate the working principles of television.
- Explain the concepts of working principles of miscellaneous electronic devices.
- Explain the concepts of working principles and troubleshoot the home appliances

Unit I MICROPHONES AND LOUDSPEAKERS 9

Microphones: Characteristics, types, Electrical, Mechanical and Acoustical Analog – Loudspeakers: types, Impedance – Woofers –Tweeters-Multispeaker Systems - Crossover Networks-Impedance Matching.

Unit II RADIO AND AV RECORDING AND PLAYBACK 9

Optical Recording and Reproduction, Disc, Reconstitution of the Audio Signal - Commercial Sound, - AM/FM Tuners, Video Disc Recording and Playbacks

Unit III TELEVISION STANDARDS AND SYSTEMS 9

Elements of a Television System, Scanning Process, Scanning Methods and Aspect ratio - Colour TV Cameras, NTSC, PAL , SECAM, Broadcasting of TV Programs, CCTV – Cable TV – HDTV, LED TV, LCD TV, plasma TV.

Unit IV MISCELLANEOUS ELECTRONIC DEVICES 9

Mobile Radio Systems, Xerography, Calculators, Digital Clocks and smart watches, UPS – Inverter, PC, Laptops, iPAD, Digital Camera, smart camera and web cameras.

Unit V HOME APPLIANCES AND TROUBLESHOOTING PRINCIPLES 9

Microwave Ovens, Washing machines, Air Conditioners and Refrigerators, smart control of home appliances - Principles of troubleshooting and repair of home appliances, television, mobile phones

Text Book:

1. S P Bali, "Consumer Electronics", Pearson Education Asia Pvt., Ltd., 2008.
2. B.R. Gupta, “Consumer Electronics“, S K Kataria & Sons Publisher, 2011.

Reference Book:

1. R.M. Reed, M.K. Reed , “The Encyclopaedia of Television, Cable, and Video”, Focal press, 2012.
2. Wayne Tomasi, “Introduction to Data Communication and Networking”, Pearson Education, 2004.
3. R.R.Gulati,” Monochrome and Color Television”, 3rd Edition , New Age International publisher, 2014

Extensive Reading:

- https://www.pssurvival.com/PS/Electronic/Repair/Troubleshooting_And_Repair_Of_Consumer_Electronics_Equipment_2004.pdf
- https://researchguides.dartmouth.edu/television/resources

23ECP06 PCB DESIGN AND THERMAL MANAGEMENT

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To know the need for PCB Design and steps involved in PCB Design and Fabrication process.
- To be familiar with the Schematic and layout design flow using Electronic Design Automation (EDA) Tools.
- To be aware of the thermal effect in PCB.

Course Outcome:

At the end of the course, the students will be able to

- Explain basics of electronic components and PCB
- Infer basics of PCB designing
- Apply advance techniques, skills and modern tools for designing and fabrication of PCBs
- Analyze various PCB production techniques
- Describe the crucial effect of temperature on electronic circuit design

Unit I PRINTED CIRCUIT BOARD FOUNDATIONS 9

Fundamental of electronic components, basic electronic circuits, Basics of printed circuit board designing: Layout planning, general rules and parameters, ground conductor considerations, thermal issues, check and inspection of artwork. Multilayer PCBs. Multiwire PCB, Flexible PCBs, Surface mount PCBs.

Unit II DESIGN RULES FOR PCB 9

Design rules for Digital circuit PCBs, Analog circuit PCBs, high frequency and fast pulse applications, Power electronic applications, Microwave applications.

Unit III ARTWORK GENERATION 9

Basic Approach to Manual Artwork, General Design Guidelines for Artwork Preparation, Artwork Generation Guidelines, Film Master Preparation, Automated Artwork Generation, Computer- Aided Design (CAD), Manual Versus Automation in PCB Design, Computer-Aided Manufacturing (CAM), Data Transfer Mechanisms, PCB Design Checklist.

Unit IV IMAGE TRANSFER TECHNIQUES 9

Photo printing, film master production, reprographic camera, basic process for double sided PCBs photo resists, Screen printing process, plating, relative performance and quality control, Etching Techniques, Solders alloys, fluxes, soldering techniques, Mechanical operations.

Unit V THERMAL MANAGEMENT FOR ELECTRONICS 9

Heat Transfer Theory; Concept of thermal resistance; Passive and Active Cooling; Aspects of heat sink design; Heat management in Automotive and Biomedical applications.

Text Book:

1. R. S. Khandpur, “Printed circuit board design, fabrication assembly and testing ", Tata McGraw Hill, 2008.
2. T. Y. Obidi, Ed. “Thermal management in automotive applications” Warrendale, Pennsylvania, USA: SAE International, 2015.

Reference Book:

1. Clyde F. Coombs, Jr, Happy T. Holden “Printed Circuits Handbook” McGraw-Hill,2016
2. Rao R Tummala&MadhavanSwaminathan “Introduction to System-on-Package” McGraw Hill, 2008
3. R. Remsburg “Thermal design of electronic equipment” CRC Press, 2001

Extensive Reading:

- https://www.udemy.com/course/circuit-design-simulation-and-pcb-manufacturing-bundle
- https://www.allaboutcircuits.com/technical-articles/pcb-thermal-management-techniques/
- http://www.wikihow.com/Create-Printed-Circuit-Boards

23EEP01 VIRTUAL INSTRUMENTATION

Offered by EEE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The development of Virtual Instruments
- Impacts of Virtual Instruments in Industrial Sector.
- Impacts of data acquisition techniques and different interfacing techniques.
- Designing real time application using LabVIEW software.

Course Outcome:

At the end of the course, the students will be able to

- Understand about Virtual Instruments, Data Flow Programming.
- Develop simple programs by applying VI programming Techniques.
- Use advanced LabVIEW functions to develop virtual instruments.
- Acquire real time signal / data using DAQ functions and Hardware in LabVIEW.
- Develop simple applications / virtual instruments using LabVIEW.

Unit I INTRODUCTION ABOUT VIRTUAL INSTRUMENTATION 9

Historical perspective, Virtual Instrumentation – Need of VI – Advantages of VI – Architecture of VI, Programming VI – data flow programming, comparison with conventional programming, Front Panel, Block diagram, Palettes – Tools palette – function palette – Control palette.

Unit II VI PROGRAMMING TECHNIQUES-I 9

VIs – Functions – Basic arithmetic and Math operations, Loops – FOR & WHILE loops – Tunneling options, Shift Registers, Feedback node, Arrays & Clusters – Basic operations on Arrays and Clusters, String handling.
Applications: Polymorphism.

Unit III VI PROGRAMMING TECHNIQUES-II 9

Structures– Formula node– Case Structure – Sequence Structure, Local and global variable Charts & Graphs – Update mode, File read / write operations – File format.
Application: Functional Global Variable – Timer development.

Unit IV DATA ACQUISITION BASICS USING VI 9

Introduction to data acquisition, Classification of Signals, Signal conditioning, DAQ hardware configuration- DAQ Software Architecture- DAQ assistant- selecting and configuring a data acquisition device- components of computer based measurement system, Installing the DAQ Card.

Unit V APPLICATION OF VI 9

Action Engine– ON/OFF controller – P-I-D controller - Simulation of a simple second order system - Temperature data acquisition system.

Text Book:

1. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW”, PHI Learning Pvt. Ltd, 2010.
2. Sanjay Gupta, Joseph John, “Virtual Instrumentation using LabVIEW”, 2nd Edition, Tata McGraw Hill Education Private Limited, 2010

Reference Book:

1. Gary W. Johnson, Richard Jennings , “LabVIEW Graphical Programming”, Fourth Edition, McGraw-Hill publications, 2006.
2. Sumathi.S & Surekha.P, “LabVIEW based Advanced Instrumentation” Springer, 2007.
3. Technical Manuals for DAS Modules of Advantech and National Instruments.
4. WEB Reference: www.ni.com

23EEP02 SOFT COMPUTING TECHNIQUES

Offered by EEE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The emerging area of intelligent control and optimization.
- Expert systems, fuzzy logic systems, artificial neural networks and optimization techniques.

Course Outcome:

At the end of the course, the students will be able to

- Explain the concept of intelligent control, Expert System and their applications.
- Explain the concept of Artificial Neural Networks and their different architectures.
- Explain the concepts of Genetic Algorithm and ant colony optimization.
- Explain the concept of a fuzzy logic controller.
- Apply ANN, genetic algorithm and fuzzy logic for engineering problems.

Unit I INTRODUCTION **9**

Approaches to intelligent control, Architecture for intelligent control, Symbolic reasoning system, rule-based systems, the AI approach, Knowledge representation, Expert systems-Architecture, applications.

Unit II ARTIFICIAL NEURAL NETWORKS **9**

Concept of Artificial Neural Network and its basic mathematical model – McCulloch-Pitts neuron model – simple Perceptron – Adaline and Madaline – Feed-forward Multilayer Perceptron – Learning and Training the neural network – Hopfield network – Self-organizing network – Neural Network based controller.

Unit III GENETIC ALGORITHM AND ANT-COLONY OPTIMIZATION TECHNIQUE **9**

Basic concept of Genetic algorithm and detailed algorithmic steps – Flowchart – GA operators – adjustment of GA parameters – Concept of ant-colony search technique for solving optimization problems.

Unit IV FUZZY LOGIC SYSTEM **9**

Introduction to crisp sets and fuzzy sets – Basic fuzzy set operation and approximate reasoning – Introduction to fuzzy logic modeling and control – Fuzzification – Inference and Defuzzification – Fuzzy knowledge and rule bases-Fuzzy logic applications.

Unit V APPLICATIONS **9**

Applications of Neural Network to engineering problems – GA applications to engineering optimization problems – Fuzzy modeling and control schemes for non-linear systems.

Text Book:

1. Sivanandam S.N., Deepa S.N., “Principles of Soft Computing”, Wiley India Pvt. Ltd., Reprint 2019.
2. Sundareswaran.K, “A Learner's Guide to Fuzzy Logic Systems”, Jaico Publishing House, 2019.
3. Jang J.S.R., Sun C.T. and Mizutani E., “Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence”, PHI Learning Private Limited, New Delhi, 2014.

Reference Book:

1. AJacek.M.Zurada, “Introduction to Artificial Neural Systems”, Jaico Publishing House, 1999.
2. Kosko B., “Neural Networks And Fuzzy Systems”, Prentice-Hall of India Pvt. Ltd., 1994.
3. Klir G.J., Folger T.A., “Fuzzy sets, uncertainty and Information”, Prentice-Hall of India Pvt. Ltd., 1993.
4. Zimmerman H.J., “Fuzzy set theory-and its Applications”, Kluwer Academic Publishers, 1994.
5. Padhy N.P., Simon S.P., “Soft Computing with MATLAB Programming, Oxford University Press, 2015.
6. Allain Bonnet, “Artificial Intelligence – Promise and Performance, Prentice Hall International Publisher,1985.

23ITP01 SOCIAL NETWORK ANALYSIS

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the Network Structure
- To familiarize with Network Modelling
- To explore various features in Location based Social Networks
- To explore variety of features in Social Networking Site.
- To have in depth idea in Social Media Content

Course Outcome:

At the end of the course, the students will be able to

- Perform various computations on the Social Networks
- Find Missing and duplicated information in the networks
- Analyze Location based Social Media
- Analyze the branded Social Networking Page.
- Perform analysis and Trend Mining in Social Content

Unit I SOCIAL NETWORK STRUCTURE AND MEASURES 9

Basics of network structure – Representing networks- Basic network structures and properties Subnetworks - Describing nodes and edges-Describing networks-Tie Strength

Unit II ENTITY RESOLUTION AND LINK PREDICTION 9

Modeling networks- Sampling methods- Egocentric network analysis- Link prediction- Entity resolution- Incorporating network data-Case Study

Unit III LOCATION-BASED SOCIAL INTERACTION AND ANALYSIS 9

Location technology-Mobile location sharing-Location-based social media analysis-Privacy and location-based social media-Social sharing and social filtering-Automated recommender systems-Analyzing public-sector social media-Case study

Unit IV UNCOVERING BRAND ACTIVITY, POPULARITY, AND EMOTIONS 9

Facebook brand page -Project planning -Analysis -Noun phrases -Detecting trends in time series -Uncovering emotions

Unit V SOCIAL MEDIA CONTENT ANALYSIS 9

Getting the data from Social Network - Sentiment analysis -Customized sentiment analysis -Named entity recognition -Combining NER and sentiment analysis -Trends Mining on GitHub -Data pull -Data processing -Data analysis

Text Book:

1. Jennifer Golbeck “Analyzing the Social Web “ Morgan Kaufmann; 1 edition 2013
2. Siddhartha Chatterjee, Michal Krystyanczuk “Python Social Media Analytics” Packt publishers, 2017

Reference Book:

1. Charu C. Aggarwal, “Social Network Data Analytics”, Springer, 2011
2. Guandong Xu , Yanchun Zhang and Lin Li, “Web Mining and Social Networking Techniques and applications”, Springer, first edition, 2011.
3. Peter Mika, “Social networks and the Semantic Web”, Springer, first edition 2007.
4. Borko Furht, “Handbook of Social Network Technologies and Applications”, Springer, first edition, 2010.
5. Dion Goh and Schubert Foo, “Social information retrieval systems: emerging technologies and applications for searching the Web effectively”, IGI Global snippet, 2008.
6. Max Chevalier, Christine Julien and Chantal Soulé-Dupuy, “Collaborative and social information retrieval and access: techniques for improved user modelling”, IGI Global snippet, 2009.
7. John G. Breslin, Alexandre Passant and Stefan Decker, “The Social Semantic Web”, Springer, 2009

23ITP02 DATA SCIENCE

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Explore the need of R tool
- Apply various Data manipulation techniques in R to import and export data
- Work on applications, implementing R Analytics to create Business Insights
- Use concepts of object oriented programming in R
- Apply graphics interface and create packages in R

Course Outcome:

At the end of the course, the students will be able to

- Apply the basics of R programming with its datatypes
- Apply the functional programming and data manipulation statements in R
- Identify packages to implement machine learning techniques in R
- Explore concepts of object oriented programming in R
- Implement graphics and create new packages with R

Unit I INTRODUCTION TO DATA SCIENCE & R **9**

Fundamentals of Data Science – Data Science Lifecycle - Introduction – R environmental setup – Installation – RStudio – Programming with R – R as a calculator – Dealing with Missing Values – Using R Packages – Expression – Data Types – Data Structures – Control Structures – Functions – Lazy Evaluation – Recursive Functions – Exercises.

Unit II DATA MANIPULATION & FUNCTIONAL PROGRAMMING **9**

Creating a R Markdown – YAML – Markdown language – R Code in Markdown documents – Data Manipulation – Data Import and Export – Manipulation data with dplyr – Vectorizing Functions – Apply Family – Infix operator – Replacement Functions – Function with arguments & return – Filter, Map and Reduce

Unit III MACHINE LEARNING **9**

Dealing with large dataset – Sampling – Regression – Linear Regression – Logistic Regression – Evaluating and Validating Models – Cross Validation – Classification – Decision Trees– Neural Network – Support Vector Machine – Unsupervised Learning - Clustering - Association Rule Mining

Unit IV CLASS AND OBJECTS **9**

Immutable objects and Polymorphic functions – Data structures – Classes Introduction: Why Classes? - Programming with New Classes - Inheritance and Inter-class Relations - Virtual Classes - Creating and Validating Objects - Programming with S3 Classes – Class Heirachies - Exercises

Unit V DATA VISUALIZATION AND PACKAGES **9**

XY Plot – Graphics Package – ggplot2 - Package concept and tools – Creating an R package – Description – Namespace – Roxygen – Adding data to Package - Documentation for Packages – Building an R Package

Text Book:

1. Thomas Mailund, “Beginning Data Science in R – Data Analysis, Visualisation and Modelling for the Data Scientist”, Apress Publication, 2017
2. John Chambers, “Software for Data Analysis: Programming with R “, Springer; 1st ed. 2008. , 2nd printing 2009 edition

Reference Book:

1. Torsten Hothorn, Brian S. Everitt, “ A Handbook of Statistical Analyses Using R “,Chapman and Hall/CRC; 2 edition ,2009
2. Thomas Lumley,” Complex Surveys: A Guide to Analysis Using R”, Wiley Series in survey methodology, 2010
3. Nicholas J. Horton, Ken Kleinman,” Using R and RStudio for Data Management, Statistical Analysis, and Graphics” , CRC Press, Second edition, 2015
4. John Maindonald, W. John Braun,”Data Analysis and Graphics Using R: An Example-Based Approach”, University Press, Cambridge, Third edition, 2010
5. John M. Quick,” Statistical Analysis with R”, Packt Publishing , 2010
6. K.G.Srinivasa, G M Siddesh, Chetan Shetty, “Statistical Programming in R”, Oxford University Press, New Delhi, 2017

23ITP03 FUZZY SYSTEMS AND APPLICATIONS

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the role of fuzzy logic for decision making problems
- To choose various fuzzy inference systems and approximate reasoning for decision making
- To understand the impact of fuzzy system for group decision making
- To understand how to evaluate the criteria in structured situations
- To learn to hybrid fuzzy with decision making methods

Course Outcome:

At the end of the course, the students will be able to

- Identify the decision making problems in fuzzy environments
- Identify the suitable FIS for decision making
- Implement fuzzy concepts for multi-person decision making
- Solve complex problems using multi-criteria decision making
- Integrate fuzzy with decision making methods for ranking

Unit I INTRODUCTION **9**

Classical and Fuzzy Sets – Operations – Properties – Classical and Fuzzy Relation – Crisp Relations – Fuzzy Relations – Composition - Max – Min Method - Individual Decision Making in Fuzzy Environments

Unit II DECISION SUPPORT SYSTEMS **9**

Features of Membership Function – Fuzzification – Defuzzification – Approximate Reasoning - Fuzzy Rule based Systems – Mamdani – Sugeno - Fuzzy and Semi Fuzzy Multi Objective Problems

Unit III MULTI-PERSON DECISION MAKING IN FUZZY ENVIRONMENTS **9**

Basic Models – Fuzzy Games – Fuzzy Team Theory – Fuzzy Group Decision Making – Fuzzy Mathematical Programming - Fuzzy Linear and Non Linear Programming – Fuzzy Multi Stage Programming

Unit IV MULTI CRITERIA DECISION MAKING IN STRUCTURED SITUATIONS **9**

Fuzzy Multi Criteria Programming – Multi Attribute Decision Making – Fuzzy Outranking – Operators and Membership functions in Decision Models

Unit V DECISION MAKING WITH FUZZY INFORMATION **9**

Fuzzy Synthetic Evaluation – Fuzzy Ordering – Non Transitive Ranking – Preference and Consensus – Multiobjective Decision Making – Fuzzy Bayesian Decision Method – Decision Making under Fuzzy States and Fuzzy Actions

Text Book:

1. Timothy J.Ross , “Fuzzy Logic with Engineering Applications”, Third Edition , Wiley Publication, 2015
2. Hans J.Zimmermann, “Fuzzy Sets, Decision Making and Expert Systems”, International Series in Management Science/Operations Research, Kluwer Academic Publishers, 1987

Reference Book:

1. S. N. Sivanandam & S. N. Deepa, “Principles of Soft Computing”, Second Edition, Wiley Publication, 2011.
2. S. Rajasekaran & G.A. Vijayalakshmi Pai, “Neural Networks, Fuzzy Logic and Genetic Algorithm: Synthesis and Applications” Prentice Hall of India ,2004

Extensive Reading:

- www.math.ucdenver.edu/~wlodwick/m4-5779/lecture3fuzzylogic
- https://link.springer.com/chapter/10.1007/978-3-642-58930-0_11

23ITP04 INTRODUCTION TO DEVOPS

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explore the fundamental concepts of Devops.
- To understand architectural changes needed for Devops
- To understand the deployment pipeline
- To understand the business value of adopting the approach developing software.
- To identify the various phases involved in deployment through DevOps

Course Outcome:

At the end of the course, the students will be able to

- Use DevOps and Agile services for development
- Apply DevOps architecture for software deployment
- Deploy and test the application
- Diagnose an anomaly from monitoring data
- Apply pipeline for the enterprises

Unit I INTRODUCTION **9**

Introduction- Need for DevOps - DevOps Perspective- DevOps and Agile- Team Structure- Co- ordination and barriers. The cloud as a platform- Operations- Operations Services- Service Operation Functions- Continual Service Improvement- Operation and DevOps

Unit II ARCHITECTURE **9**

Overall Architecture-Architectural Change in DevOps - Overall architecture structure- Micro service architecture- Amazon's rules for teams- Micro service adoption for existing systems – Ilities – Repeatability – Performance – Reliability – Recoverability – Interoperability – Testability – Modifiability – Business Considerations

Unit III BUILDING AND DEPLOYMENT **9**

Moving a system through the deployment pipeline- Crosscutting aspects- Development and preCommit testing- UAT/Staging/Performance Testing- Production- Incidents - Strategies for Managing a Deployment- Logical Consistency- Packaging- Deploying to multiple environments- partial deployments- Rollback- Tools.

Unit IV CROSSCUTTING CONCERNS **9**

Introduction- what to monitor- How to monitor- When to change the monitoring configuration- Interpreting monitoring data- challenges- tools- diagnosing an anomaly from monitoring data – Security and Audits

Unit V CASE STUDY **9**

Supporting Multiple Data centres – Business Logic and Web Tiers – Database Tier – Datacenter switch – Pipeline for enterprises – Migrating to Micro services – Future of Devops

Text Book:

1. Len Bass, Ingo Weber, Liming Zhu, DevOps A software Architect's Perspective, Pearson, First edition.

Reference Book:

1. Jennifer Davis and Katherine Daniels, "Effective DevOps", O'Reilly, First Edition
2. Deepak Gaikwad, Viral Thakkar, "DevOps Tools from practitioner's Viewpoint", Wiley, First Edition
3. Mark Treveil, Nicolas Omont, Clément Stenac, Kenji Lefevre, Du Phan, Joachim Zentici, Adrien Lavoillotte, Makoto Miyazaki, Lynn Heidmann, "Introducing MLOps", O'Reilly Nov 2020
4. Sanjeev Sharma, The DevOps Adoption Playbook, A guide to adopting DevOps in a Multi Speed IT Enterprise. Wiley, IBM Press.
5. Billy Yuen, Jesse Suen, Alex Matyushentsev, Todd Ekenstam, "GitOps and Kubernetes", O'Reilly, April 2021
6. John Schnidt and Kirit Basu, "DataOps: The Authoritative Edition", Sept 2019
7. Geradus Blokdyk, "DevSecOps: A Complete Guide", 2019 Edition

Extensive Reading:

- https://www.edureka.co/blog/devops-tutorial
- https://www.udemy.com/course/devops-docker-complete-guide-hands-on-with-practical/
- https://devops.com/
- https://www.atlassian.com/devops
- https://aws.amazon.com/devops/what-is-devops/

23ITP05 MATH FOR MACHINE LEARNING

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To solve systems of linear equations using various methods and determining relationship between them
- To incur knowledge in the foundations of probabilistic and statistical analysis methods used in varied applications of engineering and science
- To formulate complete, concise, and correct mathematical proof using optimisation techniques
- To analyse a data using linear regression mathematical techniques
- To learn the working of classification model using mathematical concepts.

Course Outcome:

At the end of the course, the students will be able to

- Compute various operations on matrices in a vector space
- Solve problem using probability distribution and vector calculus
- Perform statistical analysis on data and apply optimisation techniques
- Learn a regression model to predict the data using mathematical techniques
- Apply density estimation technique on a machine learning model

Unit I LINEAR ALGEBRA **9**

Importing, Summarizing and Visualizing Data – Linear Algebra – Linear Equations – Complex vector and Matrices – Vector Spaces – Linear Mappings – Matrix Decomposition – Eigen values and Eigenvectors – Singular Value Decomposition

Unit II VECTOR CALCULUS AND PROBABILITY DISTRIBUTION **9**

Differentiation of univariate function – Gradient of vector and matrices – Higher order derivatives – Probability space – Discrete and Continuous Probabilities – Bayes' theorem – Sum Rule – Product rule

Unit III OPTIMISATION AND STATISTICAL LEARNING **9**

Continuous Optimisation – Gradient Descent – Constrained Optimisation – Lagrange Multiplier – Data, Models and Statistical learning – Training and Testing – Estimating risk – Parameter estimation – Modelling and Inference – Model Selection

Unit IV REGRESSION AND DIMENSIONALITY REDUCTION **9**

Linear Regression – Parameter Estimation – Bayesian Regression – Maximum Likelihood as Orthogonal Projection – Least Square Estimation – Dimensionality reduction with PCA – Variance Perspective

Unit V DENSITY ESTIMATION AND CLASSIFICATION **9**

Gaussian Mixture Model – Parameter Learning via Maximum Likelihood – Expectation Maximisation Algorithm – Latent Variable – Classification with Support Vector Machine – Separating Hyperplane – Primal SVM – Dual SVM

Text Book:

1. Marc Peter Deisenroth, A. Aldo Faisal, Cheng Soon Ong, "Mathematics for Machine Learning", Cambridge University Press, 2020
2. Dirk P. Kroese, Zdravko I. Botev, Thomas Taimre, Radislav Vaisman, "Data Science and Machine Learning: Mathematical and Statistical Methods" ,CRC Press, 2020

Reference Book:

1. Shai Shalev-Shwartz and Shai Ben-David, "Understanding Machine Learning: from Theory to Algorithms" Cambridge University Press, 2014
2. W. Cheney, "Analysis for Applied Mathematics", Springer, 2001
3. Cesa-Bianchi, Nicolo, and Gabor Lugosi. Prediction, Learning, and Games. Cambridge University Press, 2006.
4. Koltchinskii, Vladimir. Oracle Inequalities in Empirical Risk Minimization and Sparse Recovery Problems, Springer, 2011.

23MEP01 PROPERTIES AND SELECTION OF ENGINEERING MATERIALS

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Selection of appropriate engineering materials and basic parts, including the use of appropriate safety factors and cost, for specific engineering applications using mechanical properties.
- Selection of materials in engineering design by applying ethical principles, engineering codes of ethics, and professional responsibilities.

Course Outcome:

At the end of the course, the students will be able to

- Select the materials in the aspects of failure and cost analysis.
- Understand the static strength of the materials.
- Study the toughness, stiffness and fatigue properties for material selection.
- Identify the correct creep and temperature ranges for the materials for the application.
- Select and use materials optimally in industries.

Unit I ISSUES IN MATERIALS SELECTION **9**

Introduction- properties of materials- Failure in service– Cost- Space filling - Fabrication route-Surface durability – Future trends – Motivation for selection – New product development – Improvement of an existing product – Problem situations and constraints on choice – Cost basis for selection – Cost-effectiveness and value analysis – Analysis of cost.

Unit II SERVICE FAILURE AND STATIC STRENGTH **9**

Selection and design in relation to anticipated service – Causes of failure in service – Mechanisms of failure – Corrosion – Role of standard specifications – Inspection and quality control – Static strength – strength of metals – strength of thermoplastics – strength of fibre-reinforced composites – cement and concrete – strength of wood – Materials selection criteria for static strength.

Unit III TOUGHNESS, STIFFNESS AND FATIGUE **9**

Toughness – importance – assessment of toughness – Fracture mechanics – General yielding fracture – Toughness in polymers and adhesives – Material selection for toughness.

Stiffness – importance – stiffness of materials – stiffness of sections – Materials selection criteria for stiffness – Comparison of materials selection criteria.

Fatigue – Micro mechanisms of fatigue in metals – assessment of fatigue resistance – Factors influencing fatigue of metals – Fatigue of non-metallic materials – Materials selection for fatigue resistance.

Unit IV CREEP, TEMPERATURE AND CORROSION **9**

Creep and temperature resistance – evaluation of creep – nature of creep – development of creep-resisting alloys – service temperatures of engineering materials – selection of materials for creep resistance – Selection for corrosion resistance – selection of materials for resistance to atmospheric corrosion – selection of materials for resistance to corrosion in water – selection of materials for chemical plant – Selection of materials for resistance to wear.

Unit V MATERIALS FOR PRODUCTS **9**

Relationship between materials selection and materials processing - formalization of selection procedures - Materials for airframes -Materials for ship structures - Materials for engines and power generation -Materials for automobile structures -Materials for bearings - Materials for springs.

Text Book:

1. F A A Crane, Justin Furness, “Selection and Use of Engineering Materials” Elsevier Science & Technology Books, 1997.

Reference Book:

1. George E. Dieter, "Mechanical Metallurgy" , Mc Graw Hill , 2017
2. R. E. Smallman and A. H. W. Ngan, "Physical Metallurgy and advanced materials" , Butter worth – Heinemann, 2011
3. Alok Nayar,”Testing of metals“, Tata Mc Graw Hill, 2005.
4. R.C. Sharma, "Principles of Heat – treatment of steels", New Age International Publishers, 2018
5. Kenneth G. Budinski and Michael K. Budinski, “Engineering Materials - Properties and Selection”, Pearson, 2009

23MEP02 INNOVATION AND DESIGN THINKING

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Stimulate creativity in themselves and others.
- Incorporate design thinking into analysis of manufacturing situations.
- Apply creative and design thinking to a real-world situation

Course Outcome:

At the end of the course, the students will be able to

- Be familiar with processes and methods of creative problem solving.
- Enhance their creative and innovative thinking skills.
- Use the design thinking methodology to develop customer centric products
- Generate concepts and select the promising one.
- Able to design a product with Product architecture and Industrial Design principles

Unit I CREATIVITY **9**

Types of Intelligence-Types of Thinking- Pattern Breaking - Critical thinking vs. Creative thinking – Barriers to Creative thinking –Exercises for Lateral thinking – Six thinking hats. Methods and tools for Directed Creativity – Basic Principles – Tools of Directed Creativity – Tools that prepare the mind for creative thought – Stimulation of new ideas – Development and Actions.

Processes in creativity ICEDIP – Inspiration, Clarification, Distillation, Perspiration, Evaluation and Incubation. Case Studies. Brain-twisters and puzzles.

Unit II INNOVATION **9**

Invention vs. Innovation. Product Development Strategies related to Innovation-Traits of Innovative people-Types of Innovation-Need driven innovation-Radical Innovation-Case Studies of technology-push products, Platform products, Customized products, Quick build products and complex systems.

Social Innovation- Understanding social problems- Human-Cantered Design. Sustainable innovation – Innovation in business & Entrepreneurship

Unit III DESIGN THINKING **9**

History of Design thinking- Arcturus IV case Study- Empathy- Customer journey mapping- Ethnography- visualization- double diamond design- journey mapping - customer co-creation- Eight-Dimensional (8D) Approach to Ideation

Ideation: Brainstorming, Reverse Brainstorming, trigger session, Brain writing, Mind maps, SCAMPER, TRIZ, Bio-mimicry, Shape mimicry

Unit IV PRODUCT DEVELOPMENT **9**

Plan and establish product specifications. Concept Generation– search externally and internally-Explore systematically - reflect on the solutions and processes.

Concept Selection - methodology - benefits. Implications - Product change - variety - component standardization - product performance – manufacturability. Concept Testing Methodologies. Planning for Prototypes.

Unit V PRODUCT ARCHITECTURE & INDUSTRIAL DESIGN **9**

Implications of Product Architecture - establishing the architecture - creation - clustering - geometric layout development- Fundamental and incidental interactions – Platform Planning- System level design issues – Secondary systems -architecture of the chunks - Creating detailed interface specifications-Case studies.

Assessing the Need for Industrial Design- The Impact of Industrial Design-The Industrial Design Process Management of the Industrial Design Process- assessing the quality of industrial design. Case Studies.

Text Book:

1. Karl T.Ulrich and Steven D.Eppinger, “Product Design and Development”, 7th edition, McGraw Hill Education (India) Private Limited, 2020.
2. Clayton M. Christensen Michael E. Raynor, “Innovator's Solution: Creating and Sustaining Successful Growth”, Harvard Business School Press India Limited, 2013.

Reference Book:

1. A. K. Chitale, R. C. Gupta, “Product Design and Manufacturing”, Prentice Hall India Learning Private Limited6thedition, 2014.
2. Floyd Hurr, “Rousing Creativity: Think New Now”, ISBN 1560525479, Crisp Publications Inc. 1999.
3. Donald A. Norman, “Emotional Design”, Perseus Books Group New York, 2004.
4. John E. Arnold, John Arnold Jr. , Arcturus IV Case Study, Amazon Digital Services LLC, 2017.

Extensive Reading:

- http://design-engine.com/
- http://meche.mit.edu/research/design

- https://www.insead.edu/executive-education/digital-transformation-innovation/innovation-design
- https://nptel.ac.in/courses/110106124/

23MEP03 MECHATRONICS

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Learn the theoretical and practical aspects of measurement system design.
- Learn the basics of sensor and actuator theory, design, and application.
- Become proficient with using laboratory instrumentation and with building basic circuits.
- Gain experience of designing and constructing basic mechatronic systems, low cost Automation systems.

Course Outcome:

At the end of the course, the students will be able to

- Develop automation technologies by using the different automation approaches and skills to solve the complex industrial problems necessary for contemporary engineering practice.
- Select appropriate sensors and actuators based on characteristics, loading effect, reliability and economic issues.
- Analyse the system models in order to choose the automatic control structures.
- Make a simple programming in a microcontroller and PLC.
- Explain various applications of designing of mechatronics systems

Unit I MECHATRONICS, SENSORS AND TRANSDUCERS 9

Introduction to Mechatronics Systems – Measurement Systems – Control Systems – Microprocessor based Controllers. Sensors and Transducers – Performance Terminology – Sensors for Displacement Position and Proximity; Velocity, Motion, Force, Fluid Pressure, Liquid Flow, Liquid Level, Temperature, Light Sensors – Selection of Sensors.

Unit II ACTUATION SYSTEMS 9

Pneumatic and Hydraulic Systems – Directional Control Valves – Rotary Actuators. Mechanical Actuation Systems – Cams – Gear Trains – Ratchet and pawl – Belt and Chain Drives – Bearings. Electrical Actuation Systems – Mechanical Switches – Solid State Switches – Solenoids – Construction and working principle of DC and AC Motors – speed control of AC and DC drives, Stepper Motors-switching circuitries for stepper motor – AC & DC Servo motors.

Unit III SYSTEM MODELS AND CONTROLLERS 9

Building blocks of Mechanical, Electrical, Fluid and Thermal Systems, Rotational – Transnational Systems, Electromechanical Systems – Hydraulic – Mechanical Systems. Continuous and discrete process Controllers – Control Mode – Two – Step mode – Proportional Mode – Derivative Mode – Integral Mode – PID Controllers – Digital Controllers – Velocity Control – Adaptive Control – Digital Logic Control – Micro Processors Control.

Unit IV PROGRAMMING LOGIC CONTROLLERS 9

Programmable Logic Controllers – Basic Structure – Input / Output Processing – Programming – Mnemonics – Timers, Internal relays and counters – Shift Registers – Master and Jump Controls – Data Handling – Analogs Input / Output – Selection of a PLC.

Unit V DESIGN OF MECHATRONICS SYSTEM 9

Stages in designing Mechatronics Systems – Traditional and Mechatronic Design - Possible Design Solutions. Case studies of Mechatronics systems- Pick and place Robot- Autonomous mobile robot-Wireless surveillance Balloon - Automatic car park barrier.

Text Book:

1. W.Bolton, “Mechatronics”, Pearson education, 6th Edition, Indian Reprint, 2019

Reference Book:

1. Smile.A and Mrad.F, "Mechatronics integrated technologies for intelligent machines", Oxford university press, 2008.
2. Rajput. R.K, A textbook of mechatronics, S. Chand & Co, 2007.
3. Michael B. Histand and David G. Alciatore, “Introduction to Mechatronics and Measurement Systems”, McGraw-Hill, 2018.
4. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, “Mechatronics”, Chapman and Hall, 1993.
5. Dan Necsulesu, “Mechatronics”, Pearson Education Asia, (Indian Reprint) 2016.
6. Lawrence J. Kamm, “Understanding Electro – Mechanical Engineering”, an Introduction to Mechatronics, Prentice – Hall of India Pvt., Ltd., 2000.
7. NitaigourPremchand Mahadik, “Mechatronics”, Tata McGraw-Hill publishing Company Ltd., 2003.

Extensive Reading:

- http://nptel.iitm.ac.in/courses.php
- http://ebookbrowsee.net/np/nptel-lecture-notes

23MEP04 METALLURGY OF STEEL

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Properties, specifications and applications of steels.
- Appropriate and effective uses of steels.

Course Outcome:

At the end of the course, the students will be able to

- Get the idea of metallurgical facts about the steel and its characteristics.
- Get an in-depth idea of the fundamental features of steel making and rolling processes.
- Understand the properties of structural engineering and stainless steel for efficient selection.
- Grades of steel for structural, heat treatable and forming grade steels.
- Application of steels in the view of reliability and component integrity.

Unit I INTRODUCTION TO STEEL **9**

Introduction – crystal structure and phase formation of steel - Iron Carbide Diagram - importance and uniqueness of steel – Types and properties of steels - factors influencing the properties of steel - factors influencing the choice of steels - Fabrication of steels - Influence of microstructures on the properties of steels.

Unit II INFLUENCE OF GRAIN SIZE AND INCLUSIONS ON THE PROPERTIES OF STEELS **9**

Introduction - Formation of grains and grain boundaries – the influence of grain size on mechanical properties of steels - grain size determination and measurement - formation of inclusions in steel - determination of inclusions types and ratings - Effect of inclusion on the properties of steels.

Unit III STEELMAKING AND ROLLING FOR QUALITY STEEL PRODUCTION **9**

Introduction to steelmaking processes, salient process features for steelmaking - features of steel making by ladle furnace and vacuum dressing - making clean steels for critical applications - killing of steels, steel casting routes - steel defects and their causes - the task of steel rolling - Cold rolling of steel.

Unit IV CLASSIFICATION, SPECIFICATION, PROPERTIES AND GRADES OF STEELS **9**

Classification of steels- Steel standards and grades - steel designation systems and equivalent grade systems - Influence of carbon and alloying elements - structural steels: properties and applications, Engineering Steels: Properties and applications, Stainless steels: Properties and applications.

Unit V SELECTION AND APPLICATION OF STEELS : CASE STUDIES **9**

Selection and application of steels: reliability, quality and quality costs, failure modes and mechanisms. Road map to the selection of steel, Selection of steels for Engineering Structures - Steel for LPG cylinder, Steel for Automotive body parts and wheel rims - Automotive Axle Shafts - Pivot Pins - Fastening Bolts and Ball Bearings.

Text Book:

1. S.K. Mandal “Steel Metallurgy – Properties, specifications and applications”, McGraw hill. 2014.

Reference Book:

1. Dieter , George E, Mechanical Metallurgy , McGraw Hill, 2017
2. Smallman R.E, Physical Metallurgy and advance materials , Butter worth – Heinemann, 7th Edition, 2011.
3. Nayar, Alok “ Testing of metals “ Tata McGraw Hill, 2011
4. Sharma , Ramesh C, Principles of Heat – treatment of steels : Newage publication, 2018

23MEP05 SURFACE COATING TECHNOLOGY

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Various techniques of surface modifications for applications such as engineering components, in which the substrate / bulk material properties are the primary consideration.

Course Outcome:

At the end of the course, the students will be able to

- Understand types of polymeric binders and polymerization reactions
- Know the role of resins and pigments in surface modifications.
- Decide the surface preparation methods suitable for different substrate materials.
- Interpret testing & evaluation of metallic coatings.
- Apply knowledge on properties offered by different coatings based on the application requirement.

Unit I INDRODUCTION TO POLYMERIC BINDERS **9**

Classification of polymers – Step-growth polymerization – Chain-growth polymerization – Industrial polymerizations – co-polymerization - Block and graft co-polymers and co-polymer networks – Ionic polymerization – Poly insertion - Ring-opening polymerization – Dendrimers – Metathesis polymerization – Group transfer polymerization – Reaction injection moulding.

Unit II INDUSTRIAL RESINS & PIGMENTS **9**

Resins: Alkyds and polyesters – Formaldehyde-based polymers – silicone resins – Epoxy resins – chlorinated rubber – Polyurethanes – Acrylic resins – Hydrocarbon resins – Fluoro-polymers – Vinyl resins.

Pigments: Inorganic pigments – Organic pigments – Extenders.

Unit III SOLVENT SELECTION AND PIGMENT DISPERSION **9**

Solvent selection: Binder's solubility – Solvent evaporation – Solvent properties – Formulating methodology.

Pigment dispersion: Theory of pigment dispersion – Dispersion characterization – Formulation of non-aqueous pigment dispersions – Water-based pigment dispersions.

Unit IV PAINT APPLICATION AND EVALUATION **9**

Surface treatments for steel - Surface treatments for aluminium - Surface treatments for polymers and plastics – Paint applications.

Mechanism of film formation – Factors affecting coating properties – Methods used for film preparations – Barrier properties of coatings – Mechanical properties of coatings – Optical properties of coatings – Ageing properties of coatings – Rheological properties of coatings – Adhesion properties of coatings.

Unit V TYPES OF COATINGS **9**

Appliance finishes – Automotive finishes – Coil coatings – Can coatings – Marine coatings – Aircraft coatings – Building coatings – Paper coatings.

Recent coating technologies: Water-borne coatings – Radiation curable coatings – Powder coatings – High-solids liquid coatings.

Text Book:

1. Swaraj Paul, Surface Coatings: Science and Technology, John Wiley & Sons, 2nd Edition, 2014.

Reference Book:

1. J. R. Davis, Surface Engineering for Corrosion and Wear Resistance, CRC Press, Taylor & Francis, 2014.
2. Arthur A. Tracton, Coatings Materials and Surface Coatings, CRC Press, Taylor & Francis, 2006.
3. James A. Murphy, Surface Preparation and Finishes for Metals, McGraw-Hill, New York 1971
4. Rose A. Ryntz, Philip V. Yaneff, Coatings of Polymers and Plastics, CRC Press, Taylor & Francis, 2014.
5. George J. Rudzki -Surface Finishing Systems. metal and non-metal finishing handbook-guide, Metals Park: ASM, 1983.

23MEP06 SOLAR ENERGY TECHNOLOGIES

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Applying of solar energy technologies in various fields like power generation, air conditioning and desalination.
- Understanding the economic feasibility of solar technology for suitable application.

Course Outcome:

At the end of the course, the students will be able to

- Understand the basics of solar radiation
- Apply Knowledge on solar photovoltaic and photochemical engineering.
- Understand the solar collector and its heating application.
- Realize the application of passive solar techniques and solar cooling methods.
- Understand the solar economics and real time application of solar energy.

Unit I SOLAR RADIATION **9**

Sun-earth geometric relationship, nature of solar radiation, global, beam and diffuse radiation, hourly, daily and seasonal variation of solar radiation, estimation of terrestrial solar radiation- measurement of solar radiation, solar charts - solar radiation data.

Unit II SOLAR PHOTOVOLTAIC AND PHOTOCHEMICAL APPLICATION **9**

Solar PV technology - stationary and concentrated PV - standalone systems - grid connected systems - hybridization, synchronization and power evacuation - site selection and land requirements - design of solar cells: cell parameters limits-losses in solar cells – analysis of PV cells-manufacture of solar cells and panels-photo catalytic reaction-solar reactors.

Unit III SOLAR COLLECTORS AND SOLAR HEATING SYSTEM **9**

Flat plate collector-liquid type, air type, evacuated tube collector-concentrating collector-parabolic trough and dish collector, Fresnel reflectors & lens. Solar water heating system: natural, forced-solar air heating system – configuration, collector design, air-preheating-solar industrial process heating: textile and milk processing.

Unit IV SOLAR COOLING AND PASSIVE SOLAR TECHNIQUES **9**

Solar refrigeration-vapour compression cycle, vapour absorption system air-conditioning application (NH_3-H_2O & LiBr- H_2O). Passive space heating-types-fundamental concept and generalized passive design methods, passive space cooling, controlling solar input, movement of air, evaporative cooling, nocturnal and radiative cooling.

Unit V SOLAR ECONOMICS AND APPLICATION **9**

Present worth method to analyse feasibility of project / policy alternatives. Solar stirling power system, solar distillation, simple solar still, solar desalination, non-convecting solar ponds, solar disinfection of water and air, solar desiccant dehumidification system, solar cookers.

Text Book:

1. D.Yogi Goswami, “Principles of solar engineering”, fourth edition, CRC press, 2023.

Reference Book:

1. HP Garg and J Prakash, “Solar Energy: Fundamentals and Applications”, Tata McGraw Hill, 2017
2. Suhatme and Nayak, “Solar Energy: Principles of Thermal Collection and Storage”, Tata McGraw Hill, 2009.
3. H P Garg, M Dayal, G Furlan, “Physics and Technology of Solar Energy- Volume I: Solar Thermal Applications”, Springer, 2007.
4. Anne Grete Hestnes, Robert Hastings, Bjarne Saxhof, “Solar Energy Houses: Strategies, Technologies Examples”, Earthscan Publications, 1st edition, 2003.
5. Solanki C.S “Solar Photovoltaics-Fundamentals, Technologies and Applications” PHI Learning, third edition, 2015.

23MEP07 AUTOMOTIVE INFOTRONICS

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To understand the basics of Automotive Infotronics
- To understand about various assistance systems for driver
- To understand about Telematics and safety systems
- To learn about comfort systems and security systems

Course Outcome:

At the end of the course, the students will be able to

- Understand about various sensors used in automobiles.
- Explain about telematics used in automobiles.
- Understand about various safety systems used in automobiles.
- Understand about different comfort systems employed in automobiles.
- Explain various security systems in automobiles.

Unit I SENSORS IN AUTOMOBILES **9**

Knock sensors, oxygen sensors, crankshaft angular position sensor, temperature sensor, speed sensor, Pressure sensor, Mass air flow sensor, Manifold Absolute Pressure Sensors, crash sensor, Coolant level sensors, Brake fluid level sensors – operation, types, characteristics, advantage and their applications.

Unit II TELEMATICS **9**

Global positioning system, geographical information systems, navigation system, architecture, automotive vision system, road recognition, Vision-based autonomous road vehicles, Dashboard controls and accessories.

Unit III SAFETY SYSTEMS **9**

Object detection, Collision warning and avoidance system, Active & Passive Sensor Safety system - Side Impact & front impact sensing system, airbags, seat belts, child lock, Lane departure warning system, Adaptive headlight system, Day time running lights (DRL), Automatic wiper system, Traffic Sign Identification. Automatic rain sensing/wiper activation system, Drowsy driver sensing system, Tyre pressure warning system.

Unit IV COMFORT SYSTEMS **9**

Adaptive cruise control system, Active suspension system, power steering, collapsible and tiltable steering column, power windows, and climate control system, Emergency Electronic braking – Types of Anti-locking braking system in vehicles.

Unit V SECURITY SYSTEMS **9**

Anti-theft technology – Mechanical, electromechanical and electronic immobilizers, alarm system, stolen vehicle tracking system, remote keyless entry, smart card system, number plate coding, Bio metric systems, Security systems: Intelligent Vehicle Systems – Unmanned ground vehicles.

Text Book:

1. William B.Ribben, Understanding Automotive Electronic: An Engineering Perspective (2012), Elsevier Science.
2. Robert Bosch GmbH, "Safety, Comfort and Convenience Systems", Wiley, 2007.

Reference Book:

1. Ljubo Vlacic, Michel Parent and Fumio Harashima, —Intelligent Vehicle Technologies, Butterworth-Heinemann Publications, Oxford, 2001.
2. Bechhold, “Understanding Automotive Electronics”, SAE, 1998.
3. Ronald K Jurgen, —Navigation and Intelligent Transportation Systems – Progress in Technology, Automotive Electronics Series. SAE, USA, 1998.

23MEP08 INDUSTRIAL REVOLUTION X

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Communicate the basic concepts of technologies involved in Smart Manufacturing
- Distinguish the technical aspects and architectures involved in IIoT
- Perform the predictive analytics using Google Cloud ML platform and Microsoft Azure.
- Learns basic framework for smart manufacturing

Course Outcome:

At the end of the course, the students will be able to

- Demonstrate the concepts and technologies involved in Internet of Things, Intelligent
- List out the technical aspects and architecture of Industrial Internet of Things
- Differentiate between the networks and architectures of IIoT.
- Evaluate the predictive analytics involved in intelligent manufacturing.
- Apply the automation tools required in manufacturing process.

Unit I UNDERSTANDING OF INDUSTRY 4.0 **9**

Introduction to Industry revolution- Evolution of Industry 1.0 to Industry 5.0-Industry Internet of Things-Power of 1%- Key IoT technologies- Cobots, Human Factors involved- Innovation in IIoT intelligent devices- Challenges and benefits of Industry 5.0-IIoT applications – health care, Oil and Gas Industry, Smart Office, Logistics.

Unit II IIOT TECHNICAL ASPECTS **9**

Miniaturization-Cyber Physical Systems (CPS)-Wireless technology-IP technology-Network Functional Virtualization (NFV)- Network Virtualization (NV)- Software-defined network (SDN)- NFV vs SDN- smart phones- cloud and fog- big data analytics- M2M learning and AI- Augmented Reality and Virtual Reality- 3D Printing- People vs Automation.

Unit III IIOT ARCHITECTURE **9**

IIC reference architecture- Industrial Internet Architecture Framework (IIAF)- Implementation- architecture topology- Three–tier topology: edge tier, platform tier, enterprise tier, gateway mediated edge, connectivity, key system characteristics, data management.

Unit IV INTELLIGENT MANUFACTURING **9**

Introduction- Cloud manufacturing- IIoT enabled manufacturing- intelligent manufacturing- intelligent manufacturing platforms – GE predix, PTC thingworx, SIEMENS: smart factory- predictive analytics – Google Cloud ML platform, Microsoft Azure.

Unit V SMART DESIGN & SMART MACHINES **9**

Smart Design - Digital Tools, Product representation and exchange technologies and standards, Agile (Additive) Manufacturing Systems and standards. Mass customization, Smart Machine Tools, Robotics and Automation (perception, manipulation, mobility, autonomy) - Smart manufacturing systems - design & Analysis, planning & control.

Text Book:

1. Uthayan Elangovan, “Industry 5.0: The Future of Industrial Economy”, 1st Edition, CRC Press, 2022.
2. Alasdar Gilchrist, “Industry 4.0: The Industrial Internet of Things”, 1st Edition, Apress, 2016

Reference Book:

1. Jeschke S., Brecher C., Song H., and Rawat D. B., “Industrial Internet of Things Cyber manufacturing Systems”, Springer, 1st Edition, 2017.
2. Tao F., Zhang M., and Nee A. Y. C., “Digital Twin Driven Smart Manufacturing”, Academic Press,
3. 1st Edition, 2019.
4. M. Kuniavsky, “Smart Things: Ubiquitous Computing User Experience Design”, Morgan
5. Kaufmann, 1st Edition, 2010.
6. A. McEwen and H. Cassimally, “Designing the Internet of Things”, Wiley, 1st Edition, 2013.

23UCP01 NANO MATERIALS AND THEIR APPLICATIONS

Offered by CHE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- Fundamental aspects of nanomaterials
- Various synthetic methods of nanomaterials
- Different characterization techniques used for nanomaterials
- Basic ideas of recent nanomaterials
- Applications of nanomaterials in different fields

Course Outcome:

At the end of the course, the students will be able to

- Gain knowledge about the fundamentals of nano science
- Synthesize nanomaterials
- Characterize the nanomaterials
- Acquire knowledge on different categories of recent nanomaterials
- Get exposure to the applications of nanomaterials in different fields

Unit I INTRODUCTION TO NANOMATERIALS 9

Background to nano technology - scientific revolutions - basic principles of nano scale materials - Comparison with bulk materials - Classification confined to one, two and three dimensions - Properties of low dimensional systems - Fraction of surface atoms, surface area and aspect ratio - Enhanced catalytic, optical and mechanical properties compared to bulk materials.

Unit II SYNTHESIS OF NANOMATERIALS 9

Bottom-up Synthesis: Physical vapour deposition, Chemical vapour deposition, Molecular Beam Epitaxy, Chemical precipitation and co-precipitation, colloidal and sol gel methods, gel combustion – Template methods - Self-assembly - Top-down Approach: Mechanical Milling, Dry etching and Lithography.

Unit III CHARACTERIZATION OF NANOMATERIALS 9

X-ray diffraction – UV-Vis. Spectroscopy (Ag and Au system)- FTIR Spectroscopy (Metal oxides) - Energy Dispersive X-ray Analysis – X-ray Photo Electron Spectroscopy - Raman spectroscopy (CNT and Graphene) – Luminescence: Photoluminescence and Electroluminescence.

Unit IV RECENT NANO MATERIALS 9

Functional materials - Carbon based nanomaterials: Structure and properties of Fullerenes, CNT and Graphene – Electroactive Polymers –Thermo, Photo and Electro Chromic materials – Luminescent materials: Photoluminescence and Electroluminescence – Ferro fluid – Superhydrophobic materials – Dendrimers.

Unit V APPLICATIONS OF NANOMATERIALS 9

Display devices: Field emission - Chemical and biological sensors -Solar energy conversion – Catalysis and Photocatalysis- Smart sunglasses - Molecular sieves – Graphene in water purification – Nano coatings: Corrosion resistant and Self-cleaning – Drug delivery – Hyper thermia - Swim-suits with sharkskin effect.

Text Book:

1. Charles P. Poole, Jr., Frank J. Owens, “Introduction to Nanotechnology”, John Wiley and Sons Publishers, 2013 Reprint.
2. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, James Murday, Textbook of Nanoscience and Nanotechnology, Springer Science & Business Media, 2013.
3. G. Cao, Nanostructures &Nanomaterials: Synthesis, Properties & Applications, Imperial College Press, 2011.

Reference Book:

1. Jeremy Ramsden, An Introduction to Nanotechnology, 2nd edition, William Andrew, 2016.
2. Wesley C. Sanders, Basic Principles of Nanotechnology, CRC Press; 1st edition, 2018.
3. Douglas Natelson, Nanostructures and Nanotechnology, Cambridge University Press, 2015.

23UCP02 COMPUTER APPLICATIONS IN CHEMICAL SCIENCE

Offered by CHE (Open Elective offered to BAD, BBE, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on basic concepts of engineering applications in chemical science
- To impart knowledge on programming application development with the help of Chemical Science

Course Outcome:

At the end of the course, the students will be able to

- Have the basics of ChemDraw application
- Gain the basic knowledge of computer software in chemistry
- Get exposure to the knowledge and applications of numerical methods in chemistry
- Develop the basic application programs for chemical science
- Develop the engineering application programs in chemical science

Unit I INTRODUCTION TO CHEMDRAW 9

Introduction – simple chemical structure – object setting – orbital structure in molecule – TLC plate – template molecule usage – molecule to journal setting – stereochemistry of isomer molecule – name to structure and structure to name – predicting 1H NMR shift and 13C NMR shift of molecule – analysis information of a molecule – ACX number from structure – writing a simple chemical reaction

Unit II COMPUTER SOFTWARE IN CHEMISTRY 9

Introduction – chemical inventory system – Material Safety Data Sheet – electronic handbooks – chemical structure and information database – Environmental Chemistry – Physical Properties Pro – Molecular Modeling Pro – Chemoffice – information storage and retrieval – modeling, simulation and optimization

Unit III NUMERICAL METHODS FOR CHEMISTRY 9

Introduction – bisection method – numerical integration – trapezoidal rule – simpson's 1/3rd rule – computation of ΔS and Cp – differentiation – curve fitting – runge-kutta method – Blakley method of balancing chemical equation with matrix – monte carlo simulation – application to first order kinetics

Unit IV DEVELOPING PROGRAMS FOR CHEMISTRY 9

C Programming for simple applications in Chemistry: water quality parameters like hardness, dissolved oxygen – emf of a cell – corrosion rate – combustion of fuel – thermodynamic parameters – binding energy – theoretical yield – solubility product

Unit V ENGINEERING APPLICATION PROGRAMS IN CHEMISTRY 9

C Programming for simple engineering applications in Chemistry: Calculation of BOD, COD of a waste water sample, Determination of percentage of elements in an organic compound, Determination of efficiency of solar cell and solar panel, Determination of energy of electromagnetic radiations (given : Wavelength or frequency), Calculation of binding energy and half-life period, Calculation of enthalpy change using Clapeyron-Clausius Equation, Calculation of degree of freedom from component and phase from phase diagram of water, Program to find porosity of refractory, Calculation of pH using Henderson's equation, Program to arrange the names of the few metals in their alphabetical order using sorting method.

Text Book:

1. Ramesh Kumari, Computers and Their Applications to Chemistry, Narosa Publishing House, India, 2011

Reference Book:

1. Pradip Dey, Manas Ghosh, Fundamentals of Computing and Programming in C, First Edition, Oxford University Press, 2013
2. K.V. Raman, Computers in Chemistry, Tata McGraw Hill, New Delhi, 11th Reprint, 2010

Extensive Reading:

- WEB REFERENCES:
- http://www.cambridgesoft.com/
- https://byjus.com/chemistry-formulas/
- http://www.chemistrylearning.com/writing-c-program/

23UMP01 NUMBER THEORY AND GRAPH THEORY FOR CRYPTOGRAPHY

Offered by MAT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To acquire knowledge on Number Theory
- To understand about linear Congruence's
- To understand about solution of higher order congruence
- To introduce the students about basic graph theory
- To know about the basic concepts in Cryptography

Course Outcome:

At the end of the course, the students will be able to

- Apply proof techniques in basic number theory
- Solve congruence and system of congruence
- Analyze the existence of solution of higher order congruence equation
- Acquire knowledge about basic concepts in graphs and the connectivity in graphs
- Know ideas in public key and symmetric key cryptography

Unit I DIVISIBILITY AND PRIMES **9**

Basic group theory – Rings and finite fields - Division algorithm – Greatest common Divisors – The Euclidean algorithm and continued fractions – Fundamental theorem of arithmetic – Euclid's Theorem and Sieve of Eratosthenes

Unit II CONGRUENCES **9**

Ring of congruence classes – Linear congruences – Euler phi function – Chinese Remainder theorem – Euler's and Fermat's theorem – Psuedoprimes and Carmichael numbers

Unit III PRIMITIVE ROOTS AND QUADRATIC RECIPROCITY **9**

Polynomials and primitive roots – power residue – Quadratic residue – Quadratic reciprocity law – Quadratic residues to composite moduli

Unit IV INTRODUCTION TO GRAPHS **9**

Graphs - degree sequences – Reconstruction problem – Elementary properties of trees - vertex connectivity and edge connectivity – Hamiltonian and Eulerian graphs (definition and example only), Matchings and independence in graphs

Unit V CRYPTOGRAPHIC BASICS AND SYMMETRIC-KEY CIPHERS **9**

Definitions and Illustrations – Enciphering and Deciphering Transformations - Symmetric-Key Ciphers – Monoalphabetic and Poly alphabetic Ciphers - Classic Ciphers - Shift Ciphers- Affine Ciphers - The Vigen`ere Auto key Polyalphabetic Cipher - Cryptanalysis of the Vigen`ere Cipher - The Hill Cipher Stream Ciphers - The Vernam Cipher - Attacks

Text Book:

1. Melvyn B. Nathanson, Elementary Methods in Number Theory, Springer New York, 2013.
2. G. Chartrand and L. Lesniak, Graphs & Digraphs, Chapman & Hall / CRC A CRC press company , USA, 6th Edition 2016.
3. R.A.Mollin," An Introduction to Cryptography", Chapman & Hall/CRC Taylor & Francis Group, New York, 2rd Edition, 2007.

Reference Book:

1. J.A. Buchmann, "Introduction to cryptography", Springer, Second Edition 2004
2. Neal Koblitz "A Course in Number Theory and Cryptography (Graduate Texts in Mathematics)", Springer Science & Business Media, Second edition,2012.

23UMP02 INTRODUCTION TO NUMBER THEORY FOR CRYPTOGRAPHY

Offered by MAT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To acquire knowledge on basic group, ring and number theory.
- To understand about congruence.
- To define and interpret primitive roots and quadratic residues.
- To know about the basic concepts in Cryptography.
- To learn about public key cryptography and digital envelop.

Course Outcome:

At the end of the course, the students will be able to

- Apply divisibility concept for solving the number theory problems.
- Solve congruence relations problems.
- Apply quadratic residue concept for finding the nature of numbers.
- Know ideas of different ciphers.
- Know algorithm for designing a new public key cryptography and digital signature.

Unit I DIVISIBILITY AND PRIMES **9**

Groups, Rings and Finite fields (examples only) – Divisibility - Division algorithm – Greatest common divisors – The Euclidean algorithm and Continued fractions – Fundamental theorem of arithmetic – Euclid's theorem and Sieve of Eratosthenes.

Unit II CONGRUENCES **9**

Ring of congruence classes – Linear congruences – Euler phi function – Chinese Remainder theorem – Euler's and Fermat's theorem – Psuedoprimes and Carmichael numbers.

Unit III PRIMITIVE ROOTS AND QUADRATIC RECIPROCITY **9**

Polynomials and Primitive roots - Power residue – Quadratic residue – Quadratic reciprocity law – Quadratic residues to composite moduli.

Unit IV CRYPTOGRAPHIC BASICS AND SYMMETRIC-KEY CIPHERS **9**

Definitions and Illustrations – Enciphering and Deciphering transformations - Symmetric-Key Ciphers – Monoalphabetic and Polyalphabetic Ciphers - Classic Ciphers - Shift Ciphers- Affine Ciphers - The Vigen`ere Auto key Polyalphabetic Cipher - Cryptanalysis of the Vigen`ere Cipher - The Hill Cipher Stream Ciphers - The Vernam Cipher - Attacks.

Unit V PUBLIC-KEY CRYPTOGRAPHY **9**

The Ideas Behind PKC - PKCs and SKCs - A Comparison - Digital Envelopes and PKCs - Trapdoor One -Way Functions - RSA - Digital Signatures - The RSA Signature Scheme - ElGamal - ElGamal Signature Scheme.

Text Book:

1. Melvyn B. Nathanson, Elementary Methods in Number Theory, Springer, New York, 2013.
2. R.A.Mollin," An Introduction to Cryptography", Chapman & Hall/CRC, Taylor & Francis Group, New York, 2rd Edition, 2007.

Reference Book:

1. J.A. Buchmann, "Introduction to cryptography", Springer, Second Edition 2004
2. Neal Koblitz "A Course in Number Theory and Cryptography (Graduate Texts in Mathematics)", Springer Science & Business Media, Second edition,2012.

23ADP08 GEO SPATIAL ANALYTICS

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Fundamentals of Geo Spatial technology
- To Designing geographic information science database
- To Familiar with the modeling techniques
- To Learn spatial, raster and terrain analysis
- To Exposed to spatial modeling and estimation

Course Outcome:

At the end of the course, the students will be able to

- Use the fundamental concepts of Geographic Information Science and Technology
- Design Geo Spatial Database
- Describe the geospatial system and represents various data model.
- Analyse Geospatial data using spatial and raster analysis techniques.
- Create and design principles, including thematic map display, map projections, and cartographic design

Unit I INTRODUCTION TO GIS **9**

Introduction – GIS Components – GIS in Organizations – Data Models : Introduction – Common Spatial Data Models – Raster Data Models – Other Data Models – Data File and Structures - Geodesy – Datums

Unit II DESIGNING GIS DATABASE WITH DIGITAL DATA **9**

Projections and Coordinate Systems – Building GIS Database – Digitizing Coordinate capture – Coordinate Transformation – Output : Maps – Data – Meta Data - Digital Data: Introduction – Global Digital Data – Attribute Data and Tables

Unit III GEOSPATIAL NAVIGATION SYSTEM AND DATA MODEL **9**

Global Satellite Navigation System : Introduction – Differential Correction – Optical and Laser Coordinate Surveying – GNSS Applications – Aerial and Satellite Images : Basic Principles – Aerial Images – Satellite Images – Air born LiDAR

Unit IV SPATIAL AND RASTER ANALYSIS **9**

Introduction – Selection and Classification – Dissolve – Proximity Functions and Buffering – Overlay – Map Algebra – Local Functions – Neighborhood, Zonal and Global Functions – Terrain Analysis

Unit V SPATIAL MODELING AND ESTIMATION **9**

Sampling – Spatial Interpolation Methods –Spatial Prediction –Core Area Mapping–Cartographic Modeling– Saptio–Temporal Models–Data Standards and Data Quality – GNSS – Datum Modernization–Improved Remote Sensing–Cloud Based GIS–Open GIS

Text Book:

1. Paul Bolstad, “GIS Fundamentals: A First Text on Geographic Information Systems”, 6th edition, 2019

Reference Book:

1. Robert Haining, “Spatial Data Analysis Theory and Practice”, Cambridge University, 2010

Extensive Reading:

- https://saylordotorg.github.io/text_essentials-of-geographic-information-systems/s12-geospatial-analysis-ii-raster-.html
- https://www.omnisci.com/learn/geospatial
- https://www.gislounge.com/methods-for-creating-spatial-databases/

23ADP09 DIGITAL ASSET MANAGEMENT SYSTEM

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the ways and means of creating digital content
- To learn the methods of storing large digital content
- To understand the content related workflows
- To know the key design issues of Content Management Systems
- To familiarize various security issue of Content Management Systems

Course Outcome:

At the end of the course, the students will be able to

- Use the concepts of digital assets for encoding media
- Apply different models for storing and retrieval using XML and storage medias
- Identify the appropriate concept for presentation of digital assets
- Apply Content Management Systems for specific application
- Use security policies needed for various Content Management System applications

Unit I INTRODUCTION **9**

Introduction to Digital Asset Management – Document and Content Management – Media Management –The Case for Digital Asset Management – Asset Formats

Unit II SYSTEM COMPONENTS **9**

System Components – XML – Cataloguing and Indexing – Search Engines – Databases – Disk storage and Media Servers – Mass Storage – Storage Management

Unit III CONTENT RELATED WORKFLOWS **9**

Content Related Workflows – File Formats – Content Representation and Metadata – Content Description Standards– Standards for Metadata Transmission and Exchange – Presentation Tier – Application Server

Unit IV CONTENT MANAGEMENT **9**

Content Management System Infrastructure – System and Data Integration in CMS – Integration Principle – CMS Legacy System– Integration of Third Party Systems – CMS and Web Integration – Applications – Future Trends

Unit V DOCUMENT SECURITY AND DIGITAL RIGHTS MANAGEMENT **9**

Document Security and Digital Rights Management – Authentication and trust – Water marking – System Integration– Project Management – Internationalization – Digital Asset Management Products – Document Management – Web Content Management – Video Asset Libraries – Applications

Text Book:

1. Boiko, B. “Content Management Bible”, Second Edition, Wiley Publishing, 2005

Reference Book:

1. Austerberry, D,”Digital Asset Management”, Burlington, MA: Focal Press. Second edition, 2013
2. Mauthe, A & Thomas, P. “ Professional Content Management Systems: Handling Digital Media Assets”, John Wiley & Sons Ltd., 2005

Extensive Reading:

- http://www.stibosystems.com/global/explore–stibo–systems/master–data–management/digital–assetmanagement.aspx
- http:// www. damguru.com/best–dam–practices–a–digital–asset–management–philosophy.html
- http://www.lac–group.com/digital–asset–management–vs–content–management–vs–knowledge–management

23ADP10 EVOLUTIONARY COMPUTING ALGORITHMS

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study the concepts of simple evolutionary algorithms.
- To understand the concepts of development systems
- To solve the problems using immune system-based algorithms
- To solve the problems using different behavioral systems
- To learn the various evolutionary algorithms based on collective systems and their applications

Course Outcome:

At the end of the course, the students will be able to

- Apply the operations of Evolutionary systems
- Use the techniques of Development systems
- Solve problems using Immune systems
- Identify the various applications for Behavioral systems
- Implement solutions to various problems based on Collective systems

Unit I EVOLUTIONARY SYSTEMS **9**

Pillars of Evolutionary Theory - Genotype - Artificial Evolution - Genetic Representations - Initial Population - Fitness Functions - Selection and Reproduction - Genetic Operators - Evolutionary Measures - Types of Evolutionary Algorithms - Schema Theory - Human-Competitive Evolution -Evolutionary Electronics - Lessons - Role of Abstraction - Extrinsic and Intrinsic Evolution - Evolutionary Digital Design -Evolutionary Analog Design - Multiple Objectives and Constraints

Unit II DEVELOPMENTAL SYSTEMS **9**

Potential Advantages of a Developmental Representation -Rewriting Systems - Synthesis of Developmental Systems - Evolution and Development - Defining Artificial Evolutionary Developmental Systems - Evolutionary Rewriting Systems - Evolutionary Developmental Programs - Evolutionary Developmental Processes - Genetic Programming for Machine Learning - Syntax Tree-Based Representation – Evolving the syntax trees

Unit III IMMUNE SYSTEMS **9**

Biological Immune Systems Working - Constituents of Biological Immune Systems - Lessons for Artificial Immune Systems - Algorithms and Applications - Shape Space - Negative Selection Algorithm - Clonal Selection Algorithm - Examples

Unit IV BEHAVIORAL SYSTEMS **9**

Behavior in Cognitive Science - Behavior in Artificial Intelligence - Behavior-Based Robotics -Biological Inspiration for Robots -Robots as Biological Models - Robot Learning - Evolution of Behavioral Systems - Evolution and Learning in Behavioral Systems - Evolution and Neural Development in Behavioral Systems - Coevolution of Body and Control - Toward Self-Reproduction - Simulation and Reality

Unit V COLLECTIVE SYSTEMS **9**

Biological Self-Organization - Particle Swarm Optimization - Ant Colony Optimization -Swarm Robotics - Firefly Algorithm - Grey Wolf Optimization - Fish Swarm Optimization – Combinatorial Optimization - Coevolutionary Dynamics: Biological Models - Artificial Evolution of Competing - Artificial Evolution of Cooperation

Text Book:

1. Dario Floreano, Claudio Mattiussi, “Bio-Inspired Artificial Intelligence: Theories, Methods, and Technologies”, The MIT Press, 2008.

Reference Book:

1. Alain Petrowski, Sana Ben-Hamida, “Evolutionary Algorithms”, Wiley Publications, First Edition, 2017
2. A.E. Eiben, J. E. Smith, “Introduction to Evolutionary Computing”, Springer 2019
3. Xinjie Yu, Mitsuo Gen, “Introduction to Evolutionary Algorithms”, Springer, 2010

Extensive Reading:

- https://www.cse.iitb.ac.in/~pb/cs621-2009/previous-years-other%20things/Evolutionary-Computation-genetic-algo.ppt
- http://www2.cs.uh.edu/~ceick/ep/Evo-Intro.ppt
- http://web.cecs.pdx.edu/~mperkows/CLASS_574/574-fall-08/Evolutionary-Algorithms.ppt
  http://www.gephi.org
- https://www.cs.virginia.edu/~evans/bio/slides/SI.ppt

23ADP11 DISTRIBUTED COMPUTING

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study the distributed system principles and architecture models
- To gain knowledge about various communication models
- To understand distributed file systems
- To learn synchronization and replication techniques
- To study the resource management techniques

Course Outcome:

At the end of the course, the students will be able to

- Explore the system models in distributed system
- Apply various communication models in distributed system
- Explore distributed file systems
- Apply synchronization and replication algorithms in distributed system
- Use resource management algorithms for load balancing

Unit I INTRODUCTION **9**

Introduction – Examples of distributed systems–Trends in distributed systems – Focus on resource sharing – Challenges – World Wide Web – System models – Physical models – Architectural models – Fundamental models

Unit II COMMUNICATION IN DISTRIBUTED SYSTEM **9**

Inter Process Communication – the API for the Internet protocols – External data representation – Multicast communication – Network virtualization: Overlay networks. MPI – Request–reply protocols – Remote procedure call. Distributed Objects: Java RMI – Group communication – Publish–subscribe systems – Message queues – Shared memory approaches – From Objects to Components: Enterprise Java Beans

Unit III PEER TO PEER SYSTEMS AND DISTRIBUTED FILE SYSTEMS **9**

Introduction – Napster and its legacy – Peer–to–peer Middleware – Routing overlays – Overlay case studies: Pastry, Tapestry. Distributed File Systems – File service architecture – Sun Network File System –Google File System – Name Services and Domain Name System – Directory services – Case studies: The Global Name System, X.500 Directory Service

Unit IV SYNCHRONIZATION AND FAULT TOLERANCE **9**

Introduction – Clocks, events and process states – Synchronizing physical clocks – Logical time and logical clocks – Global states – Coordination and Agreement – Distributed mutual exclusion – Elections –Transactions – Locks – Optimistic concurrency control – Timestamp ordering – Atomic commit protocols – Concurrency control in distributed systems – Distributed deadlocks

Unit V RESOURCE AND PROCESS MANAGEMENT **9**

Resource management: Desirable features of a good global scheduling algorithm –Task assignment approach – Load balancing approach – Load sharing approach – Process management: Process migration – Threads

Text Book:

1. George Coulouris, Jean Dollimore and Tim Kindberg, “Distributed Systems Concepts and Design”, Fifth Edition, Pearson Education, 2012
2. Pradeep K Sinha, “Distributed Operating Systems: Concepts and Design”, Prentice Hall of India, 2007

Reference Book:

1. Tanenbaum A.S., Van Steen M., “Distributed Systems: Principles and Paradigms”, Pearson Education, 2007
2. Liu M.L., “Distributed Computing, Principles and Applications”, Pearson Education, 2004
3. Nancy A Lynch, “Distributed Algorithms”, Morgan Kaufman Publishers, USA, 2003
4. MukeshSinghal and Niranjan G. Shivaratri, “Advanced Concepts in Operating Systems – Distributed, Database, and Multiprocessor Operating Systems”, Tata McGraw–Hill, 2001

Extensive Reading:

- http://www.coda.cs.cmu.edu/ljpaper/lj.html
- http://techgenix.com/windows2003–distributed–file–system/
- https://www.ntfs.com/index.html

23ADP12 DATA SCIENCE USING PYTHON

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explain the significance of Python in data science and its real-world applications.
- To apply Python to manipulate and analyze diverse data sources.
- To create informative data visualizations and draw insights from data distributions

Course Outcome:

At the end of the course, the students will be able to

- Analyze the need for data science and use the built-in data types in Python.
- Using the OOP paradigm, create an application using user-defined modules and packages.
- Utilize NumPy arrays for effective data operations and storage.
- Apply Pandas to perform effective data manipulations.
- Utilize Pandas to preprocess and visualize data.

Unit I INTRODUCTION TO DATA SCIENCE AND PYTHON PROGRAMMING 9

Introduction to Data Science - Why Python? - Essential Python libraries - Python Introduction- Features, Identifiers, Reserved words, Indentation, Comments, Built-in Data types and their Methods: Strings, List, Tuples, Dictionary, Sets, Arrays, Range.

Unit II FUNDAMENTALS OF PYTHON PROGRAMMING 9

Operators - Decision Making - Loop Control statement - Function arguments & its types - User defined Modules and Packages in Python- Files: File manipulations, File and Directory related methods – OOPS concepts -Class and Objects, Constructors – Data hiding- Data Abstraction- Inheritance

Unit III INTRODUCTION TO NUMPY 9

NumPy Basics: Arrays and Vectorized Computation- The NumPy ND array- Creating ND arrays- Data Types for ND arrays- Arithmetic with NumPy Arrays - Basic Indexing and Slicing - Boolean Indexing -Transposing Arrays and Swapping Axes - Universal Functions: Fast Element-Wise Array Functions- Mathematical and Statistical Methods- Sorting-Unique and Other Set Logic.

Unit IV DATA MANIPULATION WITH PANDAS 9

Introduction to pandas Data Structures: Series, DataFrame, Essential Functionality: Dropping Entries-Indexing, Selection, and Filtering- Function Application and Mapping- Sorting and Ranking - Summarizing and Computing Descriptive Statistics- Unique Values, Value Counts, and Membership - Reading and Writing Data in Text Format.

Unit V DATA CLEANING, PREPARATION AND VISUALIZATION 9

Data Cleaning and Preparation: Handling Missing Data - Data Transformation: Removing Duplicates, Transforming Data Using a Function or Mapping, Replacing Values, Detecting and Filtering Outliers- String Manipulation: Vectorized String Functions in pandas. Plotting with pandas: Line Plots, Bar Plots, Histograms and Density Plots, Scatter or Point Plots.

Text Book:

1. Y. Daniel Liang, “Introduction to Programming using Python”, Pearson,2012.
2. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O’Reilly, 2nd Edition,2018.
3. Jake VanderPlas, “Python Data Science Handbook: Essential Tools for Working with Data”, O’Reilly, 2017.

Reference Book:

1. Wesley J. Chun, “Core Python Programming”, Prentice Hall,2006.
2. Mark Lutz, “Learning Python”, O’Reilly, 4th Edition, 2009.

Extensive Reading:

- https://www.coursera.org/learn/python-plotting?specialization=data-science-python
- http://nptel.ac.in
- https://www.edx.org/course/python-basics-for-data-science

23ADP13 DATA VISUALIZATION

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the tableau terminologies and its fields
- To explain the methodologies to create a chart and table calculations
- To get used with chart types and frameworks in tableau
- To know the structuring of data in Power BI
- To get equipped with creation of reports and dashboards in Power BI

Course Outcome:

At the end of the course, the students will be able to

- Infer the representation of tableau and its fields
- Explore charts present in tableau
- Apply the various charts used for data visualization
- Apply visualization tips in charts
- Design Power BI Dashboards in managing workspaces

Unit I INTRODUCTION TO TABLEAU 9

Introduction to Tableau – Short comings of Traditional Information Analysis – Business Case for Visual Analysis – Tableau Software Ecosystem – Introduction to Tableau Desktop Workspace – Connect to Data – Generated Values – Direct Connection – Data Extract – Joining Database Tables with Tableau – Blending Different Datasources in a Single Worksheet

Unit II CREATION OF CHARTS AND CALCULATIONS IN TABLEAU 9

Working of Show Me – Trend Lines and Reference Lines – Sorting Data in Tableau – Enhancing Views with Filters, Sets, Groups, and Hierarchies – Creating Calculations – Aggregation – Calculated Values – Table Calculations – Building Formulas Using Table Calculations – Table Calculation Functions – Calculations with Parameters

Unit III DATA VISUALIZATION TIPS AND FRAMEWORK 9

Standard Map View – Plotting Locations on Map – Replacing Tableau's Standard Maps – Custom Background Images to Plot Spatial Data – Shaping Data to Enable Point-to-Point Mapping – Animating Maps Using the Pages Shelf – Providing Self-Service Ad Hoc Analysis with Parameters – Tips, Tricks, and Timesavers – Building Dashboards – Sharing Dashboards

Unit IV INTRODUCTION TO POWER BI 9

Power BI deployment modes – Project discovery and ingestion – Power BI project roles – Power BI licenses – Dataset design process – Data Profiling – Dataset Planning – Query design per dataset mode – Data sources – Power BI Desktop options –

SQL views – Parameters – Staging queries – Data types – Query folding – M query examples – M query editing tools – Data Model – Relationships – Model metadata – Optimizing Performance – Developing DAX measures and security roles

Unit V CREATION OF REPORTS AND DASHBOARDS IN POWER BI 9

Creating and formatting Power BI Reports – Applying Custom Visuals – Animation – Analytics – Designing Power BI Dashboards – Managing Application workspaces and Content

Text Book:

1. Daniel G. Murray, "Tableau Your Data! : Fast and Easy Visual Analysis with Tableau Software", John Wiley & Sons, Inc., Second Edition, 2016.
2. Brett Powell, "Power BI Cookbook: Creating Business Intelligence Solutions of Analytical Data Models, Reports, and Dashboards", Packt Publishing Ltd, First Edition, 2017

Reference Book:

1. Joshua N. Milligan, "Learning Tableau", Packt Publishing Ltd, Third Edition, 2019.
2. Errin O'Connor "Microsoft Power BI Dashboards Step by Step", Pearson Education, 2019.

Extensive Reading:

- https://www.datacamp.com/courses/introduction–to–data–visualization–with–python
- https://machinelearningmastery.com/data–visualization–methods–in–python/
- https://www.kaggle.com/benhamner/python–data–visualizations
- https://www.coursera.org/specializations/data-visualization
- https://towardsdatascience.com/tableau-visualizations

23BMP04 BIOMEDICAL SENSOR TECHNOLOGY

Offered by BME (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To describe different types of electrodes used in bio potential recording
- To familiarise the different pressure and flow measuring concepts.
- To understand the different physical sensors and biosensors in medical field.
- To explain the Radiology and Nuclear medicine equipment

Course Outcome:

At the end of the course, the students will be able to

- Explore the types of electrodes and its working.
- Illustrate the pressure and flow measurement equipment.
- Elucidate the different types of physical sensors
- Identify the various biosensors used in biomedical application.
- Interpret the Fluoroscopy and Nuclear medicine equipment.

Unit I BIOPOTENTIAL ELECTRODES 9

Origin of different bio potential and its propagation - Electrode-electrolyte interface - electrode–skin interface - half-cell potential - impedance - polarizable electrode - non polarizable electrodes - Types of electrodes - body surface recording electrodes - Internal Electrodes - micro electrodes and their equivalent circuits - Recording problems - Measurement with two electrodes.

Unit II PRESSURE AND FLOW MEASUREMENT 9

Sensors Terminology in human body - Cell - Body Fluids - Musculoskeletal system, Bioelectric Amplifiers - Bioelectric Amplifiers for Multiple input Circuits - Differential Amplifiers - Physiological Pressure and other cardiovascular measurements and devices-Blood pressure measurement, Oscillometric and ultrasonic non - invasive pressure measurement, Direct Methods- H2O manometer, Pressure transducer, Pressure amplifier design, Pressure differentiation circuit, Automatic zero circuit - Cardiac output measurement and blood flow measurement.

Unit III PHYSICAL SENSORS IN BIOMEDICINE 9

Temperature measurement: core temperature, surface temperature mapping, invasive temperature measurement, other applications of temperature Sensors : skin blood - flow sensor, hot film anemometer for measuring blood flow and respiratory flow - Mechanical sensors - noninvasive blood pressure measurement, Hemodynamic Invasive Blood Pressure Sensors, Mechanical Sensors in Spirometry, Sensors for Pressure Pulses and Movement, internal ocular pressure, acoustic sensors in hearing aid - Doppler sonography for blood flow measurement, Electrodynamic Sensors for Blood-Flow Rate, Sensors in Ophthalmoscopy, Artificial Retina, tactile sensors for artificial limbs.

Unit IV BIOSENSOR 9

Biosensor, Enzymatic sensor, Urea Sensors, Affinity Biosensor, Direct Immunosensor, Living Biosensor, Microbial Biosensors, Tissue based sensors, Biocompatibility of sensors.

Unit V RADIOLOGY AND NUCLEAR MEDICINE EQUIPMENT 9

Fluoroscopic Machine, Nuclear Medicine system, Computer systems used in X-ray and Nuclear Medical equipment, Calibration, Typical faults, Trouble shooting and Maintenance procedure for medical equipment, ECG Equipment and EMI - EMI to biomedical sensors, Types and sources of EMI, Fields, EMI effects.

Text Book:

1. Carr and Brown, “Introduction to Medical Equipment Technology”, Addison Wesley, 2nd Edition, 1999.
2. J. G. Webster, “Medical Instrumentation; Application and Design”, John Wiley & Sons, 5th Edition, 2015.

Reference Book:

1. Gabor Harshanyi, “Sensors in Biomedical Applications, Fundamentals Technology and Applications”, CRC Press, 2000.
2. Graham Ramsay, “Commercial Biosensors”, John Wiley & Sons, 1st edition, 1998.
3. Tran Minh Canh, “Sensor Physics & Technology – Biosensors”, 1st Edition, Chapman & Hall, 1993.
4. Sabrie Soloman, “Sensors Hand Book”, McGraw Hill, 2010

Extensive Reading:

- https://nptel.ac.in/courses/108/108/108108147/
- https://onlinecourses.nptel.ac.in/noc22_ee50/preview
- https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-ee41/
- https://nptel.ac.in/courses/108/108/108108113

23BMP05 MEDICAL WASTE MANAGEMENT

Offered by BME (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Understand the hazardous materials used in hospital and its impact on health
- Identify various waste disposal procedures and management.
- Demonstrate various hazardous materials and safety measures.

Course Outcome:

At the end of the course, the students will be able to

- Analyse various hazards, accidents and its control.
- Apply waste disposal procedures for different bio-wastes.
- Categorise wastes from different hazardous materials.
- Explore different safety facilities in hospitals.
- Identify various regulations and safety norms.

Unit I HEALTHCARE HAZARD CONTROL AND UNDERSTANDING ACCIDENTS 9

Healthcare Hazard Control: Introduction, Hazard Control, Hazard Control Management, Hazard Control Responsibilities, Addressing Behaviours, Hazard Control Practice, Understanding Hazards, Hazard Analysis, Hazard Control and Correction, Personal Protective Equipment, Hazard Control Committees, Hazard Control Evaluation, Hazards, System Safety, Ergonomics. Understanding Accidents: Accident Causation Theories, Human Factors, Accident Deviation Models, Accident Reporting, Accident Investigations, Accident Analysis, Organizational Functions That Support Accident Prevention, Workers' Compensation, Orientation, Education, and Training.

Unit II BIOMEDICAL WASTE MANAGEMENT 9

Biomedical Waste Management: Types of wastes, major and minor sources of biomedical waste, Categories and classification of biomedical waste, hazard of biomedical waste, need for disposal of biomedical waste, waste minimization, waste segregation and labeling, waste handling, collection, storage and transportation, treatment and disposal.

Unit III HAZARDOUS MATERIALS 9

Hazardous Materials: Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Hazardous Waste Operations and Emergency Response Standard, Respiratory Protection.

Unit IV FACILITY SAFETY 9

Facility Safety: Introduction, Facility Guidelines Institute, Administrative Area Safety, Slip, Trip, and Fall Prevention, Safety Signs, Colors, and Marking Requirements, Scaffolding, Fall Protection, Tool Safety, Machine Guarding, Compressed Air Safety, Electrical Safety, Control of Hazardous Energy, Permit Confined Spaces, OSHA Hearing Conservation Standard, Heating, Ventilating, and Air-Conditioning Systems, Assessing IAQ, Landscape and Grounds Maintenance, Fleet and Vehicle Safety.

Unit V INFECTION CONTROL, PREVENTION AND PATIENT SAFETY 9

Healthcare Immunizations, Centers for Disease Control and Prevention, Disinfectants, Sterilants, and Antiseptics, OSHA Bloodborne Pathogens Standard, Tuberculosis, Healthcare Opportunistic Infections, Medical Waste. Patient Safety: An Organizational Function, Errors and Adverse Events, Safety Cultures, Patient-Centered Healthcare, Quality Improvement Tools and Strategies, Healthcare-Associated Infections, Medication Safety.

Text Book:

1. Tweedy, James T, "Healthcare hazard control and safety management", CRC Press, Taylor and Francis, 2014.
2. Anantpreet Singh, Sukhjit Kaur, "Biomedical Waste Disposal", Jaypee Brothers Medical Publishers (P) Ltd, 2012.

Reference Book:

1. R.C.Goyal, "Hospital Administration and Human Resource Management", PHI – Fourth Edition, 2006
2. V.J. Landrum, "Medical Waste Management and disposal", Elsevier, 1991

Extensive Reading:

- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8985930/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9690095/

23BMP06 REGULATORY AFFAIRS FOR MEDICAL DEVICES

Offered by BME (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basic concept of regulatory affairs for Indian Medical devices.
- To compare types of Medical devices and their risk levels.
- To acquire a proficiency in Medical devices standards and Quality assurance practices.

Course Outcome:

At the end of the course, the students will be able to

- Classify the Medical Devices based on their risk classes.
- Analyze the implications of the Medical Device Rules on Medical Devices.
- Implement quality assurance and management systems.
- Apply the risk management system in medical devices
- Illustrate the India's medical device regulatory system

Unit I INTRODUCTION TO REGULATORY AFFAIRS FOR MEDICAL DEVICES 9

Basic concepts - Taxonomy of medical devices and their risk classes - The regulatory process Regulatory Affairs Pre-Clinical Trial-Clinical Trial-Regulatory Bodies in India Central Drug Regulatory System-Drug & Cosmetics Act-Medical Device Registration in India Product Development Protocol-Environmental Protection Act

Unit II MEDICAL DEVICE AND IN VITRO DIAGNOSTICS 9

Definition of Medical devices, Active Implantables and In vitro Diagnostics - Border line Products - Combination Products – Regulations: EU, US, Australia, Canada and Japan. Risk Based Classifications – Nomenclature based, Generic classification rules based - Risk Classes – Medical Device, IVD, Comparitive table.

Unit III STANDARDS OF MEDICAL DEVICE, QUALITY ASSURANCE, AND TESTING 9

Clinical Trials – Medical Devices Trials Vs Pharmaceuticals Clinical Trials, Regulations. Back ground and Orgins of ISO 13485:2003 – Management System Standards – Quality Management system – Standards of ISO 9000 and ISO 13485 – ISO 13485:2003 – Regulatory requirements and Regulatory purposes.

Unit IV MANUFACTURE OF MEDICAL DEVICES AND IVDS 9

License to manufacture a medical device, Risk Management System for medical devices (ISO 14971) - Inspection of medical device and IVD establishments, Import and export of medical devices and IVDs, Medical device regulation: International practices.

Unit V MEDICAL DEVICE REGULATORY SYSTEM IN INDIA 9

Overview - Regulatory Environment, Laws/Regulations governs Medical Devices. Functions undertaken by DCGI, Central Government, FDA and State Government. CDSCO – the Central Agency, Organization Chart. Regulatory Overview – Definition, Manufacturing Site and Product Registration(Process Flow Chart), Labelling requirement of Medical Device.

Text Book:

1. Jack Wong, Raymond Tong, “Medical Regulatory Affairs: An International Handbook for Medical Devices and Healthcare Products”, Jenny Stanford Publishing, 2022.
2. Val Theisz, “Medical Device Regulatory Practices: An International Perspective”, Pan Stanford Publishing, 2016.

Reference Book:

1. Jack Wong, Raymond Tong, “Handbook of Medical Device Regulatory Affairs in Asia”, Pan Stanford Publishing, 2013.
2. Douglas J. Pisano, David Mantus, “ FDA Regulatory Affairs- A Guide for Prescription Drugs, Medical Devices, and Biologics”, Informa Healthcare, 2003.
3. Stephen Amato,Bob Ezzell, “Regulatory Affairs for Biomaterials and Medical Devices”, Woodhead Publishing, 2014.
4. Anna Smajdor, Jonathan Herring, Robert Wheeler, “Oxford Handbook of Medical Ethics and Law”, OUP Oxford, 2022.

Extensive Reading:

- https://shop.elsevier.com/books/regulatory-affairs-for-biomaterials-and-medical-devices/amato/978-0-85709-542-8
- https://extendedstudies.ucsd.edu/courses-and-programs/regulatory-affairs-for-medical-devices
- https://onlinecourses.nptel.ac.in/noc20_ge14/preview

23BTP04 PRINCIPLES AND APPLICATIONS OF RADIOISOTOPES IN BIOTECHNOLOGY

Offered by BT

(Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Basic concepts related to radioisotopes.
- Applications of radioisotopes in biochemical assays
- Applications of radioisotopes in agriculture and food processing
- Applications of radioisotopes in diagnosis and therapeutics
- Health impacts of radioisotopes

Course Outcome:

At the end of the course, the students will be able to

- Explain the basic concepts about radioisotopes.
- Learn the applications of radioisotopes in biochemical assays.
- Apply radioisotopes in agriculture, and food processing.
- Apply radioisotopes in diagnosis and therapeutics.
- Determine the health effects of radioisotopes and radioactive waste disposal.

Unit I INTRODUCTION TO RADIOISOTOPES AND RADIOACTIVITY 9

Radioactivity – half life – radioactive elements - radioactive decay - alpha decay, beta decay, gamma ray emission, positron decay - properties of radioisotopes - radioactivity measurements: units of radioactivity.

Unit II RADIOISOTOPE METHODS 9

Autoradiography, Radioimmunoassay – Radioisotopes as tracers and its advantages - Application of Radioisotopes in Biochemical Analyses: radioactive elements in ion transport experiments – liquid scintillation spectrometry: principle and applications – Identification of calcium binding proteins using radioisotope of calcium.

Unit III AGRICULTURAL AND FOOD PROCESSING APPLICATIONS OF RADIOISOTOPES 9

Agricultural applications: radioactive tracers, plant nutrition studies, Insect pest management – Radiotracer technique in drug metabolism studies - Applications of radioisotopes in food processing.

Unit IV DIAGNOSTIC AND THERAPEUTIC APPLICATIONS OFRADIOISOTOPES 9

Application in medical field: Sterilization of medical equipments - Diagnostic radiology: X – ray, Positron Emission Tomography (PET), Single Photon Emission Computed Tomography (SPECT) – Radiopharmaceuticals : Radioactive iodine and over active thyroid gland - Radioactive chromium for labeling erythrocytes – Diagnostic use of radiolabelled antibodies for Cancer - Antibody-radionuclide conjugates for Cancer Therapy.

Unit V HEALTH IMPACTS OF RADIOISOTOPES 9

Metabolism and biological effects of deposited radio nucleotides – cellular effects of ionizing radiation – cell survival curves – radioactive wastes – sources, radioactive waste disposal.

Text Book:

1. Wilson K. & Walker J, “Principles and Techniques of Biochemistry and Molecular Biology “, Cambridge University Press, 7th Edition, 2010.
2. C. L Comar, “Radioisotopes in biology and agriculture: Principles and practice”, McGraw-Hill, 1st Edition, 1955.
3. Edward Alpen, “Radiation Biophysics”, Academic Press, 2nd Edition, 1997.

Reference Book:

1. Wilson K. & Walker J, “Practical Biochemistry”, Cambridge University Press, 5th Edition, 2003.

23BTP05 BIOFUELS

Offered by BT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Sources of energy and their types
- Various renewable feedstock of importance their availability and attributes for biofuels production.
- Biological conversion process.
- Second and third generation biofuel production from biomass and other low-cost agricultural residues and bio-wastes
- Biofuel economy

Course Outcome:

At the end of the course, the students will be able to

- Explain about the resources of biofuels.
- Find the source of second-generation different biofuels.
- Define the importance of biological conversion process for biofuels.
- Understand the role of chemical conversion process in biofuel formation.
- Estimate the biofuel economy in the industrial development.

Unit I INTRODUCTION **9**

Introduction to Energy Sources -Short Supply of Fossil Fuels- Petroleum in the World-Natural Gas as the Fastest Growing Primary Energy Source -Coal as a Fuel and Chemical Feedstock- Renewable and Bio renewable Sources - Non-combustible Renewable Energy Sources -Bio renewable Energy Sources-Ethanol as the Leading "First-generation" Biofuel-case studies-Brazil, United states

Unit II CELLULOSIC ETHANOL AS A "SECOND-GENERATION" BIOFUEL **9**

Bioethanol and Cellulosic Ethanol - Structural and Industrial Chemistry of Cellulosic Biomass-Cellulases: Biochemistry, Molecular Biology, and Biotechnology- Hemicellulases -Lignin-Degrading Enzymes as Aids to Saccharification- Biomass Substrate Pretreatment Strategies-Microbiology of Cellulosic Ethanol Production.

Unit III BIOLOGICAL CONVERSION PROCESS **9**

Conversion process for production of liquid and gaseous biofuels-Vegetable Oils and Biodiesel-Biogas-Aerobic Conversion Processes-Anaerobic Conversion Processes –Biogas Processing -Reactor Technology for Anaerobic Digestion-Algae based biofuels: Drying and harvesting techniques for biomass collection -Landfill Gas-Crude Gases from Bio renewable Feedstocks.

Unit IV CHEMICAL CONVERSION PROCESSES **9**

Introduction to Thermochemical Conversion Processes-Thermal Decomposition Mechanisms of Biorenewables - Hydrothermal Liquefaction of Biorenewable Feedstocks- The Role of Water During the HTL Process- HTU Applications-Direct Combustion of Biomass-Combustion Efficiency -Direct Liquefaction-Pyrolysis Processes-Reaction Mechanism of Pyrolysis-Gasification Research and Development-Biomass Gasification-Biomass Gasification Systems -Electricity from Cogenerative Biomass Firing Power Plants-Fischer–Tropsch Synthesis (FTS)-Supercritical Steam-Emerging liquid biofuel technologies(Microwave assisted technique, Ultrasonic assisted technique-Green diesel and biogasoline: Advanced Thermochemical process-Emerging Gaseous biofuel tecghnologies (Syngas,Steam Gasification)

Unit V BIOFUEL ECONOMY **9**

Introduction to Biofuel Economy- Estimation of Biofuel Prices- Biodiesel Economy –Bioethanol Economy- Bio renewable Energy Costs and Biohydrogen Economy-Biofuel Policy-Global Biofuel Projections.

Text Book:

1. Ayhan Demirbas, "Biofuels Securing the Planet's Future Energy Needs", springer, 2008.
2. David M. Mousdale, "Biofuels: Biotechnology, Chemistry, and Sustainable Development "CRC Press, 2008.
3. Gupta, Vijai Kumar; Tuohy, Maria G. (Eds.), "Biofuel Technologies Recent Developments", Springer, 2013.
4. Bequette B.W., "Process Control: Modeling, Design and Simulation", Prentice Hall, 1st edition, 2003.

Reference Book:

1. Robert C. Brown, "Biorenewable Resources: Engineering New Products from Agriculture", Wiley-Blackwell. 2014
2. Lee, James.,. "Biochemical Engineering", PHI, 1992.

23BTP06 MOLECULAR PATHOGENESIS OF INFECTIOUS DISEASES

Offered by BT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Basic knowledge of the characteristics of pathogens.
- Mechanisms involved in the host defense and pathogenic strategies.
- Molecular mechanism of the virulence strains.
- Different types of host-pathogen interactions.
- Modern pathogen control strategies.

Course Outcome:

At the end of the course, the students will be able to

- Explain the concepts involved in the pathogenic cycle, disease and vaccines.
- Discuss the mechanisms involved in the host defense.
- Explain the molecular pathogenesis mechanisms of various pathogens.
- Elaborate on different types of host-pathogen interactions.
- Discuss the modern approaches to control pathogens.

Unit I OVERVIEW **9**

Historical perspective - microbial toxins, vaccines, antibiotics and the birth of molecular genetics - Louis Pasteur's contributions, Robert Koch's postulates and molecular concepts - Pathogen types and Modes of entry - Attributes & components of microbial pathogenesis, Virulence, virulence factors, virulence-associated factors and virulence lifestyle factors.

Unit II SIGNAL TRANSDUCTION, HOST DEFENSE AND PATHOGEN RESPONSE **9**

Concepts of signaling in disease: receptor ligands, membrane receptor tyrosine kinases and phosphatases, G proteins, proto-oncogenes, signaling pathways, cytoplasmic protein kinases and phosphatases, transcription factors, receptor-nucleus signaling - Host defense: skin, mucosa, mechanism of killing by humoral and cellular defense mechanisms, complements, inflammation process - Pathogenic adaptations: Antigenic variation, immune destruction, latency, immune-suppression.

Unit III MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) **9**

Molecular genetics and gene regulation in virulence of pathogens: Vibrio cholerae: Cholera toxin, co-regulated pili, filamentous phage, survival - E. coli pathogens: Enteropathogenic E. coli (EPEC), type III secretion, cytoskeletal changes, intimate attachment - Tuberculosis: clinical manifestation, molecular biology of infection - early events, late events, lipid metabolism, iron uptake and models (macrophage and animal) in studying tuberculosis - Leptospirosis: epidemiology and pathogenesis - Plasmodium: Life cycle, erythrocyte stages, transport mechanism and processes to support the rapidly growing schizont, parasitophorous vacuoles, and knob protein transport, Antimalarials based on transport processes - Influenza virus: Intracellular stages, Neuraminidase & Haemagglutinin in entry, M1 & M2 proteins in assembly and disassembly, action of amantadine.

Unit IV MOLECULAR PATHOGENESIS (WITH SPECIFIC EXAMPLES) **9**

Virulence assays: adherence, invasion, cytopathic, cytotoxic effects. Criteria & tests in identifying virulence factors - Molecular characterization of virulence factors: Genetic Approach - Gene disruption, global gene inactivation, Complementation, Antisense technique, Non-genetic Approach - reporter fusion, hybridization methods - large scale approach: genomics, proteomics.

Unit V APPROACHES TO CONTROL PATHOGENS **9**

Classical approaches based on serotyping - Modern diagnosis based on highly conserved virulence factors, immune & DNA-based techniques; Antibiotics and antibiotics resistance: Principles of antibiotic mechanisms – Mechanisms of the origin of antibiotics resistance; Vaccines - DNA, subunit and cocktail vaccines - approaches behind the success story of smallpox eradication across the world and polio in India.

Text Book:

1. Iglewski B.H. and Clark V.L "Molecular Basis of Bacterial Pathogenesis", Academic Press, 1st Edition, 1990.
2. Williams, P.H., Ketley, J. and Salmond, G., "Methods in Microbiology: Bacterial Pathogenesis-Volume 27", Academic Press, 1st Edition, 1998.
3. Nester E.W., Anderson D.G., Roberts C.E., Pearsall N.N. and Nester M.T., "Microbiology: A Human Perspective", McGraw Hill, 5th Edition, 2007.
4. Janeway C.A. Jr, Travers P. and Walport M., "Immunobiology: The Immune System in Health and Disease", Garland Science, 6th Edition, 2006.

Reference Book:

1. Eduardo A. G., "Principles of Bacterial Pathogenesis", Academic Press, 1st Edition, 2001.
2. Salyers A.A., Wilson B.A., Whitt D.D. and Winkler M., "Bacterial Pathogenesis: A Molecular Approach", American Society for Microbiology, 3rd Edition, 2011.
3. Norkin L.C., "Virology: Molecular Biology and Pathogenesis", American Society for Microbiology, 1st

Edition,2010.

23BTP07 IPR, BIOETHICS AND BIOSAFETY

Offered by BT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- IPR and the extent of its applications in Biotechnology
- Legal safety and public policy issues that arise due to rapid progress in biotechnology development of new product.
- Regulatory framework pertaining to regulation of GMOs in India
- Regulatory framework pertaining to regulation of GMOs at the international level

Course Outcome:

At the end of the course, the students will be able to

- Remember the concept of intellectual property rights and its implementation in Biotechnology.
- Implement the strategies to tackle ethical issues involved in biotechnology research
- Follow the good laboratory practices; understand the various biosafety levels required for handling microorganisms and recombinant organisms.
- Remember various national regulatory authorities and their role in regulating GMOs in India.
- Recall the international regulatory guidelines that regulate GMOs.

Unit I INTELLECTUAL PROPERTY RIGHTS **9**

IPR Definition - Different forms of IPR - Benefits of IPR system. WTO - Definition, Definition - Objectives – Structural format of WTO - Economic Impact of WTO - WTO Agreements - Benefits of WTO in relation to biotechnology, TRIPS; GATT; Biodiversity& Farmer's rights.

Unit II BIOETHICS **9**

Cardinal virtues and their development , concept of morality, ordinal virtues, Senses of 'Engineering Ethics' – Variety of moral issues, Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg's theory – Gilligan's theory Ethical issues in genetic engineering, patenting human genes, cloning, genetic testing & screening - Biotechnology & social responsibility - The legal & socio-economic impact of Biotechnology - Public acceptance issue in Biotechnology - issue of access, ownership, monopoly, traditional knowledge.

Unit III BIOSAFETY **9**

Introduction - Historical Background – Laboratory acquired infections - Introduction to Biological Safety Cabinets – Certification process for biosafety cabinet - Primary Containment for Biohazards - Biosafety Levels - Biosafety Levels for handling Infectious agents and GMOs - Biosafety guidelines - Government of India - Definition of GMOs & LMOs - Environmental release of GMOs - Risk Analysis – Risk Assessment; Risk management and communication.

Unit IV BIOSAFETY- REGULATORY FRAMEWORK FOR GMOS IN INDIA **9**

Regulatory framework in India governing GMOs-Recombinant DNA Advisory Committee (RDAC) – Institutional Biosafety Committee (IBC) - Review Committee on Genetic Manipulation, Genetic Engineering Approval Committee (GEAC) - State Biosafety Coordination Committee (SBCC) - District Level Committee (DLC). Recombinant DNA Guidelines (2017) - Seed Policy (2002) The Food Safety and Standards Bill (2005) - Plant Quarantine Order (2003) - Regulation for Import of GM Products Under Foreign Trade Policy (2006-2007) - National Environment Policy (2006) - Rules for the manufacture, use/import/export and storage of hazardous microorganisms/genetically engineered organisms or cells (Ministry of Environment and Forests Notification, 1989), National biodiversity regulations

Unit V BIOSAFETY-REGULATORY FRAMEWORK FOR GMOS AT INTERNATIONAL LEVEL **4**

Convention of Biological Diversity (1992) – Cartagena Protocol on Biosafety – Objectives and salient features of Cartagena Protocol – Advanced Information Agreement (AIA) procedure – procedures for GMOs intended for direct use-risk assessment-risk management-handling, transport, packaging and identification of GMOs-Biosafety Clearing House-unintentional transboundary movement of GMOs-Benefits of becoming a party to the Cartagena Protocol status of implementation in India.

Text Book:

1. Singh K, "Intellectual Property rights on Biotechnology", BCIL, New Delhi, 2010.

Reference Book:

1. Beier, F.K., Crespi, R.S., Straus T., "Biotechnology and Patent protection", Oxford and IBH Publishing Co., New Delhi, 1st edition, 1985.
2. Sasson A., "Biotechnologies and Development", UNESCO Publications 2010.
3. "Regulatory Framework for GMOs in India", Ministry of Environment and Forest, Government of India, New Delhi, 2006.
4. "Cartagena Protocol on Biosafety", Ministry of Environment and Forest, Government of India, New Delhi, 2006.

23CEP06 CONSTRUCTION PLANNING AND MANAGEMENT

Offered by CIV (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- The necessity of planning in the diverse construction projects.
- The appropriate techniques used for scheduling the resources.
- The various cost control methods and accounting.
- The quality control and monitoring techniques.
- Management Information System.

Course Outcome:

At the end of the course, the students will be able to

- Implement the appropriate planning techniques in construction projects.
- Adopt the suitable scheduling technique for the particular project.
- Practice the modern cost account and financial systems prevalent in departments.
- Employ advanced quality control and assurance techniques towards speedy and guaranteed projects.
- Use the MIS and database systems for complex projects.

Unit I CONSTRUCTION PROJECT PLANNING 9

Project planning - Basic concepts - Planning for material, labour and equipment - Types of construction projects - Defining work tasks - Precedence relationships among activities - Estimating activity durations - Estimating resource requirements for work activities - Bar chart - Milestone chart - Coding systems.

Unit II MANAGEMENT TECHNIQUES 9

Network analysis - Fundamental rules for network construction - AOA and AON networks - CPM - Floats - Types of floats - Calculation of floats - PERT - Estimating the probability of project completion time - Resource oriented scheduling - Time-cost trade-off - Network crashing.

Unit III COST CONTROL, FINANCING, DEPARTMENTAL ACCOUNTING PROCEDURE 9

Costs and estimates associated with construction - Means of financing - Project budget - Tendering - bidding - Construction contracts - PWD accounting procedure - Administrative and technical sanction - Payment of bills - Types of accounts in PWD - Maintenance of Books and Registers - Work Charged Establishment - Nominal Muster Roll - Daily Labour Reports.

Unit IV QUALITY CONTROL AND ASSURANCE 9

Importance and elements of quality - Organization for quality control - Total quality control - Quality council – Quality circle - Quality Assurance techniques - Quality control by statistical methods - Statistical quality control with sampling by attributes and variables.

Unit V MANAGEMENT INFORMATON SYSTEM 9

Types of project information - Accuracy and use of information - Computerized organization - Management Information System (MIS) - Database and its types - Relational model of database - Other conceptual models of database - Centralized Database Management System - Database and its application programs.

Text Book:

1. Chitkara, K.K. “Construction Project Management Planning, Scheduling and Control”, Tata McGraw-Hill Publishing Co., New Delhi, 4th Edition, 2019.
2. Saleh Mubarak, “Construction Project Scheduling and Control”, John Wiley and Sons, 4th Edition, 2019.

Extensive Reading:

- https://nptel.ac.in/courses/105/103/105103093/
- https://www.cmu.edu/cee/projects/PMbook/
- https://nptel.ac.in/courses/105/106/105106149/

23CEP07 HYDROPOWER ENGINEERING

Offered by CIV (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Basic aspects of hydropower.
- Various types of hydropower plants.
- Design of various elements of power.
- Site selection for construction of dams.
- Financial implications of hydropower plants.

Course Outcome:

At the end of the course, the students will be able to

- Analyse and estimate hydropower potential.
- Select a suitable type of hydropower required for the site.
- Design a power canal based on power requirement.
- Select a suitable type of Dam.
- Analyse the economic aspects

Unit I INTRODUCTION **9**

Development of Water Power - Estimation of Hydropower potential - Comparison of hydro, Thermal and Nuclear power - Sources of energy - Status of hydropower - Advantages of hydropower - Place of hydropower in power system - Analysis of stream flow and demand - Flow duration curve - firm power, Secondary power - Load and Load duration curves - Load factor, etc.,

Unit II TYPES OF HYDRO POWER PLANTS **9**

Basic features of Hydropower plants - Classification of hydropower plants - Run-of-river plants - General layout of run-of-river plants - Valley dam plants - Storage and pondage - Examples - High head diversion plants - Diversion Canal Plants - Pumped storage plants - Tidal power plants.

Unit III WATER CONVEYANCE SYSTEM **9**

Power Canals - Alignment, Design of Power canals - Flumes - Covered conduits and Tunnels - Penstocks - Alignment, types of penstocks - Design criteria of penstocks - Economic Diameter of penstocks - Water hammer - Anchor blocks - Surge tanks- Types - Surge analysis - Types of valves.

Unit IV DAMS & SPILLWAYS **9**

Selection of site - Preliminary Investigations - Final Investigations - Types of Dams - Rigid Dams - Gravity dams - Arch and buttress dams - Basic principles of design and details of construction - Earthen dams, Design considerations - Spillways - Types - Spillway gates, Design of stilling basins.

Unit V POWER HOUSE DETAILS **9**

Forebay - Intakes - General layout of power house and arrangement of hydropower units - Underground Power stations - Advantages - Ventilations - Transmission systems - Financial implications of Hydro Power plants.

Text Book:

1. Dandekar and Sharma, “Water power Engineering", Vikas Publishing House Pvt. Ltd., 2013.
2. Madan Mohan das, Mimi Das Saikia, “Irrigation and Water Power Engineering”, PHI Learning Pvt. Ltd., 2011.

Reference Book:

1. R S Varshney, “Hydropower structures “, NEM CHAND & BROS, New Delhi, 2014.
2. Dr. Darde P N, “Treatise on Hydropower Engineering ” Vayu Education of India, 2013.

Extensive Reading:

- http://www.gomezandsullivan.com/service/engineering
- https://www.pietrangeli.com/hydropower/engineering
- https://www.stantec.com/uk

23CEP08 FUNDAMENTALS OF SMART CITY PLANNING

Offered by CIV (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- The fundamentals of smart city planning.
- The policies related to smart city planning.
- The various types of urban smart city patterns.
- The planning of smart infrastructure facilities.
- The development control and management of smart cities.

Course Outcome:

At the end of the course, the students will be able to

- Plan for urban infrastructure and other developments in a smart city.
- Analyse the strategies for design of facilities in a smart city using the knowledge of planning policies.
- Apply strategies for design of the components of the smart city.
- Plan and manage the infrastructure facilities of a smart city.
- Evolve the required policies for controlling the smart city development.

Unit I SMART URBAN INFRASTRUCTURE 9

Urbanization - Urbanization trends in 20th century & growth of cities land uses - Conceptual foundations of sustainability in city planning - Smart city - Definition, conceptual approaches to smart cities - Energy efficiency, renewable energy and sustainable urbanism.

Unit II SMART CITY PLANNING PROCESSES 9

Planning policies - Theories - Standards of planning facilities for the city - Social issues in planning – Various development plans - Various development plans - Master plan - Role of external funding in planning of cities - Dimensions of smart cities - Global experience of smart cities.

Unit III STRATEGIES FOR SMART CITY DESIGN 9

Urban growth - Urban sprawl - Urban renewal and community development - Urban design - Types of cities - Sustainable Design of cities - Smart cities - Global standards and performance benchmarks - Case studies of smart cities - Chandigarh and Pondicherry - Strategies for smart growth.

Unit IV INFRASTRUCTURE PLANNING 9

Need and importance of infrastructure planning - 100 smart cities policy and mission implemented in India - Internet of things and smart infrastructure - Housing - Intelligent and sustainable mobility planning - Smart city sensors - Smart parking development - Projects of infrastructures and services in the smart cities - Financing smart cities - Case studies of Chennai & Delhi cities.

Unit V DEVELOPMENT AND MANAGEMENT OF SMART CITIES 9

Sustainable development - Environmental and energy planning - Conservation - Development control regulations - Bye laws in planning - Natural hazards & disasters - Smart city networks - Security at the smart city - Governance of smart cities - Case studies of Chennai city & Delhi city development.

Text Book:

1. Amitabh Satyam & Igor Calzada “The Smart City Transformations: The Revolution of The 21st Century”, Bloomsbury, New delhi.2017.
2. McClellan, Stan, Jimenez, Jesus, Koutitas, George (Eds.), “ Smart Cities-Applications, Technologies Standards, and Driving Factors”, Springer International Publishing 2018.

Reference Book:

1. Carol L. Stimmel, “Building Smart Cities: Analytics, ICT, and Design Thinking”, Auerbach Publications; 1 edition (August 13, 2015.
2. Houbing Song, Ravi Srinivasan,Tamim Sookoo,Sabina Jeschke , “Smart Cities: Foundations, Principles, and Applications”, Wiley Publications; 1 edition,2017.
3. Ingram, G., A. Carbonell, Y. Hong and A. Flint. “Urban Development Patterns and Smart Growth Policies”, Cambridge, MA, 2009.

Extensive Reading:

- Smart Cities Mission - http://smartcities.gov.in/content/
- Chennai Smart City - https://cscl.co.in/
- Building a Smart India - https://www.india.gov.in/spotlight/smart-cities-mission-step-towards-smart-india.

23CEP09 BASICS OF DYNAMICS AND SEISMIC DESIGN OF STRUCTURES

Offered by CIV (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- The fundamentals of SDOF system idealization and analysis.
- The analysis of MDOF system.
- The elements of engineering seismology, characteristics of earthquake and seismic instrumentation
- Analysis of earthquake force on a building subjected to earthquake.
- The design guidelines for earthquake resistant masonry buildings.

Course Outcome:

At the end of the course, the students will be able to

- Formulate the equation of motion for SDOF system and to evaluate the natural frequencies and mode shapes.
- Formulate the equation of motion for 2DOF system and to evaluate the natural frequencies and mode shapes.
- Explain the elements of engineering seismology, characteristics of earthquake and seismic instrumentation.
- Perform seismic analysis of structures for the determination of earthquake forces.
- Design earthquake resistant structures as per standard codes.

Unit I SINGLE DEGREE OF FREEDOM SYSTEM 9

Introduction to structural dynamics and its importance – types and sources of dynamic loads - Degree of freedom – Free and forced vibration - Idealization of structure as Single Degree of Freedom (SDOF) system – D'Alemberts Principles - Formulation of equation of motion for SDOF system - Evaluation of natural frequency - Effect of damping – Damped frequency and logarithmic decrement

Unit II MULTIPLE DEGREE OF FREEDOM SYSTEM 9

Two Degrees of Freedom: Equations of motion – Eigen value problem – free vibration response – forced vibration response to harmonic excitation – response to support motion – modal analysis - introduction to MDOF systems

Unit III SEISMOLOGY 9

Elements of Engineering Seismology – Seismic hazard - Earthquake phenomenon – Seismotectonics – Seismic Instrumentation – Characteristics of Strong Earthquake motion – Estimation of Earthquake Parameters – Soil Structure Interaction – Liquefaction of soil – Seismic zone map – Response spectra.

Unit IV EARTHQUAKE LOAD ANALYSIS 9

Design spectra - Planning considerations and Architectural concepts – Codal provision – Different methods of earthquake analysis – Analysis of structure by Equivalent static method and Response spectrum method – Introduction to time-history method of analysis

Unit V EARTHQUAKE RESISTANT DESIGN 9

Philosophy of earthquake resistant design - Design and detailing as per codal provisions - Design and detailing of typical flexural member and column member - Ductile detailing of beam-column joints and footing – Concept and principle of shear wall - Introduction to performance based seismic design - Seismic isolation principles and methods.

IS CODES:

1) IS: 1893(Part I)-2016 - Criteria for earthquake resistant design General provision & Building.

2) IS: 13920-2016 - Code of Practice for Ductile Detailing of RC Structures.

3) IS: 4326-2013 - Code of Practice for earthquake resistant design & Construction of buildings.

Text Book:

1. Pankaj Agarwal and Manish Shrikhande, "Earthquake Resistant Design of Structures", Prentice Hall of India Pvt. Ltd., New Delhi, 2011.
2. S.K.Duggal, "Earthquake Resistant Design of Structures", Oxford University Press, 2013.
3. Mario Paz, Structural Dynamics – Theory and Computations, Fifth Edition 2nd printing, CBS publishers, 2006.

Reference Book:

1. Chopra A K, "Dynamics of Structures - Theory and Applications to Earthquake Engineering", Pearson Education Ltd., 2019.
2. Clough R W and Penzien J, "Dynamics of Structures", McGraw Hill, INC, 1993.
3. Minoru Wakabayashi, Design of Earthquake Resistant Buildings, Mc Graw – Hill Book Company, 1986.
4. Moorthy.C.V.R., Earthquake Tips, NICEE, IIT Kanpur,2002

23CSP04 PROGRAMMING WITH JULIA

Offered by CSE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To learn basic primitives of Julia
- To study the basics of control flow and functions in Julia
- To introduce collection types in Julia
- To learn the metaprogramming and I/O in Julia
- To perform database and networking in Julia

Course Outcome:

At the end of the course, the students will be able to

- Write programs using primitives in Julia
- Develop simple programs in Julia using control flow and functions
- Implement collection types in Julia
- Write programs using metaprogramming and I/O in jula
- Implement database and networking concepts in Julia

Unit I INTRODUCTION TO JULIA **9**

Julia programming introduction – Installing Julia – Working with Julia's shell – Packages – Installing and working with Julia Studio – Installing and working with IJulia – Installing Juno - Variables, Types, and Operations - Naming conventions, and comments – Types – Integers - Floating point numbers - Elementary mathematical functions and operations - Rational and complex numbers – Characters – Strings - Formatting numbers and strings - Regular expressions - Ranges and arrays - Dates and times - Scope and constants

Unit II CONTROL FLOW AND FUNCTIONS **9**

Control Flow introduction - Conditional evaluation - Repeated evaluation - for loop - while loop - break statement - continue statement - Exception handling - Functions - Defining functions - Optional and keyword arguments - Anonymous functions - First-class functions and closures - Recursive functions - Map, filter, and list comprehensions - Generic functions and multiple dispatch

Unit III COLLECTION TYPES **9**

Collection Types – Matrices – Tuples – Dictionaries - Keys and values – looping – Sets - Making a set of tuples - More on Types, Methods, and Modules - Type annotations and conversions - Type conversions and promotions - The type hierarchy – subtypes and supertypes - User-defined and composite types - Types and collections – inner constructors - Type unions - Parametric types and methods - Standard modules and paths

Unit IV METAPROGRAMMING & I/O **9**

Expressions and symbols – Eval and interpolation – Defining macros : Testing – Debugging – Benchmarking – Starting a task – Reflection capabilities – Basic Input and Output – Working with files – Reading and writing CSV Files– Using DataFrames : Other file formats.

Unit V DATABASES & NETWORKING **9**

A basic view of databases - Interfacing to databases - Other considerations - Relational databases- Building and loading - Native interfaces - ODBC - Other interfacing techniques – DBI - SQLite – MySQL – PyCall - Sockets and servers - UDP and TCP sockets in Julia - Echo server - Named pipes - Cloud services - Introducing Amazon Web Services - The AWS.jl package - The Google Cloud.

Text Book:

1. Ivo Balbaert, "Getting Started with Julia Programming", Packt Publishing, 2015
2. Malcolm Sherrington, "Mastering Julia", Packt Publishing, 2015

Reference Book:

1. Sandeep Nagar, "Beginning Julia Programming For Engineers and Scientists", APress, 2017
2. Jalem Raj Rohit, "Julia Cookbook", Packt Publishing, 2016
3. Zacharias Voulgaris, "Julia for Data Science", Technics Publications, 2016

Extensive Reading:

- https://en.wikibooks.org/wiki/Introducing_Julia
- https://github.com/JuliaLang
- https://juliacomputing.com/

23CSP05 PROGRAMMING MASSIVELY PARALLEL PROCESSORS

Offered by CSE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To introduce data parallelism and CUDA C programming
- To instigate details of the parallel execution model of CUDA
- To present memory architecture of GPU
- To expound parallel computing patterns for data access locality
- To establish parallel patterns to a specific application.

Course Outcome:

At the end of the course, the students will be able to

- Write simple parallel CUDA C program
- Create, organize and bind threads for sophisticated CUDA programming
- Understand memory architecture for GPU programming
- Recognize use of constant memory and cache in GPU
- Identify alternative ways of formulating the basic structure of the parallel execution for real time applications

Unit I INTRODUCTION **8**

Introduction - Heterogeneous data parallel computing: Data parallelism - CUDA C program structure - A vector addition kernel - Device global memory and data transfer - Kernel functions and threading - Calling kernel functions - Compilation.

Unit II CUDA THREADS AND ARCHITECTURE **9**

Multidimensional grid organization - Mapping threads to multidimensional data - Image blur: a more complex kernel - Matrix multiplication - Compute architecture and scheduling.

Unit III MEMORY ARCHITECTURE AND DATA LOCALITY **9**

Importance of memory access efficiency - CUDA memory types - Tiling for reduced memory traffic - A tiled matrix multiplication kernel - Boundary Checks - Impact of memory usage on occupancy - Performance considerations.

Unit IV PARALLEL PATTERNS **9**

Convolution: An introduction to constant memory and caching – Background - Parallel convolution: a basic algorithm - Constant memory and caching - Tiled convolution with halo cells - Tiled convolution using caches for halo cells - Stencil - Parallel histogram - Reduction - Merge.

Unit V ADVANCED PATTERNS AND APPLICATIONS **10**

Sorting - Radix sort - Parallel radix sort - Optimizing for memory coalescing - Choice of radix value - Thread coarsening to improve coalescing - Parallel merge sort - Other parallel sort methods - Graph traversal.

Text Book:

1. Wen-mei W. Hwu, David B. Kirk, Izzat El Hajj, “Programming Massively Parallel Processors A Hands-on Approach”, Morgan Kaufmann, 4th Edition, 2022.

Reference Book:

1. Jason Sanders, Edward Kandrot, “CUDA by Example: An Introduction to General-Purpose GPU Programming”, Addison-Wesley, Reprint 2011.

Extensive Reading:

- https://github.com/h3ct0rjs/HighPerformanceComputing/tree/master
- https://github.com/tpn/pdfs/tree/master

23CSP06 CYBER CRIME AND LAWS

Offered by CSE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To become familiar with the fundamentals of Network and Network Security concept
- To study about various cyber crimes
- To understand the various cyber laws
- To explain the importance of digital evidence
- To understand the procedure for evidence acquisition and analysis

Course Outcome:

At the end of the course, the students will be able to

- Explore various network security issues
- Identify different types of cyber crimes
- Apply cyber laws against various cyber crimes
- Perform evidence collection on digital devices
- Work with various tools to analyze collected evidence

Unit I NETWORK CONCEPTS AND NETWORK SECURITY 8

Networking Architecture – Networking Technologies – Network Models – Networking Devices – LAN Technologies – Networking Topologies – TCP/IP Protocol Suite – Physical Layer – Data Link Layer – Network Layer: Addressing – Routing – ARP – ICMP – IPv4 – IPv6 – Transport Layer – Application Layer – Security Vulnerabilities in TCP/IP suite – Security Mechanisms in Network Layer – Network Layer Security – Transport Layer Security – Application Layer Security – Firewall – Intrusion Detection System – Intrusion Prevention System

Unit II INTRODUCTION TO CYBER CRIME AND CLASSIFICATION 9

Introduction – Role of Electronic Communication Devices in Cybercrime – Mens rea and Actusreus in Cybercrime – Types – Crimes associated with mobile electronic communication devices – Classification Cyber Criminals – Execution of Cybercrime – Tools used in Cybercrime – Factors influencing Cybercrime – Challenges to Cybercrime – Strategies to prevent cybercrime – Extent of Cybercrime – Classification: Cybercrime against individual – Cybercrime against Property – Cybercrime against Nation

Unit III FUTURE OF CYBER CRIME AND CYBER LAWS 9

Cyber War – Cryptocurrency – Bitcoin – Ethereum – Blockchain – Ransomeware – Deep Web and Dark Web – Deep Web Challenges – Cyber Laws: Need for Cyber Law – Cyber Laws and Legal Issues –Cyber Security – Strategies involved in Cyber Security – Minimizing risk with Cyber Laws – Cyber Laws in India and Case Studies – International Cyber Laws and Case Studies

Unit IV INTRODUCTION TO CYBER FORENSICS AND DIGITAL EVIDENCE 10

Cyber Forensics – Disk Forensics – Network Forensics – Wireless Forensics – Database Forensics – Malware Forensics – Mobile Forensics – Email Forensics – Memory Forensics – Digital Evidence: Evidence Collection Procedure – Source of Evidence – Digital Evidence from Computer and Electronic Communication Devices - OS and Boot process –File System – Windows registry – Artifacts – Evidence from Mobile Devices – Evidence from Internet

Unit V ACQUISITION AND ANALYSIS OF DIGITAL EVIDENCE 9

Preliminaries of Digital Evidence – Acquisition and Seizure of Evidence – Chain of Custody – Fourth Amendment and Seizure – Acquisition of Computer and Electronic Evidence – Challenges of Acquisition of Digital Evidence – Analysis: Capturing of Forensic copy from Memory and Hard drive using Toolkit Forensic Imager – RAM analysis – Analysing Hard drive – Working with Autopsy – Email Tracking and Tracing

Text Book:

1. Dejey, Murugan, "Cyber Forensics", Oxford Press, 2018

Reference Book:

1. John R. Vacca , “Computer Forensics, Computer Crime Investigation”, Firewall Media, New Delhi,2nd Edition, 2005
2. Nelson, Phillips Enfinger, Steuart, “Computer Forensics and Investigations”, Cengage Learning,4th Edition,2009
3. Christopher L.T. Brown , “Computer Evidence Collection & Presentation”, Firewall Media, 2th Edition,2009
4. Chad Steel, “Windows Forensics”, Wiley India Edition, 2006
5. Talat Fatima, “Cyber Law in India”, Wolters Kluwer”, 2017.
6. Sushma Arora, Raman Arora , “Cyber Crimes & Laws”, Taxmann Publishers, 2021.
7. Alex Alexandrou , “ Cybercrime and Information Technology“,Taylor & Francis, 2021.

Extensive Reading:

- http://www.sans.org/course/computer-forensic-investigations-windows-in-depth
- http://www.porcupine.org/forensics/forensic-discovery/

23ECP07 MULTIMEDIA COMPRESSION TECHNIQUES

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To discuss the special features of multimedia and evaluation techniques.
- To analyse various compression techniques for variety of sources like audio, image, text and video.
- To develop the ability to apply compression methodologies to different multimedia applications.

Course Outcome:

At the end of the course, the students will be able to

- Analyse the requirement for compression in multimedia.
- Apply various compression algorithms for text.
- Analyse various compression algorithms for audio & speech.
- Apply various algorithms for image compression as per standards.
- Apply various algorithms for video compression as per standards.

Unit I MULTIMEDIA CONCEPTS 9

Special features of Multimedia – Graphics and Image Data Representations –Fundamental Concepts in Video and Digital Audio –Storage requirements for multimedia applications –Need for Compression –Taxonomy of compression Techniques –Lossless and Lossy compression Models – Coding-Uniquely Decodable, Prefix codes-Kraft-McMillan Inequality- Mathematical preliminaries for lossy compression.

Unit II TEXT COMPRESSION 9

Compaction techniques –– Shannon Fano coding - Huffman coding- Minimum Variance Huffman coding –Adaptive Huffman Coding –Arithmetic coding–Dictionary techniques –LZW family algorithms.

Unit III AUDIO AND SPEECH COMPRESSION 9

Audio compression techniques: μ Law and A Law companding –DCT based Audio Compression- MPEG Audio Coding - Advanced Audio Coding - Speech Coding: G.726 – Silence Compression- Speech Compression techniques – Channel-Formant and CELP Vocoders.

Unit IV IMAGE COMPRESSION 9

Predictive techniques – DPCM, DM – Adaptive Prediction and Adaptive Quantization – Transform Coding – Transforms of interest - JPEG Standard-Basic Sub band coding algorithm –Wavelet based compression Implementation using filters – EZW, SPIHT coders – JPEG 2000 – JBIG, JBIG2 standards.

Unit V VIDEO COMPRESSION 9

Motion estimation and compensation techniques - Video compression techniques and standards – H.261 Standard - MPEG-I Video Standard – MPEG-2 Video Standard (H.262)– MPEG 4– Packet Video.

Text Book:

1. Khalid Sayood, “Introduction to Data Compression”, 4th Edition, Morgan Kauffmann Publications, 2017.
2. Yun Q.Shi and Huifang Sun, “Image and Video Compression for Multimedia Engineering Fundamentals, Algorithms & Standards”, 3rd Edition, CRC press, 2021

Reference Book:

1. David Salomon, “Data Compression –The Complete Reference”, Springer (India) Pvt.Ltd, 2011.
2. Peter Symes, “Digital Video Compression”, McGraw Hill, 2003.
3. Mark S.Drew and ZeNianLi, “Fundamentals of Multimedia”, Springer Nature, 2014.

Extensive Reading:

- https://www.researchgate.net/publication/265661965_A_Comparative_Study_Of_Text_Compression_Algorithms.
- https://www.javatpoint.com/jpeg-compression
- https://www.mistralsolutions.com/articles/video-compression-standards-pros-cons/
- https://nptel.ac.in/courses/117105083.

23ECP08 DATA HIDING TECHNIQUES

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To be aware of different cover media available and the ways and means for steganographic embedding.
- To know the need for steganalytic–aware steganography.
- To be familiar with steganographic and watermarking applications.

Course Outcome:

At the end of the course, the students will be able to

- Analyze the pros and cons of hiding information in various media.
- Characterize the steganographic channel created due to different steganographic techniques.
- Deploy the right steganographic software for the problem at hand.
- Apply the appropriate steganographic and watermarking technique for a given problem scenario.
- Apply different steganographic procedures for societal applications.

Unit I STEGANOGRAPHIC COVER MEDIA 9

Data Hiding – Properties of Steganographic Communications –Methods for hiding information – Hiding in text – Disk space – Network Packets – Software and Circuitry – audio and images – Hiding information in images – Hiding data in the noise – Watermarking Techniques.

Unit II STEGANOGRAPHIC TECHNIQUES 9

Stegnaography by Cover Selection – Synthesis and Modification – Naïve Steganography – LSB embedding – LSB Matching (±1 embedding) – Palette Embedding –Distortionless Embedding – QIM – Spread Spectrum – Model preserving steganography – Matrix Embedding using binary Hamming Codes.

Unit III STEGANOGRAPHIC CHANNEL AND SOFTWARE 9

The Steganographic Channel – Frameworks for Data Hiding – Signal Processing Framework – Data Hiding from a Communications Perspective – Relationship between Communications and Signal Processing Frameworks – Issues in Information Hiding. EzStego – Hide and Seek – Hide4PGP- Jsteg-Jpeg – Mandelsteg- Steganos- Stego Dos- S-Tools.

Unit IV ATTACKS ON STEGANOGRAPHY AND WATERMARKING 9

Techniques for detecting hidden information – Code words, Typical approaches – Visual attacks, aural attacks, statistical attacks, structural attacks – Detecting signatures in stego images – Removal attacks –Desynchronization attacks – Cryptographic Attacks – Protocol Attacks.

Unit V STEGANOGRAPHIC APPLICATIONS 9

Covert Communication – Privacy with Electronic Patient Record(EPR) – Content Authentication – Copyright Protection –Steganalysis for Forensic investigation.

Text Book:

1. Husrev T. Sencar, Ramkumar Mahalingam, Ali N. Akansu, “Data Hiding Fundamentals and Applications: Content Security in Digital Media”, Academic Press Inc, 2004.
2. Neil F. Johnson, ZoranDuric and SushilJajodia, “Information Hiding: Steganography and Watermarking –Attacks and Countermeasures”, Springer, 2001.

Reference Book:

1. Peter Wayner, “Disappearing Cryptography: Information hiding: Steganography & watermarking”, 3rd Edition, Morgan Kaufmann Publishers, 2009.
2. Jessica Fridrich, “Steganography in Digital Media: Principles, Algorithms and Applications”, Cambridge University Press, 2010.

Extensive Reading:

- nptel.ac.in/courses/106105031/2
- www.ws.binghamton.edu/fridrich/
- http://www.jjtc.com/neil/

23ECP09 QUADCOPTER AND ITS APPLICATIONS

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand flight dynamics and the anatomy of Quadcopter.
- To assemble and control the operations of Quadcopter.
- To design Quadcopter and implement them for real world applications.

Course Outcome:

At the end of the course, the students will be able to

- Apply the concept of flight dynamics for building Quadcopter.
- Assemble, program and configure the Quadcopter.
- Perform testing and control operations on the Quadcopter.
- Apply control mechanism to track and control Parallax ELEV-8 Quadcopter.
- Build and use Quadcopter for real world applications.

Unit I FLIGHT DYNAMICS OF AERIAL VEHICLES 9

Definitions of Drone, UAV, RPA, Quad copters -Basic Components and Categories – Principles of Flight - Flight Maneuvers – Airframes - Creating a Frame: Materials, Different Frame Shapes – Building Airframes - Flight dynamics - Applications - Future potential - Comparison with other aerial vehicles

Unit II HARDWARE ANATOMY OF QUADCOPTER 9

Power Train – Propellers, Motors- Total Lift - Electronic Speed Controllers – Flight Battery – Radio transmitter and receiver – Flight Controller – GPS, Compass, Camera Assembling for Quad copter – Connectors, Mounting of Propellers and Powering up.

Unit III TESTING AND MAINTENANCE OF QUADCOPTER 9

Key Flight Safety Rules - Preflight Checklist and Flight Log Information – Flight Instructions - Repair and Maintenance: Crash analysis, Common issues, Voltage testing.

Unit IV PARALLAX ELEV-8 QUADCOPTER 9

Parallax Open Source Project - Building the Elev-8 Quadcoptor – Programming the Parallax Propeller Chip – Propulsors – Radio Controlled Systems and Telemetry – Servo Control Systems – Tracking and Performance Checks.

Unit V REAL WORLD APPLICATIONS AND CASE STUDIES 9

Beneficial Drones, Aerial Photography, Mapping and Surveying, Precision Agriculture, Search and Rescue, Infrastructure Inspection, Conservation. Case Studies: Agriculture Weed Classification, Microdrone surveillances.

Text Book:

1. Terry Kilby and Belinda Kilby, “Make:Getting Started with Drones “,Maker Media, Inc, 2016
2. Vasilis Tzivaras, “Building a Quadcopter with Arduino”, Packt Publishing, 2016.

Reference Book:

1. Donald Norris, “Build Your Own Quadcopter-Power Up Your Designs with the Parallax Elev-8”, McGraw-Hill Education, 2014
2. Baichtal, “Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs”, Que Publishing, 2016.
3. Austin, Unmanned Aircraft Systems: UAVS Design, Development and Deployment. Wiley, 2010.
4. Sebbane, Smart Autonomous Aircraft: Flight Control and Planning for UAV. CRC Press, 2015.
5. Zavrsnik, Drones and Unmanned Aerial Systems: Legal and Social Implications for Security and Surveillance. Springer, 2015.

Extensive Reading:

- https://www.dronezon.com/learn-about-drones-quadcopters/
- http://ardupilot.org/copter/docs/advanced-multicopter-design.html

23ECP10 ESSENTIALS OF SEMICONDUCTOR IC TESTING

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To acquire knowledge about the architecture of a generic mixed-signal Automatic Test Equipment (ATE).
- To examine the process of test programs generation from device data sheet to test plan.
- To understand the statistical analysis of measurement results and display formats.

Course Outcome:

At the end of the course, the students will be able to

- Describe the need for IC testing and its associated hardware.
- Illustrate the procedures followed in testing IC.
- Measure AC and DC parameters for digital circuits.
- Explain the techniques for analog and mixed-signal design for test.
- Write the benchmark program for DUT to identify faulty digital circuits and visualize the results.

Unit I FUNDAMENTALS OF SEMICONDUCTOR IC TESTING 9

IC Packaging Types - Design and manufacturing cycle of an IC – Manufacturing defects in an IC – Mixed-Signal Testing Challenges - Automated Test Equipment and its components - Load boards, Probe cards, Handlers, Probers, Tester Hardware - DC Resources, Digital Subsystem, AC Source and Measurement, Time Measurement System, RF Subsystem, Computing Hardware.

Unit II AUTOMATIC TEST EQUIPMENT ARCHITECTURE 9

Architecture of a mixed signal ATE – Digital subsystem, Clock, Waveform generators, digitizers. Digital subsystem – Drivers, Comparators, PMU, Timing and formatting units, Sequence controller, ATE Pin Electronics. - Project Plan, Specifications and Test Program - Test Plan Specifications – Design Test, Devices, Sample Test Program – Types, Considerations, Test Flow, Binning - Specifications from electronic-device data sheets.

Unit III DC AND AC PARAMETRIC MEASUREMENTS 9

Continuity Test Technique - Leakage Test Technique - Supply Current Tests and Test Technique-DC References and Regulators - DC Tests for Digital Circuits- Short-Circuit Current - AC Timing Tests - Setup Time, Hold Time, Propagation Delay - ATE Time Measurement Subsystem - Timing Calibration.

Unit IV MIXED SIGNAL TESTING 9

Sampling Theory – Nyquist Theorem, Coherency Formula - Frequency Domain Analysis - Generic Mixed Signal Tester Architecture – AWG and Digitizer - ADC and DAC Basic - Static Test – Histogram method - Dynamic Test – SNR, THD, SINAD.

Unit V DATA ANALYSIS AND VISUALIZATION 9

Debug Tools and data analysis, Characterization methods – Tools – Datalog, Histogram, Shmoo, pin margin, Pattern Debugger, Waveform Tool. Trouble Shooting Techniques – Statistical process control, process capability, Process capability index, Standard deviation, mean, six sigma quality, gauge repeatability and reproducibility, guard banding, Gaussian statistics.

Text Book:

1. Mark burns & Gordon W Roberts, “An Introduction to mixed-signal IC test and measurement”, Oxford University Press, 2nd Edition, 2008.
2. Michael L. Bushnell & Vishwani D. Agrawal, “Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits” Springer, 2013

Reference Book:

1. William J. Greig, “Integrated Circuit Packaging, Assembly and Interconnections”, Springer, 2007.
2. Artur Balasinki, “Semiconductors: Integrated Circuit Design for Manufacturability”, CRC Press, 1st Edition, 2011.

Extensive Reading:

- https://archive.nptel.ac.in/courses/117/105/117105137/

23ECP11 QUANTUM CIRCUIT DESIGN

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the mathematical model of quantum computation.
- To design quantum circuits using quantum gates.
- To analyze the quantum algorithms and quantum errors.

Course Outcome:

At the end of the course, the students will be able to

- Understand the mathematical behaviour of qubits.
- Design the quantum circuits using quantum thermos and gates.
- Design and analysis of quantum algorithms.
- Find the errors in the quantum codes.
- Design of Fault tolerant quantum systems.

Unit I SPIN, LINEAR ALGEBRA AND QUBITS 9

Spin, The Quantum Clock, Measurements, Randomness, Photons and Polarization - Linear Algebra, Scalar Multiplication, Orthogonal Vectors, Bra-Kets and Lengths, Matrices, Matrix Computations, Orthogonal and Unitary Matrices

Qubits: Mathematics of Quantum Spin, Equivalent State Vectors, The Mathematical Model for Photon Polarization, The Basis Associated with a Given Polarization Direction, Qubits, Alice, Bob, and Eve

Unit II CLASSICAL, QUANTUM GATES AND CIRCUITS 9

Boolean Algebra, Functional Completeness, Classical Gates & Circuits, Computation and Memory, Reversible Computation, Billiard Ball Computing – Qubits, CNOT - Quantum Gates - No Cloning Theorem, The Bell Circuit - Superdense Coding - Quantum Teleportation - Error Correction

Unit III QUANTUM ALGORITHMS 9

The Complexity Classes P and NP, Deutsch's Algorithm - The Kronecker Product of Hadamard Matrices - The Deutsch-Jozsa Algorithm - Simon's Algorithm - Complexity Classes - Shor's Algorithm and Cryptanalysis - Grover's Algorithm and Searching Data - Quantum Supremacy and Parallel Universes.

Unit IV QUANTUM ERROR CORRECTION 9

Quantum Error Correcting Codes, Single Bit-Flip Errors, Single-Qubit Phase-Flip Errors, All Single-Qubit Errors - Framework for Quantum Error Correcting Codes, Quantum Error Correcting Codes, Correctable Sets of Errors for Quantum Codes, Diagnosing and Correcting Errors Using Quantum Codes, Computing on Encoded Quantum States, Quantum Independent Error Models - CSS Codes, The Steane Code - Stabilizer Codes - CSS Codes as Stabilizer Codes

Unit V FAULT TOLERANCE AND ROBUST QUANTUM COMPUTING 9

Setting the Stage for Robust Quantum Computation - Fault-Tolerant Computation Using Steane's Code, The Problem with Syndrome Computation, Fault-Tolerant Syndrome Extraction and Error Correction, Fault-Tolerant Gates for Steane's Code, Fault-Tolerant Measurement - Robust Quantum Computation, Concatenated Coding, A Threshold Theorem.

Limitations of Quantum Computing - Alternatives to the Circuit Model of Quantum Computation - Quantum Protocols - Insight into Classical Computation - Building Quantum Computers

Text Book:

1. Chris Bernhardt, "Quantum Computing for Everyone", The MIT Press, 2019.
2. Eleanor Rieffel and Wolfgang Polak, "Quantum Computing A Gentle Introduction", The MIT Press, 2011

Reference Book:

1. George F Viamontes, Igor L Markov and John P Hayes, "Quantum Circuit Simulation", Springer, 2009.
2. Michael A Nielsen and Isaac L Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, 2010.
3. Phillip Kaye, Raymond Laflamme and Michele Mosca, "An Introduction to Quantum Computing", Oxford University Press, 2007.

Extensive Reading:

- https://quantumai.google/qsim/tutorials/qsimcirq
- https://quantiki.org/wiki/list-qc-simulators
- https://onlinecourses.nptel.ac.in/noc21_cs103/

23ECP12 TOTAL QUALITY MANAGEMENT

Offered by ECE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Identify the purpose and need for TQM activities .
- To develop an insight and understanding of Strategic Management .
- To develop quality assessment skills.

Course Outcome:

At the end of the course, the students will be able to

- Explain the principle of TQM concepts and peculiarities of their implementation.
- Assess the quality of products and services.
- Develop in-depth knowledge on various tools and techniques of quality management.
- Handle Quality Function Deployment.
- Prepare for accreditation by NBA, NACC.

Unit I NEED FOR QUALITY MANAGEMENT **9**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality - Quality statements - Basic concepts of TQM - Definition of TQM – TQM Framework - Contributions of Deming, Juran and Crosby – Barriers to TQM – Cost of Quality – Factors affecting TQM environment.

Unit II PRINCIPLES OF QUALITY MANAGEMENT **9**

Customer focus –Customer orientation, Customer satisfaction, Customer complaints, Customer retention - Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal - Continuous process improvement – PDSA cycle, 5s, Kaizen, Just-In-Time and TPS - Supplier partnership – Partnering, Supplier selection, Supplier Rating.

Unit III TOOLS & TECHNIQUES **9**

The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT – Bench marking – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

Unit IV TQM PERFORMANCE **9**

Quality circles – Quality Function Deployment (QFD) – Benefits of QFD - Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures, Washington Accord, Blooms Taxonomy.

Unit V QUALITY SYSTEMS **9**

Need for ISO 9000 and Other Quality Systems - ISO 9001:2015 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14001:2004 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT, NBA, NAAC.

Text Book:

1. Dale H.Besterfiled, et at., “Total Quality Management”, Pearson Education Asia, 3rd Edition, Indian Reprint (2006).
2. James R.Evans& William M.Lidsay, “The Management and Control of Quality”, 9th Edition South-Western (Thomson Learning)

Reference Book:

1. James R. Evans and William M. Lindsay, “The Management and Control of Quality”, 6th Edition, South-Western (Thomson Learning), 2005.
2. Oakland, J.S., “TQM – Text with Cases”, Butterworth – Heinemann Ltd., Oxford,3rd Edition, 2003.
3. Suganthi,L and Anand Samuel, “Total Quality Management”, Prentice Hall (India) Pvt. Ltd.,2006.
4. Janakiraman, B and Gopal, R.K, “Total Quality Management – Text and Cases”, Prentice Hall (India) Pvt. Ltd., 2006.

Extensive Reading:

- http://www.ibc.apqc.org/
- http://www.brint.com/BPR.htm
- http://www.qfdi.org/
- http://www.quality.org//
- http://www.wineasy.se/QMP/
- https://swayam.gov.in/nd1_noc20_mg34/

23EEP03 PLC AND INDUSTRIAL AUTOMATION

Offered by EEE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Understanding the basic PLC terminologies, digital principles, PLC architecture, and operation.
- Acquire familiarity with various programming languages used in PLC systems.
- Develop proficiency in creating PLC logic for simple applications using ladder logic.
- Gain exposure to the communication architecture employed in PLC/SCADA systems.
- Design of simple real world applications

Course Outcome:

At the end of the course, the students will be able to

- Demonstrate a solid understanding of fundamental PLC terminologies, digital principles, as well as the architecture and operation of PLC systems.
- Explain various instructions used in PLC systems.
- Apply their knowledge to develop PLC logic for straightforward applications using ladder logic.
- Upon completion, students will possess insights into the communication architecture utilized in PLC/SCADA systems, enabling them to comprehend and navigate these networks effectively.
- Able to develop a PLC logic for a specific application on real world problem

Unit I PROGRAMMABLE LOGIC CONTROLLERS 9

Evolution of PLC – Sequential and Programmable controllers – Architecture of PLC-PLC Hardware components: I/O modules, CPU, Memory–PLC Programming devices-Memory allocation and Addressing, PLC Scan CaEvolution of PLC – Sequential and Programmable controllers – Architecture of PLC-PLC Hardware components: I/O modules, CPU, Memory–PLC Programming devices-Memory allocation and Addressing, PLC Scan Cycle.ycle.

Unit II PROGRAMMING PART - I 9

Programming Methods: Ladder logic, Instruction list, Sequential function chart- NO/NC & RLO Concept – Bit Logic Instructions - Programming timers and counters using ladder logic – math instructions, Program control instructions.

Unit III PROGRAMMING PART - II 9

Symbolic Name - Local Variables – Function and Function Blocks, Instance Data block, Shared Data Block–Single Instance and Multiple Instance – Analog Signal Processing in PLC – Scaling & Normalising, Program Debugging – Cross references – Call structure – Assignment list.

Unit IV COMMUNICATION OF PLC AND SCADA 9

Communication Protocol – Modbus, HART, Profibus-SCADA: Hardware and software, Remote terminal units, Master Station and Communication architectures

Unit V APPLICATIONS 9

Development of control logic for: hoist control - Automatic control of water pump- Air compressor- Conveyor system- bottle filling system.

Text Book:

1. Frank Petruzella, “Programmable Logic Controllers” McGraw-Hill Education – Fourth Edition, 2010.
2. SIMATIC Programming with STEP 7 Manual.

Reference Book:

1. SIMATIC S7-300 & S7-400 PLC Programming Manual.
2. W. Bolton, “Programmable Logic Controllers” Newnes, Sixth edition 2015.
3. BISWANATH PAUL, “Industrial Electronics and Control Including Programmable Logic Controller”, Prentice-Hall of India Private Limited – Third Edition, 2014.
4. John W. Webb, Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications” PrenticeHall, 2003.
5. Jon Stenerson, “Programmable Logic Controllers with ControlLogics”, DELMAR Cengage Learning

23EEP04 ADVANCED OPTIMIZATION TECHNIQUES

Offered by EEE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The various classical optimization techniques
- The different advanced optimization techniques to solve engineering problems.
- Multi-objective optimization to solve real world problems.

Course Outcome:

At the end of the course, the students will be able to

- Explain the concepts of classical optimization techniques and apply them for solving engineering problems.
- Explain the concept of Genetic Algorithm and apply it for solving optimization problems.
- Explain the concept of Particle Swarm Optimization and apply it for solving optimization problems.
- Explain the concepts of Tabu search algorithm, Ant colony optimization, Bacteria Foraging optimization and Artificial immune system.
- Explain the concept of Multi-objective optimization and apply it for solving real world problems.

Unit I FUNDAMENTALS OF OPTIMIZATION 9

Definition - Classification of optimization problems - Unconstrained and Constrained optimization - Optimality conditions - Classical Optimization techniques - Linear and non linear programming - Quadratic programming - Mixed integer programming.

Unit II EVOLUTIONARY COMPUTATION TECHNIQUES 9

Evolution in nature - Fundamentals of Evolutionary algorithms - Principle of Genetic Algorithm - Evolutionary Strategy and Evolutionary Programming - Genetic Operators - Selection, Crossover and Mutation - Issues in GA implementation – GA applications.

Unit III PARTICLE SWARM OPTIMIZATION 9

Fundamental principle - Velocity updation - Parameter selection- Binary, Discrete and combinatorial PSO - Implementation issues - Convergence issues - applications.

Unit IV OTHER OPTIMIZATION METHODS 9

Principle, Algorithm, Flowchart -Tabu search algorithm - Ant colony optimization - Bacteria Foraging optimization - Artificial immune system.

Unit V MULTI-OBJECTIVE OPTIMIZATION 9

Concept of Pareto optimality - Conventional approaches for MOO - Weighted Sum and Constrained methods – Multi-objective GA - Fitness assignment - Multi-objective PSO - Necessity for multi-criteria decision making.

Text Book:

1. Kalyanmoy Deb, “Optimization for Engineering Design - Algorithms and Examples”, Prentice Hall of India, 1995.
2. KwangY.Lee, Mohammed A.El Sharkawi, “Modern heuristic optimization techniques”, John Wiley and Sons, 2008.

Reference Book:

1. Kalyanmoy Deb, “Multi objective optimization using Evolutionary Algorithms”, John Wiley and Sons, 2008.
2. Carlos A.CoelloCoello, Gary B.Lamont, David A.VanVeldhuizen, “Evolutionary Algorithms for solving Multi Objective Problems”, 2nd Edition, Springer, 2007.
3. Padhy N.P., Simon S.P., “Soft Computing with MATLAB Programming, Oxford University Press, 2015.

23EEP05 PRINCIPLES OF MANAGEMENT

Offered by EEE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To attain fundamental concept, theory about management, including the basic roles, skills and functions of management
- To envision managerial skills, leadership along with engineering background for students
- To coordinate role of managers in organization
- To describe the importance of employee motivation
- To establish the process of communication and effective control

Course Outcome:

At the end of the course, the students will be able to

- Apply the evolution of management and recent contribution to management thought.
- Describe the concept of strategic management, strategic planning process and policies.
- State the role of an organisation in managing business activities
- Evaluate the theories of leadership
- Detect key problems in controlling process and recommend effective control system

Unit I MANAGEMENT THEORY AND SCIENCE 9

Definition of Management – Management and Administration- Management functions – Science or Art — Development of Management Thought – Contribution of Taylor and Fayol – Management & Society: Social Responsibility – Ethics in management.

Unit II PLANNING 9

Definition – Nature & Purpose – Types of planning - Steps involved in Planning – Objectives – Setting Objectives – Process of Managing by Objectives – Strategies, Policies & Planning Premises- Forecasting – Decision-making.

Unit III ORGANIZING 9

Definition – The nature and Purpose of organization – Organization levels and the span of Management – Departmentation – Line/Staff Authority – Centralization – Decentralization – Effective organization & Organizational culture – Staffing – Managerial Job – An overview of staffing function (selection process, techniques and instruments) – Performance appraisal and career strategy – HRD.

Unit IV LEADING 9

Human factors in Managing – Behavioral models – Creativity and innovation – Motivational theories –techniques – Job enrichment – Leadership Behaviors & styles – Communication – Communication process – Electronic media in Communication - Barriers and breakdowns in communication – Effective communication.

Unit V CONTROLLING 9

The system and process of Controlling – Control Technique – Information Technology – Productivity & Operation Management – Overall Preventing Control – Direct and Preventive Control - Globalization and Liberalization - International Management –Global Management Theory.

Text Book:

1. Harold Koontz and Heinz Weihrich, “Essentials of Management- An International Perspective”, McGraw- Hill, 8th Edition, 2010.
2. Harold Koontz, Heinz Weihrich and A Ramachandra Aryasri “Principles of Management”, McGraw- Hill, 2nd Edition, 2016.
3. Stephen P.Robbins and David A.Decenzo, “Management”, Pearson Education, 10th Edition, 2016.

Reference Book:

1. Tim Hannagan, “Management Concepts and Practices”, Pearson Education, 5th Edition 2013.
2. P C Tripathy and P N Reddy “Principles of Management”, McGraw- Hill, 6nd Edition, 2017.
3. Charles W L Hill and Steven L McShane “Principles of Management”, McGraw- Hill, Special Indian Edition, 2017.
4. Hellriegel, Jackson and Slocum, “Management: A competency – Based Approach” South Western, 9th Edition 2002.
5. Fraidoon Mazda, “Engineering Management”, Addison Wesley,-2000.

23EEP06 PROFESSIONAL ETHICS AND HUMAN VALUES

Offered by EEE (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Engineering Ethics, Human Values & instill moral values, social values and Loyalty.
- the rights of others
- the codes of conduct for engineers in the society,
- the responsibilities, professional rights and moralities for the enhancement of an organization.
- the global issues

Course Outcome:

At the end of the course, the students will be able to

- Obtain awareness on Engineering Ethics, Human Values & instill moral values, social values and Loyalty.
- Appreciate the rights of others
- Practice the codes of conduct for engineers in the society,
- Realize their responsibilities, professional rights and moralities for the enhancement of an organization.
- Familiar with the global issues.

Unit I HUMAN VALUES AND ENGINEERING ETHICS 9

Morals, Values and Ethics - Work Ethic - Team work - Service Learning - Respect for Others - Living Peacefully – Honesty - Courage - Valuing Time - Co-operation –Commitment -Self-Confidence -Customs and religion - Senses of Engineering Ethics - Variety of moral issues -Types of inquiry, Moral dilemmas and Moral Autonomy - Kohlberg's Theory -Gilligan's Theory - Case studies and moral stories.

Unit II ENGINEERING AS SOCIAL EXPERIMENTATION 9

Engineering as experimentation - Engineers as responsible experimenters - Codes of ethics - Sample code of conduct (Specific to a particular engineering discipline) - A balanced outlook on Law - The Challenger case study.

Unit III RESPONSIBILITIES AND RIGHTS 9

Collegiality and loyalty - Respect for Authority -Collective Bargaining – Confidentiality - Conflicts of Interest (Whistle Blowing) – Occupational Crime.

Professional Rights- Employee Rights- Intellectual Property Rights (IPR) - Case studies.

Unit IV SAFETY AND RISK 9

Safety and risk - Assessment of safety and risk - Risk Benefit Analysis - Reducing risk - The Three Mile Island and Chernobyl disaster - Bhopal gas tragedy - Fukushima Daiichi Nuclear disaster case studies.

Unit V GLOBAL ISSUES 9

Multinational corporations – Environmental Ethics - Computer Ethics - Weapons Development - Engineers as Managers and Consulting Engineers - Engineers as Expert Witnesses and Advisors - Moral Leadership - Case studies.

Text Book:

1. Mike Martin and Roland Schinzinger, "Ethics in Engineering", Tata McGraw Hill, New Delhi, 4th Edition, 2014.

Reference Book:

1. Jayshree suresh, B.S.Raghavan,"Human values and professional ethics," S.Chand&company Ltd, New Delhi, 2th Edition, 2007.
2. Kiran D.R," Professional ethics and Human values," Tata McGraw Hill, New Delhi, 2007.
3. Charles D. Fleddermann, "Engineering Ethics", Pearson Education/ Prentice Hall, New Jersey, 2004 (Indian Reprint).
4. Charles E Harris, Michael S. Pritchard and Michael J Rabin's, "Engineering Ethics – Concepts and Cases", Wadsworth Thompson Learning, United States, 2000 (Indian Reprint).
5. John R Boatrigh t, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
6. Edmund G See Bauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.
7. David Ermann and Michele S Shauf, "Computers, Ethics and Society", Oxford University Press, 2003.
8. Govindarajan M, Natarajan S, Senthil Kumar V. S, " Engineering Ethics", Prentice Hall of India, New Delhi, 2004

23ITP06 INNOVATION AND ENTREPRENEURSHIP

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basic concepts, role, functions and processes of human resource management
- To be aware of the HRM practices, HR planning, Training, promotion, demotion and transfer activities
- To know about performance evaluation and appraisal systems, compensation and incentives
- To understand the concept and the process of entrepreneurship
- To learn the managing skills for the enterprise

Course Outcome:

At the end of the course, the students will be able to

- Plan the human resources for the given jobs
- Identify suitable training methods, promotion/demotion planning for the given situation
- Evaluate the performance of human resources for appraisal
- Develop entrepreneurial personality using EDP
- Identify the opportunities for developing small scale industries

Unit I INTRODUCTION TO HUMAN RESOURCE MANAGEMENT 9

Evolution of human resource management – Definition, scope and objectives of human resource management – Functions of human resource department – Human resource planning- job analysis - job design - job evaluation – Recruitment and selection process.

Unit II CAREER PLANNING, TRAINING AND DEVELOPMENT 9

Introduction – Promotion: Types, programme and procedure, Promotion system and policy –Demotion – Transfer: Policy and Procedure – Career planning – Employee training and development – Introduction – Need and Importance of training – Concept of training – Steps in training – Types of training methods – Executive development : Introduction – Executive development programmes.

Unit III PERFORMANCE EVALUATION AND ADMINISTRATION 9

Introduction – Methods for appraisal performance – Components of appraisal evaluation – Problems of appraisal – Solutions – Ethics of appraisal – Wage and salary administration –Nature and purpose – Wages: types, determination process, factors influencing wage – Compensation – Incentives.

Unit IV ENTREPRENEURSHIP DEVELOPMENT 9

Introduction – Entrepreneurship Concept – Entrepreneurship as a career – Entrepreneurial personality – Characteristics of successful Entrepreneur – Factors affecting entrepreneurial growth – Entrepreneurial Motivation – Competencies – Mobility – Entrepreneurship Development Programmes (EDP).

Unit V LAUNCHING OF SMALL ENTERPRISE 9

Definition, Characteristics – Relationship between small and large units – Opportunities for an Entrepreneurial career – Role of small enterprise in economic development – Problems of small scale industries – Institutional finance to entrepreneurs - Institutional support to entrepreneurs – Total Quality Management for small Enterprises

Text Book:

1. C.B.Mamoria and S.V.Gankar, “A Text Book of Human Resource Management”, Himalaya Publishing Company, Seventh edition, 2013.
2. S.S Khanka, “Entrepreneurial Development”, S.Chand & Company LTD, New Delhi, 2007.

Reference Book:

1. Decenzo and Robbins, “Human Resource Management”, Wiley, Eighth Edition, 2007.
2. Dessler, “Human Resource Management”, Pearson Education Limited, 2007
3. Bernadin, “Human Resource Management”, Tata Mcgraw Hill, Sixth edition, 2006.
4. Eugence Mckenna and Nic Beach, “Human Resource Management”, Pearson Education Limited, 2007.
5. Hisrich, “Entrepreneurship”, Tata McGraw Hill, New Delhi, 2001.
6. P.Saravanavel, “Entrepreneurial Development”, Ess Pee kay Publishing House, Chennai - 1997.

Extensive Reading:

- http://www.mu.ac.in/myweb_test/M.Com.%20Study%20Material/Human%20Res.%20Management%20-%20M.%20Com%20-%20I.pdf
- http://www.csb.gov.hk/english/publication/files/e-hrmguide.pdf
- https://www.uop.edu.jo/Repository/41/Strategic%20Human%20Resource%20Management.pdf
- https://biblio.ugent.be/input/download?func=downloadFile&recordOId=873189&fileOId=1134952
- http://www.ljmu.ac.uk/secretariat/docs/Getting_to_Grips_HR_Management.pdf

23ITP07 INTELLECTUAL PROPERTY RIGHTS

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Understand the basic types of Intellectual property
- Recognize the relevant criteria for generating and protecting intellectual works
- Understand the relevance and impact of IP Law on academic/scientific works/studies
- Recognize the intellectual property likely to be produced in the academic and professional environment

Course Outcome:

At the end of the course, the students will be able to

- Infer the fundamental legal principles relating to patents
- Express the use of copyrights and trademarks
- Interpret the laws of trade secrets and unfair competition
- Make use of the patent application
- Familiarize with recent developments in copyright laws

Unit I INTRODUCTION **9**

Invention and Creativity – Intellectual Property – Importance –Types of IPRs- Protection of IPR – Basic types of property - Movable Property - Immovable Property - Intellectual Property- Patents

Unit II THE LAW OF TRADEMARK AND COPYRIGHT **9**

Introduction to Trade mark – Trade mark Registration Process – Post registration Procedures – Trade mark maintenance - Transfer of Rights - Inter partes Proceeding- Infringement - Dilution of Trade mark –Trademarks claims –International Trade mark Law Introduction to Copyrights – Principles of Copyright -The subjects Matter of Copy right – The Rights Afforded by Copyright Law – Copy right Ownership, Transfer and duration -International Copyright Law

Unit III THE LAW OF TRADE SECRETS AND UNFAIR COMPETITION **9**

Introduction to Trade Secret – Maintaining Trade Secret – Physical Security –Employee Limitation - Employee confidentiality agreement - Trade Secret Law -Unfair Competition – Trade Secret Litigation – Breach of Contract – Applying State Law

Unit IV PATENT AND INTERNATIONAL CONVENTION **9**

Concept of Patent- Procedure for Filing of Patent Application and types of Applications- Procedure for Opposition- Revocation of Patents- Patent Agent- Qualification and Registration Procedure-Preparation of Patent document- Recent Developments in Patent System International convention relating to Intellectual Property – Establishment of WIPO – Mission and Activities -General Agreement on Trade and Tariff (GATT)- Indian Position Vs WTO and Strategies – Indian IPR legislations – commitments to WTO

Unit V NEW DEVELOPMENTS IN COPYRIGHT LAW **9**

Copyright Protection for Computer Programs- Copyright Protection for Automated Databases- Domain Name Protection-Objectives- domain name and Intellectual Property- Registration of domain names- disputes under Intellectual Property Rights- Jurisdictional Issues- International Perspective-Copyright in the Electronic age-Digital Millennium Copyright Act-Musical Notes-Recent Development in Copyright Law-Terms of the Trade-Vessel Hull Protection -Semiconductor Chip Protection

Text Book:

1. Deborah E. Bouchoux, “Intellectual Property Rights”, Cengage Learning India Private Ltd, 2005.

Reference Book:

1. Subbaram N.R., “Handbook of Indian Patent Law and Practice”, S.Viswanathan Printers and Publishers Pvt.Ltd.,1998.
2. Prabuddha Ganguli, “Intellectual Property Rights”, TMH, 2001.
3. Rachna Singh Puri & Arvind Viswanathan, “Practical Approach to Intellectual Property Rights”, I.K.International Publishing House Pvt.Ltd.
4. P.Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi 2010.
5. B.L.Wadehra;Law Relating to Patents,Trade Marks,Copyright Designs & Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000.
6. G.V.G Krishnamurthy, “The Law of Trademarks ,Copyright ,Patents and Design”.

Extensive Reading:

- http://www.ipindia.nic.in/ipr/patent/manual/main%20link.htm
- www.wipo.int/ebookshop

23ITP08 ETHICS IN COMPUTING

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand, identify, and apply different ethical philosophies, frameworks, and methodologies
- To identify and interpret the codes of professional conduct relating to the disciplines of computer science and software engineering
- To analyze the local and global impact of computing on individuals, organizations, and society
- To understand and apply the concepts and principles of moral thinking to problems relating to computing and digital technologies
- To understand the professional, ethical, legal, security, social issues and responsibilities

Course Outcome:

At the end of the course, the students will be able to

- Identify the ethical issues in information technology
- Apply privacy related laws and regulation to enlighten the legal constraints
- Learn the legalities to avoid plagiarism and intellectual property related crimes
- Apply the code of ethics for software development
- Exhibit ethics while working as teams in IT organizations

Unit I INTRODUCTION TO ETHICS

Ethics in Business World - Ethics in Information Technology - Ethics for IT Workers and IT users - Computer and Internet Crime - Information Technology Security Incidents - Implementing Trustworthy Computing

Unit II PRIVACY

Privacy Protection and the Law - Key Privacy and Anonymity issues - Identity Theft - Electronic Discovery - Consumer Profiling - Treating Consumer Data Responsibility - Workplace Monitoring - Advanced Surveillance Technology- Freedom of Expression-First Amendment rights-Freedom of Expression - Key issues

Unit III INTELLECTUAL PROPERTY

Definition-Copyrights-Copyright Term-Eligible works-Software copyright protection - PRO-IP-GATT- WTO and WTO TRIPS Agreement- WIPO - Digital Millennium Copyright-patents-Software Patents-Cross Licensing Agreements-Trade Secrets-Key Intellectual Property Issues – Plagiarism - Reverse Engineering - Open Source Code - Competitive Intelligence - Trademark Infringement - Cyber Squatting

Unit IV SOFTWARE DEVELOPMENT

Strategies for engineering Quality Software-Software Product Liability-Key issues in software development-Impact of IT on productivity and quality of life-Social Networking-Business Application- Ethical Issues-Online Virtual worlds

Unit V ETHICS OF IT ORGANIZATIONS

Key Ethical Issues for Organizations-Contingent Workers-H-1B Workers-Application Process - outsourcing-offshore outsourcing-pros and cons-strategies-Whistle Blowing-Protection for whistle blowers and Private sector Workers-Green Computing

Text Book:

1. George_Reynolds," Ethics in Information Technology", Cengage Learning, Fourth edition 2014

Reference Book:

1. Michael J. Quinn ,"Ethics for the Information Age", Pearson Edu, Fifth Edition, 2012
2. Deborah G.Johnson ,"Computer Ethics",Pearson,4th Edition ,2009
3. Kallman, E.A. & Grillo, J.P," Ethical Decision Making and Information Technology", McGraw-Hill, Second Edition,2006
4. Lee, Wanbil W., Information Security Management: Semi-intelligent Risk-analytic Audit, Verlag Dr Muller, 2010

Extensive Reading:

- http://www.cengage.com/resource_uploads/downloads/1111138214_259148
- http://users.jyu.fi/~riesta/Green_Computing
- https://www.aat.org.uk/about-aat/professional-ethics
- http://ethics.iit.edu/publication/WhistleBlowing_Peterson1

23ITP09 REINFORCEMENT LEARNING

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Provides an foundational ideas on which modern reinforcement learning is built
- Develop an intuitive understanding on the mathematical theory of reinforcement learning
- Implementation and testing of complete decision making systems.

Course Outcome:

At the end of the course, the students will be able to

- Implement and apply policy iteration and value iteration reinforcement learning algorithms
- Implement and apply Monte Carlo reinforcement learning algorithms
- Implement and apply temporal-difference reinforcement learning algorithms
- Construct and apply on/off-policy reinforcement learning algorithms with function approximation
- Apply planning and learning algorithms for different case studies

Unit I INTRODUCTION **9**

Introduction - Elements of RL, History of RL- Evaluative feedback -Goals and rewards – Returns – Markovian Decision Problem (MDP) – Value functions - Optimality Criterion in MDPs. Policy Evaluation- Policy Improvement- Value Iteration, asynchronous DP- Efficiency of DP.

Unit II MONTE CARLO METHODS **9**

Monte Carlo Prediction - Monte Carlo Estimation of Action Values - Monte Carlo Control- Policy Evaluation - Policy Improvement - On-policy and off - policy Monte Carlo controls -Incremental implementation.

Unit III LEARNING **9**

Temporal-Difference prediction - Optimality of TD – Sarsa – Q Learning – Off-Policy TD Control - R Learning -Actor-Critic Model- Unifying Monte Carlo and TD –Traces - Games.

Unit IV FUNCTION **9**

Approximation - Value prediction and control – Gradient Descent methods - Linear methods – Control with Function Approximation - Artificial Neural Network based approximation.

Unit V PLANNING AND LEARNING **9**

Model based learning and planning - Integrating Planning, Acting, and Learning - prioritized sweeping - Trajectory Sampling - Monte Carlo Tree Search - Heuristic search - Case Studies

Text Book:

1. Sutton R. S. and Barto A. G., "Reinforcement Learning: An Introduction", MIT Press,2015.
2. CsabaSzepesvári, “Algorithms for Reinforcement Learning”, Morgan & Claypool, 2013.

Reference Book:

1. Kevin Murphy , “Machine Learning - A Probabilistic Perspective” , MIT press, 2012.
2. Christopher Bishop, “Pattern Recognition and Machine Learning”, Springer, 2006.

23MEP09 ENGINEERING ECONOMICS AND COST ANALYSIS

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- the basics of economics.
- cost analysis related to engineering so as to take economically sound decisions.
- the different types of maintenance analysis.
- the concepts of depreciation and inflation.

Course Outcome:

At the end of the course, the students will be able to

- Understand the concept of Engineering Economics, types of costs and make economic analysis.
- Remember, understand and apply various interest formulae and their applications for different investment situations.
- Compare and analyze various investment alternatives and make appropriate decisions.
- Make replacement and maintenance analysis to take optimal decisions.
- Understand the concept of depreciation, and inflation

Unit I INTRODUCTION TO ECONOMICS 9

Need to study economics- Circular flow of economic activities - Law of supply and demand, Definition and scope of engineering economics- Types of efficiency - Ways of improving productivity - Elements of costs - Relation between cost and volume – break-even analysis- Assumptions- Break-even chart - Profit-volume chart and P/V ratio – Elementary economic analysis – Material selection for product design selection for a product, process planning.

Unit II INTEREST FORMULAE AND THEIR APPLICATIONS 9

Make or buy decision – Decisive factors – Techniques used - Value engineering –VE process - Time value of money, Interest, Interest rate, Cash flow diagrams, Terminology and symbols Interest formulae relating present and future equivalent values of single cash flow- Interest formulae relating a uniform series (annuity) to its present and future worth (sinking fund factor, payment Present worth factor and capital recovery factor) - Interest formulae relating an arithmetic gradients and geometric gradients to its present and annual worth - Nominal and Effective interest rates.

Unit III METHODS FOR MAKING ECONOMY STUDIES 10

Methods: Present worth method – Future worth method – Annual worth method (Revenue dominated cash flow diagram and cost dominated cash flow diagram for all the above three methods) – Rate of return method (Internal and External) - Payback method - Selection among alternatives – different revenues and identical lives - identical revenues and different lives - different revenues and different lives.

Unit IV REPLACEMENT AND MAINTENANCE ANALYSIS 10

Introduction – Reasons for replacement – Types of maintenance - Terminology used in replacement study - types of replacement problem, determination of economic life of an asset, Replacement of an asset with a new asset – capital recovery with return and concept of challenger and defender, Simple probabilistic model for items which fail completely – Individual replacement policy – Group replacement policy.

Unit V DEPRECIATION 7

Introduction – Depreciation terminology, Methods: Straight line method of depreciation, declining balance method of depreciation-Sum of the year's digits method of depreciation, sinking fund method of depreciation/ Annuity method of depreciation, service output method of depreciation-Evaluation of public alternatives- Benefit/Cost analysis - Inflation – Effects of inflation - Inflation adjusted decisions –Examples on comparison of alternatives and determination of economic life of asset.

Text Book:

1. Zahid A Khan, Arshad N. Siddiquee, Brajesh Kumar, Mustafa H. Abidi, "Principles of Engineering Economics with Applications", Cambridge University Press, 2nd Edition, 2018.

Reference Book:

1. Panneer Selvam, R, "Engineering Economics", Prentice Hall of India Ltd, New Delhi, 2nd Edition, 2014
2. Chan S.Park, "Contemporary Engineering Economics", Prentice Hall of India, 6th Edition, 2015.
3. Donald.G. Newman, Jerome.P.Lavelle, "Engineering Economics and analysis", Oxford University Press, 12th Edition, 2013.
4. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Pearson, 6th Edition, 2014.
5. Grant.E.L, Ireson.W.G, and Leavenworth, R.S, "Principles of Engineering Economy", Wiley, 8th Edition, 1990.
6. Smith, G.W., "Engineering Economy", Iowa State Press, 4th Edition,1987.

23MEP10 INDUSTRIAL MANAGEMENT AND PSYCHOLOGY

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- the principles and functions of management
- the students to understand the concepts of psychology.

Course Outcome:

At the end of the course, the students will be able to

- Understand the scope of Management.
- Gain the knowledge about planning and organizing.
- Understand the Concept of Directing and Controlling.
- Become familiar with the basic psychological concepts.
- Become familiar with cognitive Psychology

Unit I NATURE OF MANAGEMENT **9**

Introduction to Management – Nature and scope of Management - Definitions of Management by various schools – Management an Art or Science - Functions of management – Role of managers - types of managers – managerial roles and skills – Evolution of Management – Contribution of F.W. Taylor, Henri Fayol and Contingency Approach – Current trends and issues in Management.

Unit II PLANNING AND ORGANISING **9**

Nature and purpose of Planning process – Types of plans – Steps in Planning - Objectives – Management by Objectives (MBO) – The nature and purpose of Strategies and Policies – The strategic Planning process – Rational Decision making – Importance – Decision making steps and process – Decision making under certainty, uncertainty and risk. Formal and informal organization – Organizational level – span of management - Departmentalization – Matrix Organization – Strategic business units - authority and power – Centralization and decentralization.

Unit III DIRECTING AND CONTROLLING **9**

Staffing – Selection Process – Performance appraisal – Organizational Development - Communication – Process of communication – Barrier in communication – Effective communication – Communication and Information Technology (IT). System and process of controlling – Budgetary and non - Budgetary control techniques – Use of computers and IT in Management control – Direct and preventive control – Reporting.

Unit IV INTRODUCTION TO PSYCHOLOGY **9**

Psychology Definition – Roots of Psychology – Key issues and Controversies of Psychology – Psychological Research – Scientific method – Theories – Hypotheses – Psychological Research – Critical Research issues - Brain and Behavior – Nervous system and Endocrine System – Methods to study the Brain – States of Consciousness – Sleeping and Dreaming – Morality.

Unit V COGNITIVE PSYCHOLOGY **9**

Learning - Classical Conditioning - Operant Conditioning - Thorndike's Law of Effect - Cognitive Approaches to Learning: Latent Learning - Observational Learning. The Foundations of Memory - Sensory Memory - Short-Term Memory - Working Memory - Long-Term Memory - Recalling Long-Term Memories - Retrieval Cues - Levels of Processing - Explicit and Implicit Memory - Flashbulb Memories - Constructive Processes in Memory – Forgetting - Proactive and Retroactive Interference - Memory Dysfunctions - Cognition and Language - Thinking and Reasoning - Problem Solving – Intelligence - Theories of Intelligence - Variations in Intellectual Ability - Group Differences in Intelligence.

Text Book:

1. Herald Koontz and Heinz Weihrich, "Essentials of Management", Tata McGraw Hill Education Private Limited, 10th Edition, 2015.
2. Robert S. Feldman, "Understanding Psychology", McGraw Hill Education Private Limited, 10th Edition, 2011.

Reference Book:

1. Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
2. Miner J.B, "Industrial/Organizational Psychology", McGraw Hill, 1st Edition, 1992.
3. Aamodt M.G, "Industrial Organizational Psychology: An Applied Approach", Wadsworth/Thompson: Belmont, C.A, 5th Edition, 2007.

23MEP11 DESIGN OF EXPERIMENTS

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Design experiments to a problem situation using traditional experimental designs as well as Taguchi Methods.
- Conducting experiments and analyze the data to determine the optimal process parameters that optimize the process.

Course Outcome:

At the end of the course, the students will be able to

- Demonstrate the fundamentals of experimental designs.
- Design single factor experiments.
- Carry out factor designs.
- Analyse the 2K designs.
- Apply the Taguchi Methods.

Unit I FUNDAMENTALS OF EXPERIMENTAL DESIGNS 9

Hypothesis testing – single mean, two means, dependent/ correlated samples – confidence intervals, Experimentation – need, Conventional test strategies, Analysis of variance, F-test, terminology, basic principles of design, steps in experimentation – choice of sample size – Normal and half normal probability plot – simple linear regression, testing using Analysis of variance

Unit II SINGLE FACTOR EXPERIMENTS 9

Completely Randomized Design - effect of coding the observations - model adequacy checking - estimation of model parameters, residuals analysis - treatment comparison methods - Duncan's multiple range test, testing using contrasts- Randomized Block Design – Latin Square Design - Graeco Latin Square Design.

Unit III FACTORIAL DESIGNS 9

Main and Interaction effects - Two and three factor full factorial designs - Fixed effects and random effects model - Rule for sum of squares and Expected Mean Squares - 2K Design with two and three factors - Yate's Algorithm - fitting regression model - Randomized Block Factorial Design.

Unit IV SPECIAL EXPERIMENTAL DESIGNS 9

Blocking and confounding in 2K Designs - blocking in replicated design - 2K Factorial Design in two blocks - Complete and partial confounding - Confounding 2K Design in four blocks - Two level Fractional Factorial Designs - one-half fraction of 2K Design, design resolution, Construction of one-half fraction with highest design resolution, one quarter fraction of 2K Design.

Unit V TAGUCHI METHODS 9

Design of experiments using Orthogonal Arrays (OA), Data analysis from Orthogonal experiments Response Graph Method, ANOVA - attribute data analysis - Robust design - noise factors, Signal to noise ratios, Inner/outer OA design.

Text Book:

1. Krishnaiah K, and Shahabudeen P, "Applied Design of Experiments and Taguchi Methods", PHI, India, 2012.
2. Douglas C. Montgomery, "Design and Analysis of Experiments", John Wiley & sons, 10th Edition, 2019.

Reference Book:

1. Phillip J. Ross, "Taguchi Techniques for Quality Engineering", Tata McGraw-Hill, India, 2012.
2. Box, G. E., Hunter, W.G., Hunter, J.S., Hunter, W.G., "Statistics for Experimenters: Design, Innovation, and Discovery", 2nd Edition, Wiley, 2005.

23MEP12 LITHOGRAPHIC PROCESSES

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The fundamentals of clean room and nano fabrication by optical projection lithography.
- Printing the pattern with a radiation source.
- Printing with soft lithographic concepts.

Course Outcome:

At the end of the course, the students will be able to

- Emphasize about the importance of clean room and the necessity of photo masks.
- Understand the lithographic process at the pre-exposure stage.
- Explain about the different exposure methods to achieve lithography.
- Develop economically viable lithography techniques.
- Know the developments in the field of lithography.

Unit I BASIC PROCESS **9**

Overview of micromachining and lithography - introduction to semiconductor processing - clean room - types of clean rooms - maintenance of a clean room – Optical Pattern Formation - Aerial Images – light focus – Photoresists - Positive and Negative Resists -Adhesion Promotion - Resist Spin Coating, Soft bake, and Hard bake – Photochemistry – Acid Catalyzation - Development and Post-Exposure - Line-Edge Roughness - Multilayer Resist Processes - Methods for Addressing the Problems of Reflective Substrates.

Unit II PRE-EXPOSURE STAGE **10**

Wafer Steppers -Light Sources - Illumination Systems - Reduction Lenses - Autofocus Systems – Scanning – Dual Stage Exposure Tools – Overlay Alignment Systems - Overlay Models – Matching –Dependent Overlay Effects.

Masks and Reticles – Mask Blanks – Mechanical Optical-Pattern Generators - Electron Beam Lithography and Mask Writers - Optical Mask Writers - Resists for Mask Making - Phase-Shifting Masks – Etching – Pellicles – Mask-Defect Inspection and Repair.

Unit III RADIATION EXPOSURE AND DEVELOPMENT **9**

Radiation Exposure - Electron Beam Performance, Exposure Equipment - Electron Beam-Resist Interaction-Registration - Proximity Effects - Radiation Damage - Developing Resist Images - General Mechanisms – PMMA. Developer Sensitivity - Development of Negative Resists - Dry Development - Post bake - Physical Chemistry of Postbake - Other Methods of Hardening.

Unit IV ECONOMICS OF LITHOGRAPHY **8**

Metrology in lithography - Linewidth Measurement – Scatterometry - Measurement of Overlay -Capital costs – Consumables - Mask costs – Rework costs – Metrology costs - Maintenance costs - Labour costs - Facilities cost – Strategies to reduce cost.

Unit V MODERN LITHOGRAPHIC TECHNIQUES **9**

Extreme Ultraviolet Lithography - Background and Multilayer Reflectors - EUV Masks, Sources, Illuminators, Optics, Resists - Proximity X-ray Lithography - Electron-Beam Direct-Write Lithography - Ion-Projection Lithography – Imprint Lithography - Directed Self-Assembly - Future of Lithography.

Text Book:

1. Harry J. Levinson, “Principles of Lithography” 4th Edition(SPIE Press Monograph, Vol. PM198), 2019.
2. Wayne M. Moreau, “Semiconductor Lithography: Principles, Practices, and Materials”, Springer, 2012.

Reference Book:

1. Chris Mack, “Fundamental principles of optical lithography: The science of micro fabrication”, Wiley 2008.
2. M. Madou, “Fundamentals of micro fabrication”, 2nd Edition, CRC Press, e book 2018.
3. Stepanova, Maria, “Nano fabrication techniques and principles”, Dew, Steven (Eds.) Springer, 2012.
4. John A. Rogers & Hong H. Lee, “Unconventional nano patterning techniques and applications”, A John Wiley &Sons, Inc., 2009.
5. Sergey Edward Lyshevski, “MEMS and NEMS: Systems, devices and structures”, CRC Press LLC, 2002.
6. Zheng Cui, “Nano fabrication – Principles, capabilities and limits”, 2nd edition, Springer Science, 2017.
7. Mark J. Jackson, “Micro fabrication and nano manufacturing”, CRC Press Taylor & Francis Group, 2006.

23MEP13 THERMAL TURBOMACHINES

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The importance of the principles of various turbo machines.
- The principles, operations and applications of different types of turbo machinery components.
- Design of the components of various system in turbomachines.

Course Outcome:

At the end of the course, the students will be able to

- Have a fundamental understanding of basic concepts and operating principles of turbo machines.
- Understand the design procedure of centrifugal fans and blowers.
- Recognize the importance and to understand the concept of Centrifugal compressor.
- Familiarize with the concepts and applications of Axial flow compressor.
- Acquire knowledge about principles, operations and applications of Axial and Radial flow turbines.

Unit I PRINCIPLES OF TURBO MACHINES **9**

Introduction to turbo machines-Energy transfer between fluid and rotor-Euler turbine equation-components of energy transfer-classification of fluid machinery-impulse and reaction turbine stages-Pelton Wheel, Francis turbine and Kaplan turbine- specific speed-applications-stage velocity triangles-work and efficiency.

Unit II CENTRIFUGAL FANS AND BLOWERS **9**

Types- stage and design parameters-flow analysis in impeller blades-design procedure of centrifugal fans and blowers- volute and diffusers- losses- characteristic curves and selection, fan drives and fan noise, fan testing, blower regulations- throttling control.

Unit III CENTRIFUGAL COMPRESSOR **9**

Construction details- design procedure of centrifugal compressor-work done and pressure rise-Enthalpy-Entropy diagram-Pressure coefficient-Blade angles at root and eye tip-Impeller flow losses- slip factor-power factor- diffuser analysis-vaneless diffuser-surging of centrifugal compressors-losses and characteristic curves.

Unit IV AXIAL FLOW COMPRESSOR **9**

Stage velocity diagrams-enthalpy entropy diagrams- design procedure of axial flow compressor-stage work done-overall pressure ratio per stage-work done factor-flow coefficient-pressure coefficient- stage losses and efficiency-work done, simple stage design problems and performance characteristics.

Unit V AXIAL AND RADIAL FLOW TURBINES **9**

Stage velocity diagrams- reaction stages- design procedure of axial and radial flow turbines-degree of reaction-utilization factor-condition for maximum efficiency-stage velocity triangles-optimum blade speed ratio for maximum energy transfer-losses and Coefficients, Blade design principles, testing and performance characteristics.

Text Book:

1. Yahya, S.M., “Turbines, Compressors and Fans”, Tata McGraw Hill Publishing Company, 4th edition, 2017.

Reference Book:

1. Bruneck, “Fans”, Pergamom Press, 1973.
2. Earl Logan, Jr., “Handbook of Turbomachinery”, Marcel Dekker Inc., 2003.
3. Dixon, S.I., “Fluid Mechanics and Thermodynamics of Turbomachinery”, Pergamon Press, 2014.
4. Shepherd, D.G., “Principles of Turbomachinery”, Macmillan, 1969.
5. Stepanpff, A.J., “Blowers and Pumps”, John Wiley and Sons Inc. 2015.
6. Ganesan, V., “Gas Turbines”, Tata McGraw Hill Pub. Co., 3rd edition, 2010.
7. Gopalakrishnan .G and Prithvi Raj .D, “A Treatise on Turbo machines”, Scitech Publications (India) Pvt. Ltd., 2008.

23MEP14 FUEL CELL AND HYDROGEN TECHNOLOGY

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Electrochemistry and Thermodynamics of fuel cells
- Working principle, Design and applications of fuel cells.

Course Outcome:

At the end of the course, the students will be able to

- Understand the basic concepts and application of fuel cells.
- Know the thermodynamics of fuel cells.
- Acquire knowledge on Electrochemistry of fuel cells.
- Familiar with the concepts of design and optimization of fuel cells.
- Understand the basics of utilizing hydrogen for fuel cell application.

Unit I INTRODUCTION TO FUEL CELLS **9**

Basic Principles - Classification – Alkaline, Proton Exchange Membrane, Direct Methanol, Phosphoric Acid & Molten Carbonate, solid oxide, polymer electrolyte fuel cells – Parts - Fuel cell poisoning-application-Micro fuel cells & portable power.

Unit II THERMODYNAMICS **9**

Basic Reactions, Heat of reaction, Enthalpy of formation of substances – Enthalpy change of a reacting. system - Gibbs free energy of substances - Gibbs free energy change of a reacting system - Efficiency - Power, heat due to entropy change, and internal ohmic heating

Unit III ELECTROCHEMISTRY **9**

Nernst equation and open circuit potential, pressure effect, temperature effect -Stoichiometric coefficients and reactants utilization - Mass flow rate calculation – voltage and current in parallel and serial connection - Overpotentials and polarizations - Activation polarization - Tafel equation and exchange current density - Ionic conductivity, catalysts, Temperature and humidification effect, electro-osmotic drag effect.

Unit IV DESIGN AND OPTIMISATION **9**

Geometries of fuel cells and fuel cell stacks-planar & tubular - Rate of Diffusion of reactants – Water flooding and water management - Gas delivery and current collection - Bipolar plate configuration - Optimization of gas delivery and current collection - Heat Removal methods.

Unit V HYDROGEN ENERGY **9**

Hydrogen: as a fuel; Properties, Applications, Hydrogen production methods - Production of hydrogen from fossil fuels, electrolysis, thermal decomposition, photochemical and photo-catalytic methods. Hydrogen storage methods - Metal hydrides, metallic alloy hydrides, carbon nano-tubes – Storage Safety.

Text Book:

1. Shripad T. Revankar,Pradip Majumdar, “Fuel Cells: Principles, Design, and Analysis (Mechanical and Aerospace Engineering Series)”, CRC Press, May 2014.

Reference Book:

1. James Larminie and Andrew Dicks, “Fuel Cell Systems Explained”, John Wiley & Sons Inc., 2nd Edition, 2018.
2. B. Viswanathan and Aulice M. Scibioh, “Fuel Cells: Principles and Applications”, Universities Press, 1st Edition, 2008.
3. Matthew M. Mench, “Fuel Cell Engines”, Wiley; 1st Edition, March 2008.
4. Collier J.G., and Hewitt G.F, “Introduction to Nuclear power”, Hemisphere publishing, New York, 2000.
5. Frano Barbir, “PEM Fuel Cells Theory and Practice”, Elsevier Academic Press, 2nd edition, 2012.

23MEP15 DESIGN FOR X

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the economic process selection principles and general design principles for manufacturability.
- To learn the design consideration principles of forming in the design of casting, and forged products.
- To learn design consideration principles of assembled products.
- To learn design consideration principles reliable design and sustainable design.

Course Outcome:

At the end of the course, the students will be able to

- Select relevant process; apply the general design principles for manufacturability; GD&T.
- Discuss the factors influencing in form design.
- Apply design considerations for assembled systems.
- Exposed to reliability-based design.
- Apply design considerations for environmental issues

Unit I INTRODUCTION **9**

General design principles for manufacturability - mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits - Datum features - Tolerance stacks.

Unit II FACTORS INFLUENCING FORM DESIGN **9**

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice –Influence of materials on form design - form design of welded members, forgings and castings

Unit III DESIGN FOR ASSEMBLY **9**

Design for assembly – General assembly recommendations – Minimizing the number of parts – Design for assembly – Product design for manual assembly - Product design for automatic assembly – Robotic Assembly-Automatic assembly – Computer Application for DFMA -Case studies

Unit IV DESIGN FOR RELIABILITY **9**

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress-strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety

Unit V SUSTAINABLE DESIGN AND INTRODUCTION TO UI/UX **9**

Industrial ecology, multiple life cycle design, principles of design, green engineering, The Natural Step, biomimicry, design for reuse, dematerialization, modularization, Design for recyclability, Design for energy efficiency. User Interface (UI) and User Experience (UX) design, Comparing UI and UX, User Interface patterns.

Text Book:

1. O. Molloy, E.A. Warman, S. Tilley, Design for Manufacturing and Assembly: Concepts, Architectures and Implementation, Springer, 1998.
2. James G. Bralla, “Design for Manufacturability Handbook”, McGraw Hill Professional, 1998.

Reference Book:

1. Boothroyd, G, Design for Assembly Automation and Product Design. New York, Marcel Dekker, 1980.
2. Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
3. Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.
4. K.Venkataraman “Maintenance Engineering and Management”: PHI Learning - 2007
5. David J. Smith, “Reliability and Maintainability in Perspective”, McMillan,2nd Edition, 1985.
6. Fixel, J. Design for the Environment McGraw Hill., 1996.
7. Finster, Mark P., 2013. Sustainable Perspectives to Design and Innovation.

23MEP16 DESIGN OF MATERIAL HANDLING EQUIPMENTS

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study the usages of wire ropes in transferring heavy weights in marine & industrial application.
- To enhance essential knowledge about the basic structure, components of wire rope and fiber rope.
- To know about electromechanical cables which are used as conducting and communication cables with strength members to transfer certain load also.
- To familiarize with the maintenance of wire rope.
- To know about the mechanical properties of wire rope and its failure behaviour.

Course Outcome:

At the end of the course, the students will be able to

- Understand the basic constructional details of a wire rope
- Understand the different categories of fiber ropes
- Understand the characteristics of electromechanical cables.
- Understand the basic maintenance activities for wire ropes.
- Evaluate the performance of wire ropes.

Unit I WIRE ROPES **9**

Wire rope – Components of wire rope – classification - Types of core – Wire rope lay – Basic construction – rope size – wire rope classes – terminology - Joints – Galvanizing – Packing – Splicing and terminations – Rope damage – loop, kink.

Unit II FIBRE ROPES **9**

Types of material - natural fibres, synthetic fibres - Twist in ropes - Types of fibre ropes – plain laid ropes – cable laid ropes – Braided ropes – double braided ropes – Plaited ropes – Marline – polyethylene ropes - Precaution and maintenance of fibre ropes - Plastic covered wire rope.

Unit III ELECTROMECHANICAL CABLES **9**

Electromechanical cable – construction characteristics – Cable designation - spatial relationship - coincident – centre strength member – braided strength member – Electromechanical wire rope – mono conductors, 3 conductor, 4 conductor cables – Camesa cables.

Unit IV MAINTENANCE OF WIRE ROPES **9**

Oiling of wire ropes - chemical composition - testing of wires - spooling of ropes – Cutting of wire ropes - Rope deterioration and maintenance – precautions – Advantages & Disadvantages – Applications.

Unit V MECHANICAL PROPERTIES OF WIRE ROPE **9**

Breaking strength, - Breaking Force - space factor and load of wire ropes - calculation of the size of rope – Elongation of ropes – creep - Bending fatigue – Tension - tension fatigue - Bending-over-sheaves fatigue - Torsion fatigue.

Text Book:

1. 1. The United States Army “Naval Ships’ Technical Manual Chapter 613 Wire and Fiber Rope and Rigging” First edition, Department of Defense, 2004.
2. 2. John F. Bash “HANDBOOK OF OCEANOGRAPHIC WINCH, WIRE AND CABLE TECHNOLOGY”, Third edition, Department of Navy, 2001.

Reference Book:

1. 1.H A McKenna, J. W. S. Hearle, N O'Hear “Handbook of Fibre Rope Technology” First edition, Elsevier Science, 2004.
2. 2.George A. Costello “Theory of Wire Rope” Springer New York, 2012.

23MEP17 THERMAL AND FIRED EQUIPMENT DESIGN

Offered by MECH (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the concepts of thermal and fired equipment.
- To study the basis, design and construction of boilers.
- To study of typical fuel firing systems in the boiler.
- To study of materials requirements for pressure parts.
- To study of various boiler auxiliaries system.

Course Outcome:

At the end of the course, the students will be able to

- At the end of the course, the students will be able to
- Explain the concepts of thermal and fired equipment.
- Discuss the basis, design and construction of boilers.
- Describe of typical fuel firing systems in the boiler.
- Discuss the materials requirements for pressure parts.
- Discuss of various boiler auxiliaries system.

Unit I THERMAL AND FIRED EQUIPMENT CONCEPTS 9

Principal equipment in Thermal Power Plant, Historical developments of Boiler, Utility, Industrial boilers, Morden trends in boiler design, Basic knowledge of different types of Thermal Fired Equipment, subcritical and super critical boilers - Coal, Oil, Gas, Pulverised fuel cyclone, FBC, CFBC, MSW, and Stoker firing, Boiler efficiency, auxiliary power consumption, Performance data , Performance Correction Curves

Unit II BASIS OF BOILERS AND DESIGN 9

Codes- Design and Construction, IBR, ISO, ASME, BS, Heat balance diagram, Boiler parameters, Fuel analysis and variations, Site conditions, Furnace heat loadings, FOT, Plan area loading, Volumetric loading Balanced Draft and Pressurised Furnace, Natural / Controlled Circulation, Constant and Sliding Pressure, Boiler heat transfer surfaces, Flue gas velocities, boiler auxiliaries, Boiler schemes, Boiler Layouts

Unit III FIRING SYSTEM- FUEL AND MILLING 9

Coal / Oil / Natural Gas in any combination, Lignite, Blast Furnace Gas / Coke Oven Gas / Corex Gas Carbon Monoxide / Tail gas, Asphalt, Black Liquor, Bagasse, Rice Husk, Washery Rejects, Wheat /Rice straw MSW, wind box, Burner, Type of Stokers, Pulverisers - Bowl mill, Tube mill, Direct firing, Indirect firing, Wall firing (Turbulent / Vortex Burners), Tangential firing (Jet Burners), Fire Ball.

Unit IV PRESSURE PARTS AND DESIGN AND MATERIALS 9

Economiser, Drums, Water Walls, Headers, Links, Super Hater, Super Heaters, Reheaters, Tubes, Spiral Tubes, Surface area, Free Gas Area, Metal temperature, LMTD, Acid Due Point Temperature, Carbon steel, Low alloy steel, Titanium alloy steel

Unit V BOILER AUXILIARIES 9

Air preheaters (APH) – bi sector APH, Tri sector APH, Cold PA System, Hot PA System, Tubular APH, Steam coil Air preheater, FANS – Axial, Radial, Performance curves, MILLS- Tube, Vertical mills, Air quality Control systems, Dust Collection System - Mechanical Precipitator, Electrostatic Precipitator, FGD, SCR, SNCR

Text Book:

1. Arora S.C and Domkundwar S, “A Course in Power Plant Engineering”, Dhanpat Rai, eighth edition, 2016
2. Nag P. K, “Power Plant Engineering”, 3rd Edition, Tata McGraw- Hill, Fourth edition, 2017.

Reference Book:

1. Elwakil M, “Power Plant Technology”, McGraw Hill, New York, 1964
2. V. Ganapathy, “Steam Generators and Waste Heat Boilers: For Process and Plant Engineers (Mechanical Engineering)”, CRC Press, 1st edition,2014.
3. Donatello Annaratone,“Steam Generators: Description and Design”, Springer, 1st edition, 2008
4. Mamoru Ozawa and Hitoshi Asano, “Advances in Power Boilers (JSME Series in Thermal and Nuclear Power Generation)”, Elsevier,2021.

23UEP01 BUSINESS COMMUNICATION

Offered by ENG (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Business communication
- Communication related to business deals
- The language usage in marketing techniques and advertising
- Strategies to be a successful employee or employer in the workplace
- Specialist vocabulary in formal business and colloquial business jargon

Course Outcome:

At the end of the course, the students will be able to

- Communicate appropriately in various business environment
- Make effective business presentations and develop upgraded business reports
- Use apt language for marketing
- Analyze and adapt to the working environment
- Write business correspondences with related terms and phrases

Unit I RUDIMENTS OF BUSINESS COMMUNICATION **9**

Definition of Communication – Importance of Communication in Business - Characteristics of Communication – Channels of Communication –Managerial Communication - Group Communication and Strategies – Role of Listening and Speaking in Business - Technology Enabled Communication - Various Communication Devices and their Usage. - Ethics in Business Communication

Unit II BUSINESS COMMUNICATION – I **9**

Basic Principles of Business Message Writing – Types and Approaches to Business Messages - Communication Through Letters: Letter Formats - Application for Appointment – Orders Letters - Enquiry Letters - Offers and Quotations - Execution of Orders - Cancellation of Orders-Adjustment and Settlement of Accounts - Letter of Complaints and Responding to Complaints. Forms of Communication: Fax – Memos - Circulars – Notices - E-mail - Websites

Unit III BUSINESS COMMUNICATION PRACTICES **9**

Questionnaire Preparation for Market Survey - Writing Business Plan and Proposal - Preparation of Product Based Project Report – Content, Guidelines for Report Preparation – Project Appraisal Techniques –Steps for Product Analysis & Financial Analysis

Unit IV BUSINESS SKILLS **9**

Finding the Grounds of Business – Attracting Financial Supports - Team Building– Crisis Management – Customer Service –Leadership skills – Types of Leadership – Management Skills- Business Idioms and Phrases – Business Jargons – Basics of Financial Markets

Unit V MARKETING AND ADVERTISING **9**

Definition of Marketing and Advertising – Integrated Marketing Communication - Human Resource Communication – Functions of Advertising - Persuasion Process – Affiliate Marketing - Sales Promotion: Tools and Techniques- Art of Negotiation - Professional Blogs - Advertising in Media -Broadcast Media, Print Media, Support Media, Internet and Interactive Media etc., - Implementation and Evaluation

Text Book:

1. Raman, Meenakshi & Prakash Singh. Business Communication. New Delhi: OUP, Second edition, 2017.

Reference Book:

1. Mohanty, SangramKeshari. Fundamentals of Entrepreneurship. India: Paperback, 2005.
2. Pal, Rajendra and J. S. Korlahalli. Essentials of Business Communication 13th Edition. India: Paperback, 2011.
3. Bovee, Courtland L. and John V. Thill. Business Communication Today. 14th Edition. Uk: Hardcover, 2018
4. Sharma. Entrepreneurship Development. India: Paperback, 2017.
5. https://www1.nseindia.com/invest/resources/download/Basics_of_finmkts.pdf

23UEP02 WRITING FOR MASS MEDIA

Offered by ENG (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- General functions, laws and ethics of media writing
- Creating objective and accurate news stories in print media style
- Distinguishing modes of media writing styles among radio, television news, print journalism and advertising
- Understanding the TV programmes and film editing process
- Providing content for the trending and invincible digital media style of writing.

Course Outcome:

At the end of the course, the students will be able to

- Imbibe media writing functions, ethics and responsibilities of media writing
- Develop print media style of writing news articles and stories
- Prepare and modify convergent news stories for multimedia platforms
- Understand the various stages of TV programme and film making process
- Create personal/official blogs, effective e-contents and e-posters.

Unit I MASS MEDIA **9**

Definition of the Mass Media - Models and theories of mass communication- Challenges of the Mass Media Writing – Impact & Influence of Mass Media – Tools of Mass Communication - News Values and Ethics - Media and democracy– Mass Communication and Mass Culture - Media Writing Glossary.

Unit II PRINT MEDIA **9**

Writing for the print medium - Print Media in India - news – Hard & Soft News, story structure, Basics of reporting – newspaper, magazine, newsletter - Types of reporting – style sheet – OP-ED, letter to the Editor, film review, book review, sports review, Tech Review - Writing to Pictures & the Place of Pictures in Print Writing – Common mistakes in Writing

Unit III BROADCAST MEDIA & WRITING FOR RADIO **9**

Origin of Radio in India-FM broadcasting and Community Radio-Writing for the Broadcast Media – Techniques and Approaches to Broadcast Style - Broadcast writing tips - key elements of Radio Jockeying - Audio editing techniques for different programmes- characteristics of a radio script – radio feature, documentary, drama, interview, discussions, and commercials/jingles – future of radio

Unit IV VISUAL MEDIA **9**

Writing for visuals (Television & You Tube) – Functions of Visuals – TV News Script Format - Spots (TV ads) and creation of spots – Use of Formal/Informal/Conversational Language - Script Writing - live news - live shows - anchoring & interviews – Sensationalism & Entertainment – Short films, Subtitle Writing– Photo essays and photo features, Emerging Trends in photo journalism- Documentaries –Stories of Human- Animation - concepts and techniques- Tech Review- Brand management

Unit V DIGITAL MEDIA **9**

Writing in Digital Media –Importance of Social Media – Grammar of electronic media- Digital journalism – features – interactivity – Global Electronic Media – Language Techniques for Search Engine Optimization (SEO) – Promoting Products in Social Media – Editing for Effective User-Friendly Content – Blogging in Alternative Journalism- E-Advertisements – Corporate Communication– Trends in modern journalism

Text Book:

1. Ceramella, Nick, and Elizabeth Lee. Cambridge English for the Media. Cambridge University Press, 2016.
2. Nair, Latha. English for the Media. Cambridge University Press, 2016.

Reference Book:

1. Kershner, J.W. (2009). The Elements of News Writing. 2nd ed. Boston: Pearson/Allyn & Bacon.
2. Lieb, T. (2009) All the News: Writing and Reporting for Convergent Media. Boston: Pearson/Allyn & Bacon

23UMP03 FUZZY SET AND ITS APPLICATIONS

Offered by MAT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explain the basics of fuzzy Sets.
- To describe fuzzy Numbers and operations on fuzzy numbers.
- To apply defuzzification and fuzzification in sets.
- To define various relations in fuzzy sets.
- To solve problems using Fuzzy Decision Making

Course Outcome:

At the end of the course, the students will be able to

- Apply the fuzzy set concept in unclear situations.
- Use Arithmetic operations on fuzzy numbers
- Apply defuzzification technique in optimization problems.
- Identify the types of fuzzy relations.
- Obtain the solution for decision making problems using fuzzy theory.

Unit I BASICS OF FUZZY SET THEORY **9**

Representations of fuzzy sets - Extension principle for fuzzy sets – Operations of fuzzy sets – Types of operations – Fuzzy complements.

Unit II FUZZY NUMBERS AND OPERATIONS **9**

Fuzzy arithmetic – Fuzzy numbers - Linguistic variables – Arithmetic operations on intervals – Arithmetic operations on fuzzy numbers – Fuzzy equations.

Unit III FUZZIFICATION AND DEFUZZIFICATION **9**

Features of the membership function – Various forms – Fuzzification – Defuzzification to crisp sets – α-cut for fuzzy relations – Defuzzification to scalars.

Unit IV FUZZY RELATIONS **9**

Fuzzy relations – Crisp versus fuzzy relations - Binary fuzzy relations – Binary relations on a single set - Fuzzy equivalence relations – Fuzzy compatibility relations.

Unit V FUZZY DECISION MAKING **9**

Fuzzy decision making – Individual decision making – Multiperson decision making – Multicriteria decision making – Fuzzy ranking methods – Fuzzy linear programming.

Text Book:

1. George J. Klir and Bo Yuan, “Fuzzy sets and Fuzzy Logic Theory and Applications”, Prentice Hall of India, 2012.

Reference Book:

1. Ganesh M., “Introduction to Fuzzy sets and Fuzzy logic”, Prentice Hall of India, 2006.
2. Timothy J. Ross, “Fuzzy Logic with Engineering Applications”, 3rd Edition, Wiley Student Edition, 2010.
3. Zimmermann H.J., “Fuzzy Set Theory and its Applications”, Springer, 2013.

23UMP04 GRAPH THEORY

Offered by MAT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the basic concepts of graph theory.
- To explain the basics of connectedness in graphs.
- To introduce the students about trees, their properties and their applications as models of networks.
- To identify types of digraphs and various matrix representations.
- To solve theoretical problems using algorithms based on graph structures.

Course Outcome:

At the end of the course, the students will be able to

- Describe the basic concepts of graphs.
- Discuss the connectivity in graphs.
- Solve problems in Network using tree structure.
- Classify the types of digraphs and the matrix representations.
- Apply algorithms to solve graph theoretic problems.

Unit I INTRODUCTION TO GRAPH THEORY **9**

Graphs and its types – Representation of graphs – Incidence and degree – Graph isomorphism – Subgraphs – Operations on graphs.

Unit II CONNECTIVITY IN GRAPHS **9**

Walks, trails, paths and circuits – Connectedness and components – Cut vertices and cut edges – Vertex connectivity – Edge connectivity.

Unit III TREES **9**

Characterisation of trees – Centers and centroids of a tree – Spanning trees – Fundamental circuits – Rank and nullity – Spanning tree in a weighted graph.

Unit IV DIRECTED GRAPHS **9**

Digraphs and its types – Directed path and connectedness – Matrix representation of digraphs – Paired comparisons and tournaments.

Unit V BASIC GRAPH ALGORITHMS **9**

Dijkstra's algorithm – Warshall Floyd algorithm – Depth first search algorithm – Krushkals's algorithm.

Text Book:

1. Narsingh Deo, " Graph Theory with applications to Engineering and Computer Science", 11th Reprint, Prentice-Hall of India, 2014.

Reference Book:

1. John Clark and Derek Allan Holton, "A first look at Graph Theory", Reprint, World scientific publishing company incorporated, 2005.
2. Douglas B. West, "Introduction to Graph Theory ", 2nd Edition, Prentice-Hall of India, 2012.

23UMP05 LATTICE THEORY

Offered by MAT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explain the basic concept of various kinds of lattices and its properties.
- To classify some spacial lattices.
- To introduce the basics of homomorphism between lattices.
- To apply the concepts of Boolean algebra and sub algebra.
- To describe switching theory.

Course Outcome:

At the end of the course, the students will be able to

- Apply the concept of lattices to the problems of data mining.
- Solve problems in computer networks using special lattices.
- Perform homomorphic encryption.
- Infer Boolean Algebra for the development of logic circuits.
- Apply the concept of Boolean Algebra to solve problems in switching.

Unit I BASICS OF LATTICES **9**

Lattices as partially ordered sets -Two definitions of lattices- Hasse diagrams and their properties- Lattices as algebraic systems- Sub lattices.

Unit II SOME SPECIAL LATTICES **9**

Complete lattice – Bounded lattice - Complemented lattice - Distributive – Modular and non modular lattices with example and properties- Ideal lattice.

Unit III CONGRUENCE LATTICE **9**

Congruence relations- Congruence lattices - Homomorphism theorem and product of lattices – Congruence of direct product of lattices.

Unit IV BOOLEAN ALGEBRAS **9**

Boolean algebras as lattices - Various Boolean identities - The switching algebra with example - Sub algebra - Direct product and homomorphism.

Unit V SWITCHING THEORY **9**

Boolean forms and their equivalence- Midterm Boolean forms (excluding free Boolean algebras) - Sum and products of canonical forms - Minimization of Boolean functions - Applications of Boolean algebra to switching theory (using AND, OR and NOT gates) - The Karnaugh map method.

Text Book:

1. George Gratzer , “Lattice Theory: Foundations”, 1st Edition, Birkhäuser Basel, 2011.
2. George Gratzer, “General Lattice Theory”, 2nd Edition, Birkhäuser Basel, 2003

Reference Book:

1. Vijay K. Garg, “Introduction to Lattice Theory with Computer Science Applications”, 1st Edition, Wiley, 2015.
2. George Grätzer, “Lattice Theory: First Concepts and Distributive Lattices (Dover Books on Mathematics)”, Dover Publications, 2009.
3. Davey B.A and Priestley H.A., “Introduction to Lattices and Order”, 2nd Edition, Cambridge University Press, 2002.

23UMP06 OPTIMIZATION TECHNIQUES

Offered by MAT (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To model and solve problems using linear and non-linear programming.
- To identify the job sequence to minimize the total cost.
- To solve decision making problems.
- To apply game theory for solving problems in engineering and technology.
- To design mathematical models as networks for some real time situations.

Course Outcome:

At the end of the course, the students will be able to

- Solve linear and non-linear programming problems.
- Model the n jobs through m machines with minimal cost.
- Optimize the decisions using trees.
- Solve n-person zero sum games.
- Apply the techniques of minimizing the project duration and cost.

Unit I LINEAR AND NON-LINEAR PROGRAMMING PROBLEM 9

Mathematical formulation of LPP – Graphical solution of LPP – General NLPP – Constrained optimization with equality and inequality constraints.

Unit II SEQUENCING MODELS 9

Sequencing problems – Assumptions in sequencing problems – Processing n jobs through one machine - Processing n jobs through two machines - Processing two jobs through m machines – Processing of n jobs through m machine - Problems related to sequencing.

Unit III DECISION THEORY 9

Decision making problem – Decision making environment – Decisions under uncertainty – Decisions under risk – Decision tree analysis – Decision making with utilities.

Unit IV GAME THEORY 9

Theory of games – Characteristics of games – Game models – Rules for game theory – Mixed strategies – n-person zero sum games – Limitations of game theory.

Unit V NETWORK SCHEDULING BY PERT/CPM 9

Rules for network construction – Critical path analysis – Probability considerations in PERT – Distinction between PERT and CPM – Resource analysis in network scheduling: Time-cost optimization algorithm.

Text Book:

1. Kanti Swarup, Gupta P.K and Man Mohan, “Operation Research”, 16th Edition, Sultan Chand & sons, 2014.

Reference Book:

1. Prem Kumar Gupta and Hira D.S., "Operations Research”, 6th Edition, S.Chand & Company Ltd, 2013.
2. Taha H.A., “Operations Research”, 9th Edition, Pearson India Education, 2016.
3. Sharma J.K., “Operations Research Theory and Applications”, 5th Edition, Macmillan, 2013.

23UPP01 THIN FILMS TECHNOLOGY

Offered by PHY (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- impart a sound basis for an understanding of vacuum technology.
- provide a fundamental knowledge on various principles and methods used in the synthesis of materials in thin film form.
- introduce nucleation and growth mechanisms of thin films based on thermodynamics and molecular theory.
- acquire knowledge on growing thin films and measuring the thickness
- familiarize with physics and techniques involved in the measurement and characterization of thin films.

Course Outcome:

At the end of the course, the students will be able to

- Understand vacuum technology and vacuum pumps
- Acquire knowledge on physical methods of thin film technology
- Understand various chemical methods of thin film deposition
- Define nucleation and its consequences in growing a crystal.
- Characterize thin films usig different tchniques

Unit I VACUUM TECHNOLOGY 9

Fundamentals of vacuum, basic definition and pressure regions of vacuum, kinetic theory of gases mean free path, types of flow, conductance, vacuum pumps and systems, rotary mechanical pump, roots pump, diffusion pump, turbo molecular pump, sputter ion pump, measurement of vacuum, concept of different gauges, capacitance gauges, Pirani gauge, ionization gauge and penning gauge, vacuum system components and operation.

Unit II PHYSICAL METHODS OF THIN FILM DEPOSITION 9

Thermal evaporation, resistive heating, flash evaporation, laser evaporation, rf-heating, co-evaporation, electron bombardment heating, sputtering plasma, discharges and arc, sputtering variants, sputtering yield low pressure sputtering, rf-sputtering, reactive sputtering, magnetron sputtering, magnetron configurations, bias sputtering, evaporation versus sputtering.

Unit III CHEMICAL METHODS OF THIN FILM DEPOSITION 9

Electrodeposition, electrolytic deposition, electro less deposition, anodic oxidation, spray pyrolysis, spin and dip coating, chemical vapor deposition (CVD), homogenous and heterogeneous process, CVD reactions, pyrolysis, hydrogen reduction, halide disproportionation, transfer reactions, CVD processes and systems, low pressure CVD, laser enhanced CVD, metal organic CVD (MOCVD).

Unit IV GROWTH OF THIN FILMS AND THICKNESS MEASUREMENTS 9

Introduction: nucleation and early stages of film growth, thermodynamic aspects of nucleation, capillary theory, thin film growth modes Volmert, Weber (VW) growth, Frank-van der Merwe (FM) growth, Stranski-Krastanov growth, thickness measurement, electrical methods, microbalance monitors, quartz crystal monitor, mechanical method (stylus), optical interference methods, ellipsometry, interference fringes.

Unit V CHARACTERIZATION METHODS OF THIN FILMS 9

X-ray diffraction (XRD), scanning electron microscopy, transmission electron microscopy, energy dispersive analysis, Auger electron spectroscopy, X-ray photoelectron spectroscopy, Rutherford backscattering spectroscopy, secondary ion mass spectrometry.

Text Book:

1. Hartmut Frey.Hamid R.Khan,Hand book of Thinfilm Technology, Springer Verlag Berlin Heidelberg,2015.
2. M. Ohring, Materials Science of Thin Films: Deposition and Structure, 2nd Ed.,Academic Press (An Imprint of Elsevier), 2002.
3. Kaufmann, Characterization of Materials, 2nd Ed., Wiley, 2003

Reference Book:

1. N.Yoshimura, Vacuum Technology: Practice for Scientific Instruments, Springer Publications, 2007.
2. Z.L. Wang, Characterization of Nanophase Materials, Wiley, 2000.

23UPP02 CRYSTAL GROWTH AND SPECTROSCOPY

Offered by PHY (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the basics of nucleation and its related thermodynamic processes
- To Understand the various experimental techniques involved in crystal growth
- To know about Nonlinear optics in crystals and nano-scale materials
- To analyse the crystal using Infrared and Raman spectroscopy.
- To learn characterization techniques involved in crystal growth

Course Outcome:

At the end of the course, the students will be able to

- Understand the nucleation which leads to the crystal formation
- Explain the various conditions pertaining to the crystal growth techniques
- Accomplish the idea of nonlinear optics and nanomaterials
- Explain the IR and Raman spectroscopic techniques and their instrumentation
- Describe the various characterization techniques for the analysis of a crystal

Unit I BASICS OF NUCLEATION

Nucleation concept – Kinds of nucleation – Homogeneous and Heterogeneous nucleation – Gibbs – Thomson equation – Kinetic theory of nucleation – Energy of formation of a nucleus – Equilibrium concentration of embryos for different sizes – Secondary nucleation

Unit II GROWTH OF CRYSTAL

Growth of crystals from solutions – Solubility – Preparation of a solution – Saturation and Super-saturation – Low temperature solution growth – Evaporation method – Temperature gradient method (Melt growth) – Electro crystallization – Crystal growth from solid phase

Unit III NONLINEAR OPTICS AND NANOMATERIALS

Nonlinear Optics – Harmonic generation – Second Harmonic generation (SHG) – Phase matching – Phase conjugation – Optical mixing – NLO crystals – Nano-scale materials – Nano crystals – Harmonic generation from nano crystals and its application

Unit IV INFRARED AND RAMAN SPECTROSCOPY

Infrared Spectroscopy – Vibrating Diatomic Molecule – Diatomic Vibrating Rotator – Fourier Transform Spectroscopy

Raman Spectroscopy – Classical Theory of Raman Effect – Polarization of Light and Raman Effect – Structure Determination – Instrumentation

Unit V OTHER CHARACTERIZATION TECNHIQUES

X-ray methods – Production of X-rays and X-ray spectroscopy – Determination of crystalline particle size – Scanning Electron Microscopy – Tunneling Electron Microscopy – Luminescence – Photoluminescence – Thermo luminescence – Measurement of electrical conductivity – Measurement of dielectric constant.

Text Book:

1. Banwell, Collin N., McCash, Elaine M., Fundamentals of Molecular Spectroscopy 20th Edn, Tata McGraw Hill, 2004.
2. Ivan V Markov, Crystal Growth for Beginners, World Scientific, Singapore, 1996

Reference Book:

1. K.Sangwal, Elementary Crystal Growth, Saan Publisher, UK, 1994.
2. B.R.Pamplin, Progress in Crystal Growth Characterisation, Pergamon press Ltd., Y.K.1982.
3. J.C.Brice, Crystal Growth Processes, Blackie & Sons, London, 1986

23UPP03 PHOTONICS

Offered by PHY (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Learn about quantum confinement of materials.
- Learn about near field optics.
- Know plasmonics.
- Understand photonics in the field of biology.
- Know concepts of photonics.

Course Outcome:

At the end of the course, the students will be able to

- Understand the effects of quantization on the optical properties of semiconductors and metals.
- Know principles of surface plasmon resonance and meta materials.
- Understand fundamentals of near field optics and its applications.
- Learn interactions of light with biological systems.
- Know important features of photonic crystals and applications

Unit I QUANTUM CONFINED MATERIALS **9**

Quantum dots – optical transitions – absorption-inter-band transitions - quantum confinement intra band transitions - fluorescence/luminescence – photoluminescence/fluorescence optically excited emission – electroluminescence emission.

Unit II PLASMONICS **9**

Internal reflection and evanescent waves - plasmons and surface plasmon resonance (SPR) - Attenuated total reflection - Grating SPR coupling - Optical waveguide SPR coupling - SPR dependencies and materials - plasmonics and nanoparticles.

Unit III NEW APPROACHES IN NANO PHOTONICS **9**

Near-Field Optics - Aperture near-field optics - Aperture less near - field optics - Near-field scanning optical microscopy (NSOM or SNOM) - SNOM based detection of plasmonic energy transport - SNOM based visualization of waveguide structures - SNOM in nanolithography - SNOM based optical data storage and recovery.

Unit IV BIOPHOTONICS **9**

Interaction of light with cells – tissues - nonlinear optical processes with intense laser beams - photo induced effects in biological systems - generation of optical forces - optical trapping and manipulation of single molecules and cells in optical confinement - laser trapping and dissection for biological systems - single molecule biophysics - DNA protein interactions.

Unit V PHOTONIC CRYSTALS **9**

Important features of photonic crystals - Presence of photonic band gap - Anomalous group velocity dispersion - Micro cavity - Effects in photonic crystals - Fabrication of photonic crystals - Dielectric mirrors and interference filters - Photonic crystal laser - PC based LEDs - Photonic crystal fibers (PCFs) - Photonic crystal sensing.

Text Book:

1. Georg.A.Reider,Photonics An Introduction,Springer Cham Heidelberg, New York, 2017.
2. Sergey.V.Gapoenko,Introduction to Nano photonics.Cambridge University,2010.
3. H.Masuhara, S.Kawata & F.Tokunaga, “Nano Biophotonics”, Elsevier Science, 2007
4. V.M. Shalaev & S.Kawata, “Nano photonics with Surface Plasmons (Advances in Nano-Optics and Nano-Photonics)”, Elsevier B.V, 2007.

Reference Book:

1. M.Ohtsu, K.Kobayashi, T.Kawazoe, & T.Yatsui, “Principles of Nano photonics (Optics and Optoelectronics)”, University of Tokyo, Japan, 2003.
2. P.N. Prasad, “Introduction to Biophotonics”, John Wiley & Sons, 2003.
3. J.D.Joannopoulos, R.D.Meade & J.N.Winn, “Photonic Crystals”, Princeton University Press, Princeton, 1995.

23ADA01 INTRODUCTION TO MACHINE LEARNING

Offered by AID (Allied Elective offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Various types of machine learning and fundamental mathematical concepts
- To Supervised Learning techniques like regression, classification tree
- To Neural network based Classification and Clustering techniques
- To Evaluating various classifications and clustering algorithms
- To Implementation of various models using Python/R

Course Outcome:

At the end of the course, the students will be able to

- Apply the basic mathematical foundation for various Machine learning techniques
- Implement supervised learning techniques for various data sets
- Implement and analyse data sets for clustering
- Apply various reinforcement learning algorithms on data sets
- Design Bayesian Network and deep learning networks for different applications

Unit I INTRODUCTION **9**

Definition and Need for Machine Learning – Types of ML algorithms – ML process —Understanding Data: Descriptive Statistics —Central tendency —Dispersion —Univariate, bivariate, Multivariate Data Analysis — Data Pre-processing —Essential: Gaussian Elimination —Matrix Decomposition —Induction Biases —Modelling & Evaluation

Unit II SUPERVISED LEARNING **9**

Regression – Types —Linear regression— Logistic regression – Regularizations: Ridge – Lasso— Classification algorithms: K–NearestNeighbour – Decision Trees – Naïve Bayes algorithm— Support Vector Machine – Kernel trick – Artificial Neural Networks – Feedforward – Back propagation– Case study on various classification applications

Unit III UNSUPERVISED LEARNING **9**

Clustering algorithms – Proximity measures —Types —Partitioning methods: K-Means – K-Medoids – DBSCAN – Hierarchical clustering – Spectral Clustering– Case study on various clustering applications

Unit IV REINFORCEMENT LEARNING **9**

Scope —Reinforcement Learning as Machine Learning —Components —Policies —Markov Decision process model – Multi-arm Bandit problem —Model based Learning —Planning algorithms —policy iteration – Model free methods —Q-Learning – SARSA – Case study on various reinforcement applications

Unit V ADVANCED MACHINE LEARNING TECHNIQUES **9**

Adaptive Resonance Theory – Graphical Models – Bayesian Networks – Expectation Maximization – Model Optimization techniques- Evolutionary optimization techniques – Particle swarm – Genetic algorithms

Text Book:

1. Jiawei Han, Micheline Kamber and Jian Pei, “Data Mining: Concepts and Techniques”, Morgan Kaufmann, 2011
2. S.Sridhar, M.Vijayalakshmi, “Machine Learning”, Oxford University Press, 2021

Reference Book:

1. Saikat Dutt, Subramanian Chandramouli, Amit kumar Das, “Machine Learning”, Pearson, 2018
2. Ethem A lpaydin. “Introduction to Machine Learning” Second Edition, PHI Learning,2012
3. Mitchell Tom M. “Machine Learning”, Tata McGraw–Hill,1997
4. Witten Ian H., Eibe Frank, Mark A. Hall, and Christopher J. Pal. “Data Mining: Practical machine learning tools and techniques”, Morgan Kaufmann,2016

Extensive Reading:

- SVM,MIT OpenCourseWare, https://www.youtube.com/watch?v=_PwhiWxHK8o
- Data sets repository: https://archive.ics.uci.edu/ml/index.php
- towards data science : https://towardsdatascience.com/
- Google colab: https://research.google.com/colaboratory/
- Adaptive Resonance Theory: https://www.geeksforgeeks.org/adaptive–resonance–theory–art/
- Self Organizing maps: https://www.cs.hmc.edu/~kpang/nn/som.html\

23ADA02 FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE

Offered by AID (Allied Elective offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To provide a comprehensive understanding of fundamental concepts in Artificial Intelligence.
- To introduce key techniques and algorithms used in AI.
- To develop problem-solving skills using AI approaches.
- To explore the ethical considerations and societal impacts of AI.

Course Outcome:

At the end of the course, the students will be able to

- Understand the basic concepts in artificial intelligence.
- Use Search Algorithms to solve real world AI problems.
- Utilize Diverse Knowledge Representation.
- Understand uncertainty by effective decision making.
- Interpret Learning techniques and AI Applications.

Unit I INTRODUCTION **9**

Introduction to Artificial Intelligence - History of AI¬¬ - Problem Solving Approach to AI problems - Production Systems - Control Strategies - Reasoning – Forward and Backward Reasoning - AI Agents: Types – Structure

Unit II SEARCHING PROBLEMS **9**

Breadth first Search – Depth first Search – Heuristics Search – Iterative Deepening – Hill Climbing - Simulated annealing - Best first search, A* algorithm, AO* algorithm, Minmax & game trees, Refining minmax, Alpha – Beta pruning, Means End analysis and constraint satisfaction

Unit III KNOWLEDGE REPRESENTATION **9**

Knowledge Representation - Logical Representation, Semantic Network Representation, Frame Representation, Production Rule. Logical Representation: Boolean Logic – Inference in Boolean Logic, First Order Predicate Logic – Inference in FOL – Unification – Forward Chaining-Backward Chaining – Resolution.

Unit IV PLANNING AND UNCERTAINITY **9**

Representation for planning, Symbolic-Centralized vs. Reactive-Distributed, Partial order planning algorithm. Uncertainty - Types - degree of belief and truth, Probability constructs - prior probability, conditional probability, probability axioms, probability distributions, and joint probability distributions, Bayes' rule, Dempster - Shafer theory

Unit V LEARNING AND APPLICATIONS **9**

Learning from Observations - Inductive Learning - Learning Decision Trees - Natural Language Processing - Parsing Techniques, components of communication - AI applications - Healthcare, Education, Business, Autonomous Vehicles, Robotics.

Text Book:

1. Russell and Norvig, “Artificial Intelligence, A Modern Approach”, 3rd edition, Pearson Prentice Hall,2009.
2. Elaine Rich, Kevin Knight, Shivashankar B. Nair, “Artificial Intelligence”, 3rd edition, Tata McGraw Hill, 2009.

Reference Book:

1. Dan W. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Prentice Hall of India, 2009.
2. Akerkar, “Introduction to Artificial Intelligence”, Prentice-Hall of India, 2011
3. Deepak Khemani, “A First Course in Artificial Intelligence”, Tata Mc Graw Hill Education 2013
4. William F. Clocksin, Christopher S. Mellish, “Programming in Prolog”, 5th Edition Springer-Verlag, 2008.

Extensive Reading:

- https://www.youtube.com/watch?v=kXlr6ydiPAQ
- https://www.youtube.com/watch?v=z-EtmaFJieY
- http://nptel.ac.in

23ADA03 DATA VISUALIZATION WITH PYTHON

Offered by AID (Allied Elective offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basic concepts of data visualisation
- To learn Ipython for visualisation
- To study concepts of numpy and pandas objects
- To understand the concepts of matplotlib
- To expose other python libraries for visualization

Course Outcome:

At the end of the course, the students will be able to

- Explore the data visualization concepts for applications
- Use Ipython commands for data visualisation
- Apply numpy and Pandas for data visualisation
- Use matplotlib for visual analytics
- Apply python libraries for visualization

Unit I FOUNDATIONS FOR DATA VISUALIZATION 9

Introduction to Visualization – Visualization stages – Experimental Semiotics based on Perception – Gibson's Affordance theory – A Model of Perceptual Processing – Costs and Benefits of Visualization – Types of Data

Unit II IPYTHON 9

Introduction to Ipython – IPython Shell – Keyboard Shortcuts in the IPython Shell – Ipython Magic Commands – Input and Output History – IPython and Shell Commands – Shell–Related Magic Commands – Errors and Debugging –Controlling exceptions – Debugging – Profiling and Timing Code

Unit III NUMPY AND PANDAS 9

Data Types – Basics of NumPy Arrays – Computation on NumPy Arrays : Universal Functions – Aggregations – Arrays – Comparisons – Masks and Boolean Logic – Fancy Indexing – Sorting Arrays – Structured Data: NumPy's Structured Arrays – Introduction to Pandas – Pandas Objects – Data Indexing and Selection – Operating on Data in Pandas – Handling Missing Data – Hierarchical Indexing – Concat and Append – Merge and Join – Aggregation and Grouping – Pivot Tables – Vectorized String Operations – Working with Time Series – High Performance Pandas

Unit IV VISUALIZATION WITH MATPLOTLIB 9

Importing matplotlib – Line Plots – Scatter Plots – Visualizing Errors – Density and Contour Plots – Histograms – Binnings – Density – Customizing Plot Legends – Customizing Colorbars – Multiple Subplots – Text and Annotation – Customizing Ticks – Customizing Matplotlib: Configurations and Stylesheets – Three–Dimensional Plotting in Matplotlib – Geographic Data with Basemap – Visualization with Seaborn

Unit V VISUALIZATION WITH OTHER LIBRARIES 9

Seaborn – Creating plots with Seaborn – Features of Bokeh – Creating plots with Bokeh – Altair – Creating an Altair Charts plots – Plotly – GGplts – Geopondas – Geoplot – VisPy

Text Book:

1. Jake VanderPlas, "Python Data Science Handbook: Essential Tools for Working with Data", Oreilly Media, First Edition 2016
2. Daniel Nelson "Data Visualization in Python" Independent Publisher, 2020

Reference Book:

1. Chad Adams, "Learning Python Data Visualisation", Packt Publishing, 2014
2. Scott Murray, "Interactive Data Visualization for the Web", O'Reilly Media, First Edition, 2013
3. Isabel Meirelles, "Design for Information", Rockport Publishers, 2013

Extensive Reading:

- https://www.datacamp.com/courses/introduction–to–data–visualization–with–python
- https://machinelearningmastery.com/data–visualization–methods–in–python/
- https://www.kaggle.com/benhamner/python–data–visualizations

23ADA04 WEB DEVELOPMENT USING NODE AND REACT JS

Offered by AID (Allied Elective offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the basics of React JS.
- To study the various React Components and programming.
- To learn about writing simple applications with Node JS and Mongo DB.
- To understand the Controllers and View Models in Node JS.
- To adopt persisting data to applications

Course Outcome:

At the end of the course, the students will be able to

- Perform Functional programming with JavaScript.
- Create webpack with React JS.
- Write simple applications with Node JS and Mongo DB
- Apply Controllers and View Models with Node JS.
- Use persisting data to applications with Mongo DB

Unit I REACT ECO SYSTEM **9**

Welcome to React -History -React is not a Framework -React and MVC - React Ecosystem - File Repository - React Developer Tools -Installing Node.js. Emerging JavaScript: Declaring Variables in ES6 - Arrow Functions - Transpiling ES6 -ES6 Objects and Arrays - Module Imports and Exports -Promises –Classes. Functional Programming with JavaScript: Functional - Imperative vs Declarative - Functional Concepts -Data Transformations -Higher Order Functions -Composition

Unit II REACT JS **9**

Pure React: Page Setup - Virtual DOM - React Elements - ReactDOM - Children - Constructing Elements with Data - React Components - DOM Rendering – Factories. React with JSX: React Elements as JSX - Babel - Recipes as JSX - Babel Presets - webpack -Webpack Loaders- useState Hook

Unit III NODE AND MONGODB BASICS **9**

Full Stack : Introduction to Node.js - npm – the Node Package Manager - Sharing and reusing JavaScript -simple server with Node.js - NoSQL movement - MongoDB - Node and MongoDB . Installing Node.js - Installing MongoDB - Writing applications - Adding the application code. Node and MongoDB : JavaScript - Data types - Operators and flows -objects -arrays -functions -JSON - Event-driven -Installing modules using npm - basics of MongoDB

Unit IV TEMPLATING, CONTROLLER AND VIEW MODEL **9**

Introducing Express: Web application frameworks - Express.js-Building web - Using and understanding middleware - configure module - Routers and controllers - Custom middleware - Handlebars as view engines. Templating with Handlebars: Templating engines -Server-side and client-side templating - Views - Layouts - Partial views - Handlebars - Handlebars helpers - Rendering the views. Controllers and View Models : Controllers - View models - Updating the home controller - image controller - Helpers for reusable code

Unit V PERSISTING DATA WITH MONGODB **9**

Using MongoDB with Node.js - Connecting to MongoDB – Inserting, Retrieving document - Introducing Mongoose - Static methods - schemas and models - Adding CRUD to the controllers - home controller - image controller - Helpers - Iterating by adding an image removal capability - Updating jQuery - Refactoring and improvements

Text Book:

1. Alex Banks and Eve Porcello, “Learning React Functional Web Development with React and Redux”, O’Reilly, First Edition, 2016
2. Mithun Satheesh, Bruno Joseph D'mello, Jason Krol, “Web Development with MongoDB and NodeJS”, Packt Publishing, Second Edition, 2015

Reference Book:

1. Azat Mardan , “Practical Node.js: Building Real-World Scalable Web Apps”, Apress, 2018
2. Vipul A M, Prathamesh Sonpatki, “ReactJS by Example - Building Modern Web Applications with React”, Packt Publishing, 2016
3. Pedro Teixeira, “Professional Node.js :Building Javascript Based Scalable Software”, Wiley, 2012
4. Marc Harter, Alex Young, “Node.js in Practice”, Manning, 2014

Extensive Reading:

- https://www.geeksforgeeks.org/reactjs-tutorials/
- https://www.geeksforgeeks.org/nodejs-tutorials/
- https://www.w3schools.com/nodejs/
- https://www.w3schools.com/react/

23ADA05 PROBLEM SOLVING USING PYTHON

Offered by AID (Allied Elective offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about the basic programming techniques, control flow and strings
- To understand the usage of functions and modules
- To familiarize with all the data structures supported in Python
- To study the usage of file handling and exception handling
- To appreciate the object oriented programming support in Python

Course Outcome:

At the end of the course, the students will be able to

- Apply appropriate Python control flow structure
- Implement user defined python functions and modules
- Develop basic programs using fundamental structures
- Create programs using file handling and exception handling mechanism
- Design programs using object oriented programming concept

Unit I BASICS, CONTROL FLOW AND STRINGS 9

Introduction: Features – History – Future of Python – Writing and Executing Program – Literal Constants – Variables and Identifiers – Data Types – Input Operation – Comments – Operators and Expressions – Operations on Strings – Other Data Types – Type Conversion. Decision Control Statements: Introduction– Selection/Conditional Branching Statements – Basic Loop Structures/Iterative Statements – Nested Loops – break, continue, pass –else with Loops. – Strings:String operations – Immutableproperty – String Formatting Operator – Built-in Methods and Functions – Slicing – String Module – Regular Expressions – Meta-characters in Regular Expression

Unit II FUNCTIONS AND MODULES 9

Introduction – Function Definition – Function Call – Variable Scope and Lifetime – The return statement – More on Defining Functions – Lambda Functions or Anonymous Functions – Documentation Strings – Good Programming Practices – Recursive Functions – Modules – Packages in Python Standard Library modules – Globals(), Locals(), and Reload() – Function Redefinition

Unit III DATA STRUCTURES 9

Sequence – Lists – operations, methods – list comprehension - Functional Programming – Tuple – operations – handling multiple values - Sets – Dictionaries – operations – functions – Iterator and generator

Unit IV FILES AND EXCEPTION HANDLING 9

Coding functions- Scope basics – scope rules – global statement – Scopes and nested functions – Nonlocal statement – Argument Passing Basics – Special Argument Matching modes – function design concepts- Recursive functions – function objects – Anonymous functions – mapping functions

Unit V OOPS 9

Classes and Objects: Introduction – Class Method and self Argument – The__init__() Method – Class Variables and Object Variables – Public and Private Data Members, Methods –Method Invocation –Check, Get, Set and Delete Class Attributes – Built-in Class Attributes – Garbage Collection – Static Methods. Inheritance: Introduction – Inheriting Classes– Types of Inheritance – Composition or Containership or Complex Objects – Abstract Classes and Interfaces. Operator Overloading: Introduction – Implementing– Overriding __getitem__() and __setitem__() Methods

Text Book:

1. Reema Thareja, “Python Programming – using problem solving approach”, Oxford University Press, 2023..

Reference Book:

1. Mark Lutz, “Learning Python”, Fifth Edition, O,Reilly, 2013
2. David Beazley, Brain K Jones “Python CookBook” Third edition,2013
3. CHUN, WESLEY J, “Core Python Programming”, Pearson Education 2012

Extensive Reading:

- http://www.tutorialspoint.com/python/
- http://www.learnpython.org/
- http://www.codecademy.com/en/tracks/python
- http://www.pyschools.com/
- http://www.python-course.eu/python3_course.php

23BMA01 BIOLOGICAL SCIENCE AND ENGINEERING

Offered by BME (Allied Elective offered to BAD, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To familiarise the basics of cell biology.
- To understand the concepts of protein synthesis.
- To describe the metabolism of Biological Enzymes
- To demonstrate the industrial Applications of microbiology.

Course Outcome:

At the end of the course, the students will be able to

- Illustrate the basic concepts of cell biology
- Explore the biochemical aspects of human biology.
- Elucidate the fundamental concepts of metabolism and enzymes
- Summarise the inheritance concepts of genes.
- Identify the applications of microbiology in industries.

Unit I BASIC CELL BIOLOGY **9**

Cell, Basic Properties of Cells, An Overview of Cell, Chemical composition of cell, Prokaryotic Cells, Eukaryotic Cells, cell membrane models, Cell wall, Cell Cycle and Cell Division, M Phase, Meiosis, Cell Differentiation

Unit II BIOCHEMISTRY **9**

Biological Diversity --Chemistry of life: chemical bonds--Biochemistry and Human biology, Transcription and translation factors play key roles in protein synthesis, Protein synthesis—DNA,RNA, Stem cells and applications, Tissue engineering

Unit III ENZYMES AND INTRODUCTION TO METABOLISM **9**

Enzymes, Classification and Nomenclature of Enzymes, Co-Factors, Importance of Enzymes, Metabolism and Its Concepts, Metabolic Basis for Living—Anabolic and Catabolic Pathways, Concept of Non-Equilibrium and Steady State, Photosynthesis, Photorespiration (C2 Cycle), C4 Pathways, CAM Cycle (In Succulent Plant), Factors Affecting Photosynthesis, Respiration, Glycolysis, Fermentation, Aerobic Respiration.

Unit IV GENETICS **9**

Mendelian inheritance-Multiple alleles-Gene Mapping-Gene Interaction-Epistasis-Mutation-Law of Dominance and Recessiveness-Human Genetics, Genetic Disorders.

Unit V MICROBIOLOGY AND ITS INDUSTRIAL APPLICATIONS **9**

Microorganisms, Growth Kinetics, Culture Media, Sterilization, Microscopy, Applications of Microbiology, Immunology and Immunity, Cancer Biology, Stem Cell

Text Book:

1. Thyagarajan S., Selvamurugan N., Rajesh M.P., Nazeer R.A., Thilagaraj W., Barathi S., and Jaganthan M.K., "Biology for Engineers", Tata McGraw-Hill, New Delhi, 2012.
2. Dr.Suraish Kumar," Biology for Engineers", oxford University press, 1st Edition,2019

Reference Book:

1. Dr. Sohini Singh and Dr. Tanu Allen, "Biology for Engineers", Vayu Education of India, New Delhi, 2014.
2. Arthur T. Johnson, "Biology for Engineers" CRC Press, 2011
3. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson
4. Education Ltd, 2014.
5. L. M. Prescott, J. P. Harley and C. A. Klein, "Microbiology", McGraw Hill Higher Education, 2005.

Extensive Reading:

- https://nptel.ac.in/courses/121/106/121106008/

23BMA02 HOSPITAL PLANNING AND EQUIPMENT MANAGEMENT

Offered by BME (Allied Elective offered to BAD, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the overview of hospital management aspects of various sectors of hospital.
- To familiarize the duties and responsibilities of a clinical engineer.
- To learn the different types of equipment management procedures

Course Outcome:

At the end of the course, the students will be able to

- Explore the details of basics of hospital Management.
- Summarize the health sectors in India.
- Analyse the various challenges in hospital Management.
- Paraphase the duties of clinical engineers in hospitals.
- Apply different procedures for equipment management.

Unit I HOSPITAL MANAGEMENT – AN INTRODUCTION **9**

History of Hospital In India – Classifications of Hospitals – Role of hospitals in Primary Health care –Medical Staff and Hospital Organization – Planning A Modern hospital – health and National Economy – health system performance.

Unit II HEALTH SECTOR IN INDIA **9**

Health Sectors in India – Health financing - Health Infrastructure - Human Resource in Health, National Health Policies - NHP 1986, NHP 2000.

Unit III CHALLENGES IN HOSPITAL MANAGEMENT **9**

Managing A Service Organization - Hospital Service Delivery – Quality Control – Six Sigma, NABH Hospital Queuing Systems – Simple Queuing Systems, Interdependent Queuing Systems, - Hospital Management Functions – Operation Management, Finance And Cost Management, HR Management , Materials Management - Case Studies

Unit IV TRAINED TECHNICAL PERSONNEL **9**

Function of Clinical Engineer, Role to be performed in Hospital, Manpower requirement for different types of hospitals, Professional Registration, Structure in Hospital.

Unit V EQUIPMENT MAINTENANCE MANAGEMENT **9**

Organizing Maintenance Operations, Paper Work Control, Maintenance Job Planning, Maintenance Work Measurement and Standards, Preventive Maintenance, Computerized Maintenance Management System (CMMS), Maintenance Budgeting and Forecasting, Maintenance Training, Contract Maintenance

Text Book:

1. Ramani K V, “Hospital Management-Text and Cases”, Pearson education, New Delhi, 2013.
2. R.C.Goyal, “Human Resource Management in Hospital”, Prentice Hall of India, 5th edition, 2007.

Reference Book:

1. Malhotra A K, “Hospital management - An Evaluation”, Global India Publications, New Delhi, 2009.
2. Cesar A. Caceres and Albert Zara. M, “The Practice of Clinical Engineering”, Academic Press, New York, 1977
3. Jacob Kline, “Handbook of Bio Medical Engineering”, Academic Press Inc., San Deigo, 1988.
4. Webster J.G. and Albert M.Cook, “Clinical Engineering Principles and Practices”, Prentice Hall Inc.,Englewood Cliffs, New Jersey, 1979.
5. Syed Amin Tabish, “Hospital and Health services Administration Principles and Practices”, Oxford Press, New Delhi, 2001.

23BTA01 BIOLOGY FOR ENGINEERS

Offered by BT (Allied Elective offered to BAD, BBE, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- importance of origin of biological classification based on Evolution, morphology, biochemistry and ecology
- biomolecules are building blocks of life.
- importance of genetics and genes as basic units of inheritance.
- energy transactions in biological system.
- microbial world and its application in various fields.

Course Outcome:

At the end of the course, the students will be able to

- Relate the complexity of hierarchy of organization of organisms and evolution.
- Apply the knowledge on basics of chemical bonding and reactions to biomolecules.
- Evaluate the inheritance pattern of characters and diseases.
- Adapt the knowledge on energy production in biotic systems to chemical synthesis of energy.
- Harness the potential microbes for industrial purposes.

Unit I EVOLUTION AND CLASSIFICATION OF ORGANISMS 9

Outline on theories of Evolution - Natural selection - evidences for evolution, Taxonomy - basis of classification of organisms, taxonomic hierarchy, Five kingdom classification, Eukaryotic classification – Outline of phyla under the various kingdoms protista, fungi, animalia, plantae.

Unit II CELL AND BIOMOLECULES 9

Structure of prokaryotic and eukaryotic cell (animal and plant cells), cellular organelles and their functions, difference between eukaryotic and prokaryotic cell, Molecules found in cell- Carbohydrates - Monosaccharide, glycosidic linkage, disaccharides and polysaccharides, Proteins- Amino acids, Peptide bond, Polypeptides, structure of proteins (Primary, secondary and tertiary structures), enzymes, lipids: nucleotides, nucleic acids.

Unit III GENES AND INHERITANCE 9

Chromosome organisation, Double helical structure of DNA, replication, transcription, translation, outline of gene regulation, mutations, mendelian inheritance- inheritance of one gene, inheritance of two genes, Genes and sex determination: ploidy and syndromes.

Unit IV ENERGY IN LIVING SYSTEMS 9

Energy and chemical reactions - Entropy, activation energy, phosphorylation energy. Energy stores of the cell: ATP, NADH, NADPH, FAD. Energy making processes in cells - respiration (Glycolysis and Krebs cycle-oxidative phosphorylation), Photosynthesis (Light and Dark reaction), ATP yield in the processes.

Unit V MICROBIAL WORLD 9

Viewing microbes-Microscopy and staining, bacterial classification (outline), microbes in industry (pharma, food, leather, tannery, textiles), health and disease, environment, bioremediation, biosensors, biofuels

Text Book:

1. Sutton J., " Biology", Macmillan Foundations, Macmillan Press Ltd, Hampshire RG21 6XS, London, 1998
2. Verma P. S., Agarwal V.K. "Cell Biology, Genetics, Molecular biology, Evolution and Ecology", S. Chand and Company Ltd, Ram Nagar, New Delhi. 14th Edition, 2006.

Reference Book:

1. Biology: A global approach: Campbell, N. A.; Reece, J. B.; Urry, Lisa; Cain, M, L.; Wasserman, S. A.; Minorsky, P. V.; Jackson, R. B. Pearson Education Ltd, 11 th Edition, 2018
2. Outlines of Biochemistry, Conn, E.E; Stumpf, P.K; Bruening, G; Doi, R.H., John Wiley and Sons, 5th Edition, 2006
3. PrescottL.M.,HarleyJ.P.,KleinD.A.,"Microbiology",Wm.C.Brown Publishers,7th Edition 2008.

23BTA02 BASIC MICROBIOLOGY

Offered by BT (Allied Elective offered to BAD, BBE, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- History of microbiology and techniques used in microbiology
- Characteristic feature of prokaryotes and eukaryotes and viruses
- Impact of microbes on environment, health and disease

Course Outcome:

At the end of the course, the students will be able to

- Be able to view and identify microbes
- Differentiate eukaryotes and prokaryotes
- Become proficient in culturing microbes and control their growth
- Use microbes to control environment pollution
- Know the role of microbes in disease and ways to control them

Unit I INTRODUCTION TO MICROBIOLOGY 9

History & Development of microbiology, Microscopy: Simple, Compound Microscopy: Staining: Principle and technique of simple & differential staining, (Gram, Acid-fast & Endospore staining).

Unit II STRUCTURE OF MICROORGANISMS 9

Prokaryotes and Eukaryotes, Virus; Bacteria: Bacterial morphology & subcellular structures (General morphology of bacteria, shapes & sizes), Slime layer & capsule, Cell wall structure of gram positive and gram negative cells, General account of Ribosome, Flagella & Fimbriae, Chromatin materials, plasmids and episomes.

Unit III BACTERIAL GROWTH AND NUTRITION 9

Cultivation of microbes, Nutritional types of microbes, Culturing bacteria, Sterilization – Physical and chemical sterilizing agents – Principle, Mode of action and application. Culturing techniques.

Unit IV ENVIRONMENTAL MICROBIOLOGY 9

Biodegradation of xenobiotics (pesticides) – Microbes in waste treatment: solid and liquid wastes – sewage treatment (Primary, secondary & tertiary treatments) – COD & BOD

Unit V MICROBES IN HEALTH AND DISEASE 9

Pathogenic microbes:, principles of infectious diseases: disease caused by viruses, bacteria, fungi and protists, food borne and water borne diseases - an overview, epidemiology, infectious disease cycle, pathogen transmission, control of epidemics (Cholera, Plague, Dengue, Bird flu) – Case study. Microbes in health: Probiotics – LAB, Bifidobacterium.

Text Book:

1. Pelczar M.J., Chan E.C.S., Krein N.R., “Microbiology”, Tata McGraw Hill Edition,5th edition, 2001.
2. Prescott L.M., Harley J.P., Klein D.A., “Microbiology”, Wm. C. Brown Publishers,10th edition 2010.

Reference Book:

1. Black, J.G., Black, L.J. “Microbiology - Principles and Explorations”, Wiley, 9th edition,2014
2. Murray R., “Manual of Clinical Microbiology: Illustrations”, American Society for Microbiology, 9th edition, 2007

23BTA03 BASIC BIOCHEMISTRY

Offered by BT (Allied Elective offered to BAD, BBE, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Describe the chemical basis of living organisms.
- Classify the biomolecules

Course Outcome:

At the end of the course, the students will be able to

- Describe the chemical basis of organisms and the laws of thermodynamics.
- Classify carbohydrates and explain their biological role.
- Summarize the structure and functions of proteins.
- Comprehend the chemistry of lipids and their properties
- Discriminate the structure and function of DNA and RNA

Unit I INTRODUCTION TO BIOMOLECULES 9

Definition and aim of Biochemistry, Biochemical process as the basics of life sciences and health, Biochemical basis of diseases, biological significance of water, water as an ideal biological solvent pH and Buffers, biomolecules and their functional groups, Transformation of energy in living organisms and laws of Thermodynamics-Entropy and enthalpy.

Unit II CARBOHYDRATES 9

Definition, Classification of carbohydrates based on the number of monomers, number of carbon atom and, functional groups, Structure of glucose, fructose, sucrose, maltose, starch, glycogen and cellulose, Functions and physiological significance of hexose.

Unit III PROTEINS 9

Amino acids-general structure and classification and three-letter abbreviation, peptide bond formation and peptides, proteins, Biologically Active Peptides and Polypeptides, classification of proteins, hierarchy of protein structure, function of proteins, - enzymes, influence of pH, temperature, substrate concentrations on enzyme activity.

Unit IV LIPIDS 9

Definition, physiological significance, classification, fatty acids: classification- saturated and unsaturated fatty acids, essential and non-essential fatty acids. triacylglycerols: nomenclature, physical properties, chemical properties and characterization of fats - hydrolysis, saponification, acid value, rancidity of fats.

Unit V NUCLEIC ACIDS 9

Definition, purine and pyrimidine bases, types of nucleic acids-RNA and DNA, experimental evidences to prove DNA as the genetic material, Double helical structure of DNA, types and functions of RNA, difference between DNA and RNA.

Text Book:

1. Moran L. A., Horton R.A., Scrimgeour G., Perry M., Rawn D., “Principles of Biochemistry” 5th Edition, Pearson New international Edition,2014.
2. Nelson D.L., Cox M.M., “Lehninger’s Principles of Biochemistry”, 7th Edition. Macmillan Publisher, 2017.
3. Berg J. M., Tymoczko J. L., Stryer, L., “Biochemistry” 7th Edition, Macmillon, 2012.

Reference Book:

1. Voet D., Prat W.C., Voet J., “Principles of Biochemistry”, John Wiley and Sons, 4th Edition 2012.
2. Rodwell V., Bender D., Botham K., Kennelly P., Anthony Weil P., “Harpers Illustrated Biochemistry” McGrawHill, 31th Edition 2018.

23BTA04 FUNDAMENTALS OF IMMUNOLOGY

Offered by BT (Allied Elective offered to BAD, BBE, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- organization of immune system.
- basic components in innate immunity.
- role of adaptive immune system and vaccination concepts.
- immune system disorders.
- importance of transplantation and immunotherapy

Course Outcome:

At the end of the course, the students will be able to

- explain the various types of cells and organs involved in immune system.
- illustrate the various barriers of innate immunity and importance of complement system.
- understand the various concepts and molecules of adaptive immunity and methods involved in vaccine designing.
- analyze the reason behind the various autoimmune disorders.
- apply the concepts of immunotherapy of infectious diseases and transplantation

Unit I ORGANIZATION OF IMMUNE SYSTEM **9**

History, Hematopoiesis, primary & secondary lymphoid organs, myeloid cells, lymphoid cells, dendritic cells and natural killer cells.

Unit II INNATE IMMUNITY **9**

Innate immunity: Anatomical, physiological, phagocytic and inflammatory barriers, The complement system: overview, Induced innate responses to infections.

Unit III THE ADAPTIVE IMMUNE AND INFECTION **9**

Cell-Mediated Immune response: T cell mediated response, Humoral Immune Response, Antibodies: structure of immunoglobulins, immunoglobulin subtypes, T cell receptor, cytokines: functions, Infectious agents and how they cause disease: Bacterial (Tuberculosis), viral (Influenza) and parasitic infection (helminthes), vaccines: history, principle of vaccination, Conventional and recombinant vaccines.

Unit IV IMMUNE DISORDERS **9**

Inherited immunodeficiency diseases: SCID, DiGeorge's syndrome, X-linked agammaglobulinemia, Acquired immune deficiency syndrome:AIDS, Hypersensitivities: Type I, II, III and IV, Autoimmune responses: Graves disease, Rheumatoid Arthritis, Diabetes Mellitus Type I, II. myesthenia gravis.

Unit V TRANSPLANTATION AND IMMUNOTHERAPY **9**

Tissue typing and matching transplantation: heart, liver, kidney, immunosuppression, transplant rejection, immunotherapy: Infections, cancer.

Text Book:

1. Peter J. Delves., Seamus J. Martin., Dennis R. Burton., Ivan M. Roitt., "Essential Immunology", Wiley-Blackwell; 13th edition, 2017.
2. Abbas, K.A., Litchman, A.H., Pober, J.S., "Cellular and Molecular Immunology", Elsevier., 9th Edition, 2017.
3. William E.P., "Fundamental Immunology", Lippinkott Williams and Wilkins a Wolters Kluwer business, 7th Edition, 2012.

Reference Book:

1. Ashim K.C., "Immunology and Immunotechnology", Oxford University Press, 1st Edition, 2006.
2. Kuby J., "Immunology", WH Freeman & Co., 8th Edition, 2018.
3. Christine D., "Clinical Immunology and Serology: A laboratory Perspective"; F.A. Davis Co.; Philadelphia 3rd Edition, 2009.

23CEA01 BUILDING PLANNING AND DRAWING

Offered by CIV (Allied Elective offered to BAD, BBE, BBT, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The fundamentals of building planning.
- The climate and weather suitability for buildings.
- Statutory requirements of buildings.
- Basic drawing principles.
- Preparation of building drawing and utility layouts.

Course Outcome:

At the end of the course, the students will be able to

- Read out and mark the building blueprints.
- Design buildings to adopt for the existing climatic and weather conditions.
- Employ appropriate statutory requirements of buildings.
- Draw basic building layouts.
- Prepare building and utility drawings.

Unit I FUNDAMENTALS OF BUILDING PLANNING 9

Principles of planning - Classification of buildings - Dimensions of buildings and its components - Marking and Setting out.

Unit II CLIMATE AND WEATHER SUITABILITY FOR BUILDINGS 9

Climatology - Elements of climate - Sun, Wind, Relative Humidity, Temperature effects - Comfort conditions for house - Types of macro climatic zones - Design of houses and layouts based on climatic conditions - Orientation of buildings - Solar Charts - Ventilation.

Unit III STATUTORY REQUIREMENTS OF BUILDINGS 9

Basic requirements of building elements as per NBC - Building Bye-laws - Set back distances and calculation of carpet area, plinth, floor area ratio and open spaces.

Unit IV BASIC DRAWING PRINCIPLES 9

Conventional signs in building drawing - Development of plan, elevation and section - Schedule of openings from the given line diagram of residential buildings (not to scale).

Unit V PREPARATION OF BUILDING DRAWING AND UTILITY LAYOUTS 9

Functional design of building using inter connectivity diagrams (bubble diagram) - Development of line diagram for non-residential buildings - Preparation of water supply, sanitary and electrical layouts using line diagrams.

Text Book:

1. Swamy N.K, Rao K, “Building Planning and Drawing”, Charotar Publishing House Pvt. Ltd. - Anand; 8th Edition, 2015.
2. S. S. Bhavikatti, M. V. Chitawa, “Building Planning and Drawing”, I K International Publishing House Pvt. Ltd, 2014.

Reference Book:

1. B. P. Verma, “Civil Engineering Drawing and House Planning”, Khanna publishers, 2016.

Extensive Reading:

- http://www.bepls.com/dec2013/34a.pdf
- https://www.designingbuildings.co.uk/wiki/Types_of_drawings_for_building_design
- https://classes.engineering.wustl.edu/2009/spring/jme4900/Blueprint%20Reading%20Material.pdf
- http://navybmr.com/study%20material/14069a/14069A_ch11.pdf

23CEA02 INDUSTRIAL POLLUTION PREVENTION AND CONTROL

Offered by CIV (Allied Elective offered to BAD, BBE, BBT, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- The types of environmental pollution.
- The air pollution control methods.
- The principles of wastewater treatment.
- The concept of sustainability.
- The environmental regulations

Course Outcome:

At the end of the course, the students will be able to

- At the end of the course, the students will be able to
- Familiarize the pollution and its regulating standards.
- Select the different air pollution control methods gases and particulates.
- Apply the principles of wastewater treatment and recovery methods.
- Understand the importance of sustainability and its indicators, strategies and barriers.
- Implement the environmental regulations, policies for clean environment.

Unit I TYPES OF POLLUTION **9**

Definition of pollutant - Types of pollution - Air, water, land & Noise - Adverse effects of pollutants on eco system and human health - Need for effluent treatment - Standards for drinking water, Effluent discharge – Air and Noise standards.

Unit II AIR AND NOISE POLLUTION CONTROL METHODS **9**

Particulate Emission Control - Gravitational Settling Chambers - Cyclone separators - Fabric filters - Electrostatic Precipitators - Wet scrubbers - Absorbers - Control of sulphur - di-oxide - Oxides of nitrogen - Carbon monoxide and hydrocarbons. Noise pollution measurements and its control.

Unit III PRINCIPLES OF WASTEWATER TREATMENT **9**

Preliminary treatment, Primary Treatment - Sedimentation tanks, coagulation, Secondary treatment -, Trickling filters, Activated Sludge Process, Oxidation ponds. Tertiary treatment - Chlorination - Advanced wastewater treatments - Recovery of metals from process effluents (Theoretical concepts only).

Unit IV SUSTAINABILITY **9**

Industrial activity and environment - Industrialization and sustainable development - Indicators of sustainability- Sustainability strategies - Barriers to sustainability - Pollution prevention in achieving sustainability.

Unit V ENVIRONMENTAL REGULATIONS **9**

Prevention vs. control of industrial pollution - Environment policies and Regulations to encourage pollution prevention - Environment friendly chemical processes (Sources of waste and principles) - Source reduction techniques – waste audit, evaluation of pollution prevention options, waste minimization circles. - Regulations for clean environment and implications for industries.

Text Book:

1. Freeman.H.M, "Industrial Pollution Prevention Hand Book", McGraw Hill, 2017.
2. Garg, S.K., “Environmental Engineering I & II”, Khanna Publishers, New Delhi, 2022 (42nd edition)

Reference Book:

1. Pandey.G.N and Carney.G.C, “Environmental Engineering”, Tata McGraw Hill, New Delhi, 2017.
2. James. G. Mann and Liu.Y.A, "Industrial Water Reuse and Waste Water Minimization", McGraw Hill, 2002.
3. Bishop.P, "Pollution Prevention: Fundamentals and Practice", McGraw Hill International, McGraw Hill Book Co., Singapore, 2010.

Extensive Reading:

- Kapoor.B.S, “Environmental Engineering”, 5th Edition, Khanna publishers,2012.
- https://sustainabledevelopment.un.org/resources/sd21

23CEA03 INTRODUCTION TO ENGINEERING SEISMOLOGY

Offered by CIV (Allied Elective offered to BAD, BBE, BBT, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- The fundamentals of about Engineering Seismology.
- The awareness about the earthquake recording instruments and seismic records.
- The earthquake hazards and seismic hazard assessment.
- The various seismic hazard analysis.
- The different types of risk and vulnerability assessment.

Course Outcome:

At the end of the course, the students will be able to

- At the end of the course, the students will be able to
- Categorize the various components of engineering seismology.
- Understand the mechanism and results different types of seismic recording instruments.
- Classify the various earthquake hazards and seismic hazard assessment.
- Do various seismic hazard analysis.
- Analyze the types of risk and vulnerability.

Unit I ENGINEERING SEISMOLOGY **9**

Introduction to engineering seismology - Terminologies and definitions - Earthquake types - Overview of plate tectonics - Earthquake source mechanisms - Source models - Types of faults - Activity and fault studies - Concepts of seismic magnitudes and intensity -Earthquake size, different magnitude scales and relations, Theory of wave propagation - Seismic waves, body and surface waves.

Unit II EARTHQUAKE RECORDING INSTRUMENTS **9**

Earthquake recording instrumentations - Concept of seismograph - Seismic station - Sensors and data loggers - Mechanical and digital sensors - Interpretation of Seismic Records - Acceleration, Velocity and Displacement - Frequency and Time Domain parameters - Response spectrum and spectral parameters - Epicentre and magnitude determination.

Unit III SEISMIC HAZARD ASSESSMENT **9**

Introduction to seismic hazard - Strong ground motions and site effects - World great Earthquakes - Large and Damaging Earthquakes of India - Instruction to seismic zones and codes - Global and National seismic hazard assessment mapping programs - Safety of individual site - Concept of seismic microzonation - Types and Scale - Methodology.

Unit IV SEISMIC HAZARD ANALYSIS **9**

Introduction to Seismic Hazard Analysis- Methods - Deterministic and Probabilistic - Attenuation models and Simulation of Strong Ground Motion - Introduction to Site characterization - Different methods and experiments - Geotechnical properties - Site classification and worldwide code recommendation.

Unit V RISK CLASSIFICATIONS AND MAPPING **9**

Concept of site response - Local site effects and evaluation methods - Ground motion amplifications and estimation - Development of response /design spectrum - Introduction to liquefaction - Mechanism and factors causing liquefaction - estimation methods and procedures- Mapping - Earthquake induced landslide - Landslide hazard mapping - Tsunami hazard - Consideration for Tsunami hazard mapping.

Text Book:

1. Seth Stein and Michael Wysession, “An Introduction to Seismology, Earthquakes and Earth Structure”, 1st edition, Wiley Blackwell publishers, 2008.
2. Steven L Kramer, “Geotechnical Earthquake Engineering”, Pearson Education, 2003.

Reference Book:

1. Bozorgnia Y and Bertero VV “Earthquake Engineering - From Engineering Seismology to Performance - Based Engineering” CRC Press, Washington, 2004.
2. Leon Reiter, “Earthquake hazard Analysis - Issues and Insights”, Columbia University Press, New York, 1990.
3. Havskov J and Alguacil G “Instrumentation in Earthquake Seismology”, Springer, The Netherlands, 2016.

Extensive Reading:

- Recent Advances in Earthquake Geotechnical Engineering and microzonation, edited by Ansal A, Springer, Netherlands, 2004.
- Assessing and managing Earthquake risks, edited by Oliveira CS, Roca A and Goula X, Springer, Netherlands, 2006.

23CEA04 PRINCIPLES OF GLOBAL POSITIONING SYSTEM

Offered by CIV (Allied Elective offered to BAD, BBE, BBT, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The basic principles of Global Positioning System.
- GPS signals and data.
- Collection of GPS data and its processing.
- Various errors in GPS data.
- The skills required to link locational data to certain projections and present same as maps.

Course Outcome:

At the end of the course, the students will be able to

- At the end of the course, the students will be able to
- Acquaint with the fundamentals of Global Positioning System.
- Employ various methods to collect GPS data by receiving signals from receiver.
- Perform basic GPS receiver operation and data processing.
- Check the accuracy of GPS data and able to do necessary adjustments.
- Produce a simple map from field data acquired using hand-held GPS

Unit I FUNDAMENTALS OF GPS **9**

Components of GPS - GPS receivers - Reference coordinates systems - Datum, geoid, ellipsoid, WGS 84 system - Time and signal propagation through atmosphere- Their modelling and estimation - Satellite orbit and Engineering Applications.

Unit II GPS SIGNALS AND DATA **9**

Navigational data - Collection methods - Static positioning, kinematic positioning, Pseudo - Kinematic and stop and go methods - Observation planning and strategy

Unit III GPS OBSERVABLES **9**

Pseudo range and carrier phase parameters - Estimations, data handling, cycle slip detection and correction, ambiguity resolution - GPS data processing - Single, Double and Triple differences.

Unit IV ERRORS IN GPS DATA **9**

Satellite geometry - Errors in different segments - Multipath errors - Accuracy of GPS data and measures - Network adjustments.

Unit V APPLICATIONS OF GPS **9**

Positioning and Navigation Applications- Personal, Automotive, and Aviation Navigation. Mapping and Surveying- Military and Defense Applications- Environmental and Scientific Applications-Climate, Earthquake and Volcano monitoring. Precision Agriculture- Farming and Crop Management-Challenges and Future Trends

Text Book:

1. Satheesh, Gopi, “Global Positioning System and its Applications”, McGraw Hill, 2005.
2. Kaplan, E.D. and Hegarty, C.J., “Understanding GPS: Principles and Applications”, Artech House, 2006.

Reference Book:

1. Leick, A., “GPS Satellite Surveying”, John Wiley & Sons, 2004.
2. Gunter, S., "Satellite Geodesy:Foundation, Methods and Applications“, 2nd Ed., De Gruyter, 2008

23ECA01 IMAGE PROCESSING

Offered by ECE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the fundamentals of image processing and image enhancement methods.
- Examine methods for image restoration and image segmentation.
- Explore the processes involved in image compression and recognition.

Course Outcome:

At the end of the course, the students will be able to

- Explain the principles of elements of visual perception and image processing algorithms.
- Describe the approaches of image enhancement and apply in practical applications.
- Infer the different restoration methods of noisy images.
- Recognise the essentials of image segmentation, image representation, and description algorithms.
- Describe the algorithms for compression, and image processing applications.

Unit I IMAGE FUNDAMENTALS **9**

Digital Camera principles - Elements of digital image processing systems – Elements of visual perception, brightness, contrast, hue, saturation, mach band effect – Color image fundamentals, RGB, HSI models- Basic relationship between pixels –Image file formats – comparisons of imaging modalities - x ray, MRI, Ultrasound.

Unit II IMAGE ENHANCEMENT **9**

Basic Intensity Transformations – Histogram equalization and specification techniques - Spatial Smoothing Filters, Spatial sharpening Filters – Frequency domain Smoothing and Sharpening Filters – Homomorphic filtering–Pseudo Color image processing, Full color image processing.

Unit III IMAGE RESTORATION **9**

Model of the Image Degradation/Restoration Process – Noise Models, Estimation of noise parameters – Restoration in the presence of Noise only situation, Mean filters, Order statistic filters, Adaptive mean and median Filters – Periodic noise reduction by Frequency domain filtering – Inverse filtering.

Unit IV IMAGE SEGMENTATION, REPRESENTATION AND DESCRIPTION **9**

Point, Line and Edge detection – Edge linking via Hough transform – Thresholding – Region based segmentation, Region growing, Region splitting and Merging – Image representation schemes – Boundary descriptors – Regional descriptors.

Unit V COMPRESSION AND IMAGE APPLICATIONS **9**

Compression fundamentals – Huffman, Arithmetic coding - Bit plane coding, Run Length encoding - JPEG Compression Standard. Image Registration – Image Fusion – Image Mosaicking – Image Denoising - Object Detection – Content based image retrieval - Water marking - Steganography–Video Analysis.

Text Book:

1. Rafael C. Gonzalez and Richard E. Woods, “Digital Image Processing', 4th Edition, Pearson Education, 2019.
2. Anil K. Jain, “Fundamentals of Digital Image Processing”, Pearson Education, 2015.

Reference Book:

1. Kenneth R. Castleman, “Digital Image Processing”, Pearson, 2006.
2. Rafael C. Gonzalez, Richard E. Woods and Steven Eddins, “Digital Image Processing using MATLAB”, 3rd Edition, Gatesmark Publishing, 2020.
3. D. E. Dudgeon and RM. Mersereau, “Multidimensional Digital Signal Processing”, Prentice Hall Professional Technical Reference, 1990.
4. William K. Pratt, , “Digital Image Processing”, 4th Edition, Wiley India Private Limited, 2010
5. Milan Sonka, “Image Processing, Analysis and Machine Vision”, 4Th Edition, Cengage India Private Limited, 2017.

Extensive Reading:

- www.digitalimageprocessingplace.com
- www.ou.edu/class/.../articles/CompressionMethods_Gif_Jpeg_PNG.html
- https://swayam.gov.in/nd1_noc19_ee55/

23ECA02 ARDUINO FOR ENGINEERS

Offered by ECE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To describe the structure of embedded system
- To examine the hardware of Arduino board
- To apply skills on programming and interfacing of peripheral devices with Arduino
- To utilize the Arduino board for practical applications

Course Outcome:

At the end of the course, the students will be able to

- Elucidate the core structure of embedded system
- Describe the hardware architecture of Arduino
- Program Arduino board with memory and libraries
- Interface peripherals with Arduino board
- Design Arduino based practical real life applications

Unit I EMBEDDED COMPUTING PLATFORM **9**

Introduction to Embedded System – History of Embedded Systems, Classification – Purpose of Embedded Systems – Application Areas – Core of Embedded System – Memory – Sensors and Actuators – Arduino Family – Types of Arduino Devices – Arduino-Compatible Devices – Arduino Application Areas.

Unit II ARDUINO HARDWARE **9**

AVR Microcontroller – Internal Architecture – Peripheral Functions – Analog Comparator – Analog-to-Digital Converter – Serial I/O: UART, SPI, I2C – Watchdog Timer – Interrupts – Overview of ATmega168/328 Architecture.

Unit III ARDUINO PROGRAMMING **9**

Overview of Arduino IDE – Building an Arduino Sketch – Using the Header Sockets – Working with Strings – Implementing Structures – Creating Functions - Creating Dynamic Variables – Using Flash to Store Data – Using the EEPROM Memory - Using Libraries – Creating Your Own Libraries

Unit IV ARDUINO INTERFACING **9**

Working with Digital Interfaces – Interfacing LED and Switch – Seven-Segment Display Interfacing – Working with Analog Interfaces – Interfacing Potentiometer – Interfacing Temperature Sensor – Interfacing Touch Sensor – Working with Motors: DC motor, Servo Motor – DC motor speed control with PWM

Unit V SYSTEM DESIGN WITH ARDUINO **9**

Digital Code Lock – Temperature Monitoring System – Automatic Light System – Ultrasonic Distance meter – Automatic Irrigation System – Home Automation – Line follower Robot – Room Cleaning Robot with ultrasonic sensors

Text Book:

1. J. M. Hughes, “Arduino: A Technical Reference”, 1st Edition, O’Reilly Media, Inc, USA, 2016.
2. Richard Blum, “Arduino Programming in 24 Hours, Sams Teach Yourself”, 1st Edition, Pearson Education, Inc, USA, 2014

Reference Book:

1. Shibu K V, “Introduction to Embedded Systems”, 2nd Edition, McGraw Hill Education Private Limited, India, 2016.
2. Yogesh Misra, “Programming and Interfacing with Arduino”, 1st Edition, CRC Press, Taylor & Francis Group, USA, 2022
3. Michael Margolis, Brian Jepson, Nicholas Robert Weldin, “Arduino Cookbook”, 3rd Edition, O'Reilly Media, Inc., USA, 2020

Extensive Reading:

- https://www.arduino.cc/en/Tutorial/HomePage
- https://circuits4you.com/arduino-projects-vol-1/
- https://www.tutorialspoint.com/arduino/

23ECA03 EMBEDDED SYSTEMS FOR INDUSTRIAL APPLICATIONS

Offered by ECE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce embedded systems, its hardware and software.
- To introduce devices and buses used for embedded networking.
- To realize the significance of Industry 4.0 and digital twins
- To explain embedded system design concepts.

Course Outcome:

At the end of the course, the students will be able to

- Realize the components in embedded systems
- Recognize the embedded systems design approaches
- Implement distributed embedded system
- Facilitate industrial controls through digital twins in Industry 4.0
- Develop embedded control system applications

Unit I COMPONENTS OF EMBEDDED SYSTEMS 9

Characteristics – Design Challenges – Performance – Hardware components: CPU Core, Memory, I/O – Communication Interface – Software Components: Firmware, Operating Systems – Other System Components: Reset Circuit – Brown–out Protection Circuit – Oscillator Unit – Real Time Clock – Watchdog Timer.

Unit II EMBEDDED SYSTEM DESIGN 9

Embedded System Design Process – Hardware Development – Embedded Firmware Design approaches – Components of Embedded Programs – Model of programs – UML – Development and Debugging – Integration of Hardware and Firmware – Hardware Software Co-Design Issues.

Unit III DISTRIBUTED EMBEDDED SYSTEMS 9

Network abstractions, CAN bus, I2C bus – Distributed computing in automobiles – Distributed industrial control systems - Design Example: manufacturing unit, process control system, and automation

Unit IV INDUSTRY 4.0 AND DIGITAL TWINS 9

Evolution of Industry 4.0 - Key principles, and technologies - Digital Twins in industrial processes - Integration of Industry 4.0 and digital twins - WSN for industrial automation - Edge computing in industrial processes - RTOS in industrial environments.

Unit V EMBEDDED CONTROL APPLICATIONS 9

Reconfigurable Embedded Control Systems, Design Example: Optical tachometer, intrusion detection in industrial control systems, and fuzzy logic based security system.

Text Book:

1. Shibu K.V, “Introduction to Embedded Systems“, 2nd Edition, McGraw Hill Education India Private Limited, India, 2016.
2. Marilyn Wolf, “Computer as Components”, 5th Edition, Morgan Kaufmann, Inc., USA, 2022.

Reference Book:

1. Raj Kamal, “Embedded Systems”, 4th Edition, McGraw Hill Education India Private Limited, India, 2020.
2. Lyla B. Das, “Embedded Systems: An Integrated Approach”, Pearson Education India, India, 2014.
3. Steven F. Barrett and Daniel J. Pack, “Embedded Systems: Design and Applications”, 1st Edition, Pearson Education India, India, 2008.

Extensive Reading:

- http://nptel.ac.in/courses/108102045/
- https://users.ece.cmu.edu/~koopman/lectures/index.html

23ECA04 SMART SENSORS

Offered by ECE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce various types of sensors and the design of basic circuit building blocks.
- To impart knowledge on Smart sensing technology and its applications.
- To introduce the standards and protocols used for smart sensing.

Course Outcome:

At the end of the course, the students will be able to

- Explain the fundamentals of Sensors.
- Apply knowledge gained to a practical project involving designing, implementing, and evaluating a sensor system for a specific application.
- Design basic building blocks for a Smart sensor.
- Analyze interface electronic circuits.
- Apply smart sensors for Health, Industrial and Home related applications.

Unit I FUNDAMENTALS AND CHARACTERISTICS 9

Sensor, actuator and transducer - Sensor Classification: passive and active sensor, absolute and relative Sensor - Units of Measurements - Sensor Characteristics - Transfer Function - calibration – nonlinearity - saturation repeatability - Dead Band, Resolution.

Unit II EVOLUTION OF SENSOR TECHNOLOGIES 9

Occupancy and Motion Detectors: Ultrasonic – Microwave motion – Capacitive occupancy- optoelectronic motion detectors. Position, Displacement, and Level: potentiometric-capacitive-inductive and magnetic- optical. Velocity and Acceleration: capacitive- piezoresistive- piezoelectric- thermal and gyroscopes; Force, Strain, and Tactile Sensors; Pressure Sensors Neuro sensors, Biosensors, MEMS Sensors.

Unit III SMART SENSOR INTEGRATION AND FUNCTIONALITY 9

Classic vs Smart sensor - architecture of smart sensors and its components. Monolithic integrated smart sensor - hybrid integrated smart sensor - impedance sensing system - smart temperature sensor - smart wind sensor - smart hall sensor. Integration of micromachining and microelectronics - wafer bonding - LIGA process - standard of smart sensor Network - communication for smart sensors.

Unit IV INTERFACE CIRCUITS 9

Input characteristics of interface circuits – amplifiers - excitation circuits - analog to digital converters - direct digitization and processing - bridge circuits- data transmission - batteries for low power sensors.

Unit V APPLICATIONS AND CASE STUDIES 9

Design and implementation of IoT for environmental condition monitoring - development of smart bed for health care.

Case Study: smart city and its design - wearable smart sensors in health care.

Text Book:

1. Gerard Meijer, Kofi Makinwa, Michiel Pertijs, “Smart Sensor Systems: Emerging Technologies and Applications”, IEEE press, Wiley, 2014.
2. Manabendra Bhuyan, “Intelligent Instrumentation: Principles and Applications” CRC Press, 2011.

Reference Book:

1. Kevin Yallup, Krzysztof Iniewski, “Technologies for Smart Sensors and Sensor Fusion”, CRC Press, 2014.
2. Krzysztof Iniewski, “Smart Sensors for Industrial Applications”, CRC Press, 2013.
3. Jacob Fraden “Sensor Technology Design & Application”4th edition, Springer .2010

Extensive Reading:

- https://www.elprocus.com/smart-sensor/
- https://onlinecourses.nptel.ac.in/noc21_ee32

23EEA01 PRINCIPLES OF ELECTRICAL SYSTEM

Offered by EEE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Understand the various electrical system components
- Know the residential and commercial electrical systems
- Concepts of Electrical heating and welding
- Concepts of Industrial automation
- Functions of Programmable Logic Controller.

Course Outcome:

At the end of the course, the students will be able to

- Familiar with electrical system components with standard symbols and drawings, SLD.
- Understand the electrical wiring systems for residential, commercial and industrial consumers
- Explain the concepts of Electricity in heating and welding applications.
- Choose the components of industrial electrical systems
- Explicate the Architecture of Industrial Automation and working of Programmable Logic Controllers

Unit I ELECTRICAL SYSTEM COMPONENTS 9

LT system wiring components, selection of cables, wires, switches, distribution box, metering system, Tariff structure, protection components- Fuse, MCB, MCCB, ELCB, inverse current characteristics, symbols, single line diagram (SLD) of a wiring system, Contactor, Isolator, Relays, MPCB, Electric shock and Electrical safety practices.

Unit II RESIDENTIAL AND COMMERCIAL ELECTRICAL SYSTEMS 9

Types of residential and commercial wiring systems, general rules and guidelines for installation, load calculation and sizing of wire, rating of main switch, distribution board and protection devices, earthing system calculations, requirements of commercial installation, deciding lighting scheme and number of lamps, earthing of commercial installation, selection and sizing of components.

Unit III ELECTRICAL HEATING AND WELDING TECHNIQUES 9

Introduction to Electrical Heating – Induction Heating– Principle, Effects of Supply Voltage and Frequency–Dielectric Heating– Principle, Effects of supply voltage and frequency– Advantages and Applications. Introduction to Electrical welding – Resistance Welding – Principle, classification and schemes of resistance welding – Advantages and Applications.

Unit IV INDUSTRIAL ELECTRICAL SYSTEMS 9

HT connection, industrial substation, Transformer selection, power and energy calculation, Power factor correction– kVAR calculations, type of compensation, Introduction to PCC, MCC panels. Specifications of LT Breakers
DG Systems, UPS System, Battery banks, Sizing the DG, UPS and Battery Banks, Selection of UPS and Battery Banks.

Unit V INDUSTRIAL ELECTRICAL SYSTEM AUTOMATION 9

Study of basic PLC, Role of in automation, advantages of process automation, PLC based control system design, Panel Metering and Introduction to SCADA system for distribution automation.

Text Book:

1. S. L. Uppal and G. C. Garg, “Electrical Wiring, Estimating & Costing”, Khanna publishers, 2008.
2. K. B. Raina, “Electrical Design, Estimating & Costing”, New age International, 2007.
3. S. Singh and R. D. Singh, “Electrical estimating and costing”, Dhanpat Rai and Co., 1997.
4. H. Joshi, “Residential Commercial and Industrial Systems”, McGraw Hill Education, 2008

Reference Book:

1. W. Bolton, “Programmable Logic Controllers” Newnes, Sixth edition 2015.
2. Jon Stenerson, “Programmable Logic Controllers with Control Logics, DELMAR Cengage Learning,2010.
3. John W. Webb, Ronald A. Reis, “Programmable Logic Controllers: Principles and Applications” Prentice Hall of India, 2003.
4. BISWANATH PAUL, “Industrial Electronics and Control Including Programmable Logic Controller” Prentice-Hall of India Private Limited – Third Edition, 2014.

23EEA02 ELECTRICAL MACHINES AND DRIVES

Offered by EEE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The basic concepts of different types of electrical machines and their performance.
- The different methods of starting D.C motors and induction motors.
- Conventional and solid-state DC and AC drives.

Course Outcome:

At the end of the course, the students will be able to

- Enumerate the concepts, different types and characteristics of DC machines.
- Explicate the concepts, different types and characteristics of AC machines.
- Describe the basic concept of electrical drives.
- Explain about conventional and solid-state speed control of DC drives.
- Explain about conventional and solid-state control of AC drives.

Unit I D.C. MACHINES **9**

DC Machine – Construction – DC generator - Principle of operation – EMF equation – Self and separately excited generators – Characteristics of series, shunt and compound generators. DC motor–Principle of operation – Back emf and torque equation – characteristics - Applications.

Unit II A.C. MACHINES **9**

Alternators – Construction – Types – Induced EMF – Voltage regulation using EMF method. Three-phase induction motors – Construction – Types – Principle of operation – slip-torque characteristics. Single-phase induction motors – Construction–Types– Principle of operation.

Unit III INTRODUCTION TO ELECTRICAL DRIVES **9**

Introduction: drive system, types, choice of electrical drives- Dynamics of electrical drives: fundamental torque equation, classification of load torques, components of load torques - multi-quadrant operation - equivalent values of drive parameters - steady state stability - modes of operation.

Unit IV CONVENTIONAL AND SOLID STATE SPEED CONTROL OF D.C. DRIVES (QUALITATIVE TREATMENT ONLY) **9**

Speed control of DC series and shunt motors – Armature and field control, Ward- Leonard control system - Using single phase controlled rectifiers and DC choppers (Circuit diagram and operation) –Applications.

Unit V CONVENTIONAL AND SOLID STATE SPEED CONTROL OF A.C. DRIVES (QUALITATIVE TREATMENT ONLY) **9**

Speed control of three phase induction motor – Voltage control, V/f control, slip power recovery scheme – Using AC voltage regulators and inverters (Circuit diagram and operation)– Applications.

Text Book:

1. A K Theraja & B L Theraja “A Text Book of Electrical Technology Vol-2,” 23rd Edition S.Chand Publications, 2007.
2. Dubey G.K., “Fundamentals of Electrical Drives”, Narosa Publishing House, Second Edition, 2015.

Reference Book:

1. P.C.Sen.,“Principles of Electrical Machines and Power Electronics”, Second Edition ,Wiley India Pvt. Lt&Sons. 2013.
2. M.D.Singh, K.B.Khanchandani, “Power Electronics”, Second Edition, McGraw-Hill, 2002.
3. Vedam Subramanyam, “Electric Drives – Concepts and Applications”, Second Edition, McGraw Hill, 2010.
4. Nagrath .I.J. & Kothari .D.P, “Electrical Machines” ,Fourth Edition, McGraw-Hill, 2010.

23EEA03 FUNDAMENTALS OF ELECTRIC POWER UTILIZATION

Offered by EEE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Different types of lamps
- Methods of heating and welding
- Refrigeration and Air Conditioning
- Electrolytic processes and storage of electricity
- Electric traction systems
- Electrical energy conservation

Course Outcome:

At the end of the course, the students will be able to

-

Unit I ILLUMINATION, INDUSTRIAL HEATING AND WELDING 9

Different types of lamps - incandescent – fluorescent – mercury vapour lamps.

Role of electric heating for industrial applications – resistance heating – induction heating – dielectric heating - electric arc furnaces.

Brief introduction to electric welding – welding generator, welding transformer and their characteristics.

Unit II REFRIGERATION AND AIR CONDITIONING 9

Principle of a refrigerator – Vapour Compression System – Mechanical and Electrical circuits – Voltage Regulator – Water Cooler – Coefficient of Performance – Standard rating – Maintenance and trouble shooting of refrigerators – Air conditioning system – Types – operation – Mechanical and Electrical circuits – Cooling capacity – Thermo-electric Refrigeration – Central Air Conditioning System.

Unit III ELECTROLYTIC PROCESSES AND STORAGE OF ELECTRICITY 9

Electrolysis, Faraday's laws of Electrolysis – Electroplating – Electrical Equipments – Agitation and Filtration Plant – Extraction and refining of metals – Storage of Electricity – Lead Acid Battery – Characteristics – Indications of a fully charged battery – Nickel iron and Nickel cadmium batteries – Applications –Capacity rating of batteries – Charging and maintenance of batteries – Battery chargers.

Unit IV ELECTRIC TRACTION 9

Merits of electric traction – requirements of electric traction system – supply systems – traction motors – d.c. series motor – mechanics of train movement – Speed Time curve –tractive effort – specific energy consumption.

Unit V ECONOMIC ASPECTS OF ELECTRICAL ENERGY UTILISATION 9

Introduction to Energy conservation and Energy auditing - Tools for Energy auditing – Energy conservation in Chemical industry, Pulp and Paper industry, Sugar industry, Cement industry, Textile industry, Iron and Steel Industry – Energy Conservation in household and commercial sectors – Energy Conservation Legislation – Tariffs - Influence of power factor – The most economic power factor - PF improvement.

Text Book:

1. C.L. Wadhwa, 'Generation, Distribution and Utilization of Electrical Energy', New Age International Pvt. Ltd, Third Edition 2015.
2. E. Openshaw Taylor, 'Utilization of Electrical Energy in SI Units', Orient Longman Pvt. Ltd, Eleventh Edition 2007.

Reference Book:

1. H. Partab, 'Art and Science of Utilisation of Electrical Energy', Dhanpat Rai and Co, New Delhi, Third Edition 2014.
2. J.B. Gupta, 'Utilization of Electric Power and Electric Traction', S.K.Kataria and Sons, Eleventh Edition 2015.
3. G.C.Garg, 'Utilization of Electric Power and Electric Traction', Khanna Publishers, Ninth Edition 2009.
4. A.Chakrabarti, M.L.Soni, P.V.Gupta, U.S.Bhatnagar, 'A text Book on Power System Engineering', Dhanpat Rai and Co, New Delhi, 2009.
5. N.V.Suryanarayana, 'Utilisation of Electric Power : Including Electric Drives and Electric Traction', New Age International Publishers, Second Edition 2014.
6. V.K.Mehta, Rohit Mehta, 'Basic Electrical Engineering', S.Chand Limited, 2008.

23EEA04 GREEN ENERGY SOURCES

Offered by EEE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The concept of various forms of renewable sources of energy
- Stand alone and grid connected renewable energy systems.
- Conceptualize the implementation of Hybrid renewable energy systems.

Course Outcome:

At the end of the course, the students will be able to

- Explain environmental impact of using fossil fuels
- Explain the concept of solar energy harvesting by various methods
- Enumerate the basics of Wind Energy conversion system and its impacts
- Describe various types other renewable energy sources and their harvesting methods
- Explain the concept of Hybrid energy systems

Unit I INTRODUCTION & SOLAR ENERGY **9**

Renewable energy scenario in India – importance of renewable energy sources- Environmental aspects of energy utilization- CO2 Emission Potentials – Achievements– Applications.

Solar Energy: Sun and Earth-Basic Characteristics of solar radiation- measurements - Solar Room Heating – Solar Room cooling

Unit II SOLAR COLLECTORS **9**

Angle of sunrays on solar collector - Flat plate and concentrating collectors- Solar Pond – Solar Desalination - Photovoltaic cell-characteristics- Equivalent circuit-Photovoltaic modules and arrays- Maximum Power Point Tracking (MPPT) Algorithms – P&O , I&C .

Unit III WIND ENERGY **9**

Wind – Power available in wind – Power coefficient -site selection – factors affecting wind energy - wind energy conversion devices – classification - Types of wind energy systems – Horizontal and Vertical axis wind conversion system- Drag force and Lift force - Betz limit – Tip speed ratio - Performance characteristics of of wind turbine characteristics - Three blade design – Power Vs Wind speed characteristics - Safety and Environmental Aspects.

Unit IV OTHER RENEWABLE ENERGY SOURCES **9**

Fuel cell – principle of working- various types - construction and applications.

Biogas - generation - types of biogas Plants

Small hydro - Geothermal energy- site selection, construction, environmental issues

Unit V OCEAN ENERGY TECHNOLOGIES & HYBRID RENEWABLE ENERGY SYSTEMS **9**

Wave Energy - Tidal energy –OTEC - site selection, construction, environmental issues

Introduction to Hybrid Renewable Energy System - Need for Hybrid Systems- Range and type of Hybrid systems- Quantitative study of Diesel-PV and Wind-PV systems

Text Book:

1. B.H.Khan, “Non-Conventional Energy Resources”, TMH Education, 3rd Edition, 2017.
2. G.S.Sawhney, “Non-conventional Energy sources”,PHI, 2012.
3. R.K.Rajput, “Non-conventional Energy Sources And Utilisation – Energy Engineering”, S.Chand, 2nd Edition, 2019.

Reference Book:

1. Sukhatme S P, Nayak J K, “Solar Energy: Principles of Solar Thermal Collection and Storage”, Tata McGraw Hill, 2008
2. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K, 1996.
3. Kothari D. P & Singal K. C & Ranjan, Rakesh, “Renewable Energy Sources and Emerging Technologies”, PHI Learning Private Limited, New Delhi, 2013.
4. Rai. G.D, “Non conventional energy sources”, Khanna publishers, 2014
5. N.K.Giri, “Alternate Energy – Sources, Applications and Technologies”, Khanna Publishers, First Print, 2016.
6. John Twidell and Tony Weir, “Renewable Energy Resources”, Tylor and Francis, Second Edition,2015

23ITA01 WEB DESIGN AND DEVELOPMENT

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To develop an understanding in the basics of html like forms, lists etc
- To develop an insight in PHP
- To develop a Webpage design with CSS
- To understand the basics of JavaScript
- To acquire knowledge about Ajax and MySQL

Course Outcome:

At the end of the course, the students will be able to

- Design a website in HTML
- Apply concepts of PHP
- Create styles for the HTML document
- Perform validation using JavaScript
- Connect with the Web server and perform database operations.

Unit I INTRODUCTION : MARKUP WITH HTML 9

Introduction-Document background color and image – Text Structuring –Character Formatting – Lists – Ordered – Unordered – Definition Lists – Links to a web page – Tables – Borders and Rules – Rows and Cells – Formatting with Tables –Form handling-Building Forms-HTML5 Features

Unit II PHP INTRODUCTION 9

Incorporating PHP Within HTML-The Structure of PHP -Expressions and Control Flow in PHP-Operators-Conditionals

Unit III PRESENTATION WITH CSS 9

Introduction to CSS- Importing a Style Sheet –CSS Rules-Style Types-CSS Selectors -The CSS Cascade - Measurements - Fonts and Typography -Managing Text Styles -CSS Colors - Positioning Elements –Pseudo-classes- The Box Model and Layout -Advanced CSS with CSS3- Attribute Selectors -CSS3 Backgrounds - CSS3 Borders –Text Effects-Transformations

Unit IV JAVASCRIPT INTRODUCTION 9

Exploring JavaScript-Using Comments-Semicolons-Variables-Operators-Variable Typing-Functions - Global Variables-Local Variables-The Document Object Model-Expressions and Control Flow in JavaScript-Expressions-Literals and Variables- Operators -The with Statement -Using try ... catch -Conditionals -Looping - JavaScript Arrays -JavaScript and PHP Validation and Error Handling-Validating User Input with JavaScript-Regular Expressions -Redisplaying a Form After PHP Validation

Unit V MYSQL AND AJAX 9

Accessing MySQL Using PHP- Querying a MySQL Database with PHP -A Practical Example -Practical MySQL - Performing Additional Queries-Preventing SQL Injection -HTML Injection -Using Ajax- Using XMLHttpRequest

Text Book:

1. Steven M.Schafer, " HTML, XHTML and CSS", Wiley Publishing, Inc., Fifth edition 2010.
2. Nixon Robin "Learning PHP, MySQL, JavaScript, CSS & HTML5 A step- by-step guide to creating Dynamic Websites" , O'Reilly Media, Inc, USA,June 2014..

Reference Book:

1. Chuck Musciano Bill Kennedy, "HTML & XHTML: The Definitive Guide", O'Reilly, 6th Edition, October 24, 2006
2. Thomas A. Powell, "Web Design: The Complete Reference", McGraw Hill, June 2000
3. Jeffrey C.Jackson, "Web Technologies--A Computer Science Perspective", Pearson Education, 2006
4. Thomas Powell,"HTML & CSS: The Complete Reference", McGraw Hill, Fifth Edition, Mar 2010
5. Lemay Laura ,"Mastering HTML, CSS & Javascript Web Publishing" BPB Publishers,July 2016.
6. Jon Duckett ,"Beginning Web Programming with HTML, XHTML, and CSS", Wrox Publications, 2008

Extensive Reading:

- www.codecademy.com
- http://www.w3schools.com/html/
- http://www.w3schools.com/css/
- https://www.khanacademy.org/computing/computer-programming/html-css
- http://tutorialehtml.com/en/
- http://www.alternetwebdesign.com/htmltutorial/lesson1.htm
- http://www.htmlhelp.com/reference/css/

23ITA02 INTRODUCTION TO JAVA

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Understand fundamentals of programming such as variables, conditional and iterative execution, methods, etc.
- Understand fundamentals of object-oriented programming in Java, including defining classes, invoking methods, using class libraries, etc
- Have the ability to write a computer program to solve specified problems
- Be able to use the Java SDK environment to create, debug and run simple Java programs

Course Outcome:

At the end of the course, the students will be able to

- Write basic programs using fundamental structures.
- Create basic programs using object oriented concepts.
- Create classes that can handle exception and various errors handling mechanism.
- Create Simple applications with GUI
- Develop applications using applet and graphics.

Unit I JAVA FUNDAMENTALS 9

Overview of JDK framework – Identifiers – variables – Assignment statements and Expressions – Constants - Numeric data types, operations and conversions – String Type – Scanner class – if switch statements – while – do while – for loop – nested loop- Defining a method- Calling a method – Passing parameters by values – Overloading methods.

Unit II OBJECT ORIENTED PROGRAMMING CONCEPTS 9

Class Fundamentals-Using predefined classes--Constructors-Access control-Modifiers -Methods-Dealing with Static Members and Methods-Method Overloading-Interfaces-Importing Packages-Understanding Class Path-Implementing Packages-Java Doc Comments-Inheritance-Polymorphism.

Unit III EXCEPTION / ERROR HANDLING 9

Garbage Collection-Finalize () Method-Exceptions & Errors-Types of Exception-Control Flow In Exceptions-Use of try -catch-finally-throw-throws in Exception Handling -In-built and User Defined Exceptions-Checked and Un Checked Exceptions

Unit IV APPLICATION PROGRAMMING WITH GUI 9

Event-Driven Programming- Event and Event Sources – Listeners, Registration and handling events – Mouse events – Key events -Introduction to Swings-Frame-Components-Text Input-Choice Components-Menus-Dialog Box-Layout Management

Unit V APPLETS AND GRAPHICS 9

Applet class – JApplet class – Enabling applets to run as application – Passing string to applets – Html file and applet tag- Graphics class – paint component method – Drawing graphics on panels – Drawing strings , lines, Rectangles, and Ovals, Polygons , Polylines, FontMetrics class.

Text Book:

1. Y.Daniel Liang " Introduction to Java Programming" 7th Edition, Pearson Education,2013

Reference Book:

1. P.J.Deitel&H.M.Deitel, "Java: How to Program Java 2", Prentice Hall, Seventh Edition, 2011.
2. Herbert Schildt, "Java The Complete Reference",TataMcgrawHill, Eight Edition, 2011.
3. E.BalaGurusamy, "Programming with java A Primer", Tata McGraw, Hill Education, Fourth Edition, 2009
4. Cay S. Horstmann and Gary Cornell, "Core Java:Volume I –Fundamentals", Prentice Hall, Ninth Edition, 2015

Extensive Reading:

- http://mark.random-article.com/weber/java/schedule.html
- http://www.oracle.com/technetwork/java/index.html
- http://docs.oracle.com/javase/tutorial/ -
- http://horstmann.com/corejava
- www.deitel.com
- http://www.kodejava.org/
- http://www.tutorialspoint.com/java

23ITA03 PYTHON SCRIPTING

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Understand fundamental programming constructs of scripting
- Understand debugging and testing options
- Understand fundamentals of file handling and text processing functions
- Develop graphical user interfaces for interactive modules
- Understand database connectivity in python

Course Outcome:

At the end of the course, the students will be able to

- Apply control structures in Python scripting
- Implement debugging and testing functions
- Design functions and modules for file handling and text processing
- Use graphical user interface for design
- Implement statistics and database concepts

Unit I SCRIPTING OVERVIEW **9**

Python Installation – Jupyter Notebook – Geany & Pycharm – Python Interpreter – Interactive console – Importing Modules - Strings – String Operations – Lists – Basic Lists Operations – Tuples – Sets – Dictionaries – Command Line Arguments – Decision Making – Loops – Iterators – Generators – Functions - Modules

Unit II DEBUGGING AND TESTING **9**

Debugging- Error Handling – Debuggers Tools – Debugging Basic Program Crashes – Profiling and timing Programs – Unit Test – Unit Test Creation – Methods – Accepting Input – Handling password – Executing External Commands – Capturing Output – Prompting for Passwords – Reading Configuration Files – Adding Warning Code – Launching Web Browser- OS Module – Making Backups

Unit III FILE HANDLING AND TEXT PROCESSING **9**

Handling Directories – Handling Data – Working Paths – Comparing Data – Merging Data – Pattern Matching – Metadata – Compressing and Restoring – File Archiving – Encryption – Decryption – Text Wrapping – Regular Expressions – Unicode Strings – Documentation and Reporting – Working with Various Files

Unit IV NETWORKING AND GRAPHICAL USER INTERFACES **9**

Socket Programming – http package – ftplib module – urllib package – Email Handling – Remote Monitoring – telnetlib – SSH – Building Graphical User Interfaces – Working with Apache and other Log Files – SOAP and REST API Communication – Web Scraping

Unit V STATISTICS AND DATABASE ADMINISTRATION **9**

NumPY Module – Pandas Module – Data Visualization – Matplotlib – Plotly – MySQL Database Administration - SQLite Database Administration

Text Book:

1. Ganesh Sanjiv Naik, “Mastering Python Scripting for System Administartors”, Packt Publisher, First Edition, 2019.

Reference Book:

1. Narendra Polu, “Complete Python Scripting for Automation”, Packt Publishers, First Edition 2020.
2. Hans Petter Langtangen, “Python Scripting for Computational Science”, Springer, First Edition 2004

Extensive Reading:

- https://www.coursera.org/specializations/introduction-scripting-in-python
- https://www.python-course.eu/python3_execute_script.php

23ITA04 E-WASTE MANAGEMENT

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the materials used in manufacturing electrical and electronic products
- To learn Recycling ,Recovery and Integrated Approach to e-Waste Recycling
- To understand the various solution to WEEE Compliance
- To study the various types of Hazards
- To have an overview of Responsibility in e-Waste Management

Course Outcome:

At the end of the course, the students will be able to

- Analyze the materials used in manufacturing electrical and electronic products
- Apply the concept of Recycling and Recovery to e-Waste
- Implement the various solution to handlewaste
- Identify the methods to handle RF Hazards
- Realize the Responsibility in e-Waste Management

Unit I OVERVIEW AND MATERIALS USED IN MANUFACTURING ELECTRICAL AND ELECTRONIC PRODUCTS 9

Electronic Waste Management: Introduction - Producer Responsibility Legislation –Waste Electrical And Electronic Equipment (WEEE) Directive – Rohs Directive – Treatment Options – Material Composition – Socio-Economic Factors – Logistics Of WEEE - WEEE Health And Safety Implications - Materials Used In Manufacturing Electrical And Electronic Products: Rohs Proscribed Materials - Soldering And The Move To Lead-Free Assembly – Printed Circuit Board Materials

Unit II DUMPING BURNING AND LANDFILL WITH HAZARDS 9

Encapsulants Of Electronic Components – Polymeric Materials - WEEE Engineering Thermoplastics - Materials Composition Of WEEE: Mobile Phones – Television – Washing Machines – Landfill – Burning – Incineration – Mass Burn – Energy Recovery – Pollution From Incineration - RF Hazards: Wired And Wireless Communication – RF And Microwave Radiation Hazards- Occupational Exposure- Public Exposure

Unit III RECYCLING ,RECOVERY AND INTEGRATED APPROACH TO E-WASTE RECYCLING 9

Separation And Sorting -Treatment -Outputs And Markets -Emerging Technologies -Recycling And Recovery Technologies-Emerging Recycling And Recovery Technologies-Printed Circuit Boards-Sector-Based Eco-Design

Unit IV LIQUID CRYSTAL DISPLAYS 9

Overview Of Liquid Crystals-Liquid Crystal Displays Based On Nematic Mesophase - LCD Manufacturing Process-Environmental Legislation And Lifecycle Analysis-Potentially Hazardous Constituents - Toxicity Of LCD Constituents.

Unit V RESPONSIBILITY AND ASSESSMENT OF ELECTRONICS ENCLOSURE PLASTICS 9

WEEE Directive -E-Waste Laws And Voluntary Agreements In Other Countries - Recommendations To Implement IPR - Instrumental Techniques – Visible-NIR Spectroscopy Of Engineering Thermoplastics-Analysis Of Plastics Containing Flame- Retardant Additives

Text Book:

1. R. E. Hester and R. M. Harrison, “Electronic Waste Management”, Royal Society of Chemistry, London, 2009.
2. Mackenzie L. Davis, and David A. Cornwell, “Introduction to Environmental Engineering”, Tata McGraw Hill, New Delhi, 2010.

Reference Book:

1. William W. Nazarodd and Lisa Alvarez-Cohen, “Environmental Engineering Science”, Wiley-India, New Delhi, 2010.
2. Gilbert M Masters, “Introduction to Environmental Engineering and Science”, Prentice Hall of India, New Delhi, 2004.
3. Klaus Hieronymi ,Ramzy Kahhat and Eric Williams “E-Waste management:From Waste to Resource ”, Routledge,2012.

Extensive Reading:

- http://ec.europa.eu/environment/waste/weee/index_en.htm
- https://www.sepa.org.uk/regulations/waste/waste-electrical-and-electronic-equipment-weee/
- http://www.hse.gov.uk/waste/waste-electrical.htm
- http://ec.europa.eu/environment/waste/weee/index_en.htm
- http://www.prnewswire.co.in/

23ITA05 DIGITAL ASSET MANAGEMENT

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the ways and means of creating digital content
- To understand the methods of storing large digital content
- To know the key design issues of Content Management Systems
- To know various security issue of Content Management Systems

Course Outcome:

At the end of the course, the students will be able to

- Apply the concepts of digital assets for encoding media
- Apply different models for storing and retrieval using XML and storage medias
- Identify the appropriate concept for presentation of digital assets
- Apply Content Management Systems for specific application
- Use security policies needed for various Content Management System applications

Unit I INTRODUCTION **9**

Introduction to Digital Asset Management – Digital Asset Management (DAM) - Document and Content Management – Web Content Management - Media Management –The Case for Digital Asset Management – Asset Formats – Encoding Multimedia Proxies.

Unit II SYSTEM COMPONENTS **9**

System Components – XML – Markup Languages - Cataloguing and Indexing – Search Engines - Databases – Disk storage and Media Servers – Mass Storage – Storage Management – Storage Networks – Hierarchical Storage Management – Wide–area File Transfer.

Unit III CONTENT RELATED WORKFLOWS **9**

Content Related Workflows - File Formats – Content Representation and Metadata - Content Description Standards – Standards for Metadata Transmission and Exchange - Presentation Tier – Application Server.

Unit IV CONTENT MANAGEMENT **9**

Content Management System Infrastructure – System and Data Integration in CMS - Integration Principle - CMS Legacy System- Integration of Third Party Systems – CMS and Web Integration – Applications – Future Trends.

Unit V DOCUMENT SECURITY AND DIGITAL RIGHTS MANAGEMENT **9**

Document Security and Digital Rights Management – Authentication and trust – Water marking - System Integration – Project Management - Internationalization – Digital Asset Management Products – Document Management - Web Content Management - Video Asset Libraries – Applications.

Text Book:

1. Austerberry, D,"Digital Asset Management", Burlington, MA: Focal Press. Second edition, 2013

Reference Book:

1. Boiko, B. "Content Management Bible", Second Edition, Wiley Publishing, 2005
2. Mauthe, A & Thomas, P. " Professional Content Management Systems: Handling Digital Media Assets", John Wiley & Sons Ltd., 2005

Extensive Reading:

- http://www.stibosystems.com/global/explore-stibo-systems/master-data-management/digital-asset-management.aspx
- http:// www. damguru.com/best-dam-practices-a-digital-asset-management-philosophy.html
- http://www.lac-group.com/digital-asset-management-vs-content-management-vs-knowledge-management

23MEA01 AUTOMOTIVE MAINTENANCE AND POLLUTION CONTROL

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The concepts of automobile maintenance
- The methods of pollution control in automobiles

Course Outcome:

At the end of the course, the students will be able to

- Understand the basic concept of engine maintenance
- Acquire knowledge about the Chassis Drive-line Maintenance
- Understand the Maintenance and servicing of auxiliaries
- Understand concept of Automobile air Pollution
- Apply the Exhaust Emission Control methods

Unit I ENGINE MAINTENANCE **9**

Engine removal and disassembly-Engine cleaning and repair-Smoke diagnosis-Noise diagnosis-Engine block service Cylinder liner fitting-Valve diagnosis and repair-Engine balance – Engine testing-Engine troubles, effects & remedies

Unit II CHASSIS DRIVE-LINE MAINTENANCE **9**

Manual and automatic transmission system-testing, faults and services-Drive shafts-Faults and services-Diagnosing brake system-Calliper and brake pad- Overhauling and Replacement-Brake inspection after repair-Suspension system, Shock absorbers and struts, Coil springs , steering knuckles-Diagnosis, inspection and service- defects in vehicle chassis and body- Service, repair and overhaul.

Unit III MAINTENANCE, SERVICING OF AUXILIARIES **9**

Air conditioning system- service and performance test- leak detection and repair-Servicing of lubricating system Petrol and diesel injection systems-Symptoms, possible faults and services – Battery failure- Battery test-Ignition system- Symptoms, possible faults and services. Tyre –inspection and maintenance-Tyre pressure monitoring system- Retreading and wheel balancing

Unit IV AIR POLLUTION DUE TO AUTOMOBILE EXHAUST **9**

Air pollution due to IC engines-Emission norms- Bharat stage and EURO norms-Engine emissions-Hydrocarbon Carbon monoxide- Oxides of Nitrogen-Particulates- Other emissions – Sources and effects of pollution

Unit V EMISSION CONTROL **9**

Basic methods of emission control, catalytic converter-particulate traps-Selective Catalytic Reduction- Exhaust gas recirculation- Fuel additives -Non-Exhaust emission control-Crank case blow by control- Measurement devices for HC, CO, NOX, Smoke.

Text Book:

1. Doshi J.A,"Vehicle Maintenance and Garage Practice",Prentice Hall India Learning Private Limited,2014.
2. Ganesan V, "Internal Combustion Engines", Tata McGraw-Hill, 4th Edition, 2017.

Reference Book:

1. Tim Gilles,"Automotive Service: Inspection, Maintenance, Repair", Delmar Cengage Learning; 4th edition,2011
2. B.P. Pundir ,"Engine Emissions: Pollutant Formation and Advances in Control Technology, Narosa publishing, 2nd Edition, 2017.
3. Newton, Steeds and Garet, "Motor Vehicles", Society of Automotive Engineers, U.S., 13th revised Edition, 2002.
4. Joseph Heitner, "Automotive Mechanics", East-West Press, 2nd Edition, 2004.
5. Martin W. Stockel and Martin T Stockel, "Automotive Mechanics Fundamentals," Goodheart-Willcox,1985.

23MEA02 ADDITIVE MANUFACTURING

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- The fundamentals of Direct Digital Manufacturing technology and the associated Aerospace, Architecture, Art, Medical and Industrial applications.
- Various geometric modeling and meshing techniques.
- The different processes and be able to develop prototypes of products

Course Outcome:

At the end of the course, the students will be able to

- At the end of the course, the students will be able to
- Understand history, concepts and terminology of additive manufacturing.
- Apply the reverse engineering concepts for design and development of products.
- Comprehend the variations of additive manufacturing techniques and their respective applications.
- Study the know-hows of processes suitable for making metal prototypes.
- Design and develop cost-effective temporary tooling for making prototypes in less time.

Unit I INTRODUCTION **9**

Need - Development of Additive Manufacturing systems – Additive Manufacturing process chain - Impact of Additive Manufacturing on Product Development- Virtual Prototyping- Rapid Prototyping to Additive Manufacturing -Classification of Additive Manufacturing processes – Benefits- Applications.

Unit II REVERSE ENGINEERING AND CAD MODELING **9**

Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies.

Unit III LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS **9**

Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoating issues, materials, advantages, limitations and applications – Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. – Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications – Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies.

Unit IV POWDER BASED ADDITIVE MANUFACTURING SYSTEMS **9**

Selective Laser Sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS): Processes, materials, products, advantages, limitations and applications– Case Studies.

Unit V RAPID TOOLING & APPLICATIONS **9**

Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications & Case studies in design. Jewellery, coin, tableware, Biomedical, automotive, aerospace, electronics, Engineering , Analysis and Planning industries.

Text Book:

1. Chua C.K., Leong K.F., and Lim C.S., “Rapid prototyping: Principles and applications”, 3rd edition, World Scientific Publishers, 2010.
2. Gebhardt, Andreas, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”, Hanser Publications, 2012.

Reference Book:

1. Ian Gibson, David Rosen, Brent Stucker, “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing”, 2nd Edition, Springer, 2015.
2. LiouW.Liou, Frank W.Liou, “Rapid Prototyping and Engineering applications: A tool box for prototype development”, CRC Press, 2019.
3. Ali K. Kamrani, Emad Abouel Nasr, “Rapid Prototyping: Theory and practice”, Springer, 2006.
4. Peter D.Hilton Hilton, Paul F.Jacobs, “Rapid Tooling: Technologies and Industrial Applications”, CRC press, 2000.
5. D. T. Pham and S.S. Dimov, “Rapid Manufacturing”, Springer-Verlag London Limited 2001.

23MEA03 DECISION SUPPORT AND INTELLIGENT SYSTEMS

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To review and clarify the fundamental terms, concepts associated with Decision Support Systems, computerized decision aids, expert systems, group support systems and executive support systems.
- To discuss the modelling and analysis of the Decision Support Systems.
- To understand the enterprise DSS and knowledge management.
- To understand the intelligent systems used in DSS.
- To discuss organizational and social implications of Decision Support Systems

Course Outcome:

At the end of the course, the students will be able to

- Demonstrate an understanding of the theory of decisions and decision analysis including probability, decisions under uncertainty, risk taking, and real-world problems.
- Demonstrate the different models used in the DSS.
- Analyze, design and build an information system using emerging tools and technologies for a given business problem.
- Describe about the role of expert systems.
- Illustrate the implementation, integration and impacts of Decision Support Systems.

Unit I DECISION MAKING AND COMPUTERIZED SUPPORT **9**

Decision Making: Introduction and Definitions - Managers and Decision Making - Managerial decision making and Information Systems - Managers and computerized support Need - framework for decision support – concept of decision support systems (DSS) –executive support systems - preview of the modeling process-phases of decision making process.

Unit II MODELING AND ANALYSIS **9**

DSS components- DSS classifications - Data warehousing, access, analysis, mining and visualization - modeling and analysis- Static and dynamic models – influence diagrams – Optimization via mathematical programming – Heuristic programming – simulation – multidimensional modeling – model base management.

Unit III ENTERPRISE DECISION SUPPORT SYSTEMS AND KNOWLEDGE MANAGEMENT **9**

Group decision making – Group support systems- Technologies – Creativity and Idea generation - enterprise information systems (EIS) – Comparing and Integrating EIS and DSS - supply and value chain and DSS- supply chain problems and solutions – Computerized systems - knowledge management methods, technologies and tools.

Unit IV INTELLIGENT SYSTEMS **9**

Artificial intelligence (AI) – Concepts and Definitions – AI versus natural intelligence - expert systems-concepts, structure, types and benefits and problems – knowledge Engineering - knowledge acquisition and validation - knowledge representation – Techniques – Inference techniques

Unit V IMPLEMENTATION, INTEGRATION, AND IMPACTS **9**

Implementation – Major issues of implementation – implementation strategies – Models of integration – Intelligent DSS – Intelligent modelling and model management – problems and issues in integration - impact of management support systems - overview – personnel management issues – impact of Individuals – Impacts on productivity, quality and competitiveness – Issues of legality, privacy and ethics – Other societal impacts.

Text Book:

1. Efraim Turban and Jay E Aronson, “Decision Support and Intelligent Systems”, Prentice Hall, 9thEdition, 2010.

Reference Book:

1. George M. Marakas, “Decision Support Systems”, Prentice Hall, 2nd Edition, 2002.
2. Daniel J. Power, “Decision Support Systems: Concepts and Resources for Managers”, Greenwood Publishing Group, 1st Edition, 2002.
3. Quazi Khabeer, “Business Process Management and Decision Support Systems”, Alpha Science International Limited, 1stEdition, 2013.
4. Elain Rich, Kevin Knight and Shivashankar B. Nair , “Artificial intelligence”, Tata McGraw-Hill Publishing Company Limited, 3rd Edition, 2009.

23MEA04 ENERGY EFFICIENT BUILDINGS

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Impact of solar radiation in buildings.
- Utilization of energy efficient technologies.
- Concept of indoor air quality.
- Design, construction and operation of energy efficient buildings.
- Significance of green buildings and its operation.

Course Outcome:

At the end of the course, the students will be able to

- Be familiar about basic concepts of energy efficient buildings.
- Understand the operation of various energy efficient technologies.
- Know about the different components inside building environment.
- Calculate the different energy transfer in buildings.
- Understand the concept of green buildings and codes.

Unit I INTRODUCTION **9**

The sun-earth relationship - Energy balance on the earth's surface - climate, wind, solar radiation and solar temperature - sun shading and solar radiation on surfaces - Energy impact on the shape and orientation of buildings - Thermal properties of building materials - Technology Roadmap on Energy efficient buildings.

Unit II ENERGY EFFICIENT TECHNOLOGIES **9**

Passive cooling and day lighting - active solar and photovoltaic building energy analysis methods - building energy efficiency standards - different lighting technologies - Energy conservation in pumps, fans and blowers - heat rejection equipment - energy efficient motors and insulation - Energy Efficiency in Residential and Commercial Buildings.

Unit III ENVIRONMENTAL COMPONENTS INSIDE BUILDING **9**

Psychrometry - comfort conditions - thermal comfort - ventilation and air quality - air conditioning requirement - visual perception - auditory requirement - illumination requirement - choice of lighting - lighting standards - control of lighting - lighting economics and aesthetics - energy saving - impacts of lighting efficiency - electronic ballast - Ventilation – Requirements – Minimum standards for ventilation – Ventilation Design – Energy conservation in ventilating systems.

Unit IV ENERGY TRANSFER IN BUILDINGS **9**

Concepts of energy efficient buildings - Energy efficient HVAC systems - Heating and Cooling Equipment - Building's energy balance accounting for solar energy gain – Heat losses - Internal heat sources - Study of climate and its influence in building design for energy requirement - Low energy and zero energy buildings.

Unit V GREEN BUILDINGS **9**

Ecological sustainable design - Barriers to green buildings - green building rating tools - material selection - embodied energy - operating energy - facade systems – transportation - water treatment systems - water efficiency - building economics - LEED and IGBC codes.

Text Book:

1. John Littler and Randall Thomas, "Design with Energy: The Conservation and Use of Energy in Buildings", Cambridge University Press, 1984.

Reference Book:

1. ColinPorteous,"TheNew Eco-Architecture",SponPress, 2002.
2. LeverMoreG J,"BuildingEnergy ManagementSystems",Eand F.N Spon,London,2000.
3. MeansR.S.,"Greenbuilding:projectplanningandcostestimating",Kingston,2006.
4. KibertC.J."SustainableConstruction:GreenBuildingDesign",Wiley, 2ndEdition,2007.
5. Eicker U.,"Low EnergyCooling for SustainableBuildings",Wiley, 2009.
6. AttmannO.,"GreenArchitecture",McGraw-Hill,2010.

Extensive Reading:

- http://www.bee-india.nic.in
- http://www.iea.org
- http://www.unep.org

23MEA05 ELECTRONICS PACKAGING TECHNOLOGY

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The importance of electronics packaging.
- The basics of electronic component packaging.
- Key areas of usage of electronic packages.

Course Outcome:

At the end of the course, the students will be able to

- Understand the necessity and the basics of Electronics packaging.
- Design basic circuit component packages.
- Understand the role of package subassemblies
- Explain about the role of interconnections and enclosures
- Design packages considering thermal issues and list the applications of electronics packaging.

Unit I PACKAGING IMPLEMENTATION **9**

Requirements of electronics packaging – levels of packaging – packaging priorities – general packaging issues – product applications –Integrated Circuit process technologies – Application Specific Integrated Circuits packaging

Unit II CIRCUIT COMPONENT PACKAGING **9**

Electronic and electro-mechanical circuit components – Bare die termination techniques (Chip and wire bonding, controlled collapse soldering and Tape Automated Bonding) – Hybrid microcircuits – Chip on board technology – Die attachment and protection – Multichip modules.

Unit III PACKAGE SUB ASSEMBLIES **9**

Electrical performance requirements – Materials for packaging and interconnecting structures –general assemble selection considerations – Through hole mount and surface mount technologies (process and advantages) - rework considerations.

Unit IV INTERCONNECTIONS, CABLING AND ENCLOSURES **9**

Backplane structures and connectors – solder less wrap backplane wiring – electrical characteristics of wiring – Wire and cable materials, configurations – cabling connectors –wire terminations. General Enclosure Selection Considerations – Cabinets – Small Equipment Enclosures – Portable Carrying Cases - Printed Board Enclosures.

Unit V THERMAL MANAGEMENT AND APPLICATIONS **9**

Basic Thermal Management Considerations - General Thermal Analysis - Heat Sinks and Air movers – Liquid cooling – Thermoelectric pump modules – case studies. End product applications in Consumer Electronics, Data Processing Equipment, Avionics, Military Shipboard Electronics and Biomedical Electronics.

Text Book:

1. Gerald L Ginsberg, “Electronic Equipment Packaging Technology”, Springer Science + Business Media,1992
2. Glenn R Blackwell, “The Electronic Packaging Handbook, CRC Press LLC”, 2000. E book published on 2017

Reference Book:

1. Charles A Harper, “Electronic Packaging and Interconnection Handbook”, McGraw Hill, 4th edition, 2004
2. Puligandla Viswanadham, “Essentials of Electronic Packaging: A Multidisciplinary Approach”, ASME Press,2011.
3. C. P. Wong, “Electronic Packaging: Design, Materials, Process, and Reliability”, McGraw-Hill, 1998.

23MEA06 FUNDAMENTALS OF ENERGY RESOURCES

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The basics of Conventional and non-conventional energy resources.
- The basic principles and methods of utilizing Biomass
- Exposure to energy conservation techniques

Course Outcome:

At the end of the course, the students will be able to

- Understand the basics of energy systems.
- Apply the fundamentals of energy conversion for practical applications.
- Realize the importance of non-conventional energy systems.
- Understand the concepts of Biomass energy.
- Know about energy conservation techniques

Unit I INTRODUCTION TO ENERGY **9**

Introduction to energy – Primary and secondary energy – Commercial and non-commercial energy - Global energy scene – Indian energy scene -Energy needs of growing economy -Energy pricing – Energy sector reforms - Atmospheric Pollution, general classification of energy, energy crisis, energy alternatives.

Unit II CONVENTIONAL ENERGY **9**

Conventional energy resources, Thermal power plant - combustion processes, fluidized bed combustion, Fuel and ash circuit, Air and flue gas circuit, feed water and steam flow circuit, cooling water flow circuit, hydel power plant – Working principle, Layout, Water hammer effect, Nuclear power plant - Nuclear chain reaction, Efficiency, merits and de-merits.

Unit III NON-CONVENTIONAL ENERGY **9**

Solar energy, solar thermal systems, flat plate collectors, focusing collectors, solar water heating, solar cooling, solar distillation, solar refrigeration, solar dryers, solar pond, solar thermal power generation. Wind energy, types of windmills, ocean wave energy conversion, ocean thermal energy conversion, tidal energy conversion, geothermal energy.

Unit IV BIOMASS ENERGY **9**

Biomass origin - Resources – Biofuels – Photosynthesis – Energy crops. Thermochemical conversion- Pyrolysis, Gasification – Biological conversion – Aerobic and Anaerobic digestion- biogas - Classification of biogas plant , Chemical conversion – Hydrolysis & hydrogenation, Biodiesel.

Unit V ENERGY CONSERVATION **9**

Energy conservation - Act; Energy management importance, duties and responsibilities; Energy efficiency benefits, Key factors to implement energy management - Energy audit – Types and methodology, reports, instruments. Material and energy balance, thermal energy management.

Text Book:

1. Rao, S. and Parulekar, B.B., “Energy Technology: Non-conventional, Renewable and Conventional”, Khanna Publishers, 2007.
2. Nagpal, G.R., “Power Plant Engineering”, Khanna Publishers, 2008.

Reference Book:

1. Godfrey Boyle, “Renewable Energy, Power for a Sustainable Future”, Oxford University Press, U.K., 3rd Revised Edition 2012.
2. Rai, G.D., “Non-conventional Energy Sources”, Khanna Publishers, New Delhi, 2010
3. Twidell, J.W. & Weir, A., “Renewable Energy Sources”, EFN Spon Ltd., UK, 1986.
4. Tiwari G.N., “Solar Energy – Fundamentals Design, Modelling and applications”, Narosa Publishing House, New Delhi, 2002.
5. Freris L.L., “Wind Energy Conversion systems”, Prentice Hall, UK, 1990.

23MEA07 FUNDAMENTALS OF FIRE SAFETY ENGINEERING

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To provide in-depth knowledge about the fundamentals of fire and explosion.
- To understand the causes and effects of fire and explosion.
- To know the various fire and explosion prevention systems and protective equipment.
- To understand the protection of buildings from fire.
- To understand the various fire prevention techniques to be followed in a building.

Course Outcome:

At the end of the course, the students will be able to

- Make familiar with basic concepts of fire science
- Understand the operation of various types of firefighting equipment.
- Know about the different causes and effects of fire.
- Equip the students to effectively employ fire protection techniques in the building.
- Understand the technics of the prevention of explosion.

Unit I FUNDAMENTALS OF FIRE **9**

Combustion process & concepts, combustion in solids, liquid, gases- smouldering fires- Spontaneous combustion - rapid fire progress phenomena- Properties influencing fire hazard – properties of solid, liquid and gaseous fuels - classification of fires.

Unit II FIRE CONTROL **9**

Fire extinguishers – Location and operation of extinguishers - Extinguishing methods- extinguishing agents: water, foam, chemical powder, CO2, sand, steam, saw dust – Fire detectors – Fire tender - Automatic fire extinguishing system - Fixed firefighting installations - Risk analysis: risk assessment, consequence analysis, risk reduction – Fire drill – Emergency procedures.

Unit III PRODUCTS AND EFFECTS OF COMBUSTION **9**

Heat: Conduction, convection, radiation- effects of heat- effects of flames – different fire gases and their effects – effects of smoke on humans– Smoke movement control and venting

Unit IV BUILDING FIRE SAFETY **9**

Objectives of fire safe building design, Fire load, fire resistant material and fire testing – concept of egress design - exits – width calculations -– fire safety requirements for high rise buildings – Behavior of materials & structures in fire – Concrete and steel. Flame spread in high rise building – Statutory requirements.

Unit V FUNDAMENTALS OF EXPLOSION **9**

Introduction – Explosion fundamentals – Types – - Effects of explosion – Negative pressure wave – Fragmentation Physical, Boiling Liquid Expanding Vapour Explosion, Chemical explosion – Vapour cloud explosion – Dust explosion – Explosion prevention – Explosion mitigation, case studies.

Text Book:

1. Purandare D.D., Abhay D. Purandare, “Hand Book on Industrial Fire Safety”, P & A Publications, 1st Edition, 2006.
2. Jain V.K., Fire Safety in Building, Taylor & Francis, 2nd edition, 2016.

Reference Book:

1. Gupta, R.S., “Hand Book of Fire Technology” Orient Longman, Bombay, 2010.
2. “Accident Prevention manual for industrial operations” N.S.C., Chicago, 1988.
3. Dinko Tuhtar, “Fire and explosion protection – A system approach”, Ellis Horwood Ltd, 1989.
4. “Firefighters hazardous materials Reference Book Fire Prevention in Factories”, Nostrand Rein Hold, New York, 1991.
5. “Fire Prevention Handbook”, NFPA, 20th edition, 2008.
6. “Fire Prevention and fire fighting”, International Maritime Organisation, London, 2000

23MEA08 RELIABILITY ENGINEERING

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To provide students with knowledge in concepts, methodology, and tools of reliability engineering.
- To develop the ability of students to construct models for the estimation andimprovement of reliability parameters of manufactured products and components.

Course Outcome:

At the end of the course, the students will be able to

- Recognize the concepts of reliability and hazard rate models.
- Perform reliability analysis of a system and designing the same.
- Get familiar with design for reliability.
- Apply the concepts of various reliability test and analyse the failure data.
- Gain the knowledge about maintainability and system availability.

Unit I RELIABILITY ENGINEERING **9**

Definition of reliability - Reliability functions – Failure Data – Mean Time to failure (MTTF) – Mean Time between Failures (MTBF) – Hazard Rate Function - Bath tub curve – Conditional Reliability - Constant Failure Rate Model: Exponential distribution - CFR Model Time dependent Failure models – Weibull distribution – Normal Distribution – Lognormal distribution.

Unit II RELIABILITY OF SYSTEMS **9**

Introduction – Series, Parallel and Combined Series-Parallel Configuration – System Structure function, Minimal cuts and Minimal paths – Markov analysis – Load sharing Systems – Stand-by systems – Degraded systems- Three state devices – Physical Reliability models: Covariate, Static and Dynamic models.

Unit III DESIGN FOR RELIABILITY **9**

System effectiveness, Economic analysis and Life cycle costs. - Design Methods: Parts and material selection – Derating – Stress strength analysis – Complexity and technology – Redundancy - Failure Analysis: Identification of failure modes – determination of cause – assessment of effect – Estimation of probability of occurrence – Computation of criticality index – Determination of corrective action - System Safety and Fault tree analysis.

Unit IV FAILURE DATA ANALYSIS **9**

Data collection – Empirical methods: Ungrouped / Grouped Complete Data – Ungrouped / grouped Censored data – Static Life Estimation - Reliability Life testing – Test time calculations – Burn – In – Testing – Acceptance Testing Accelerated Life testing – Reliability Growth Testing - Identifying Failure and Repair Distributions - Goodness of fit tests – Chi square Test – Bartlett's Test – Mann's test – Kolmogorov-Smirnov test.

Unit V MAINTAINABILITY **9**

Analysis of downtime – Repair time distribution – System Repair time – Reliability under preventive maintenance - Design for Maintainability: Maintenance requirements – Design methods – Fault isolation and self-diagnostics – Parts standardization and interchangeability – Modularization and Accessibility – Repair Vs Replacement – Proactive Maintenance –– Maintenance prediction and Spares provisioning – System availability.

Text Book:

1. Charles E. Ebeling, "An introduction to Reliability and Maintainability engineering", McGraw Hill Education Publication, 12th Edition, 2017.
2. Srinath, L.S., "Reliability Engineering", East west press, 4thEdition, 2005.

Reference Book:

1. Connor P.D.T.O. "Practical Reliability Engineering", John Wiley, 5th Edition, 2012.
2. Sharma S.C. "Inspection Quality Control and Reliability", Khanna Publishers, 1st Edition, 2002.
3. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2nd Edition, 2013.

23MEA09 STATISTICAL QUALITY CONTROL

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the concept of Statistical Quality Control.
- To understand about process control and acceptance sampling procedures

Course Outcome:

At the end of the course, the students will be able to

- Understand and interpret the mean, variance, and standard deviation of distributions for modelling process quality.
- Grasp the importance of quality and the means to control it using SQC.
- Apply the concepts of various control chart methods in statistical process control.
- Perform analysis of process capability and measurement system capability.
- Appreciate the role of various acceptance sampling procedure in quality control.

Unit I INTRODUCTION TO QUALITY CONTROL 9

The Meaning of Quality and Quality Improvement; Brief History of Quality Methodology; Statistical Methods for Quality Control and Improvement; Total Quality Management (quality philosophy, links between quality and productivity, quality costs, legal aspects of quality implementing, quality improvement).

Unit II MODELING PROCESS QUALITY 9

Describing Variation - Discrete Distributions - Continuous Distributions – Normal. Lognormal, Exponential, Weibull, Gamma distribution – Central Limit theorem Probability Plots - Some Useful Approximations - Statistics and Sampling Distributions - Statistical Inference for a Single and Two Samples - Type I and Type II errors, the probability of Type II error - Linear Regression Models - Simple Numerical Problems

Unit III METHODS OF STATISTICAL PROCESS CONTROL 9

Chance and assignable causes, Statistical Basis of the Control Charts - Control Charts for X-Bar and R- Charts, Control Charts for –x and s - The Control Chart for Fraction Nonconforming - Variable Sample Size - Operating-Characteristic Function and Average Run Length Calculations - p chart and np chart - Control Charts for Nonconformities (Defects) - C and U charts - State of control and process out of control identification in charts

Unit IV PROCESS MEASUREMENT AND MONITORING TECHNIQUES 9

Process Capability Analysis Using a Histogram or a Probability Plot, Control Chart, Designed Experiments, Attribute Data - Gauge and Measurement System Capability Studies - Cumulative Sum Control Chart - Exponentially Weighted Moving Average Control Chart - The Moving Average Control Chart - other univariate statistical Process monitoring and Control techniques - multivariate process Monitoring and control.

Unit V ACCEPTANCE SAMPLING 9

Lot-By-Lot Acceptance Sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, OC curves, Military Standard 105E, the Dodge-Roaming sampling plans Average Outgoing Quality Limit (AOQL), Lot Tolerance Percent Defective (LTPD) -Acceptance Sampling by Variables - Designing a Variables Sampling Plan with a Specified OC Curve - MIL STD 414 - Other Variables Sampling Procedures - Chain Sampling – Continuous Sampling - Skip-Lot Sampling Plans.

Text Book:

1. Douglas.C.Montgomery. “Statistical Quality Control: A Modern Introduction”, John Wiley, 7thEdition, 2013.

Reference Book:

1. John.S. Oakland. “Statistical process control”, A Butterworth-Heinemann Title, 6thEdition, 2007.
2. Eugene L. Grant, Richard S. Leavenworth “Statistical Quality Control”, McGraw-Hill, 7thEdition 2008
3. Monohar Mahajan. “Statistical Quality Control”, Dhanpat Rai & Sons, 3rdEdition, 2012.
4. Gupta. R.C.. “Statistical Quality control”, Khanna Publishers, 8th Edition, 2008.

23MEA10 COMPUTER AIDED DESIGN

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Understand fundamental concepts of computer graphics and its tools in a generic framework.
- Impart the parametric fundamentals to create and manipulate geometric models using curves and surfaces.
- Study the concepts of solid modelling
- Provide clear understanding of CAD systems for 3D modelling, transformation techniques, viewing and clipping

Course Outcome:

At the end of the course, the students will be able to

- Enhance their perspective of modern computer system with modelling, analysis and interpretation of 2D and 3D visual information.
- Interpret the most common modelling approaches.
- Create surface primitives using parametric modelling.
- Create the different solid primitives using the different representation schemes
- Apply geometric transformations on the created geometric entities.

Unit I COMPUTER GRAPHICS FUNDAMENTALS 9

Overview of Graphics systems: Video Display Devices, Raster-Scan System, Random-Scan Systems, Graphics Monitors and Workstations, Input Devices, Hard-Copy Devices, Graphics Software. Output primitives: Line Drawing Algorithm - DDA, Bresenham's and Parallel Line Algorithm. Circle generating algorithm – Midpoint Circle Algorithm.

Unit II GEOMETRIC MODELLING 9

Classification of wireframe entities, Curve representation methods, Parametric representation of analytic curves: line, circle, arc, conics, Parametric representation of synthetic curves: Hermite cubic curve, Bezier curve, B-Spline curve, NURBS.

Unit III SURFACE MODELLING 9

Classification of surface entities, Surface representation methods, Parametric representation of analytic surfaces: plane surface, ruled surface, surface of revolution, tabulated cylinder, Parametric representation of synthetic Surfaces: Hermite cubic surface, Bezier surface, B-Spline surface.

Unit IV SOLID MODELLING 9

Geometry and topology, Boundary representation, The Euler-Poincare formula, Euler operators, Constructive solid geometry: CSG primitives, Boolean operators, CSG expressions, Interior, Exterior, closure, Sweeping: linear and non-linear, Solid manipulations, feature modelling.

Unit V TRANSFORMATIONS AND CLIPPING 9

Geometric Transformations: Coordinate Transformations, 2D Geometric Transformations-Translation, Scaling, Shearing, Rotation and Reflection, 3D transformations, Windowing and Clipping, Line clipping – Cohen Sutherland Line clipping

Text Book:

1. Ibrahim Zeid, "Mastering CAD/CAM", McGraw Hill, International Edition, 2010.

Reference Book:

1. Chennakesava R Alavala, "CAD/CAM Concepts and Applications", Prentice Hall India Learning Private Limited, 2008.
2. Groover M.P., "CAD/CAM: Computer-Aided Design and Manufacturing", Pearson education,2003.

23MEA11 DIGITAL MANUFACTURING

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Theorize the challenges faced by manufacturing
- Exhibit the importance of digital manufacturing for business processes
- Demonstrate the importance of digital manufacturing in Product Lifecycle Management.
- Make aware of developing the digital manufacturing work environment.
- Make competent in using computer-aided technology to support the above.

Course Outcome:

At the end of the course, the students will be able to

- Graduate exhibits the use of various elements of OOTB manufacturing tools.
- Selects proper procedure of validating practical work through OOTB validation.
- Administer for installing, configuring, integrating OOTB manufacturing tools.
- Analyse and optimise various practical manufacturing processes through OOTB simulation.
- Create a framework for integrated design of mechatronic systems.

Unit I INTRODUCTION TO DIGITAL MANUFACTURING **9**

A Brief History of Manufacturing, Digital Manufacturing Today, Digital Design, Digital Materials, Digital Fabrication, Digital Products, Technology Development, Applications Development, People and Business, The Digital Economy, Transition from Industrial Manufacturing

Unit II PROCESS SIMULATION AND VALIDATION **9**

Assembly and component manufacturing, process simulation and validation, Ergonomic/ human simulation, Robotic simulation and Offline Programming (OLP)

Unit III PLANT DESIGN, SIMULATION AND OPTIMISATION **9**

Station / work-cell layout design, Throughput simulation, Discrete event simulation, Optimisation of material flow and logistic

Unit IV MANUFACTURING PROCESS SIMULATION SOLUTION CUSTOMISATION **9**

Functionality enhancements as extensions of OOTB software solution, Reports customisation, User interface customisation

Unit V SPECIAL TOPICS **9**

Informatics platform for designing and deploying e-manufacturing systems, framework for integrated design of Mechatronic systems, Collaborative supplier integration for product design and development. Reconfigurable manufacturing systems design, Virtual Reality based platform for collaborative product review and customisation.

Text Book:

1. Wang, Lihui; Nee, Andrew Y.C. (Eds.) Collaborative Design and Planning for Digital Manufacturing, Springer, 2009.

23MEA12 STRESS MANAGEMENT

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Understand the concept of stress, job stress, and consequences of stress in the workplace.
- Enable the students to consider the management of work-related stress at an individual and organizational level
- Help in formulating the key areas and situations where management can and should help employees in performance planning and career advancement.
- Develop an alternative approach to dealing with problems in organizations with the applications of stress management techniques to help employee's issues.

Course Outcome:

At the end of the course, the students will be able to

- Learn the concept of stress and stress drivers and linkages between physical and mental illness.
- Identify the signs and symptoms of stress-related illness.
- Know about the work stress and its sources.
- Apply appropriate stress management techniques and remedial measures to overcome stress.
- Understand the remedial actions to control stress

Unit I UNDERSTAND STRESS **9**

Concept, Definitions and types of stress. Basic condition of stress, GAS, Stress reaction, Consequences of stress. Causes of stress. Impact of stress on human physical and mental health.

Unit II STRESS AND ILLNESS **9**

Symptoms of stress. Possible signs of stress in young people. Associated illnesses related to stress

Unit III OCCUPATIONAL STRESS OR JOB STRESS **9**

Meaning, and concept of work stress. Sources of job stress: Organizational, Individual, and environmental. Effect of stress on job performance and job satisfaction.

Unit IV STRESS MANAGEMENT TECHNIQUES **9**

Aims of stress management. Coping strategies of stress in the organization: Individual, and organizational strategies. Techniques to combat stress: Cognitive behavioral techniques to change thought, Problem-solving approach, Positive thinking.

Unit V THERAPIES AND REMEDIAL ACTION TO CONTROL STRESS **9**

Behaviour therapies, Relaxation training, Visualization, Expressive therapies, Storytelling and Counseling Methods, Meditation, Yoga and exercise.

Text Book:

1. Jerrold S. Greenberg, (2013), Comprehensive Stress Management, 12th edition, McGraw-Hill Higher Education.

Reference Book:

1. Walt Schafer, (2000), Stress Management for Wellness, Cengage Learning.
2. Richard Regis, (2004), Stress Management, NHRD Network, Coimbatore Chapter. Rita Agarwal (2001), Stress in Life and work, Response Books, 284pp, Journal of Human Values. D. M. Pestonjee, (2008), Stress and Coping: the Indian Experience, 2nd Edition, Sage Publications.

23MEA13 ENERGY CONSERVATION TECHNOLOGIES

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
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Course Objective:

To impart knowledge on

- Study the various energy conversion technologies with lesser energy consumption.
- Impart knowledge on energy resources and different energy management strategies.

Course Outcome:

At the end of the course, the students will be able to

- Understand the commercial energy and renewable energy sources.
- Understand the energy economics and energy audit
- Analyse the working principle of various energy conversion system
- Infer the Encon opportunities in electrical utilities
- Know about the various bioenergy conversion system

Unit I ENERGY RESOURCES

Coal, Oil, Natural gas, Nuclear power, Hydro and Renewable energy - their utilization pattern in the past, present and future projections of consumption pattern.

Solar thermal collectors and power plant, HAWT, biomass resources, OTEC, geothermal

Unit II ENERGY MANAGEMENT

Energy audit types, energy audit instruments and metering, precautions, smart metering. roles and responsibilities of energy manager, accountability. energy consumption, production, cumulative sum of differences (CUSUM) – Cost / Energy Share Diagram – Break Even Analysis – Depreciation – Financial Analysis Techniques – CUSUM Technique – Energy Management Information Systems (EMIS) ESCO Concept – ESCO Contracts.

Unit III ENERGY CONVERSION TECHNOLOGIES

Thermionic converters – MHD, Ferro electric converter, Hydrogen energy – storage and power generation, Solar photovoltaic cells, fuel cell types- working of AFC, PAFC, SOFC, MCFC, DMFC, PEMFC and bio battery.

Unit IV ELECTRICAL UTILITIES

Electricity Billing: Components & Costs, Need & Control, Determination of kVA demand & Consumption, types of Tariff, Assessment of Motor Efficiency under operating conditions, Factors affecting performance, New Generation Luminaries (LED / Induction Lighting) - Soft Starters/Auto Star-Delta, Variable Speed & Frequency Drives – Time Sensors, Occupancy Sensors.

Unit V BIOFUEL CONVERSION

Gasifier types, pyrolysis, Carbonization Techniques – merits of carbonized fuels, biodiesel from waste oil and algae, health, environment challenges and performance of biodiesel.

Text Book:

1. Hamies “Energy Auditing and Conservation; Methods Measurements, Management and Case study”, Hemisphere, Washington, 1980
2. Handbook on Energy Efficiency, TERI, New Delhi, 2001

Reference Book:

1. Bent Sorensen , “Renewable Energy”, Elsevier, Academic Press, 2011
2. Trivedi P.R. and Jolka K.R., “Energy Management”, Commonwealth Publication, New Delhi,1997
3. David Boyles, “Bio Energy Technology Thermodynamics and costs”, Ellis Hoknood Chichester, 1984.

Extensive Reading:

- https:\\www.energymanager training.com

23MEA14 PRODUCT LIFE CYCLE MANAGEMENT

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
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Course Objective:

To impart knowledge on

- Familiarize with various strategies of PLM
- Understand the concept of product design and simulation.
- Develop New product development ,product structure and supporting systems
- Interpret the technology forecasting and product innovation and development in business processes.
- Understand product building and Product Configuration

Course Outcome:

At the end of the course, the students will be able to

- Understand the various strategies of PLM.
- Study of concept of product design and simulation.
- Exposure to develop new product, product structure and supporting systems.
- Know about the product innovation and development in business processes.
- Knowledge on product building and product configuration

Unit I INTRODUCTION TO PLM AND PDM **9**

Introduction to PLM, Need for PLM, opportunities and benefits of PLM, different views of PLM, components of PLM, phases of PLM, PLM feasibility study. PLM Strategies, strategy elements, its identification, selection and implementation. Product Data Management, implementation of PDM systems

Unit II PRODUCT DESIGN **9**

Engineering design, organization and decomposition in product design, product design process, methodical evolution in product design, concurrent engineering, design for 'X' and design central development model. Strategies for recovery at end of life, recycling, human factors in product design. Modelling and simulation in product

Unit III PRODUCT DEVELOPMENT **9**

New Product Development, Structuring new product development, building decision support system, Estimating market opportunities for new product, new product financial control, implementing new product development, market entry decision, launching and tracking new product program. Concept of redesign of product.

Unit IV TECHNOLOGY FORECASTING **9**

Technological change, methods of technology forecasting, relevance trees, morphological methods, flow diagram and combining forecast of technologies Integration of technological product innovation and product development in business processes within enterprises, methods and tools in the innovation process according to the situation, methods and tools in the innovation process according to the situation.

Unit V PRODUCT BUILDING AND STRUCTURES **9**

Virtual product development tools for components, machines, and manufacturing plants: 3DCAD systems, digital mock-up, model building, model analysis, production (process) planning and product data technology, Product structures: Variant management, product configuration, material master data, product description data, Data models, Life cycles of individual items, status of items.

Text Book:

1. Stark, John. "Product Lifecycle Management: Paradigm for 21st Century Product Realisation" Second Edition, Springer, 2011.
2. Fabio Giudice, Guido La Rosa "Product Design for the environment-A life cycle approach", First edition, CRC Press, 2006.

Reference Book:

1. Antti Saaksvuori, Anselmi Immonen "Product Lifecycle Management" First edition, Springer, 2005.
2. Michael Grieves "Product Lifecycle Management" First edition, McGraw Hill LLC, 2005.

Extensive Reading:

- http://www.johnstark.com/PLM_The_Executive_Summary.html

23ADA06 INTRODUCTION TO DEEP LEARNING TECHNIQUES

Offered by AID (Allied Elective offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Fundamental techniques and principles of Neural Networks
- To Different models in ANN and their applications
- To Explore the machine learning algorithms
- To Deep learning techniques
- To Convolutional Neural Network to solve real world problems

Course Outcome:

At the end of the course, the students will be able to

- Interpret the basic concepts in Neural Networks and applications
- Apply Machine Learning techniques for solving real world problems
- Use various architectures of Artificial Neural Network
- Design Deep Learning models for solving huge Data set problems
- Implement various CNN techniques to solve problems

Unit I INTRODUCTION TO NEURAL NETWORKS **9**

Fundamentals of Neural Networks – Model of Artificial Neuron – Neural Network Architectures – Learning Methods – Taxonomy of Neural Network Architectures – Applications

Unit II PROBABILISTIC AND BAYESIAN NETWORKS **9**

Introduction – Bayesian Network Model – Learning Bayesian Network – Bayesian Network Inference – Sampling Methods – Hidden Markov Models – Mixture Models –Bayesian approach to Neural Network learning – Boltzman Machines

Unit III MACHINE LEARNING **9**

Introduction to Machine Learning – Learning Algorithms – Supervised Learning – Unsupervised learning – Reinforcement Learning – Capacity, Overfitting and Underfitting – Hyperparameters and Validation Sets

Unit IV DEEP LEARNING **9**

Feed Forward network– Recurrent Network – Regularizations - Training deep models – Dropouts, Training Deep Neural Networks using Back Propagation - Setup and initialization issues, vanishing and exploding Gradient problems, Gradient– Descent Strategies

Unit V CONVOLUTIONAL NEURAL NETWORKS **9**

Convolutional Neural Network, Basic structure of Convolutional Network, Case studies: Alex net, VGGNet, Google Net, Applications of CNN– Object Detection, Content based image Retrieval

Text Book:

1. YoshuaBengio and Ian J.Goodfellow and Aaron Courville, "Deep Learning", MIT Press, 2015

Reference Book:

1. Bishop, Christopher M,“Pattern Recognition and Machine Learning”, Springer, 2006
2. Charu C.Aggarwal, “Neural Networks and Deep learning”, Springer International Publishing, 2018
3. Satish Kumar, “Neural Networks, A Classroom Approach”, Tata McGraw -Hill, 2007
4. Simon Haykin, “Neural Networks, A Comprehensive Foundation”, 2nd Edition, Addison Wesley Longman, 2001
5. Duda, Richard, Peter Hart, and David Stork, “Pattern Classification”, 2nd edition, wiley, 2000

Extensive Reading:

- http://www.deeplearning.net
- www.cs.toronto.edu/~fritz/absps/imagenet.pdf
- http://neuralnetworksanddeeplearning.com/

23ADA07 IOT AND ITS APPLICATIONS

Offered by AID (Allied Elective offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Fundamental concepts of IoT and its necessary towards society
- To Use of different protocols
- To Familiarize with IoT architectures
- To Sensors, actuators, development boards and Arduino programming
- To Understand the concepts of web of things and applications

Course Outcome:

At the end of the course, the students will be able to

- Identify the fundamentals of IoT
- Illustrate various IoT Protocols for establishing communication between things
- Design and Develop IoT application using IoT architecture
- Build simple IoT Systems using Arduino and Raspberry Pi
- Create IoT solutions using sensors, actuators and Devices

Unit I INTRODUCTION TO IOT **9**

Introduction – Elements of an IoT ecosystem – Technology drivers – Business drivers – Trends and implications – Overview of Governance – Privacy and Security Issues

Unit II IOT PROTOCOLS **9**

Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFIDProtocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security

Unit III IOT ARCHITECTURE **9**

IoT Open source architecture (OIC) – OIC Architecture & Design principles– IoT Devices and deployment models– IoTivity : An Open source IoT stack - Overview– IoTivity stack architecture– Resource model and Abstraction

Unit IV IOT HARDWARE AND PROGRAMMING **9**

Basics of sensors and actuators – Examples and working principles of sensors and actuators – Arduino Programming for IOT – Raspberry Pi– Reading from Sensors. Communication: Connecting microcontroller with Bluetooth and USB – Connection with the Internet using Ethernet

Unit V APPLCIATIONS AND CASE STUDY **9**

Connected vehicles – Traffic management - Smart grids – Environmental monitoring – Smart buildings/smart homes – Smart cities – Supply chain management – Industrial, agricultural and commercial management

Text Book:

1. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press,2012.

Reference Book:

1. ArshdeepBahga, Vijay Madisetti, “Internet of Things – A hands-on approach”, Universities Press, 2015
2. David Easley and Jon Kleinberg, “Networks, Crowds, and Markets: Reasoning About a Highly Connected World”,Cambridge University Press, 2010
3. Olivier Hersent, David Boswarthick, Omar Elloumi , “The Internet of Things – Key applicationsand Protocols”,Wiley, 2012
4. Dieter Uckelmann, Mark Harrison, Michahelles, Florian (Eds), “Architecting the Internetof Things”, Springer,2011

Extensive Reading:

- https://www.survivingwithandroid.com/iot-protocols-list/
- https://www.geeksforgeeks.org/architecture-of-internet-of-things-iot/

23ADA08 ESSENTIALS OF BIG DATA

Offered by AID (Allied Elective offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Study about Map reduce concept
- To Study about Streaming Analysis and Link Analysis
- To Study about applying clustering algorithms using Spark
- To Study about Large Scale Machine Learning

Course Outcome:

At the end of the course, the students will be able to

- Apply map reduce concept for parallel processing
- Perform Streaming analysis and Link Analysis
- Perform clustering on big data Spark
- Apply Bigdata analytics algorithms to analyze social network
- Apply concepts of Large Scale Machine Learning

Unit I MAP REDUCE FRAMEWORK **9**

Distributed File Systems – Map Reduce – Algorithms using Map Reduce – Extensions to MapReduce – Cost Model – Complexity Theory for MapReduce –Case study : PLANET algorithm

Unit II MINING DATA STREAMS AND LINK ANALYSIS **9**

The Stream Data Model – Sampling Data in a Stream – Filtering Streams – Counting Distinct Elements in a Stream – Estimating Momens – Counting Ones in a Window – Decaying Windows – Link Analysis : Page Rank – Efficient Compuation of Page Rank – Topic – sensitive Page Rank – Link Spam – Hubs and Authorities – Case Study : Devloping a classification model using Spark

Unit III CLUSTERING **9**

Hierarchical Clustering in a Euclidean and Non-Euclidean Space – The Algorithm of Bradley, Fayyad, and Reina – A variant of K-means algorithm – Processing Data in BFR Algorithm – CURE algorithm – Clustering models with Spark – Clustering for Streams and Parallelism – Developing a clustering model using Spark

Unit IV MINING SOCIAL-NETWORK GRAPHS **9**

Clustering of Social-Network Graphs – Direct Discovery of Communities – Partitioning of Graphs – Finding Overlapping Communities – Counting Triangles using MapReduce – Neighbourhood Properties of Graph – Case Study : Recommendation System

Unit V LARGE SCALE MACHINE LEANRING **9**

The Machine Learning model – Perceptrons – Support Vector Machine –Learning from Nearest Neighbours – Comparison of Learning methods – Deep Neural Networks – Case Study : Parallel SVM

Text Book:

1. JureLeskovec, AnandRajaraman, Jeff Ullman, “Mining of Massive Datasets”, Standford Press, 2015
2. NickPentreath, “Machine Learning with Spark”, Packt Publishing, 2015

Reference Book:

1. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley,2014.
2. Tom White, “Hadoop: The Definitive Guide”, O’Reilly, 4th Edition, 2015.
3. Seema Acharya, SubhashiniChellappan, “Big Data and Analytics”, Wiley Publications, Second Edition, 2019.
4. Holden Karau, Andy Konwinski, Patrick Wendell Matei Zaharia ,“Learning Spark – Lightning Fast Data Analysis”,O’Reilly , First Edition,2015

Extensive Reading:

- http://www.mmds.org/
- PSVM : https://static.GOOGLEU4SERCONTENT.com/media/research.google.com/en//pubs/archive/34638.pdf
- PLANET : https://static.googleusercontent.com/media/research.google.com/en//pubs/archive/36296.pdf
- https://spark.apache.org/docs/latest/api/python/index.html

23ADA09 DATA ENGINEERING

Offered by AID (Allied Elective offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Explore the necessity of R tool
- To Apply various functions to import and export data
- To work with data using dplyr package
- To visualize the data using ggplot2 package
- To implement Machine Learning algorithms

Course Outcome:

At the end of the course, the students will be able to

- Apply the basics of R programming with its data structures
- Implement R program to import and export of Data
- Apply the functional programming and data manipulation statements in R
- Visualize data using ggplot2 package
- Implement machine learning techniques in R

Unit I INTRODUCTION **9**

Features and Importance of R —Installing R and R studio —R environment —R script file —operators —R as a Calculator—Operators —Data structures and its operations —List —Matrices —Data frames — Factors —Arrays — Coercion

Unit II CONTROL STATEMENTS & DATA HANDLING **9**

Decision control statements : if, if else, ifelse(), switch —Iterative statements —Break, Next statements — R Functions —Lazy evaluation —Built-in functions —recursive functions —Infix operators —Generating Random numbers —Reading & Writing Data into files Binary formats in R —Writing Data frames to files —handling Excel in R

Unit III WORKING WITH DATA **9**

Basic functions —Regular expressions —Apply family functions (Looping functions) —Table functions —Dealing with Date and Time in R —dplyr package : basic functions, join operations, Pipe operators, Applying row wise operations, Combining Two data Sets

Unit IV DATA TIDYING AND VISUALIZATION **9**

Tidyr package —gather, spread, unite, separate functions, plotting graphs in R: histogram, Bar graph, Pie chart, Line chart, X-Y Graph, Boxplot graphs, Density plots —saving plots in R —Customizing Text in Graph —Advanced plots with ggplot — statistical transformation —Facets —Customising the histogram —Combining graphs —Overlapping histograms —Plotting Time series data

Unit V MACHINE LEARNING ALGORITHMS **9**

Introduction to Machine Learning Algorithms: Linear Regression, types of relationships — Simple Linear Regression —Logistic Regression —Decision Trees —Naïve Bayes —k Means — Implementing ML algorithms —building Linear model —Prediction —Logistic Regression —implement Decision Trees —k-Means —Implementing Naïve Bayes

Text Book:

1. Reema Thareja ,“Data Science and Machine Learning with R”,McGrawHill, 2021
2. Seema Acharya, “Data Analytics using R”, McGrawHill, 2018

Reference Book:

1. Dr.Mark Garderner, “Beginning R The Statistical Programming Language”, Wiley Publication, 2012
2. K.G.Srinivasa, G M Siddesh, ChetanShetty, “Statistical Programming in R”, Oxford University Press, New Delhi,2017
3. TorstenHothorn, Brian S. Everitt, “ A Handbook of Statistical Analyses Using R “,Chapman and Hall/CRC;2 edition
4. Nicholas J. Horton, Ken Kleinman,” Using R and RStudio for Data Management, Statistical Analysis, and Analysis, and Graphics” , CRC Press, Second edition, 2015
5. Thomas Lumley,” Complex Surveys: A Guide to Analysis Using R”, Wiley Series in survey methodology, 2010

Extensive Reading:

- R Programming tutorials https://www.tutorialspoint.com/r/index.htm
- R Programming https://www.w3schools.com/r/
- https://www.javatpoint.com/r-tutorial
- https://data-flair.training/blogs/r-tutorials-home/
- https://www.datacamp.com/community/tutorials/machine-learning-in-r

23ADA10 DESIGN THINKING IN ARTIFICIAL INTELLIGENCE

Offered by AID (Allied Elective offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- To learn the different views of learning
- To study the various search strategies
- To study the knowledge representation framework
- To understand the transition from micro world to knowledge representation
- To learn the brain architecture

Course Outcome:

At the end of the course, the students will be able to

- Recognize mind by its design
- Perform various search strategies
- Prepare various learning frameworks
- Represent Knowledge using KRL
- Adopt connectionist approach for problem solving

Unit I INTRODUCTION **9**

Mind Design – Perspectives and Things – Turing Test – Intentionality –Formal systems – Automatic Formal systems – Computers and Intelligence – GOFAI – Interpreted Formal systems – New Fangled AI – Connectionist Networks – Embodied and Embedded AI – Imitation Game– Critique of the new problem – Machines Concerned – Digital Computers – Universality – Contrary Views – Learning Machines

Unit II SEARCH STRATEGIES **9**

Intentional Strategy – Working – True Believers – Computer Science as Empirical Inquiry: Symbols and Search – Symbols and physical symbol systems – Laws of Qualitative Structure – Development of the symbol–system hypothesis – Evidence – Heuristic Search – Problem Solving – Search Trees – Forms of Intelligence – Intelligence without much Search

Unit III FRAMEWORK FOR REPRESENTING KNOWLEDGE **9**

Frames – Artificial intelligence and human problem solving – Language, understanding, and scenarios – Words, sentences, and meanings – Scenarios and questions – Questions, systems, and cases – Learning, memory, and paradigms – Requests to memory – Clusters, classes, and a geographic analogy – Analogies and alternative descriptions – Frames and paradigms

Unit IV KNOWLEDGE REPRESENTATION: AI AT AN IMPASE **9**

Micro–worlds – SHRDLU: Understanding Natural Language – Scene Parsing and Computer Vision – Learning New Concepts or Categories – Knowledge Representation –Scripts and Primitive Actions – KRL: A Knowledge – Representation Language – Minds, Brains, and Programs

Unit V THE ARCHITECTURE OF MIND: A CONNECTIONIST APPROACH **9**

Brain–Style Computation –The Connectionist Framework – Computational Features Of Connectionist Models – State of The Art – Architectures – Scaling Problem – Generalization Problem – Connectionist Modelling: Neural Computation / Mental Connections – Levels of Analysis: Neural and Mental Structures – Symbolic Paradigm – Sub symbolic Paradigm – Semantic Interpretation – The Sub symbolic Level – Sub symbolic Computation – Sub symbolic Inference And The Statistical Connection – Higher–Level Descriptions – The Best–Fit Principle – Productions, Sequential Processing and Logical Inference – Dynamics Of Activation Patterns – Schemata

Text Book:

1. John Haugeland, “Mind Design III – Philosophy Psychology Artificial Intelligence”, The MIT Press, Third Edition, 2023.

Reference Book:

1. Denis Rithman , “Artificial Intelligence By Example”, Packt Publishers, First Edition, 2018.
2. Melanie Mitchell,“Artificial Intelligence: A Guide for Thinking Humans”, Penguin Publishers, First Edition, 2019.
3. Michael Lewrick, Patrick Link and Larry Leifer, “The Design Thinking Playbook”, Wiley Publishers, First Edition, 2019.

Extensive Reading:

- https://medium.com/udacity/tagged/design-thinking
- https://www.cuelogic.com/blog/design-thinking-for-ai
- https://www.ibm.com/design/thinking/page/badges/ai

23BMA03 BIOSENSORS AND ITS APPLICATIONS

Offered by BME (Allied Elective offered to BAD, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To acquire the fundamentals and significance of biosensors.
- To familiarise the concept of enzyme biosensors.
- To understand the types of transducers
- To identify the different applications of biosensors and use of nanomaterials.

Course Outcome:

At the end of the course, the students will be able to

- Elucidate the insights of the basics of bio sensors
- Explore the different types of Enzyme biosensors.
- Classify biosensors based on transducer and design.
- Explore the various applications of biosensors
- Summarise the uses of different nanomaterials used in biosensors

Unit I INTRODUCTION TO BIOSENSORS **9**

Biosensors- The first Biosensor- Urea Biosensors-The Bananatrode- Other Names of Biosensors- Performance factors- Applications- Biological Elements- Enzymes, Examples, Tissue Elements –Microorganism-Mitochondria – Antibodies, Nucleic Acid, Receptors- Choice of bioreceptor, immobilisation of bioreceptors.

Unit II ENZYME BIOSENSORS **9**

Principle of operation- Theoretical aspects- Practical aspects- Potentiometric enzyme electrodes- Amperometric enzyme electrode- Semiconductor enzyme sensors-Optical enzyme sensors- Thermal enzyme sensors- Piezoelectric enzyme sensors, Microbial Sensors, Comparison, Possibilities and limitation

Unit III TRANSDUCERS **9**

Transducers principles – Transducers types – Calorimetric Sensors, Optical Sensors, Potentiometric / Amperometric Sensors, Conductometric Sensors / Resistormetric Sensors, Piezoelectric Sensors, Semiconductor Sensors, Impedimetric Sensors, Chemiluminiscene Sensors.

Unit IV APPLICATION AND USES OF BIOSENSORS **9**

Operating Methods -Medical Applications- Biotechnology -Fermentation Process Control- Environmental Monitoring- Defence and Security Industries- Fabrication and Mass Production- Locs For Point-Of-Care Testing (Poct), Sample/Reagent Introduction, Mixing In Loc,Paper-Based Loc.

Unit V APPLICATIONS OF NANOMATERIALS IN BIOSENSORS **9**

Gold nanoparticles, Quantum dots, Zinc oxide Nano structures, Carbon Nano tubes and Graphene, Nanoporous Gold, Role of nano material in Signal Amplifications, Detection and Transducer Fabrication

Text Book:

1. Jeong-Yeol Yoon, “Introduction to Biosensors”, Springer, 2nd Edition, 2016.
2. Tran Minh Canh, “Sensor Physics & Technology – Biosensors”, Champan & Hall, 1st Edition, 1993.

Reference Book:

1. Antony P F Turner, Isao Karube S, George S Wilson, “Biosensors Fundamentals and Application”, Oxford University press, 1987
2. Dr.B R Eggins, “Biosensors: An Introduction”,John Wiley,1996
3. Graham Ramsay, “Commercial Biosensors”, John Wiley, 1st edition 1998.
4. Mohammed Zourob, “Recognition Receptors in Biosensors”, Springer, 1st Edition, 2010.

Extensive Reading:

- https://www.edx.org/course/principles-of-electronic-biosensors
- https://www.news-medical.net/health/Biosensor-Applications.aspx
- https://onlinecourses.nptel.ac.in/noc20_ph13/preview
- https://nptel.ac.in/courses/102/104/102104062
- https://nptel.ac.in/noc/courses/noc16/SEM2/noc16-bt06/

23BMA04 INTRODUCTION TO BIOMEDICAL DEVICES

Offered by BME (Allied Elective offered to BAD, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To familarize the function of different sensors and bio-potential electrodes.
- To describe the different Cardiac function measuring devices.
- To discuss respiratory, electrosurgical and clinical lab equipment.

Course Outcome:

At the end of the course, the students will be able to

- Elucidate the functions of different biomedical sensors.
- Identify the functions of different bio-potential electrodes.
- Explore the cardiac function measurement devices
- Illustrate different respiratory and electrosurgical devices.
- Demonstrate various clinical lab equipment.

Unit I SENSORS AND MEASUREMENTS **9**

Introduction to biomedical sensors, physical sensors- linear and Angular displacement sensors, Measurement of Fluid Dynamic Variables, Force Measurement, Velocity Measurement, Accelerometers, Biomedical Applications of Physical Sensors.

Unit II BIOPOTENTIAL ELECTRODES **9**

Sensing Bioelectric Signals, Electrical Characteristics, Body-Surface Bio potential Electrodes, Metal Electrode, Electrodes for Chronic Patient Monitoring, Intra-cavitary and Intra-tissue Electrodes, Transparent Electrodes, Microelectrodes, Biomedical Applications

Unit III CARDIAC FUNCTION MEASUREMENT DEVICES **9**

Introduction Indicator–Dilution Method, Fick Method, Ejection Fraction, External Defibrillators, Mechanism of Fibrillation and Defibrillation, Clinical Defibrillators, Electrodes Synchronization, Defibrillator, Implantable Defibrillators, Implantable Cardiac Pacemakers

Unit IV RESPIRATORY AND ELECTROSURGICAL DEVICES **9**

Lung Volume, Pulmonary Function Tests, Physiological Dead Space, Positive-Pressure Ventilators, Ventilation Modes, Theory of Operation of ES unit, Monopolar Mode, Dispersive Electrodes, Bipolar Mode, ESU Hazards.

Unit V CLINICAL LAB EQUIPMENTS **9**

Introduction to Separation Methods, Chromatographic Separations, Gas Chromatography, High-Performance Liquid Chromatography, Basis for Spectral Methods, Fluorometry, Flame Photometry, Atomic Absorption Spectroscopy, Turbidimetry and Nephelometry, Nonspectral Methods and Automation, Particle Counting and Identification, Electrochemical Methods, Ion-Specific Electrodes, Radioactive Methods, Coagulation Timers, Osmometers.

Text Book:

1. Joseph D Bronzonio and Donald R Peterson, “Medical Devices and Human Engineering”, CRC press,Taylor and Francis group,4th edition, 2017.
2. R S Khandpur, “Handbook of Biomedical Instrumentation”, Tata McGraw Hill, 2014.

Reference Book:

1. L A Geddes, L A Baker, “Principles of Applied Biomedical Instrumentation”, Wiley India edition,3rd edition 2008.
2. Joseph J. Carr and John M Brown, “Introduction to Biomedical Equipment Technology”, Pearson; 4th edition, 2001.

Extensive Reading:

- https://www.coursera.org/learn/bioengineering
- https://nptel.ac.in/courses/127106136

23BTA05 BIOLOGICAL WASTE MANAGEMENT

Offered by BT (Allied Elective offered to BAD, BBE, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Hazardous wastes and its effects.
- Classification and Risks associated with biohazardous wastes.
- Regulatory and policy aspects of health care wastes.
- Disposal of biological wastes.
- Safe handling and management of biological wastes.

Course Outcome:

At the end of the course, the students will be able to

- Explain about hazardous wastes, its origin and effects on public health.
- Impart knowledge about sources of biohazardous wastes, risks associated, and management.
- Know the Legislative, Regulatory and Policy Aspects Of Health-Care Waste.
- Apply the methods for treatment, disposal, and minimization.
- Study the concepts of waste minimization, reducing and recycling.

Unit I INTRODUCTION TO HAZARDOUS WASTE 9

Definition of waste, hazardous waste. Impact of hazardous waste. Classifications of hazardous waste and its sources. Characteristics of hazardous waste. Hazardous waste identification process. Waste analysis. Waste management requirements. Effects on public health and environment. Controlling systems and tools for risk minimization.

Unit II BIO HAZARDOUS WASTE 9

Biological, biomedical and healthcare wastes. Sources. Bio hazardous wastes classification. Risks associated with bio hazardous waste. Risk of trauma and infection. Survival of microorganisms in environment. Risks associated with the inappropriate processing and dumping of hazardous medical waste. Biosafety levels. Need for control. Healthcare waste-management plans. Infectious waste management plans.

Unit III LEGISLATIVE, REGULATORY AND POLICY ASPECTS OF HEALTH-CARE WASTE 9

National policies and its five guiding principles. State Pollution Control Board. Policy Document and Technical Guidelines. International agreements - Basel convention (1995), Rotterdam convention (1998), Stockholm convention (2001). World health organization (WHO). The International Solid Waste Association (ISWA) and its policy document.

Unit IV BIOLOGICAL WASTE TREATMENT, DISPOSAL AND MINIMIZATION 9

Segregation, storage and transport of healthcare and biological wastes - Treatment and disposal method healthcare waste - Disposal of biological and sharp wastes - Health and safety practices for health-care personnel and waste workers. Healthcare waste minimization, reuse and recycling.

Unit V BIOTECHNOLOGICAL MANAGEMENT OF WASTE 9

Use of microbial systems. Nature and kinetics of biological growth: Aerobic process – activated sludge system, trickling filters, Anaerobic process – CSTR, Anaerobic Filters, Up Flow - Anaerobic Sludge Blanket Reactor (UASB) Process design. Bioremediation. Phytoremediation.

Text Book:

1. Blackman W. C., “Basic Hazardous Waste Management”, CRC Press, 3rd Edition, 2001.
2. Cheremisinoff, N. P., Cheremisinoff P. N., “Hazardous Materials and Waste Management: A Guide for the Professional Hazards Manager”, Noyes Publications, 1995.
3. Mukesh Doble and Anil Kumar, “Biotreatment of Industrial Effluent”, Elsevier, USA, 2005.

Reference Book:

1. Panda H., “The Complete Book on Biological Waste Treatment and their Utilization”, NIIR Project Consultancy Services, 2013.
2. Henry J. G., Heinke G. W., “Environmental Science and Engineering”, Prentice Hall India Learning Private Limited, 2nd Edition, 2004.

23BTA06 NANOBIOTECHNOLOGY

Offered by BT (Allied Elective offered to BAD, BBE, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Basics of nanobiotechnology.
- Measurement of physical properties of nanomaterials.
- DNA, proteins, amino acids, drug delivery-based biomedicines.
- Nano devices and polymer-based drug delivery systems.
- Application of nanomaterials in biotechnology.

Course Outcome:

At the end of the course, the students will be able to

- Learn physicochemical properties of nanomaterials and the unique changes that happen at nanoscale.
- Know the properties and measurements of nanomaterials.
- Understand the DNA based nanostructures.
- Explain the protein-based nanostructures.
- Know the application of nanomaterials to biological problems including nanomedicine.

Unit I NANOSCALE AND NANOBIOTECHNOLOGY 9

Introduction to Nanoscience and Nanotechnology; Milestones in Nanotechnology; Overview of Nanobiotechnology and Nanoscale processes; Approaches for the synthesis of nanomaterials -Special carbon-based nanomaterials, Carbon-based quantum dots, Core–shell nanoparticles Metal-based nanostructured materials Lessons from Nature on making nanodevices.

Unit II PROPERTIES AND MEASUREMENT OF NANOMATERIALS 9

Optical Properties: Absorption, Fluorescence, and Resonance; Crystal structure characterization-XRD; Surface charge analysis- zeta potential analyzer; Methods for the measurement of nanomaterials; Microscopy measurements: SEM, TEM, AFM and STM. Confocal and TIRF imaging.

Unit III DNA BASED NANOSTRUCTURES 9

DNA based nanostructures –Topographic and Electrostatic properties of DNA and proteins –Hybrid conjugates of gold nanoparticles –DNA oligomers –Use of DNA molecules in nanomechanics and Computing.

Unit IV APPLICATIONS OF NANOTECHNOLOGY 9

Protein based nanostructures building blocks and templates – Proteins as transducers and amplifiers of biomolecular recognition events –Nanobioelectronic devices and polymer nanocontainers (Nano Cellulose, cyclodextrine nanoparticle, chitosan, starch nanoparticle)–Virus Like Particles-- Micelles and Liposomes- Dendritic Nanoparticles- Nanocrystals and Nanosuspensions- Microbial production of inorganic nanoparticles – Magnetosomes. Use of Nanotechnology in Agriculture.

Unit V NANOMEDICINE 9

Nanoparticles as carrier for genetic material – Nanomedicine, Nanotechnology for Regenerative Medicine, Drug delivery, Molecular design using biological selection, Harnessing molecular motors, Artificial life, Hybrid materials, Biosensors, Future of Bionanotechnology

Text Book:

1. Chris Binns, Introduction to Nanoscience and Nanotechnology, Wiley, 3rd Edition, 2021.
2. Claudio Nicolini , Nanobiotechnology and Nanobiosciences, CRC Press. 1st Edition, 2012.
3. A.S Edelstein, R.C Cammaratra, Nanomaterials; Synthesis, Properties and Applications, Taylor & Francis, Second Edition, 1998.
4. Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor) “Nanobiotechnology: Concepts, Applications and Perspectives”, Wiley VCH; 1st Edition , 2004.
5. Oded Shoseyov and Ilan Levy “NanoBioTechnology: BioInspired Devices and Materials of the Future”, Humana Press; 1st Edition 2007.

Reference Book:

1. Clarke. A.R. and Eberhardt C. N. (Editors), “Microscopy Techniques for Material Science”, CRC Press. 1st Edition, 2002.
2. David S.G., “Bionanotechnoology: lessons from nature”, John Wiley & Sons, 1st Edition, 2004

23BTA07 INTRODUCTION TO BIOINFORMATICS

Offered by BT (Allied Elective offered to BAD, BBE, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- building blocks of biological molecules
- use of computers and operating systems in studying biological databases
- features of understanding sequence analysis
- alignment of sequences for comparison through various algorithms
- concepts and algorithms in phylogenetic analysis.

Course Outcome:

At the end of the course, the students will be able to

- interpret the biomolecules in mathematical expressions.
- use computers to analyse biological databases
- decode the methodology of sequence analysis
- perform different types of sequence alignments
- analyse methods to be used for phylogenetic tree generation.

Unit I INTRODUCTION TO BIOLOGICAL MACROMOLECULES

Mathematical and Computational Approach in understanding following basic concepts of molecular biology: nucleic acids, proteins – Central Dogma of Molecular Biology – Replication – Transcription – Translation – Protein Structural hierarchy – 3 dimensional visualization of protein.

Unit II COMPUTERS AND DATABASES

Introduction to Operating systems, interfacing Computers and Biology - Data file formats, Data life cycle, Database management system models, Biological sequences and structure databases.

Unit III SEQUENCE ANALYSIS

DNA and Protein Sequence, Sequence Analysis - substitution matrices, string similarity, Dynamic programming algorithms for computing edit distance, Pairwise alignment, Multiple sequence alignment, Generating motifs and profiles

Unit IV SEQUENCE ANALYSIS ALGORITHMS

Local and Global alignment, Needleman-Wunsch algorithm, Smith-Waterman algorithm. Tools: BLAST, ClustalX

Unit V NEXT GENERATION SEQUENCING

Genome Sequencing, Sequence Assembly, Genome Annotation, Gene Prediction, Prediction of Promoters, Transcription-Factor-Binding Sites, Translation Initiation Sites, and the ORF

Text Book:

1. Supratim Choudhuri., “Bioinformatics for Beginners”, Academic Press, 1st Edition, 2014
2. Neil J. Jones (Author), Pavel A. Pevzner Introduction to Bioinformatics Algorithms, ANE Books; 1st Edition, 2009
3. David W. M., “Bioinformatics Sequence and Genome Analysis”, Cold Spring Harbor Laboratory Press, 2nd Edition, 2008.
4. Pavel A Pevzner, “Computational Molecular Biology: An Algorithmic Approach”, Prentice Hall India Learning Private Limited; 2nd Edition, 2004.

Reference Book:

1. Durbin R., Eddy S. R., Krogh A., Mitchinson A., “Biological Sequence Analysis Probabilistic Models of proteins and nucleic acids”, Cambridge University Press, 7th Reprint, 2003.

Extensive Reading:

- http://web.stanford.edu/class/cs173/papers/bioprimer.pdf

23CEA05 RESOURCES AND ENERGY RECOVERY FROM WASTE

Offered by CIV (Allied Elective offered to BAD, BBE, BBT, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- Fundamental processing of waste for recycling.
- The biological conventional methods to process the waste.
- Anaerobic digestion process for converting waste to energy.
- Thermal processing of waste materials.
- Application of recovery process of the recyclable materials and energy recovery.

Course Outcome:

At the end of the course, the students will be able to

- At the end of the course, the students will be able to
- Understand the initial processing methods of waste recycling.
- Apply biological process for transformation of solid waste to useful by-products.
- Know about the anaerobic digestion process.
- Select the suitable thermo chemical waste conversion process.
- Assess the recycling and recovery concepts of various solid wastes and e-waste.

Unit I MECHANICAL PROCESSING FOR MATERIAL RECYCLING 9

Resource recovery for a sustainable development - Systems and processes for reduction, reuse and recycling - Source Segregation and Hand Sorting-Waste Storage and Conveyance - Shredding - Pulping - Size Separation by Screens - Density Separation by Air Classification - Magnetic and electromechanical separation processes.

Unit II BIOLOGICAL PROCESSING FOR RESOURCE RECOVERY 9

Mechanisms of Biological Processing - Aerobic Processing of Organic fraction - Composting methods - factors affecting the composting process- In Vessel Composting - Compost Quality Control - Vermiculture: definition, scope and importance - Applications of vermiculture.

Unit III BIO-CHEMICAL CONVERSION OF WASTE TO ENERGY 9

Principles of Anaerobic Digesters - Process characterization and control - - Toxic substances in anaerobic treatment - Methane generation by Anaerobic Digestion - Single stage and multistage digesters - Gas collection systems- Methane Generation and Recovery in Landfills - Biofuels from Biomass.

Unit IV THERMO-CHEMICAL CONVERSION OF WASTE TO ENERGY 9

Incinerator - Mass Burn and RDF Systems- Composition and calorific value of fuels and waste, Determination of the stoichiometric air consumption, removal of bottom ash- Emission Controls - Flue gas cleaning, de-dusting, flue gas scrubbers, dioxins and furans - Alternative thermal processes: co-incineration, pyrolysis and gasification - Process characterization and control - Waste heat recovery-

Unit V CASE STUDIES 9

Recycling technologies for paper, glass, metal and plastic - Used Lead Acid Battery Recycling - End of Life Vehicle Recycling - Electronic Waste Recycling - Waste Oil Recycling.

Text Book:

1. Resource recovery from waste : Business models for energy, nutrient and water reuse in low & middle-income countries, Routledge 2018.
2. Operation of water resource recovery Facilities , Manual Practice No 11 seventh edition McGraw-Hill Education , 2016.

Reference Book:

1. Chiumenti, Chiumenti, Diaz, Savage, Eggerth, and Goldstein , Modern Composting Technologies , JG Press October 2005.
2. Gary C. Young, "Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons", John Wiley & Sons, 2010.

23CEA06 GEOTECHNICAL FUNDAMENTALS OF EARTHQUAKE

Offered by CIV (Allied Elective offered to BAD, BBE, BBT, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The fundamentals of earthquake vibrations.
- The dynamics of earth and to estimate dynamic properties of soils.
- The site-specific design spectrum for design of sub structure and evaluation of liquefaction potential.
- Buildings for earthquake forces and introduce design concepts.
- The concepts of engineering seismology.

Course Outcome:

At the end of the course, the students will be able to

- Understand the various components of engineering seismology.
- Determine the dynamic properties of soil based on various tests.
- Classify the various earthquake hazards and seismic hazard assessment.
- Do the various seismic hazard analysis.
- Analyze the types of risk and vulnerability.

Unit I SEISMOLOGY AND EARTHQUAKES 9

Internal structure of the earth - Elastic rebound theory - Different sources of seismic activity - Geometric notation - Zones and location of earthquakes - Magnitude and intensity- Classification of earthquakes.

Unit II DYNAMIC PROPERTIES OF SOILS 9

Measurement of dynamic properties of soils - Field tests - Low strain - Seismic reflection - Seismic refraction - Horizontal layering - Steady state vibration - Spectral analysis of surface wave - Seismic cross hole - down hole & up hole tests - Laboratory tests - Resonance column test - Bender element - Cyclic tri-axial test.

Unit III SEISMIC HAZARD ANALYSIS 9

Identification and evaluation of earthquake sources - Geologic evidence - Tectonic evidence - Historical seismicity - Instrumental seismicity - Deterministic seismic hazard analysis - Probabilistic seismic hazard analysis

Unit IV GROUND RESPONSE ANALYSIS 9

Ground response analysis - One dimensional linear evaluation of transfer function - Uniform undamped soil on rigid rock - Uniform damped soil on Rigid Rock - Uniform damped soil on elastic rock - Layered damped soil on elastic rock - Equivalent linear Approximation – Deconvolution.

Unit V LIQUEFACTION ANALYSIS 9

Liquefaction - Flow liquefaction - Cyclic mobility - Evaluation of liquefaction Hazards - Liquefaction susceptibility - Criteria – Historical - Geological - Compositional - State - Evaluation of initiation of liquefaction - Cyclic stress approach - Characterization of Liquefaction Resistance - Various correction factors - Factor of Safety.

Text Book:

1. Steven L Kramer, “Geotechnical Earthquake Engineering”, Pearson Education, 2003.
2. Shivsharan Sharma, “Geotechnical Earthquake Engineering”, Random Publications; First Edition, 2017.
3. Roberto Villaverde, “Fundamental Concepts of Earthquake Engineering”,CRC Press, 2009.

Reference Book:

1. Ayothiraman R. & Hemanta Hazarika, “Earthquake Hazards and Mitigation”, I K International Publishing House, 2013.
2. Robert W. Day, “Geotechnical Earthquake Engineering”, McGraw Hill Education, Second edition 2012.

Extensive Reading:

- Kameswara Rao, N.S.V., "Dynamics soil tests and applications", AH Wheeler Publishing Company, 2000.

23CEA07 ROAD AND RAIL TRANSPORT

Offered by CIV (Allied Elective offered to BAD, BBE, BBT, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The various aspects of planning and design of Road Transportation Systems.
- The importance of maintenance operation and safety systems.
- The various aspects of planning and design of Rail Transportation Systems.
- The rail sections, its properties and to plan for the maintenance operation.
- The various components in development of rail infrastructure.

Course Outcome:

At the end of the course, the students will be able to

- Design and prepare detailed Road transport project report.
- Plan for safety measures, signal implementation and carry over the maintenance operation in road transport system.
- Prepare detailed Rail transport project report.
- Plan the maintenance operation in rail transport system.
- Prepare layout of railway station for effective transit with needed infrastructure.

Unit I ROAD TRANSPORT **9**

Road Transport - Role of Roads in India's Economy - Road Development Plan - Highway Administration and Finance - Long Term Highway and Transport Planning - Surveys - Design, Drawings, Estimates and Project Report - Tenders, Contracts and Specifications.

Unit II ROADS MAINTANENECE & SAFETY **9**

Highway Maintenance - Need for Maintenance - Maintenance of Roads - Maintenance of Surfaces - Maintenance of Shoulders - Maintenance of Bridges and Culverts - Hill Road Maintenance - Maintenance Practice in India - Maintenance Management System - Highway Safety - Road Accidents and Highway Design - Road Signs - Road Markings - Traffic Signals - Road Making Machinery - Role of Labours in Road Construction.

Unit III RAIL TRANSPORT **9**

Rail Transport - Basics - Future of Railways - Indian Railways - Railway Surveys - New Railway Lines - Factors Influencing - Categories - Project Report and Drawing - Construction of New Lines - Train Resistances - Rolling Stock - Locomotives - Coaches - Wagons - Train Brakes - Rail Gauges.

Unit IV RAIL MAINTANENCE **9**

Rails - Basic Requirements - Functions - Types - Weight and Section of Rails - Length of Rail - Welding and Wear of Rails - Renewal and Failure of Rails - Maintenance - Necessity for Track Maintenance - Maintenance of Track, Railway Bridges and Rolling Stock - Accidents - Signalling during Maintenance - Tools Required during Maintenance.

Unit V RAIL INFRASTRUCTURE **9**

Stations - Definition, Purpose and site selection - Platforms and Yard - Definition and Types - Level Crossing - Station Machinery - Signalling - Objectives and Types - Typical Layout - Control of Movements of Trains - Telecommunication - Materials Management.

Text Book:

1. Dr. L.R. Kadyali, Dr. N.B. Lal, "Principles and Practices of Highway Engineering", 7th Edition, Khanna Publishers, 2013.
2. Rangwala, "Railway Engineering", 20th Edition, Charotar Publishing House Pvt. Ltd., 2017.

Reference Book:

1. C. Jotin Khistya and B. Kent Lall, "Transportation Engineering", by Prentice Hall of India Private Limited, 2006.
2. C A O'Flaherty, "Transport Planning and Traffic Engineering", Butterworth Heinemann, Elsevier, Burlington, MA, 2006.
3. Subramanian K.P., "Highways, Railways, Airport and Harbour Engineering", Scitech Publications (India), Chennai, 2010.

Extensive Reading:

- Transportation Engineering I - https://nptel.ac.in/courses/105/101/105101087/
- Transportation Engineering II - https://nptel.ac.in/courses/105/107/105107123/

23CEA08 GEOGRAPHICAL INFORMATION SYSTEM FOR DISASTER MANAGEMENT

Offered by CIV (Allied Elective offered to BAD, BBE, BBT, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- Classification of disasters.
- The fundamentals of remote sensing.
- The skill of mapping and projections.
- The application of spatial data for disaster management.
- The mitigation measures with the help of GIS.

Course Outcome:

At the end of the course, the students will be able to

- At the end of the course, the students will be able to
- Understand the various disasters and their principles.
- Implement the remote sensing techniques.
- Map the disaster thematic maps based on requirements.
- Understand the basics concepts of cartography.
- Plan the disaster relief activities.

Unit I DISASTER PRINCIPLES **9**

Disaster - Concepts and definition of disaster - Hazard, vulnerability, resilience, risk - Causes, characteristics and effects of various types of natural and manmade disasters – Global scenario - Vulnerability profile in India - Institutional framework for disaster management - Role of government administration and NGOs - International disaster assistance - Sharing technology and technical expertise.

Unit II REMOTE SENSING TECHNIQUES **9**

Principles - Electromagnetic Spectrum – Basics of Optical remote sensing – Thermal remote sensing – Hyperspectral remote sensing - Spectral signature – Spectroradiometer – Spectral reflectance of vegetation, soil and water.

Unit III FUNDAMENTALS OF CARTOGRAPHY **9**

Definition of Map - Mapping Organizations in India - Ellipsoid and Geoid – Co-ordinate Systems - Rectangular and Geographic Coordinates – Projection – Function - Types of Map Projections – Transformations – Function - Affine transformation.

Unit IV SPATIAL DATA FOR DISASTER MANAGEMENT **9**

Point, Line Polygon / Area, elevation and surface –Tessellations - Data Sources – Ground and Remote sensing survey - Map scanning and digitization and Geo-referencing - Ground Control Points - Raster Vs. Vector Comparison – File Formats for Raster and Vector – Data conversion between Raster and vector.

Unit V GIS APPLICATIONS IN DISASTER MANAGEMENT **9**

Hazard evaluation – Zonation – Risk assessment and vulnerability – Damage assessment – Land use planning and regulation for sustainable development - Spatial and non-spatial data bank creation - Pre-disaster and post disaster planning for relief operations – Disaster mapping.

Text Book:

1. Brian Tomaszewski, “Geographic Information Systems (GIS) for Disaster Management”, CRC press, Taylor & Francis Group 2nd new edition 2020.
2. C.P. Lo, Albert K.W. Yeung, "Concepts and Techniques of Geographic Information Systems", 2nd Edition, Prentice Hall, 2009.
3. John Jensen, Ryan Jensen, "Introductory Geographic Information Systems", International Edition, Pearson Publishers, 2012.

Reference Book:

1. Linda C. Bottersll & Donald A. wilhite, "From Disaster response to Risk management". springer, 2010.
2. C.Emdad Haque, "Mitigation of natural Hazards & disasters", springer, 2010.
3. Sisi zlatanova & Andrea Fabbri jonathanli, "Geomatic solutions for Disaster management, Springer Verlag, 2010.
4. Gerard Blokdijk, Disaster recovery planning and services, Gennaio publishers, 2008.
5. Mohamed Gad "Large scale disasters : prediction, control and mitigation", Cambridge university press, 2008.
6. Kang-tsung Chang, "Introduction to Geographic Information Systems" 9th Edition, Mc Graw Hill, 2018.

23ECA05 VLSI CIRCUITS

Offered by ECE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the characteristics of CMOS systems.
- To discuss about the various steps involved in fabrication.
- To study the HDL fundamentals.

Course Outcome:

At the end of the course, the students will be able to

- Analyse the characteristics of MOS Technology.
- Explain the importance of low power in VLSI.
- Describe the Fabrication process of IC.
- Design combinational circuits and PLAs.
- Synthesize the combinational circuits using Verilog HDL.

Unit I MOS & CMOS TECHNOLOGY **9**

MOS transistor – D MOSFET – E MOSFET - Ideal I–V characteristics, C–V characteristics, Non ideal I–V effects - DC transfer characteristics - Scaling of Devices – CMOS Inverter - CMOS technologies - VLSI design Flow.

Unit II LOW POWER VLSI DESIGN **9**

Basic principle of low power design – Sources of power consumption - pass transistor logic synthesis - asynchronous circuits - Special techniques- power reduction in clock networks-CMOS floating gate- delay balancing.

Unit III IC FABRICATION **9**

IC classification –fundamental of monolithic IC technology –epitaxial growth, masking and etching –diffusion of impurities. Realisation of monolithic ICs and packaging –Fabrication of diodes –capacitance, resistance and FETs.

Unit IV DIGITAL LOGIC DESIGN **9**

Design of Combinational circuits - Design procedure – Half adder / Subtractor – Full Adder / Subtractor – Parallel binary adder/Subtractor –Decoder – Encoder-Magnitude Comparator - Implementation of combinational logic circuits using Programmable Logic Array (PLA) - Programmable Array Logic (PAL) –Field Programmable Gate Array (FPGA).

Unit V HARDWARE DESCRIPTION LANGUAGE **9**

Verilog HDL fundamentals –Types of Modelling –HDL for Logic Gates –Half Adder –Full Adder –Half / Full Subtractor –Comparators – Test benches.

Text Book:

1. N.H.E.Weste et al, “CMOS VLSI Design”,4th Edition, Pearson, 2015
2. Samir Palnitkar, “Verilog HDL - A Guide to Digital Design and Synthesis”, Pearson, 2003.

Reference Book:

1. Wayne Wolf, “Modern VLSI design”, 4th edition Pearson Education, 2009
2. Mark Gordon Arnold, “Verilog Digital –Computer Design”, Prentice Hall (PTR), 1999.
3. Micheal D.Ciletti, “Modeling, Synthesis and Rapid Prototyping with the Verilog HDL”, Pearson, 1999.
4. Dimitrios Soudris, Chirstian Pignet, Costas Goutis, “Designing CMOS Circuits for Low Power”, Kluwer, 2011.
5. Kaushik Roy and S.C.Prasad, “Low power CMOS VLSI circuit design”, Wiley, 2000.
6. S.Salivahanan and S.Arivazhagan, “Digital Circuits and Design”, 5th Edition, Oxford University Press, 2018.
7. Donald A Neaman, “Semiconductor Physics and Devices”, 4th Edition, Tata McGrawHill Inc. 2017
8. D.RoyChoudhry, Shail Jain, “Linear Integrated Circuits”,6th Edition, New Age International Pvt. Ltd., 2021.

Extensive Reading:

- http://web.ewu.edu/groups/technology/Claudio/ee430/Lectures/L1-print.pdf
- http://www.circuitstoday.com/integrated-circuits
- http://www.tutorialspoint.com/vlsi_design/vlsi_design_digital_system.htm

23ECA06 ROBOTICS

Offered by ECE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To acquire essential skills in using robot anatomy for various operations
- To develop the ability to make use of end effectors, sensors, vision systems, kinematics of robots
- To develop robotic applications using in Artificial Intelligence and open-source tools.

Course Outcome:

At the end of the course, the students will be able to

- Integrate sensors and Robotic vision in robotic system
- Control robotic actuators and ensure adaptive control
- Analyze kinematics and dynamics of robotic manipulator
- Realize the importance of Artificial Intelligence algorithms in robotic applications
- Implement robotics application using robot programming languages and open-source tools.

Unit I SYSTEMS OVERVIEW OF A ROBOT **9**

Historical Perspective of Robots – Classification by Co-ordinate system – Basic components of a Robot System – Sensor Classification – Non Optical and Optical position sensors – Encoders – Velocity, Acceleration, force, Torque, Proximity, touch and slip sensors – Robotic Vision

Unit II CONTROL OF ACTUATORS IN ROBOT **9**

End effectors – Hydraulic and Pneumatic Actuators – Stepper Motors – Brushless DC Motors – Direct drive actuator – Closed Loop control – effect of friction and gravity – Robot Joint Control – Adaptive control – Servo Amplifiers.

Unit III TRANSFORMATIONS AND KINEMATICS **9**

Links and joints – Kinematic Chains – Translational and Rotational Transformations – Co-ordinate reference Framer – Homogeneous Transformations – Forward solution – Inverse solution – Robot arm dynamics.

Unit IV ARTIFICIAL INTELLIGENCE ALGORITHMS **9**

Artificial Intelligence in Problem-Solving: Uninformed Search, Informed Search – Knowledge and reasoning: First-Order Logic and Inference – Overview of Probabilistic Reasoning – Planning: Planning Languages, Goal Stack Planning – Rule based Expert Systems – Learning: Decision Trees and Reinforcement Learning.

Unit V ROBOT PROGRAMMING AND OPEN-SOURCE TOOLS **9**

Robot Programming – Robot Languages – Programming solution for Pick and Place Robot using VAL – Open source tools: ROS, VREP – Design example: Egg Packing System, Mars Rover and Farm Drone.

Text Book:

1. John J. Craig, “Introduction To Robotics: Mechanics And Control”, Pearson Education, Third Edition, 2018.
2. Parag Kulkarni, Prachi Joshi, “Artificial Intelligence – Building Intelligent Systems”, Prentice Hall India Learning Private Limited, 2015

Reference Book:

1. Russell, S.J. and Norvig, P., “Artificial intelligence – A modern approach”, 3rd edition, Pearson, 2014.
2. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education, 1st Edition, 2015.
3. Subir Kumar Saha, “Introduction to Robotics”, Tata McGraw-Hill Education, 2nd edition, 2014.

Extensive Reading:

- http://www.galileo.org/robotics/
- http://www.learnaboutrobots.com/
- http://www.roboanalyzer.com/
- http://timobrien.tech/projects/mars-rover/
- http://blueye.co.kr/skin/page/farmdrone.html
- https://nptel.ac.in/courses/112105249
- https://nptel.ac.in/courses/107106090

23ECA07 MOBILE COMMUNICATION

Offered by ECE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To gain knowledge on the fundamental concepts of mobile communication systems.
- To understand multiple access techniques in mobile communications.
- To acquire information of digital cellular systems.

Course Outcome:

At the end of the course, the students will be able to

- Interpret the cellular radio concepts and interference among cellular systems.
- Explain frequency management and handoff process in cellular mobile systems.
- Compare digital modulation and error coding techniques.
- Apply the concepts on multiple access and spread spectrum techniques in mobile communication.
- Analyse the current and future cellular mobile communication systems.

Unit I CELLULAR MOBILE SYSTEMS 9

Historic perspective and overview of Mobile Communication Systems – A basic cellular system – operation of cellular systems – overview of generations of cellular systems – concept of frequency reuse – co–channel interference and Non–co–channel interference – co–channel interference reduction factor – desired C/I from a normal case in an omni directional antenna system

Unit II CELL COVERAGE, CELL SITE, FREQUENCY MANAGEMENT AND HANDOFF 9

Cell coverage for signal and traffic – cell site and mobile antennas – frequency management and channel assignment – Handoff – dropped calls and cell splitting.

Unit III MODULATION METHODS AND CODING FOR ERROR DETECTION AND CORRECTION 9

Digital modulation methods– PSK – QPSK- OFDM – Linear Block Codes: Hamming Code.

Unit IV SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES 9

Spread Spectrum Techniques – DSSS – FHSS – Frequency division multiple access (FDMA) – Time–division multiple access (TDMA) – code division multiple access (CDMA) – performance comparison.

Unit V GENERATION OF WIRELESS SYSTEMS (QUANTITATIVE APPROACH) 9

1G, 2G-GSM, IS–136 (D–AMPS), IS–95 – Third generation wireless systems – GPRS – EDGE – WCDMA – 4G- LTE-5G.

Text Book:

1. William, C. Y. Lee, “Mobile Cellular Telecommunications”, 2nd Edition, McGraw Hill, 2006.
2. Mischa Schwartz, “Mobile Wireless Communications”, Cambridge University Press India, 2005

Reference Book:

1. Jerry D. Gibson, “Mobile Communication Hand Book”, 3rd Edition, CRC press, 2017.
2. Theodore S Rappaport, “Wireless Communication Principles and Practice”, 2nd Edition, Pearson Education, 2010.
3. Lawrence Harte, “3G Wireless Demystified”, McGraw Hill Publications, 2002.
4. Kaveh Pahlavan and Prashant Krishnamurthy”, Principles of Wireless Networks”, Prentice Hall, 2001.

Extensive Reading:

- http://webmail.aast.edu/~khedr/Courses/Graduate/Wireless%20Communications_F08/Lecture%20four%20channel%20II.pdf
- https://nptel.ac.in/courses/106106167
- https://nptel.ac.in/courses/117104115

23ECA08 BRAIN COMPUTER INTERFACE

Offered by ECE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the basic concepts of brain computer interface
- To study the various signal acquisition methods
- To study the different types of BCI

Course Outcome:

At the end of the course, the students will be able to

- Explain the basics of Neuroscience and BCI Ethics
- Analyze the concepts of Invasive BCIs
- Learn about Semi Invasive BCIs
- Explain about Non Invasive BCIs
- Design BCI for different applications

Unit I FUNDAMENTALS OF BCI AND ETHICS **9**

Introduction - Basic Neuroscience - Structure of BCI system - Major Types of BCIs – Recording Signals from the Brain, Stimulating the Brain, Simultaneous Recording and Stimulation– BCI Ethics - Medical, Health, and Safety Issues, BCI Security and Privacy – Legal Issues – Moral and Social Justice Issues

Unit II INVASIVE BCIS **9**

Building a BCI: Brain Responses Useful for Building BCIs - Invasive BCIs - BCIs based on Operant Conditioning – population decoding - Invasive BCIs in Animals – Invasive BCIs in Humans - Long Term Uses of Invasive BCIs.

Unit III SEMI INVASIVE BCIS **9**

Semi-Invasive BCIs : Electrocorticographic (ECoG) BCIs – ECoG based BCIs in Animals – ECoG based BCIs in Humans- BCIs Based on Peripheral Nerve Signals

Unit IV NON INVASIVE BCIS **9**

Non-Invasive BCIs: Electroencephalographic (EEG) BCIs - Other Non-invasive BCIs: fMRI, MEG, and fNIR - BCIs that Stimulate: Sensory Restoration – Motor Restoration - Bidirectional and Recurrent BCIs.

Unit V APPLICATIONS OF BRAIN-COMPUTER INTERFACES **9**

Medical Applications : Sensory restoration - Motor restoration- Cognitive restoration - Brain- Controlled Wheelchairs - Nonmedical Applications: Lie Detection and Applications in Law – Robotic Avatars – Monitoring Alertness - Education and Learning - Security, Identification, and Authentication – Gaming and Entertainment— Brain Controlled Art-Applications in Space.

Text Book:

1. Rajesh P. N.Rao, “Brain Computer Interfacing – An Introduction”, 1st Edition, Cambridge University Press, 2013.

Reference Book:

1. Leif Sornmo, Pablo Laguna, “Bioelectrical Signal Processing in Cardiac and Neurological Applications”, Academic Press, 2005.
2. Andrew Webb, “Statistical Pattern Recognition”, Wiley International, Second Edition, 2002.
3. Jonathan Wolpaw and Elizabeth Winter Wolpaw, “Brain–Computer Interfaces: Principles and Practice”, Oxford Scholarship 2012, Print ISBN-13: 9780195388855.
4. ArnonKohen, “Biomedical Signal Processing”, Vol I and II, CRC Press Inc, ocaRato, Florida.
5. Desney S. Tan Anton Nijholt, “Brain-Computer Interfaces - Applying our Minds to Human-Computer Interaction”, Springer-Verlag London Limited 2010, ISSN 1571-5035, ISBN 978-1-84996-271-1.

Extensive Reading:

- https://computer.howstuffworks.com/brain-computer-interface.htm
- https://www.sciencedaily.com/news/mind_brain/brain-computer_interfaces/
- http://bcisociety.org/events/
- https://www.tandfonline.com/loi/tbci20

23EEA05 POWER SUPPLY CIRCUITS

Offered by EEE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Different types of power semi-conductor devices and their switching characteristics.
- Operation, characteristics and performance parameters of controlled rectifiers.
- Operation, switching techniques and basic topologies of DC-DC switching regulators.
- Different modulation techniques of pulse width modulated inverters and to understand the harmonic reduction methods.
- Operation of AC voltage controllers.

Course Outcome:

At the end of the course, the students will be able to

- Identify and select the switching devices for different power converter applications.
- Design a suitable power converter for given dc load specification from AC input.
- Design and analyze different DC-DC converter with various loads.
- Design and analyze the single or three phase inverter.
- Analyze the AC voltage controller

Unit I POWER SEMI-CONDUCTOR DEVICES 9

Introduction to Power Electronics - Study of switching devices: structure, operation, static and switching characteristics of SCR, TRIAC, BJT, MOSFET, IGBT-SCR: Two Transistor model, turn on circuits

Unit II PHASE-CONTROLLED CONVERTERS 9

1-pulse, 2-pulse converters - circuit, operation, waveforms - Estimation of average load voltage and average load current for continuous current operation - Input power factor estimation for ripple free load current

Unit III DC TO DC CONVERTER 9

Step-down and step-up chopper - Time ratio control and current limit control – Buck, boost, buck-boost converter, Isolated Converters: Fly back and Forward converter

Unit IV INVERTERS 9

Single phase and three phase inverters (both 120 degree mode and 180 degree mode) - PWM techniques: single, multiple, sinusoidal PWM, modified sinusoidal PWM – Voltage and harmonic control

Unit V AC TO AC CONVERTERS 9

Single phase AC voltage controllers –Integral cycle control, phase angle control - Estimation of RMS load voltage, RMS load current and input power factor - Single phase to single phase cycloconverter

Practical Course 0

Text Book:

1. Muhammad H.Rashid, “Power Electronics Circuits, Devices and Applications”, Pearson Publication, 4 th Edition, 2007

Reference Book:

1. Mohan, Undeland, Robbins,” Power Electronics: Converters Applications and Design”, John Wiley & Sons, 3rd Edition, 2003
2. Robert W. Erickson, Dragan Maksimovic, “Fundamentals of Power Electronics”, Springer Science & Business Media, 2nd edition 2001.

23EEA06 FUNDAMENTALS OF POWER QUALITY

Offered by EEE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Various Power Quality issues.
- Power quality problems and methods of control.
- Various methods of power quality monitoring and suppression.

Course Outcome:

At the end of the course, the students will be able to

- Analyze the various power quality issues.
- Analyze the power quality events and assessment.
- Mitigate the power quality problems using relevant devices.

Unit I INTRODUCTION TO POWER QUALITY **9**

Terms and definitions: Overloading, under voltage, sustained interruption; sags and swells; waveform distortion, Total Harmonic Distortion (THD), Computer Business Equipment Manufacturers Associations (CBEMA) curve.

Unit II VOLTAGE SAGS AND SWELLS **9**

Sources of sags and interruptions, estimating voltage sag performance, motor starting sags, estimating the sag severity, fast transfer switches- Sources of over voltages: Capacitor switching, lightning, ferro-resonance; mitigation of voltage swells.

Unit III HARMONICS **9**

Harmonic distortion: Voltage and current distortion, THD-TDD, harmonic sources from commercial and industrial loads, locating harmonic sources- resonance-harmonic distortion evaluation, devices for controlling harmonic distortion, passive filters, active filters.

Unit IV POWER QUALITY BENCHMARKING **9**

Benchmarking Process-RMS voltage variation Indices-Harmonic Indices-Power Quality Contracts-Power Quality Insurance.

Unit V POWER QUALITY MONITORING **9**

Monitoring consideration-Power quality measuarement equipment: harmonic / spectrum analyzer, flicker meters, disturbance analyzer- applications of expert system for power quality monitoring.aMonitoring consideration-Power quality measurement equipment: harmonic / spectrum analyzer, flicker meters, disturbance analyzer- applications of expert system for power quality monitoring.

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Text Book:

1. Roger.C.Dugan, Mark.F.McGranagham, Surya Santoso, H.Wayne Beaty, “Electrical Power Systems Quality”, Tata McGraw Hill Publishing Company Ltd, New Delhi, Third Edition, 2013.
2. Math H.J.Bollen, “Understanding Power Quality Problems-Voltage Sag & Interruptions”, (New York: IEEE press, 2000).

Reference Book:

1. C.Sankaran, “Power Quality”, CRC press, 2002.
2. Arindam Ghosh, “Power Quality Enhancement Using Custom Power Devices”, Springer International Edition, 2002
3. PSCAD User Manual.
4. J.Arrilaga, N.R.Watson, S.Chen, “ Power System Quality Assessment”, John Wiley & Sons, 2000.

23EEA07 CONTROL ENGINEERING (EXCEPT FOR ECE)

Offered by EEE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- Transfer function modeling of electrical and mechanical systems.
- Time domain, frequency domain and stability analysis.
- Industrial application of automatic control schemes

Course Outcome:

At the end of the course, the students will be able to

- Develop mathematical models of electrical and mechanical systems.
- Estimate the time domain and frequency domain specifications.
- Analyze the performance and stability of system through time domain approach.
- Analyze the performance and stability of system through frequency domain approach.
- Apply basic controller action on various industrial processes.

Unit I SYSTEM MODELLING AND REPRESENTATION 9

System concepts-Classifications of control system with examples -Transfer function Modeling of Electrical systems, Mechanical systems (Translational & Rotational systems only)-Electrical Analogy of Mechanical Systems –Block diagram reduction techniques –Signal flow graphs–Mason' gain formula.

Unit II TIME RESPONSE ANALYSIS 9

Standard test signals-Time response of First-order system for different input Signals -Time response of Second -order systems for step input signal -Time domain specifications -Steady state error constants: Position, Velocity and Acceleration error constants-Generalized error series.

Unit III STABILITY ANALYSIS 9

Characteristics equation –Concepts of Stability -Location of roots in S-plane for stability-Routh-Hurwitz Stability criterion –Necessary and sufficient conditions for stability–Root locus concept-Rules for construction of root loci Root locus plot for stability analysis.

Unit IV FREQUENCY RESPONSE ANALYSIS 9

Frequency domain specifications –Peak resonance, Resonant frequency, Bandwidth and Cut-off rate Correlation between time and frequency responses for second order systems-Gain margin and phase margin –Bode plot method -Polar plot method -Stability analysis using Gain and Phase margin.

Unit V COMPENSATOR DESIGN 9

Compensators: Types of Compensation, Performance criteria – Lag and Lead compensators Using Electrical networks– Design of Lag, and Lead compensators using Bode plot method.

Text Book:

1. Nagrath.J and Gopal.M," Control System Engineering", New Age International Publishers, 5th Edition, 2012.
2. Norman S Nise, "Control System Engineering", John Wiley & Sons, New Delhi, 2013.

Reference Book:

1. Gopal.M, "Digital Control and State Variable Methods", McGraw-Hill, 4th Edition, 2012.
2. Palani.S,"Control Systems Engineering", McGraw-Hill Education (India) Pvt Ltd, 4th Edition ,2012.
3. Richard C. Dorf& Robert H. Bishop, "Modern Control Systems", Pearson Education, 12th Edition 2011.
4. Schaum's Outline Series, "Feedback and Control Systems", McGraw-Hill, 2nd Edition, 2011.
5. DhaneshN.Manik, "Control Systems", Cengage Learning, Delhi, 1st Edition, 2012.
6. Benjamin C Kuo, "Automatic Control Systems", John wiley& sons, inc., 9th Edition, 2009.
7. Ogata K, "Modern Control Engineering", 5th Edition, Prentice Hall of India, New Delhi, 2010.

23EEA08 INDUSTRIAL MEASUREMENTS AND INSTRUMENTATION

Offered by EEE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- Basic concepts on measuring instruments.
- Measurement of Acceleration, vibration and force.
- Measurement of pressure and temperature in industry.

Course Outcome:

At the end of the course, the students will be able to

- Analyze Instrumentation systems and explain their applications to various industries.
- Explain the application instrumentation to various industries.
- Measure the change in pressure in an industry.
- Measure the low temperature changes using Thermometers, RTD etc in an industry.
- Measure the high temperature using thermocouples, Radiation methods etc in an industry.

Unit I CHARACTERISTICS, ERRORS & STANDARDS OF INSTRUMENTS 9

Functional elements of generalized Instrumentation Systems-Static characteristics: Accuracy, Precision, Sensitivity, Linearity, Resolution, Range or Span and Dynamic characteristics: Speed of response, Measuring lag, Fidelity, Dynamic error of measuring instruments - Absolute, gross, systematic, random and limiting errors in measurements -Statistical estimation of measurements data: Arithmetic mean, Average deviation, Standard deviation, Variance and Probable error of mean - Standards and calibration.

Unit II MEASUREMENT OF ACCELERATION, VIBRATION AND FORCE 9

Vibration measuring Instruments: Reasons for the measurement of vibrations- Vibrometer / Seismic Instrument Frequency response analysis of systems- Accelerometers: Piezoelectric, LVDT, Strain gauge and Variable reluctance type accelerometers - Different types of load cells: Hydraulic, Pneumatic, Strain gauge and Piezoelectric load cells.

Unit III PRESSURE MEASUREMENT 9

Units of pressure – Liquid Manometers: U-tube, Well type and Inclined tube Manometer- McLeod Gauge-Elastic type pressure gauges: Bourdon tube, bellows and diaphragms - Capacitive type pressure transducer – Piezo-resistive pressure sensor- Pirani gauge: Thermal conductivity gauges – Ionization gauge - Calibration of pressure gauges: Dead weight tester.

Unit IV LOW TEMPERATURE MEASUREMENT 9

Definitions Boiling point, Freezing point and Triple point - Temperature Measurement Scales- Liquid-in-Glass Thermometer, Pressure Thermometers, Bimetallic Thermometer - Calibration of Thermometers - Resistance Temperature Detector (RTD)- characteristics and signal conditioning-3 lead and 4 lead RTDs-Thermistors.

Unit V HIGH TEMPERATURE MEASUREMENT 9

Thermocouples: Laws of thermocouple - Fabrication of industrial thermocouples – Compensating cable- Signal conditioning for thermocouple - Radiation fundamentals - Radiation methods of temperature measurement - Total radiation pyrometers - Optical pyrometers.

Text Book:

1. Doebellin, E.O.and Manik D.N., “Measurement systems Application and Design”, Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd, 2007.
2. A. K. Sawhney, Puneet Sawhney, “Course in Mechanical Measurements and Instrumentation and Control”, Dhanpat Rai & Sons, New Delhi, 2014.

Reference Book:

1. Jones. B.E," Instrument Technology”, Vol.2, Butterworth-Heinemann, International Edition, 2003
2. Liptak, B.G., “Instrumentation Engineers Handbook (Measurement)”, CRC Press, 2005
3. Patranabis,D., “Principles of Industrial Instrumentation”, 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.
4. Eckman D.P., “Industrial Instrumentation”, Wiley Eastern Limited, 2003.
5. S.K.Singh., “Industrial Instrumentation and Control”, 3rd Edition, Tata McGraw - Hill Education, 2008

23EEA09 INSTRUMENTS IN BIOENGINEERING RESEARCH

Offered by EEE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Human physiological system for diagnosis and research.
- Various types of bio potential electrodes and their characteristics.
- Bio signals conditioning unit and recording instruments for electro–physiological parameters.
- Various instruments for patient life assisting purpose.
- Medical imaging systems for diagnosis and research.

Course Outcome:

At the end of the course, the students will be able to

- Identify the necessary instruments for biological systems.
- Explain the various electrical origins of recording methods of ECG, EEG, & EMG
- Explain how to use the latest medical instruments available for medical imaging systems and diagnosis.
- Apply the instruments for bio engineering research.
- Analyze, interprets, and display the bio signals

Unit I HUMAN PHYSIOLOGICAL SYSTEM 9

Cell and its Structure – Action potential – Resting potential – Propagation of Action potential and Sodium pump action – Nerve cell: Neuron – Axon – Synapse – Central Nervous System-Peripheral Nervous System – Respiratory System-Electro Physiology of Cardiopulmonary Circulation system.

Unit II BIO-POTENTIAL ELECTRODES AND BIOTRANSDUCERS 9

The electrode – electrolyte interface, Polarization, Ag-Agcl electrodes, Bio-Electrodes: Micro, Needle and Surface Electrodes, Transducers in used in medicine -Pressure Transducers-Temperature transducers-pulse sensors- piezo electric transducers –ultrasonic transducers.

Unit III INSTRUMENTS FOR PATIENT LIFE ASSISTING 9

Pacemakers and its types –Defibrillators: D.C and AED – Ventilators: Pressure limited, Volume limited and Servo controlled ventilators – Nerve and Muscle stimulators-Surgical diathermy machines: Short wave, Microwave and Ultrasonic diathermy – Hemo and Peritoneal dialyzers.

Unit IV BIOSIGNALS CONDITIONING UNIT & RECORDING INSTRUMENTS FOR ELECTRO–PHYSIOLOGICAL PARAMETER 4

Operational Amplifier- Differential Operational amplifier – Medical preamplifier – Isolation Amplifier- Different Lead configurations and recording methods of Electrocardiograph(ECG) – Electromyography (EMG)- Electroencephalograph(EEG) – Brain Waves: Alpha, Beta, Theta and Delta waves and their frequency spectrum.

Unit V MEDICAL IMAGING SYSTEMS FOR DIAGNOSIS AND RESEARCH 9

Block diagram, operations and applications of: X-Ray machines– Computer Tomography – Magnetic Resonance Imaging (MRI) System – Ultrasonography – Medical Thermography – Bio-telemetry systems.

Text Book:

1. Khandpur.R.S, “Hand book of Bio-Medical Instrumentation”, Tata McGraw –Hill, 2014.
2. John. Can. Brown, “Introduction to Bio Medical Equipment Technology”, Pearson Education of ASIA, 2001.
3. Geddes L.A. and Baker L.E., “Principles of Applied Bio-Medical Instrumentation”, John Wiley & Sons, 3rd Edition, 2013.
4. Ed. Joseph D. Bronzino, “The Biomedical Engineering Handbook”, Second Edition, Boca Raton, CRC Press LLC, 2000.

Reference Book:

1. John G. Webster, “Medical Instrumentation Application and Design”, John Wiley and sons, India, 3rd Edition, 2013.
2. Barbara L. Christe, “Introduction to biomedical Instrumentation” Cambridge University Press, 2009.
3. Leslie Cromwell, Fred J.Weibell, Erich A. Pfeiffer, “Bio-Medical Instrumentation and Measurements”, Pearson Education, 2011 / PHI, 2nd Edition.
4. Bentley.J.P, “Measurement Systems”, Pearson Education, Delhi, 2003.
5. Prof.Venkataram.S.K, “Bio-Medical Electronics & Instrumentation”, Galgotia Publications, 2000.

23ITA06 GRAPHICS PROGRAMMING

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explore the basic Primitives and attributes in OpenGL
- To study the geometric objects and transformations
- To Understand the various lighting and shading effects
- To gain a proficiency by applying Modelling Techniques
- To gain knowledge in curves and surfaces

Course Outcome:

At the end of the course, the students will be able to

- Apply basic Primitives and Attributes for 2D transformations
- Work with 3D transformations using OpenGL
- Implementing Lighting and shading effects
- Applying various Modelling Techniques
- Applying various Curves and Surfaces for different objects

Unit I GRAPHICS PROGRAMMING **9**

Introduction-Sierpinski Gasket-Programming 2D Applications-OpenGL Application Programming Interface-Primitives and Attributes-Color-Viewing-Control Functions-Gasket program-Polygons and Recursions-3D Gasket-Adding Interaction-Menus

Unit II GEOMETRIC OBJECTS AND TRANSFORMATIONS **9**

Scalars points and Vectors-3D primitives-Coordinate systems and Frames-Frames in Open GL-Modelling a colored cube-Affine Transformations-Translation,Rotation and scaling-Transformation in homogeneous coordinates-Transformation matrices in OpenGL-spinning of the cube-Interface to 3D applications-quaternions-classical and computer viewing-parallel,Perspective Projections with OpenGL-Hidden surface Removal

Unit III LIGHTING AND SHADING **9**

Light and Matter-Light sources-The Phong Reflection Model-computation of vectors-Polygonal Shading-specifying Light Parameters-Implementing a Lighting Model-Shading of the sphere Model-Per Fragment Lighting-Vertices to fragments-Clipping-Line Segment Clipping-Polygon Clipping-Clipping in 3D-Rasterization-Bresenhams Algorithm-Polygon Rasterization-Hidden Surface Removal

Unit IV MODELING AND HIERARCHY **9**

Symbols and Instances-Hierarchical Models-A Robot Arm-Trees and Traversal-Animation –Graphical objects-Scene Graphs-Open Scene Graphs-Graphics and Internet-Procedural Methods-Algorithmic Models-Newtonion Particles-Constraints-A Simple Particle System-Language Based Models-Recursive Methods and fractals-Procedural Noise

Unit V CURVES AND SURFACES **9**

Representation of curves and surfaces-Design Criteria-Parametric cubic Polynomial Curves-Interpolation-Hermite curves and surfaces-Bezier curves and surfaces-Cubic B Splines-General B Splines-Rendering curves and surfaces-Utah teapot-Advanced Renderning-Parallel-volume-Direct Volume-Image Based Rendering

Text Book:

1. Edward Angel ,Dave Shreiner ,"Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL" ,Sixth Edition,2015

Reference Book:

1. Sumanta Guha Computer Graphics Through OpenGL: From Theory to Experiments, CRC Press, Second Edition,2015
2. Tom McReynolds, David Blythe ,"Advanced Graphics Programming Using OpenGL"Morgan Kauffmann,2005
3. Clayton Walnum," 3-D graphics programming with OpenGL," Que, 1995

Extensive Reading:

- http://learnopengl.com/
- http://www.videotutorialsrock.com/
- http://www.cs.uccs.edu/~ssemwal/indexGLTutorial.html
- http://www.opengl-tutorial.org/
- http://courses.cs.vt.edu/~cs4204/lectures/opengl_basics.pdf

23ITA07 BIG DATA AND APPLICATIONS

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the fundamental concepts of big data and analytics
- To learn various data analysis patterns
- To perform mining on huge data
- To analyze the big data for useful business applications using analytics techniques
- To gain knowledge on various visualization techniques

Course Outcome:

At the end of the course, the students will be able to

- Identify the need for big data analytics for a domain
- Use NOSQL database for retrieving data
- Develop applications using Hadoop and MapReduce Framework
- Apply various techniques for analytics
- Use techniques to extract the insights of big data through visualization

Unit I INTRODUCTION TO BIG DATA ANALYTICS 9

Analytics – Descriptive Analytics – Diagnostic Analytics – Predictive Analytics – Prescriptive Analytics – Big Data – Characteristics of Big Data – Examples of Big Data – Analytics Flow for Big Data – Big Data Stack – Analytics Patterns – Case Study – Data Acquisition.

Unit II BIG DATA PATTERNS & NOSQL 9

Load Leveling with Queues - Load Balancing with Multiple Consumers - Leader Election - Sharding - Consistency, Availability & Partition Tolerance (CAP) - Bloom Filter - Materialized Views - Lambda Architecture Scheduler – Agent - Supervisor - Pipes & Filters - Web Service - Consensus in Distributed Systems – Mapreduce Patterns – Document Databases - MongoDB

Unit III BIG DATA STORAGE AND ANALYSIS 9

HDFS – Architecture – Usage Examples – Mapreduce Programming Model – Hadoop YARN – Hadoop Schedulers – Mapreduce Examples – Pig – Data Types – Data Filtering & Analysis – Storing Results – Debugging Operators – Pig Examples

Unit IV MACHINE LEARNING ALGORITHM 9

Analytics Algorithms – Clustering – k-means - Classification – Naïve Bayes – Decision Tree – Random Forest - Gradient Boosting Machine - Support Vector Machine – Deep Learning – Regression – Linear Model - Recommendation Systems

Unit V CASE STUDY AND DATA VISUALISATION 9

Case Study – Song Recommendation system – Genome Data Analysis – Classifying Handwritten Digits – Data Visualisation – Frameworks & Libraries – Types - Line Chart – Scatter Plot - Bar Chart - Box Plot - Pie Chart - Dot Chart - Map Chart - Gauge Chart - Radar Chart - Matrix Chart - Spatial Graph - Distribution Plot - Violin Plot - Count Plot - Heatmap - Pair Grid - Facet Grid

Text Book:

1. Arshdeep Bahga, Vijay Madisettai, “Big Data Science & Analytics”, Vpt Publisher, 2016
2. Tom White, “Hadoop: The Definitive Guide”, O’Reilly, 4th Edition, 2015.

Reference Book:

1. Seema Acharya, SubhashiniChellappan, “Big Data and Analytics”, Wiley Publications, First Edition, 2015.
2. Bart Baesens, “Analytics in a Big Data World: The Essential Guide to Data Science and its Applications”, Wiley, 2014.
3. Jure Leskovec, Anand Rajaraman and Jeffrey David Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
4. Michael Berthold, David J. Hand, “Intelligent Data Analysis”, Springer, 2007.
5. “Data Science and Big Data Analytics”, EMC2 Education Services, 2013.

Extensive Reading:

- http://inside-bigdata.com/2013/09/19/getting-free-data-science-education/
- http://strata.oreilly.com/2013/10/stream-mining-essentials.html
- https://hadoop.apache.org/docs/r1.2.1/mapred_tutorial.html
- http://www.w3resource.com/mongodb/nosql.php
- http://www.christof-strauch.de/nosqldbs.pdf
- https://www.mongodb.com/

23ITA08 INTELLIGENT DECISION MAKING METHODS

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the logic of MCDM Methods
- To learn how to do pairwise comparison
- To learn to do normalization of attributes
- To understand the role of fuzzy logic for decision making problems
- To understand various MCDM methods to choose the best alternative

Course Outcome:

At the end of the course, the students will be able to

- Explore various MCDM methods for decision making
- Apply quantification methods for decision making problems
- Evaluate using relative weights for the attributes in order of relative importance
- Apply fuzzy with MCDM methods for decision making
- Evaluate the results of fuzzy with MCDM to choose the best alternative

Unit I INTRODUCTION **9**

Multi- Criteria Decision Making – A General Overview – Classification of MCDM Methods – Weighted Sum Model (WSM) – Weighted Product Model (WPM) – Analytic Hierarchy Process (AHP) – Revised AHP – The Technique for Order of Preference by Similarity to Ideal Solution(TOPSIS)

Unit II QUANTIFICATION **9**

Qualitative data for MCDM problems – Scales for Quantifying Pair wise Comparisons – Evaluating different scales – Simulation – Analysis of the Computational Results

Unit III EVALUATION OF WEIGHTS **9**

Deriving Relative Weights – Sensitivity Analysis – Evaluation of methods – Process a decision matrix – Ranking abnormalities

Unit IV FUZZY MULTI- CRITERIA DECISION MAKING **9**

Fuzzy Operations – Ranking of Fuzzy Numbers - Fuzzy WSM method – Fuzzy WPM method – Fuzzy AHP method – Fuzzy Revised AHP method – Fuzzy TOPSIS method

Unit V FUZZY EVALUATION CRITERIA **9**

Testing the methods – First Evaluative Criterion – Second Evaluative Criterion - Computational Experiments - Analysis

Text Book:

1. Evangelos Triantaphyllou, “Multi-criteria Decision Making Methods: A Comparative Study”, Kluwer Academic Publishers, Springer 2000.

Reference Book:

1. Witold Pedrycz, Petr Ekel, Roberta Parreiras, “Fuzzy Multicriteria Decision-Making: Models, Methods and Applications” , Wiley 2010
2. Hans J.Zimmermann, “Fuzzy Sets, Decision Making and Expert Systems”, International Series in Management Science/Operations Research, Kluwer Academic Publishers, 1987
3. Timothy J.Ross , “Fuzzy Logic with Engineering Applications”, Third Edition , Wiley Publication, 2015

Extensive Reading:

- http://www.dii.unisi.it/~mocenni/Note_AHP
- http://www.faez.ir/CourseFile/TOPSIS.pdf

23ITA09 PHP PROGRAMMING

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce web development with PHP
- To work with various operations in PHP
- To model the design in a web environment
- To develop a webpage with database
- To test and work with a PHP application

Course Outcome:

At the end of the course, the students will be able to

- Create simple basic PHP programs
- Create programs using functions and strings
- Explore the usage of arrays and objects
- Implement graphics, security and web techniques in designing
- Implement database connectivity with PHP

Unit I INTRODUCTION TO PHP **9**

PHP – History and Evolution – Installation – Language Basics – Lexical Structure – Datatypes – Variables – Expression & Operators – Flow Control statements – embedding PHP in web pages

Unit II FUNCTIONS & STRINGS **9**

Calling a function – Defining a function – Variable scope – function parameters – return values – variable functions – Strings – Quoting string constants – Printing string – cleaning strings – encoding and escaping – comparing strings – manipulating and searching strings

Unit III ARRAYS & OBJECTS **9**

Indexed versus Associative Arrays – Identifying elements of an array – Storing data in arrays – Multidimensional arrays –Extracting multiple values – Conversion between arrays and variables – Traversing arrays – Sorting – Working with arrays – Objects – Creation – Accessing Properties and methods – Declaration of class – Introspection

Unit IV WEB TECHNIQUES, GRAPHICS & SECURITY **9**

HTTP basics – Server Information – Processing Forms –Setting Response Headers – Maintaining State – SSL – Graphics – Embed an image – Create and draw images – Images with text – Dynamic buttons – Color handling – Security – Cross site scripting – File uploads and Access

Unit V DATABASE ACCESS & APPLICATION **9**

PHP to access a database – Relational databases and SQL – MySQL object interface – Connectivity – Direct file level manipulation – Application techniques – code libraries – handing output - error reporting and suppression – performance tuning

Text Book:

1. Kevin Tatroe, Peter MacIntyre & Rasmus Lerdorf, “Programming PHP”, Creating Dynamic Web Pages, O'Reilly Media, 3rd Edition, 2013

Reference Book:

1. Steven Holzner ,”PHP: The Complete Reference”, McGraw Hill Education,2008
2. Timothy Boronczyk , Martin E. Psinas,”PHP and MYSQL: Create - Modify – Reuse”, Wiley India Private Limited ,2008
3. Matt Doyle,”Beginning PHP 5.3”, Wiley Publishing Inc., 2009

Extensive Reading:

- http://php.net/
- http://www.tutorialspoint.com/php/
- http://www.toves.org/books/php/ch03-first/index.html
- http://www.codecademy.com/en/tracks/php
- http://www.w3schools.com/php/

23ITA10 GO PROGRAMMING

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn fundamentals of Go programming, including its syntax, and basic datatypes
- To understandcomposite types, functions and methods concepts in Go
- To gain knowledge in Go interfaces for essential tasks.
- To be familiar with advanced concepts Goroutines, Channels and concurrency.
- To explore packages, testing and reflection concepts in Go.

Course Outcome:

At the end of the course, the students will be able to

- write and comprehend Go programs, demonstrating a strong foundation in the language
- demonstrate competence in applying composite types, functions and methods in practical scenarios
- work with Gointerfaces for various real-time problems
- apply advanced Go concepts, such as Goroutines, Channels and concurrency
- develop packagesusing Go and test them

Unit I INTRODUCTION TO GO PROGRAMMING **9**

Overview of Go programming language –Origin of Go–Program Structure – Names - Declarations - Variables - Assignments - Type Declarations - Packages and Files – Scope - Basic Data Types - Integers - Floating-Point Numbers - Complex Numbers - Booleans - Strings - Constants

Unit II COMPOSITES TYPES, FUNCTIONS AND METHODS **9**

Composite Types - Arrays - Slices - Maps - Structs - JSON - Text and HTML Templates - Functions - Function Declarations - Recursion - Multiple Return Values - Errors - Function Values - Anonymous Functions - Variadic Functions - Deferred Function Calls - Panic - Recover - Methods - Method Declarations - Methods with a Pointer Receiver - Composing Types by Struct Embedding - Method Values and Expressions - Example: Bit Vector Type - Encapsulation

Unit III INTERFACES **9**

Interfaces - Interfaces as Contracts - Interface Types - Interface Satisfaction - Parsing Flags with flag.Value - Interface Values - Sorting with sort.Interface - The http.Handler Interface - The error Interface - Expression Evaluator - Type Assertions - Discriminating Errors with Type Assertions - Querying Behaviors with Interface Type Assertions - Type Switches - Token-Based XML Decoding

Unit IV GOROUTINES, CHANNELS AND CONCURRENCY **9**

Goroutines and Channels - Goroutines - Concurrent Clock Server - Concurrent Echo Server - Channels - Looping in Parallel - Concurrent Web Crawler - Multiplexing with select - Concurrent Directory Traversal - Cancellation - Chat Server - Concurrency with Shared Variables - Race Conditions - Mutual Exclusion: sync.Mutex - Read/Write Mutexes: sync.RWMutex - Memory Synchronization - Lazy Initialization: sync.Once - The Race Detector - Concurrent Non-Blocking Cache - Goroutines and Threads

Unit V PACKAGES, TESTING AND REFLECTION **9**

Packages and the Go Tool - Introduction - Import Paths - The Package Declaration - Import Declarations - Blank Imports - Packages and Naming - The Go Tool - Testing - The go test Tool - Test Functions - Coverage - Benchmark Functions - Profiling - Example Functions - Testing - The go test Tool - Test Functions - Benchmark Functions - Profiling - Example Functions - Reflection - reflect.Type and reflect.Value - Display, a Recursive Value Printer - Encoding S-Expressions - Setting Variables with reflect.Value

Text Book:

1. Alan A.ADonovan, Brian W Kernighan, “The Go Programming Language”, Addison-Wesley Professional, 1st Edition, 2016.

Reference Book:

1. Mark Bates, Cory LaNou, Tim Raymond,”How To Code in Go”, McGraw Hill Education, 2020
2. Ivo Balbaert,”The Way to Go: A Thorough Introduction to the Go Programming Language”, iUniverseInc,2012
3. Wei-Meng Lee,”Go Programming Language For Dummies”, Wiley Publishing Inc., 2021

Extensive Reading:

- https://codilime.com/blog/what-is-go-language/
- https://awesome-go.com/websites/
- https://gobyexample.com
- https://www.w3schools.com/go/

23MEA15 FUNDAMENTALS OF AIRCRAFT AND SPACE TECHNOLOGY

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To provide knowledge in the evolution of aircrafts.
- To give understanding of concept of aerospace engineering.
- To get exposed to the various aircraft materials and aircraft structures.
- To develop knowledge in satellites and satellite launching vehicles.
- To analyse the current trends in the field of reusable launch vehicle.

Course Outcome:

At the end of the course, the students will be able to

- This course would make familiar of basic concepts of aviation.
- Course would be helpful to understand the basic principle behind the aircraft structures.
- Students would be trained in the current engineering materials and structures of an aircraft.
- One would be able to make use of basic knowledge of rocket, satellites.
- This Course would equip the students to effectively enhance the concepts of space crafts and space shuttles.

Unit I INTRODUCTION TO AVIATION **9**

Lighter-than-air aircraft, Heavier-than-air aircraft - Historical perspective of aviation: Balloon flight, Airship, Ornithopter, Gliders, Monoplane, Biplane, and recent Airbus.

Atmospheric Science: Earth's atmosphere, structure, classification, constituents – Temperature across atmospheric layers – International standard atmosphere (ISA) - Space Debris – Airport METARs.

Unit II AEROSPACE ENGINEERING **9**

Aerodynamic forces – primary motions – lift generation – aerofoils – drag – anatomy of an aircraft – major parts of an aircraft (Radome, Fuselage, Wings, Wing box, Landing Gear, Empennage, Jet engines, Black box) – Types of aircraft – helicopters – aircraft instruments – Cockpit – fatigue failure in aircrafts – Airplane Disasters.

Unit III AIRCRAFT MATERIALS & PERFORMANCE **9**

Light-weight materials in aircraft - Fiber Reinforced Plastic (FRP): Applications of FRP in principal parts of aircrafts. Aircraft performance: Take-off, Climb, Cruise, Descent, Approach, Landing, Taxiing, Manoeuvres – Research Issues in aircraft: Bird-strike problem, ice-impact problem, lightening impact problem – Smart skins in aircraft-Structural Health Monitoring (SHM) of aircrafts.

Unit IV ROCKETS & SATELLITES **9**

Introduction to rockets – types of rockets launched by India – rocket engines: elements of liquid propulsion systems – solid rocket motors – liquid rocket static testing – launch tower, launch pad– Indian space research centers.

Types of satellites- present-day satellites in India- Parts of a satellite - application of shape memory alloy (SMA) in satellites deployment.

Unit V REUSABLE LAUNCH VEHICLES **9**

Recent developments in Reusable Launch Vehicle in India: Present and Future. Overview of Re-entry vehicles and Manned missions - Shuttle components - Orbiter Vehicle (OV), a pair of recoverable solid rocket boosters (SRBs)- expendable external tank (ET) – Space shuttle disasters: A case study.

Text Book:

1. Anderson, D. F. and Eberhardt, S., "Understanding Flight", 2nd Edition, McGraw-Hill, 2009.
2. Turner, M. J. L., "Rocket and Spacecraft Propulsion: Principles, Practice and New Developments", 3rd Edition, Springer, 2009.

Reference Book:

1. Anderson, J. D., "Introduction to Flight", 7th Edition, McGraw-Hill, 2011.
2. Megson, T. H. G., "Aircraft Structures for Engineering Students", 4th Edition, Butterworth-Hein-emann, 2007.
3. Riccardo Niccoli, "History of Flight-From Leonardo's Flying Machine to the conquest of space", Whitestar Publishers, 2013.
4. Stephen. A. Brandt, Introduction to Aeronautics: A design perspective, 2nd Edition, AIAA Education Series, 2012.

Extensive Reading:

- https://www.isro.gov.in/
- https://www.nasa.gov/
- https://www.spacex.com/
- https://nptel.ac.in/

23MEA16 FUNDAMENTALS OF NANOMATERIALS

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Fundamental aspects of nanomaterials
- Various synthetic methods of nanomaterials
- Different characterization techniques used for nanomaterials
- Applications of nanomaterials in different fields

Course Outcome:

At the end of the course, the students will be able to

- Gain knowledge on the fundamentals of nano science
- Synthesize of nanomaterials
- Characterize the nanomaterials
- Acquire knowledge on different categories of recent nanomaterials
- Get exposure to the applications of nanomaterials in different fields

Unit I INTRODUCTION TO NANOMATERIALS 9

Background to nano technology - scientific revolutions - basic principles of nano scale materials - Comparison with bulk materials - Classification confined to one, two and three dimensions - Properties of low dimensional systems - Fraction of surface atoms, surface area and aspect ratio - Enhanced catalytic, optical and mechanical properties compared to bulk materials

Unit II SYNTHESIS OF NANOMATERIALS 9

Bottom-up Synthesis: Physical vapour deposition, Chemical vapour deposition, Molecular Beam Epitaxy, Chemical precipitation and co-precipitation, colloidal and sol gel methods, gel combustion – Template methods – Self-assembly - Top-down Approach: Mechanical milling, Dry etching and Lithography

Unit III CHARACTERIZATION OF NANOMATERIALS 9

X-ray diffraction – UV-Vis. Spectroscopy (Ag and Au system) - FTIR Spectroscopy (Metal oxides) - Energy Dispersive X ray Analysis – X-ray Photo Electron Spectroscopy - Raman spectroscopy (CNT and Graphene) – Luminescence: Photoluminescence and Electroluminescence.

Unit IV RECENT NANO MATERIALS 9

Functional materials - Carbon based nanomaterials: Structure and properties of Fullerenes, CNT and Graphene – Electroactive Polymers – Thermo, Photo and Electro Chromic materials – Luminescent materials: Photoluminescence and Electroluminescence materials – Ferro fluid – Superhydrophobic materials – Dendrimers.

Unit V APPLICATIONS OF NANOMATERIALS 9

Display devices: Field emission - Chemical and biological sensors -Solar energy conversion – Catalysis and Photo catalysis- Smart sunglasses - Molecular sieves – Graphene in water purification – Nano coatings: Corrosion resistant and Self- cleaning – Drug delivery – Hyper thermia - Swim-suits with sharkskin effect.

Text Book:

1. Charles P. Poole, Jr., Frank J. Owens, “Introduction to Nanotechnology”, John Wiley and Sons Publishers, 2013 Reprint.
2. B.S. Murty, P. Shankar, Baldev Raj, B.B. Rath, James Murday, Textbook of Nanoscience and Nanotechnology, Springer Science & Business Media, 2013.
3. G. Cao, Nanostructures & Nanomaterials: Synthesis, Properties & Applications, Imperial College Press, 2011.

Reference Book:

1. Jeremy Ramsden, An Introduction to Nanotechnology, 2nd edition, William Andrew, 2016.
2. Wesley C. Sanders, Basic Principles of Nanotechnology, CRC Press; 1st edition, 2018.
3. Douglas Natelson, Nanostructures and Nanotechnology, Cambridge University Press, 2015.

23MEA17 FUNDAMENTALS OF THERMAL SCIENCE

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Different concepts of thermodynamics and heat transfer

Course Outcome:

At the end of the course, the students will be able to

- Understand the basic concepts of thermodynamics.
- Acquire knowledge about the power plants.
- Know the applications of psychrometry.
- Understand the basic concepts of Refrigeration and Air conditioning.
- Understand the basic concepts of heat transfer.

Unit I INTRODUCTION TO THERMODYNAMICS 9

Basic Concepts: System, Control Volume, Surrounding, Boundaries, Universe, Types of Systems, Thermodynamic Equilibrium, Property, Process, Cycle – Reversibility – Quasi-static Process, Irreversible Process, Types, Work and Heat, Point and Path function, Concept of quality of Temperature, Principles of Thermometry, Steady Flow Energy Equation, Limitations of First Law of Thermodynamics, Second law of Thermodynamics, entropy (Elementary treatment only).

Unit II POWER PLANTS 9

Introduction to thermodynamic cycles (Elementary treatment only), Steam, Hydel, Diesel, Tidal, Geothermal, Wind, Nuclear, Gas Turbine and Solar power plants, Ocean Thermal Energy Conversion -schematic and working.

Unit III PSYCHROMETRY 9

Properties of air-water vapour mixtures: Dry Bulb Temperature, Wet Bulb Temperature, Relative Humidity, dew point temperature, degree of saturation, thermodynamic wet bulb temperature, enthalpy of moist air, sensible heating and cooling, Adiabatic humidification and dehumidification, By-pass factor, Cooling load calculations using psychrometric table and chart.

Unit IV REFRIGERATION AND AIRCONDITIONING (ELEMENTARY TREATMENT ONLY) 9

Vapour compression refrigeration cycle- super heat, sub cooling – working principle of vapour absorption system, Comparison between vapour compression and absorption systems - Simple designs of air conditioning system- summer, winter and Year round air conditioning systems.

Unit V PRINCIPLES OF HEAT TRANSFER 9

Conduction -– Fourier Law of Conduction – Convection - Forced Convection - Free Convection – Boiling – Pool Boiling and Flow boiling – Condensation - Heat exchangers- Types - Laws of Radiation – Stefan Boltzmann Law, Kirchhoff's Law –Wien's displacement law - Black Body Radiation– Introduction to Gas Radiation – Greenhouse effects

(Use of standard thermodynamic tables, Mollier diagram, Psychrometric chart and Refrigerant property tables are permitted)

Text Book:

1. R.S.Khurmi ,"A Textbook of Thermal Engineering", S Chand publisher; (2022)
2. Yunus A. Cengel, "Fundamentals of Thermal-Fluid Sciences", McGraw-Hill College; 5th edition (2017)

Reference Book:

1. Nag.P.K, "Engineering Thermodynamics", Tata McGraw-Hill, 5th Edition, New Delhi, 2017.
2. Nag P. K, "Power Plant Engineering", Tata McGraw- Hill, 4th Edition, 2017.
3. Rajput. R. K., "Thermal Engineering", Laxmi Publications, eleventh edition, 2020.
4. Cengel, "Thermodynamics – An Engineering Approach" TataMcGraw Hill, New Delhi, 8th Edition, 2017.
5. EI-Wakil M.M, "Power Plant Technology", Tata McGraw-Hill 2017.
6. Sarkar, B.K, "Thermal Engineering", Tata McGraw-Hill Publishers, 2017.
7. Kothandaraman.C.P, Domkundwar.S, Domkundwar. A.V., "A course in thermal engineering", Dhanpat Rai & sons, 5th Edition, 2016.

23MEA18 PROPELLANTS, EXPLOSIVES AND PYROTECHNICS

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study about the process of conversion of the high energy released by materials due to decomposition into useful work.
- This course deals with the study of the application of the released energy into different categories like explosives, propellant and pyrotechnics.
- To understand the background aspects of the different products of explosives, pyro techniques and propellant by any engineering student.

Course Outcome:

At the end of the course, the students will be able to

- Understand the classification and properties of explosives
- Understand the basic characteristics of Propellants.
- Understand the different ingredients of Propellants
- Know about the basic composition of pyrotechnics.
- Understand the various processing techniques and tests of explosives in an ethical manner.

Unit I TYPES AND PROPERTIES OF EXPLOSIVE 9

High energetic material – Definition – Classifications – Non permitted explosives- compatibility and stability – Properties of explosives – Applications – High performance explosives, TNT, Nitro glycerine, dynamite, nitrocellulose, Lead azide, mercury fulminate, High melting explosives, heat resistant explosives, Binders and plasticizers.

Unit II PROPELLANTS 9

Classification – Performances - Gun propellant –Force constant, burning rate, thrust and specific impulse, Formulation and ingredients. Liquid gun propellant Hydroxyl ammonium nitrate and DMAZ. Solid and liquid propellants, rocket propellants - High energy propellants

Unit III INGREDIENTS OF PROPELLANTS 9

Functions, characteristics and types of Binders, stabilisers, Plasticizers, modifiers, inhibitors. Testing, materials of ingredients – recent trends, novel systems. Insulators – characteristics, materials and process for insulation.

Unit IV PYROTECHNICS 9

Pyrotechnics – General features - Ingredients of Pyrotechnic Formulations – Fuel, Oxidizers, Binders, Coolants, Retardants, Dyes, Colour Intensifiers, Moderators – Characteristics- Pyrotechnic formulations - Illuminating formulations - Delay formulations - Smoke formulations - Incendiary formulations, Green Pyrotechnics, performance assessments.

Unit V PROCESSING TECHNIQUES FOR EXPLOSIVES AND TESTS 9

Extrusion - Casting types– Normal, Sedimentation, squeeze casting, Pressing – Unidirectional, Double Action, Incremental, Hydrostatic, Iso-static pressing – Vacuum stability test – Heat test – Impact sensitivity test – Friction sensitivity test, electric spark sensitivity and shock sensitivity, Determination of detonation velocity.

Course Pre-requisites:

- Materials: Inorganic materials, Ferrous and Non-ferrous materials.
- Organic materials, Polymers.
- Fundamentals of Combustion.
- Chemistry of burning.
- Hazardous materials.

Text Book:

1. “High Energy Materials – Propellants, Explosives and Pyrotechnics” Jai Prakash Agarwal, Wiley-VCH Verlag GmbH & Co. KGaA, Weinheim, 2010.

Reference Book:

1. "High Energy Oxidisers for Advanced Solid Propellants and Explosives - Advances in Solid Propellant Technology”, First International HEMSI Workshop, Ranchi, India, 2002.
2. “The Chemistry of Powder and Explosives”, Davis, Tenney L., Journal of chemical education, 1941 vol.18, issue 10, Page no. 500 – Open source downloadable
3. (http://www.gunshoplosangeles.com/Pyrotechnic/Pyrotechnic_Books/Tenney_L._Davis_Chemistry_of_Powder_and_Explosives_Ocr.pdf).

23MEA19 FUELS AND EMISSIONS

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The different types of fuels, availability and its properties.
- The basic theory, principles and measurements behind the the usage of fuels for various applications and their emission characteristics.

Course Outcome:

At the end of the course, the students will be able to

- Know the availability of resources and study the properties of various fuel.
- Understand the handling and usage of CNG and LPG for commercial application and study its performance.
- Knowledge on alternate source of energy from hydrogen and fuel cells.
- Using basic knowledge on emission form spark and compression ignition engines.
- Address complex problems with measuring emissions and procedures associated with measurements.

Unit I INTRODUCTION **9**

Estimate of petroleum reserve, need for alternate fuel, availability and comparative properties of alternate fuels, CNG, LPG, Alcohol, Vegetable oil and Bio-gas

Unit II CNG AND LPG **9**

Availability, properties, modifications required in SI and CI engines, performance and emission characteristics, storage, handling and dispensing, safety aspects. Alcohol - Manufacture of alcohol, properties, blending of Methanol and Ethanol, engine design modifications required and effects of design parameters, performance and emission characteristics, durability. Types of vegetable oils for engine application, esterification, biogas, properties, engine performance and emission characteristics.

Unit III HYDROGEN AND FUEL CELLS **9**

Production methods, properties, performance and emission characteristics, storage and handling, safety aspects, Working principle, classification, description of fuel cell systems, fuel cell components, properties of fuel cell, general performance characteristics, emission characteristics, merits and demerits, vehicle design and layout aspects.

Unit IV EMISSIONS FROM SI & CI ENGINES AND ITS CONTROL **9**

Emission formation in S.I. engines – Hydrocarbons – Carbonmonoxide – Nitric Oxide, Lead particulates – Polynuclear aromatic hydro carbon emission – Effects of design and operating variables on emission formation in spark ignition engines – Controlling of pollutant formation in engines –Thermal reactors – Catalytic converters – Charcoal Canister Control for evaporative emission – Positive crank case ventilation system for UBHC emission reduction.

Chemical delay – Significance – Intermediate compound formation – Pollutant formation on incomplete combustion– effect of operating variables on pollutant formation – Controlling of emissions – Driving behavior – Fumigation –Exhaust gas recirculation – Air injection – Cetane number effect.

Unit V EMISSION MEASUREMENT AND TEST PROCEDURE **9**

Measurement of CO, CO2, by NDIR. Hydrocarbon by FID –Chemiluminescent detector for NOx measurement, Smoke meters – Dilution tunnel technique for particulate measurement. Procedures on Engine and Chassis

Constant Volume Sampling procedures –Emission Test– Sampling probes and valves – Quantifying emissions – Dynamometers

Text Book:

1. Ganesan.V, Internal Combustion Engines, Tata McGraw Hill, 2017

Reference Book:

1. Crouse.W.M, Anglin.A.L., Automotive Emission Control, McGraw Hill, 1995.
2. Patterson, D.J, Henin.N.A, Emissions from Combustion engines and their Control, Anna Arbor Science, 1985.
3. Linden.D, Handbook of Batteries and Fuel Cells, McGraw Hill, 1995.

23MEA20 MODELING AND ANALYSIS OF ADVANCED MANUFACTURING SYSTEM

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Acquire the basic knowledge in manufacturing system.
- Understand the various phases involved in the implementations of six-sigma.
- Understand how lean management today represents a profound change in the competitive business culture and a leading indicator of excellence in the organization.
- Understand the tools required for Lean six-sigma and material handling devices.
- Understand how by implementing lean management organizations can improve product & processes without adding any more money, people, equipment, inventory or space and aim for perfection.

Course Outcome:

At the end of the course, the students will be able to

- Develop a comprehensive set of skills that will allow students to function effectively by using manufacturing system and design.
- Understand issues & challenges in implementing & developing facility layout & its contribution for improving organizational performance.
- Apply material handling and storage to bring competitive business culture for improving organization performance.
- Analyse how lean techniques can be applied to manufacturing & service industry.
- Analyse how the queuing networks can create value for an organization.

Unit I MANUFACTURING SYSTEMS AND DESIGN 9

Types and principles of manufacturing systems, types and uses of manufacturing models, physical models, mathematical models, model uses, model building; Assembly lines - reliable serial systems; Approaches to line balancing – largest candidate rule, Kilbridge and Wester method, ranked positional weight heuristic, COMSOAL, sequencing mixed models; Transfer lines and general serial systems – paced lines with and without buffers, unpaced lines.

Unit II FACILITY LAYOUT AND FLEXIBLE MANUFACTURING SYSTEMS 9

Types of layout, advantages, limitations, systematic layout planning, layout design procedures - quadratic assignments approach, graph theoretic approach; Robotics and automated assembly; Cellular systems -Group technology, coding schemes, assigning machines to groups, production flow analysis, binary ordering algorithm, single pass heuristic, similarity coefficient method; System components – planning and control hierarchy, system design, system setup, scheduling and control – flow shop scheduling, job shop scheduling; Flexible inspection system.

Unit III MATERIAL HANDLING AND STORAGE 9

Material handling principles, equipment's, conveyor analysis, AGV systems; Warehousing – warehouse components, analysis of storage and retrieval systems, carousal storage systems; Introduction to material handling and storage software.

Unit IV THE TOOLS FOR LEAN SIX- SIGMA 9

Define tools- Project Definition Form(PDF) and SIPOC; Measure tools- Process mapping, Parato chart, cause and effect matrix, FMEA, Brain-storming, NGT, Multi-voting, Cause & Effect diagram, Check sheets, Gauge R&R, Run charts, Control charts and process capability analysis; Analyze tools- scatter plots, ANOVA, Regression analysis and time trap analysis; Improve tools- Mistake proofing, KAIZEN, Reducing congestions and delays, SMED, TPM, Design of Experiments and the pull system; Control tools-SPC.

Unit V GENERIC MODELING APPROACHES 9

Queuing models – notations, performance measures, m/m/1 queue, m/m/m queue, batch arrival queuing systems, queues with breakdowns; Queuing networks – open and closed networks, central server model; Petri net modeling - classical petrinets, transformation firing and reachability, reachability graphs, representation schemes, timed Pertinets, modeling of manufacturing systems.

Text Book:

1. Mikell P. Groover, "Automation, Production Systems, and Computer-Integrated Manufacturing", Pearson Education India, 2016.
2. Ronald G Askin, "Modelling and Analysis of Manufacturing Systems", John Wiley and Sons, Inc, 1993.

Reference Book:

1. Mengchu Zhou, "Modelling, Simulation and Control of Flexible Manufacturing Systems: A Petri Net Approach", World Scientific Publishing Company Pvt. Ltd., 2000.
2. Ronald G.Askin and Jeffrey B.Goldberg, Design and Analysis of Lean Production Systems, Wiley; 1 edition, 2007.
3. Jean Marie Proth and XiaolanXie, "Petri Nets: A Tool for Design and Management of Manufacturing Systems", John Wiley and Sons, New York, 1996.

4. Viswanatham N and Narahari Y “Performance Modeling of Automated Manufacturing Systems”, Prentice Hall Inc., 1992.

23MEA21 FACILITIES LOCATION AND DESIGN

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Acquire the basic knowledge in single and multi-facility system
- Understand the various phases involved in the implementations of floor layout.
- Understand how material handling devices are handled in the industry.
- Understand flow and activity relationship takes place in an organization.
- Understand how by implementing lean management organizations can improve product & processes without adding any more money, people, equipment, inventory or space and aim for perfection

Course Outcome:

At the end of the course, the students will be able to

- Develop a comprehensive set of skills that will allow students to function effectively by using manufacturing system and design.
- Understand issues & challenges in implementing & developing floor layout & its contribution for improving organizational performance.
- Apply material handling and storage to bring competitive business culture for improving organization performance
- Analyse how flow, space and activity relationship can be applied to manufacturing & service industry.
- Analyse how the SLP procedure can create value for an organization.

Unit I SINGLE AND MULTI FACILITY LOCATION **9**

Introduction, nature of facilities location problem, distance measures in location problems, relevant costs, types of single facility location problem - straight line distance problem, rectangular distance problem, lp distance problem; Variants of single facility location problems: Points and area destinations with rectangular distance, location of a linear facility, probabilistic destination locations; multi-facility location: rectangular and lp distance models.

Unit II FLOOR LAYOUT **9**

Quadratic assignment problem, Branch and bound technique, heuristic procedures, the Hall m-dimensional quadratic placement algorithm.

Unit III MATERIAL HANDLING AND STORAGE **9**

Material handling principles, equipment's, conveyor analysis, AGV systems; Warehousing – warehouse components, analysis of storage and retrieval systems, carousal storage systems; Introduction to material handling and storage software.

Unit IV FLOW, SPACE AND ACTIVITY RELATIONSHIP **9**

Departmental planning, flow patterns and measurement, space requirements

Unit V LAYOUT PLANNING MODELS **9**

Design cycle – SLP procedure, computerized layout planning procedure – ALDEP, CORELAP, and CRAFT.

Text Book:

1. Tompkins, White, Bozer and Tanchoco, "Facilities planning", John Wiley, Fourth Edition, 2010.

Reference Book:

1. Richard Francis. L. and John A.White, "Facilities Layout and location – an analytical approach", PHI., 2002.
2. Ronald G.Askin and Jeffrey B.Goldberg, Design and Analysis of Lean Production Systems, Wiley; 1 edition, 2007.
3. Robert F Love, James G Morris and George O Wesolowsky," Facilities Location – Models and Methods", Elsevier, 1988.
4. James Apple, M. "Plant layout and Material Handling", John Wiley, 1977.

23MEA22 CONCEPTS IN DESIGN

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Impart knowledge on various concepts in engineering design, material selection and manufacturing methods.
- Learn the principles of implementing quality in a product or services using different tools.
- Enhance the quality of product by use of failure mode effect analysis and implement methods to uphold the status of six sigma.

Course Outcome:

At the end of the course, the students will be able to

- Understand fundamentals of design process and material selection for developing a quality product.
- Apply the quality concepts to develop a robust product.
- Perform Failure Mode Effect Analysis on a product
- Utilise different experimental design methods in product development
- Implement six sigma principles to enhance product quality

Unit I DESIGN FUNDAMENTALS **9**

Morphology of Design – The Design Process – Computer Aided Engineering – Concurrent Engineering – Competition Bench Marking – Creativity – Theory of Problem solving (TRIZ) – Value Analysis - Design for Manufacture, Design for Assembly

Unit II DESIGN FOR QUALITY **9**

Quality Function Deployment -House of Quality-Objectives and functions-Targets Stakeholders- Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design – testing noise factors- Running the experiments – Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

Unit III FAILURE MODE EFFECTS ANALYSIS AND DESIGN FOR SIX SIGMA **9**

Basic methods: Refining geometry and layout, general process of product embodiment- Embodiment checklist-Advanced methods: systems modeling, mechanical embodiment principles-FMEA method- linking fault states to systems modeling-Case study- computer monitor stand for a docking station. Basis of SIX SIGMA –Project selection for SIX SIGMA- SIX SIGMA problem solving- SIX SIGMA in service and small organizations - SIX SIGMA and lean production – Lean SIX SIGMA and services

Unit IV DESIGN OF EXPERIMENTS **9**

Design of experiments-Basic methods- Two factorial experiments-Extended method reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design-Statistical analysis of experiments: Degree of freedom, correlation coefficient, standard error of the residual t-test, ANOVA-ratio test, other indicators-residual plots, Advanced DOE method for product testing- Product applications of physical modeling and DOE, Blender panel display evaluation, coffee grinder experimental optimization-Taguchi method.

Unit V STATISTICAL CONSIDERATION AND RELIABILITY **9**

Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter diagrams –Multivariable charts – Matrix plots and 3-D plots -Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distribution.

Text Book:

1. Amitava Mitra,“Fundamentals of Quality control and improvement”, John Wiley & Sons, 2016.
2. Kevin N. Otto and Kristin L. Wood, “Product Design: Techniques in Reverse Engineering and New Product Development”, Prentice Hall, 2001.

Reference Book:

1. George E. Dieter, Linda C. Schmidt, “Engineering Design”, McGraw Hill Education Pvt. Ltd., 2013.
2. Karl T. Ulrich, Steven D. Eppinger, “Product Design And Development, Tata Mcgraw -Hill Education, 2015.
3. James R. Evans, William M. Lindsay, “An Introduction to Six Sigma and Process Improvement” Cengage Learning; 2nd edition, 2014.
4. Montgomery, D.C., “Design and Analysis of experiments”, John Wiley and Sons, 2017.
5. Phillip J. Ross, “Taguchi techniques for quality engineering”, Tata McGraw Hill, 2005.

23MEA23 APPLICATIONS OF NANOFLUID

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Apply the nanotechnology in the area of fluids.
- Demonstrate about the superior thermos physical properties of nano fluids.
- Show through analytical and numerical analyses of nano fluids in comparison with conventional fluids.
- Research on modern mini and microchannel heat exchangers with nanofluids exhibiting much higher thermal efficiency and saving energy.
- Study the effect of Nanofluids in Refrigeration and Air Conditioning systems.

Course Outcome:

At the end of the course, the students will be able to

- Apply the knowledge of nanotechnology in fluids and thermal engineering.
- Design a system, component, or process to meet desired needs using nano fluids in R&AC.
- Effect and applications of nano fluid in automobiles.
- Have the capability to carry out nano fluid based research project in heat exchangers.
- Identify the nano fluids recommended in various instruments.

Unit I INTRODUCTION TO NANO FLUIDS 10

Nanomaterial – Methods of synthesis – Synthesis of Nano fluids- single step methods- two step method stability – Sonication- Colloidal stability - Electrical double layer- stabilization methods – steric stabilization - electrostatic stabilization – Surfactants- Types of surfactants – DLVO Theory- Methods of stability measurement - Dynamic light scattering system – Zeta potential – Acoustic Attenuation spectroscopy - Properties of nano fluids- thermal conductivity –viscosity – specific heat – Maxwell's relations- thermal conductivity models- wetting characteristics. Microscale Fluidic Applications.

Unit II APPLICATION IN REFRIGERATION AND AIR CONDITIONING 10

Application of nanofluids in refrigeration and air conditioning - Magnetic nano particles - Rheological fluids - Ferro fluids. Application of nanofluids in Lubricants – Types of lubricants – properties- Nano lubricant additives –solid lubricant additives – lamellar structure – synthesis and characterization - MoS2/WS2/graphene nanoparticles- Synthesis methods - Hydraulic assisted exfoliation – Friction and wear measurements – pin on disc –four ball tester. CO2 sequestration – absorption media – absorption mechanisms.

Unit III APPLICATION IN AUTOMOBILES 10

Fuels – properties - Nano fuel additives – catalytic nano particles – synthesis and characterization - cerium – defects - cerium based mixed oxide nanoparticles – oxygen storage capacity –diesel engine exhaust emissions HC, CO, NOx, CO2, smoke - Diesel particulate filter -DPF regeneration, – Alumina in combustion process- Nanoparticle counters. Heterogeneous catalyst for trans esterification of biodiesel- Copper-oxide and Aluminum-oxide brake nanofluid- Electronics applications- Bio medical applications.

Unit IV APPLICATION IN HEAT EXCHANGERS 7

Active and passive methods of enhancing heat transfer – Nanofluid – Heat exchangers – Nanofluid Coolant Modified surfaces – Surface wetting - Flow stability in thermosyphon loops

Unit V APPLICATIONS IN VARIOUS INSTRUMENTS 8

Non-intrusive measurements– electric and magnetic field - acoustic waves; Nano encapsulated phase change material- boiling and condensation; Solar-Thermal Energy Collectors - Optical properties of nanofluids – Calorimetry.

Text Book:

1. Nanofluids: Science and Technology, Sarit K. Das, Stephen U. Choi, Wenhua Yu, T. Pradeep, Wiley, 2007.

Reference Book:

1. Heat Transfer Enhancement with Nanofluids, Vincenzo Bianco, OronzioManca, Sergio Nardini, KambizVafai, CRC Press, 2017.
2. Thermal Energy Storage Using Phase Change Materials: Fundamentals and Applications, Amy S. Fleischer, Springer, 2015.
3. Applications of Nanofluid for Heat Transfer Enhancement, Mohsen Sheikholeslami and Davood Domairry Ganji, Elsevier, 2017.
4. Nanofluids: Synthesis, Properties and Applications, S M SohelMurshed, Carlos Nieto de Castro, Nova Science Publishers, 2014.

23MEA24 ENERGY ANALYSIS OF INDUSTRIAL SYSTEMS

Offered by MECH (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT)

L	T	P	C
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Course Objective:

To impart knowledge on

- Energy management in real industrial systems

Course Outcome:

At the end of the course, the students will be able to

- Identify the demand supply gap of energy in Indian scenario
- Carry out energy analysis of factories
- Carry out energy analysis of buildings and transportation systems
- Understand energy management concepts
- Understand the concepts of energy audit

Unit I INTRODUCTION TO GLOBAL ENERGY SCENARIO 8

Global Energy Requirements, Depletion of Conventional Energy Resources, Availability of Non-conventional Energy Sources, The Evolution of Electric Power, Energy costs, Energy analysis and thermodynamics – Thermodynamic laws, Rankine cycle and Carnot cycle.

Unit II ENERGY ANALYSIS OF FACTORIES 9

Process system optimization, Electrical system optimization – Load management, conduction loss, Switching loss, Magnetic loss, Harmonics compensation, Motor control and Lighting energy savings; Cogeneration, HVAC systems – Heat recovery.

Unit III ENERGY ANALYSIS OF BUILDINGS AND TRANSPORTATION SYSTEMS 10

Energy Consumption in Buildings, Construction Cost vs Life Cycle Cost, Building Design—Walls and Roof, Water Supply Systems, Lighting Systems, Building Data Loggers.

Energy Conservation in Transportation - Pattern of Energy Consumption, Emission Targets for Transportation; New Technologies, Progress in Clean Diesel Technology.

Unit IV ENERGY MANAGEMENT 8

Energy planning, Energy staffing, Energy costing, Energy monitoring, Environment Pollution due to Energy use, Evaluation of Alternative Energy Sources, Saving Energy and Implementation of Energy Conservation, Need for Energy Management Programme, Agenda for Organization Structure.

Unit V ENERGY AUDIT 10

Energy audit – types and categories, Ventilation Audit, Measuring and Detection Instruments for Energy Survey, Scope of Energy Audit, Energy Accounting and Analysis, Energy efficiency, Impacts on energy consumption, Life cycle costing, Energy conservation actions, Energy Management in Deregulated Environment, Energy Pricing, Measures for energy conservation

Text Book:

1. Chakrabarti, Amlan, "Energy Engineering and Management", PHI Learning Private Limited, 2nd edition, 2019

Reference Book:

1. Rajan G.G., "Energy Efficiency Optimization", Productivity & Quality Publishing private Ltd, 2019
2. Meenu Agrawal, "Energy Conservation & Energy Security in India", Kunal Books, 2012
3. Smith C.B., "Energy Management Principles", Pergamon Press, 2nd edition, 2015

23UBA01 ESSENTIALS OF ACCOUNTING AND FINANCE

Offered by MBA (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To develop an understanding of business related finance.
- To have an understanding of finance in order to contribute to the organization's success.
- To improve the financial skills in order to make critical business decisions involving budgets, cost savings and growth strategies

Course Outcome:

At the end of the course, the students will be able to

- understand Goals and Functions of Finance
- make decision on budgeting and investment
- understand about the various Sources of funds
- interpret financial statements
- Understand the financial system of india

Unit I INTRODUCTION TO FINANCE **9**

Role for Finance for Individual and Organization – Goals and Functions of Finance - Time Value of Money – Significance

Unit II FINANCIAL PLANNING AND DECISIONS **9**

Financial Planning – Decisions – Investment Decision – Financing Decision - Dividend Decision - Evaluation of Investment Projects and Financing – Working Capital

Unit III FUNDS MANAGEMENT **9**

Funds Mobilization – Sources – Internal and external

Unit IV FINANCIAL STATEMENTS **9**

Financial Statements - Balance Sheet – PL account - Cash/Fund Flow - Analysis

Unit V OVERVIEW OF INDIAN FINANCIAL MARKETS **9**

Financial System – Bank and Financial Institutions – Capital Market - Money Market

Text Book:

1. I. M. Pandey, "Financial Management", (10th ed.), Vikas Publishing House Pvt. Ltd., 2013.

Reference Book:

1. Prasanna Chandra, "Financial Management", (7th ed.), Tata McGraw Hill, 2008.
2. Khan M Y and Jain P K, "Financial Management", (6th ed.), McGraw Hill, 2013.

23UBA02 ESSENTIALS OF HUMAN RESOURCE MANAGEMENT

Offered by MBA (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To make the participant understand the role of HR Department in an organization
- To know the various functional areas of HRM
- To understand the recent developments in HR

Course Outcome:

At the end of the course, the students will be able to

- Understand the basic concepts in HRM
- Aware of human resource requirement for an organization
- Aware of the ways for developing the skills and knowledge of the employees
- Understand the motivation model in an organization
- Aware of present development in HR

Unit I INTRODUCTION **9**

Introduction to HRM – Meaning, Importance and Objectives, History of Managing Human Resources, Environment of HR. Functions and Roles of HR Manager

Unit II PROCUREMENT OF HUMAN RESOURCES **9**

Job Analysis – Meaning, Process and Methods, Human Resource Planning – Importance, Process, HR Demand and Supply Forecasting Techniques. Recruitment – Importance, Recruitment Sources, Selection – Process Socialization / Induction – Importance and Types

Unit III DEVELOPMENT / TRAINING **9**

Training – Purpose, Process – Need Identification, On-the-Job Methods and Off-the-Job Methods. Executive Development Programmes – Difference from training. Performance Appraisal – Process, Techniques – MBO and 360 Degree Feedback. Job Changes - Promotion, Demotion and Transfer

Unit IV COMPENSATION AND MOTIVATION **9**

Job Evaluation – Meaning, Process, Compensation Plan – Deciding factors & Framing Process. Human Needs – Motivation Theories – Maslow's Need theory and Herzberg's two factor theory, Applications – Rewards and Reinforcement. Grievances – Causes and Redressal methods. Disciplinary Action – Nature and Types

Unit V MAINTENANCE AND SEPARATION **9**

The Factories Act, 1948 – Health, Safety and Welfare Provisions. The Industrial Employment (Standing Orders) Act, 1946 – Framing Standing Order. Separation – Retirement, Layoff, Out-placement & Discharge. Latest trends in HRM - HRIS – Meaning and Implementation Process. E-HRM.

Text Book:

1. Arun Monappa, "Managing Human Resources", (1st ed.), Trinity Press Publications, 2014.
2. Dessler, "Human Resource Management", (12th ed.), Pearson Education Limited, 2011.

Reference Book:

1. Aswathappa K., "Human Resource Management", (7th ed.), Tata McGraw Hill, New Delhi, 2013.
2. Decenzo and Robbins, "Human Resource Management", (10th ed.), Wiley, 2010.
3. Mamoria C.B & Mamoria S., "Personnel Management", Himalaya Publishing Co., 2010.
4. Eugence Mckenna & Nic Beach, "Human Resource Mgmt", (2nd ed.), Pearson Education Ltd, 2008.
5. Wayne Cascio, "Managing Human Resource", (9th ed.), Tata McGraw Hill, 2012.
6. Ivancevich, "Human Resource Management", (12th ed.), Tata McGraw Hill, New Delhi, 2012.

23UBA03 ESSENTIALS OF MARKETING

Offered by MBA (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basics of Marketing Management as a functional area of an organisation.
- To understand the basic elements that makes up the marketing function.
- To understanding the functions of a marketing department.
- To understand the importance of marketing to an organisation.

Course Outcome:

At the end of the course, the students will be able to

- Describe a Marketing Department and the functions of a marketing department.
- Choose and understand the needs of the customers.
- Combine the four Ps of marketing to design a marketing model
- Have a basic ideas on how a market segmented and customers are targeted.
- Have a basic understanding on the elements of the marketing mix

Unit I UNDERSTANDING MARKETING MANAGEMENT – AN OVERVIEW 9

Introduction, Marketing department functions, Selling vs Marketing, Marketing concepts (Marketers and Prospects, Needs, Wants, and Demands, Value and Satisfaction), Basics of Market segmentation, Target markets and Positioning.

Unit II THE MARKETING MIX ELEMENT – PRODUCT 9

Introduction, Characteristics of the product life cycle and their marketing implications, Facets of the PLC, New product development, The market diffusion process, Organizing for new product development

Unit III THE MARKETING MIX ELEMENT – PRICE 9

Introduction, Price and the marketing mix, Pricing objectives, Factors affecting pricing decisions, Setting a price, Pricing industrial goods, Pricing and information technology

Unit IV THE MARKETING MIX ELEMENT – PROMOTION 9

Communications contact techniques (Promotion mix) - Advertising, Direct marketing, Sales promotion, Personal selling, Sponsorship, Publicity

Unit V THE MARKETING MIX ELEMENT – PLACE: CHANNELS OF DISTRIBUTION 9

Introduction, Intermediaries in channels of distribution - Sales agents, Distributors, Wholesalers, Retailers, Franchising, Internet marketing

Text Book:

1. Marilyn A. Stone, John Desmond, “Fundamentals of Marketing” (Special Indian Edition), Routledge, Taylor & Francis Group, 2014.

Reference Book:

1. William J. Stanton, Michael J. Etzel, Bruce J. Walter, “Fundamentals of Marketing”, (10th ed.), TMH, 1994.
2. Philip Kotler, “Marketing Management: A South Asian Perspective”, (14th ed.), Pearson India, 2012.

23UBA04 ESSENTIALS OF ENTREPRENEURSHIP

Offered by MBA (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Students should understand the nuances of being an entrepreneur and develop a confidence for entrepreneurship.

Course Outcome:

At the end of the course, the students will be able to

- Appreciate the rationale of entrepreneurship
- Develop skills for initiating entrepreneurship
- Deal with the procedural aspects of entrepreneurship
- Identify the financial support available for entrepreneurs
- Identify the institutional support available for entrepreneurs

Unit I INTRODUCTION TO ENTREPRENEURSHIP 9

Evolution of the Concept of Entrepreneur, Characteristics of an Entrepreneur, Distinction between an Entrepreneur and a Manager, Functions of an Entrepreneur, Types of Entrepreneur , Intrapreneur

Concept of Entrepreneurship, Growth of Entrepreneurship in India, Role of Entrepreneurship in Economic Development.

Concept of Women Entrepreneurs , Functions, Growth and Problems of Women Entrepreneurs, Development of Women Entrepreneurship - Recent Trends

Unit II FACTORS AFFECTING ENTREPRENEURIAL GROWTH 9

Economic Factors, Non-Economic Factors, Government Actions

Motivation, Motivating Factors, Achievement Theory

Meaning of Entrepreneurial Competency or Trait, Major Entrepreneurial Competencies, Developing Competencies

Factors Influencing Mobility, Occupational Mobility, Locational Mobility

Unit III BUSINESS START-UP 9

Meaning of Project, Project Identification and Selection

Project formulation - Significance of Project Report, Contents, Formulation of a Project Report, Planning Commission's Guidelines, Specimen of a Project Report, Network Analysis, Common Errors.

Project appraisal - Concepts, Methods of Project Appraisal

Ownership Structures, Proprietorship, Partnership, Company, Co-operative, Selection of an Appropriate Form of Ownership Structure, Ownership Pattern in Small-Scale Enterprises in India

Unit IV FINANCIAL SUPPORT FOR ENTREPRENEURSHIP 9

Financing of enterprise, Need for Financial Planning, Sources of Finance, Capital Structure, Term-Loans, Sources of Short-Term Finance, Capitalisation, Venture Capital Export Finance

Institutional finance to Entrepreneurs - Commercial Banks, Industrial Developmental Banks - National Level and State level Banks – Banks for Large Industries and Small Industries. Universal Banking Concept.

Lease Financing and Hire-Purchase - Advantages of Leasing, Difference between Hire Purchase and Leasing, Procedure for Hire Purchase

Unit V INSTITUTIONAL SUPPORT FOR ENTREPRENEURSHIP 9

Need for Institutional Support, Institutional Support to Small Entrepreneurs: National Small Industries Corporation Ltd. (NSIC), Small Industries Development Organisation (SIDO), Small Scale Industries Board (SSIB), State Small Industries Development Corporations (SSICS), Small Industries Service Institutes (SISI), District Industries Centres (DICs), Industrial Estates, Specialised Institutions, Technical Consultancy Organisations (TCOs)

Taxation Benefits to Small-Scale Industry - Need for Tax Benefits, Tax Holiday, Depreciation, Rehabilitation and Investment Allowance, Expenditure on Scientific Research, Amortisation of Certain Preliminary Expenses, Tax Concessions to Small-Scale Industries in Rural Areas and Backward Areas

Government Policy for Small Scale Enterprises, Government Support to Small-Scale Enterprises during Five Year Plans.

Text Book:

1. S.S.Khanka, “Entrepreneurial Development”, S.Chand and Company Limited, New Delhi, 2012.
2. Hisrich, “Entrepreneurship”, (9th ed.), Tata McGraw Hill, New Delhi, 2012.

Reference Book:

1. Cynthia .L.Greene, “Entrepreneurship ideas in action”, (5th ed.), Thompson – Southwestern, 2012.
2. Donald.F.Kurato, “Entrepreneurship”, (8th ed.), Thompson – Southwestern, 2009.
3. HBR on “Entrepreneurship”.
4. Peter.F. Drucker, “Innovation and entrepreneurship”, Harper business, 1993.
5. K.Dennis Chambers, “The Entrepreneur’s guide to writing Business plans and proposals”, Macmillan, 2008.
6. Mathew Manimala, “Entrepreneurship Theory at the Crossroads”, Paradigms & Praxis, (2nd ed.), Biztrantra,

2005.
7. “Projects: Planning, Analysis, Selection, Financing, Implementation and Review”, (7th ed.), Prasanna Chandra, Tata McGraw - Hill Education, (2009).

23ECH01 SENSORS AND ACTUATORS

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand different types of sensors and actuators for different environments.
- To find the different measurements methods using sensors
- To design suitable sensors and actuators for engineering applications

Course Outcome:

At the end of the course, the students will be able to

- Analyze the Performance characteristics of Sensors, and Actuators
- Illustrate the concepts of Thermal sensors and actuators
- Illustrate the concept of Optical sensors and actuators
- Relate the concept of Electric and magnetic sensors and actuators
- Apply suitable sensors and actuators for engineering applications.

Unit I CLASSIFICATION AND PERFORMANCE CHARACTERISTICS OF SENSORS AND ACTUATORS 9

Classification of Sensors and Actuators - General Requirements for Interfacing - Units and Measures - Transfer function - Impedance and matching - Range, Span, Resolution, Accuracy, Errors, Repeatability, Sensitivity and Sensitivity analysis - Hysteresis , Nonlinearity and saturation - Frequency response, response time and bandwidth - Calibration - Excitation - Deadband - Reliability.

Unit II TEMPERATURE SENSORS AND THERMAL ACTUATORS 9

Thermo resistive Sensors: Thermistors, Resistance temperature sensors - Silicon resistive sensors - Thermoelectric Sensors - PN Junction Temperature Sensors - Optical and Acoustical Sensors - Thermo mechanical sensors and Actuators

Unit III OPTICAL SENSORS AND ACTUATORS 9

Optical Units and materials - Effects of Optical Radiation - Quantum-Based Optical Sensors - Photoelectric Sensors - Coupled Charge (CCD) Sensors and Detectors - Thermal-Based Optical Sensors - Active Far Infrared (AFIR) Sensors - Optical Actuators.

Unit IV ELECTRIC & MAGNETIC SENSORS AND ACTUATORS 9

The Electric Field: Capacitive Sensors and Actuators - Magnetic Fields: Inductive sensors and Hall effect sensors - Magneto hydrodynamic (MHD) Sensors and Actuators - Magnetometers - magnetic Actuators - Voltage and Current Sensors

Unit V PROGRAMMING OF IOT SENSORS AND ACTUATORS 9

Programming for IoT, Interfacing and Programming of IR Sensors, Ultrasonic Sensors, Temperature Sensors, Pressure Sensors. Interfacing and Programming of Actuators: LED, Seven Segment Display, Stepper Motor, DC Motor, Servo Motor.

Text Book:

1. Nathan Ida, “Sensors, Actuators and their Interfaces”, Institution of Engineering and Technology, 2020.
2. Patranabis D, “Sensor and Actuators”, Prentice Hall of India (Pvt) Ltd. 2003.

Reference Book:

1. Clarence W. de Silva, “Sensors and Actuators: Engineering System Instrumentation”, 2nd Edition, CRC Press, 2015
2. Ernest O. Doeblin, “Measurement system, Application and design”, Tata McGraw Hill Publishing Company Ltd., Fifth Edition, 2004
3. Bradley D.A., Dawson D, Burd N C, Loader A J,” Mechatronics: Electronics in products and processes”, CRC Press, 2018
4. Renganathan.S, “Transducer Engineering”, Allied Publishers (P) Ltd., 2003.
5. Bolton W.,” Mechatronics”, 7th edition, Pearson, 2018.

Extensive Reading:

- www.endnote.com/downloads/style/sensors-and-actuators
- www.iav.com/en/engineering/.../sensor-and-actuator-systems
- www.biophysics.org/2015naiwat
- https://www.postscapes.com/iot-sensors-actuators/
- https://swayam.gov.in/nd1_noc19_ee41

23ECH02 IOT ARCHITECTURE AND FRAMEWORK

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the concepts and perspectives of Internet of Things
- To apply the knowledge on IoT architecture and modules
- To design Internet of Things with Embedded systems using data analytics

Course Outcome:

At the end of the course, the students will be able to

- Determine the supporting technologies for design of IoT applications
- Apply the architecture and core modules for IoT applications
- Develop IoT applications using embedded systems
- Illustrate the necessary framework required for IoT application
- Apply data analytics for IoT applications

Unit I IOT CONCEPTS AND ENABLING TECHNOLOGIES 9

Introduction – Definition and Characteristics of IoT – Benefits of IoT –Physical design of IoT – Logical design of IoT – IoT Enabling Technologies–Resource Management – Resource Partitioning – Computation Offloading - Identification and Resource/Service Discovery – IoT Levels

Unit II IOT ARCHITECTURE AND ITS CORE MODULES 9

Reference architecture for IoT – SOA based & API oriented architecture – Four layer architecture – Seven Layer architecture – fog computing – Open stack cloud architecture – Gateways,Edge Devices, Data acquisition systems, Cloud services.

Unit III EMBEDDED PROTOTYPING OF IOT 9

Overview of Raspberry Pi – General-Purpose Input/Outputs – Sensors with Raspberry Pi – Actuators with Raspberry Pi –Web Server with Raspberry Pi – Raspberry Pi as a Database Server – ESP8266 WiFi Module – Block Diagram, Features, applications

Unit IV IOT FRAMEWORK & INDUSTRIAL IOT 9

IoT Value Chain – IoT Platforms – Cisco, Salesforce, Azure IoT, Eclipse IoT, Thingworx, GE Predix, AWS IoT, Watson IoT, Kaa – Introduction to Industrial Internet of Things & Industry 4.0 – IIoT Architecture – Applications and Challenges

Unit V DATA ANALYTICS & IOT CASE STUDIES 9

IoT Data Management – Analytics –ApacheHadoop–ProgrammingModel,JobExecution,Hadoop Cluster – Case Studies – Smart Parking, Smart Irrigation Control, Air Pollution Monitoring, Forest Fire Detection, Weather Forecasting.

Text Book:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things, A Hands-on-Approach”, 1st Edition, Universities press Pvt. Ltd., India, 2015.
2. Mayur Ramgir, “Internet of Things- Architecture, Implementation, and Security”, 1st Edition, Pearson Education,India, 2019

Reference Book:

1. Rajkumar Buyya, Amir VahidDastjerdi, “Internet of Things: Principles and Paradigms”, 1st Edition, Elsevier, USA, 2016
2. Dimitrios Serpanos, Marilyn Wolf, “Internet-of-things (IoT) systems: architectures, algorithms, methodologies”, 1st Edition, Springer, UK, 2017.
3. Charles Bell, “Beginning Sensor Networks with Arduino and Raspberry Pi” , 1st Edition, Apress Publishers, USA, 2013.

Extensive Reading:

- https://www.raspberrypi.org/
- https://nurdspace.nl/images/e/e0/ESP8266_Specifications_English.pdf
- https://swayam.gov.in/nd1_noc20_cs24
- https://swayam.gov.in/nd2_arp19_ap52

23ECH03 COMMUNICATION PROTOCOLS FOR IOT

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explore the fundamental concepts of IoT protocols and standards.
- To examine the IoT protocol standards in data link and networking layers.
- To assess the performance of different IoT protocols through open source tools.
- To describe the security issues of protocols in IoT.

Course Outcome:

At the end of the course, the students will be able to

- Describe the evolving communication standards for IoT.
- Demonstrate and visualize the data link protocols for IoT.
- Elucidate the network protocols and standards for IoT.
- Analyze the importance of IoT Edge devices.
- Apply security mechanisms for IoT protocol security.

Unit I EVOLVING IOT STANDARDS **9**

Overview and Approaches – IoT Ecosystem – Protocols for IoT- Structural Aspects- Key Technologies-Sensor Technology-RFID technology – CoAP – REST – ETSI M2M

Unit II DATA LINK PROTOCOLS **9**

IEEE 802.15.4e - IEEE 802.11 ah – WirelessHART - Z-Wave - Bluetooth Low Energy - Zigbee Smart Energy - DASH7 – HomePlug - G.9959 - LTE-A – LoRaWAN – Weightless - DECT/ULE

Unit III NETWORK LAYER PROTOCOLS **9**

Routing Protocols – RPL – CORPL – CARP - Encapsulation Protocols - 6LoWPAN - 6TiSCH - 6Lo - IPv6 over G.9959 - IPv6 over Bluetooth Low Energy - Session Layer Protocols – MQTT – SMQTT – XMPP – DDS

Unit IV IOT EDGE COMPUTING **9**

Edge Computing – Purpose and Definition– Edge Hardware Architectures – Operating System – Edge Platforms – Virtualisation – Containers – Use Cases – Ambient Computing – Synthetic Sensing

Unit V SECURITY AND PRIVACY **9**

Security Issues in the IoT - Security Mechanisms- Key Agreement, Distribution, and Security Bootstrapping -Key Agreement Protocols. Privacy Issues in the IoT - Role of Authorization - IoT-OAS: Delegation-based Authorization for the Internet of Things - IoT-OAS Application Scenarios

Text Book:

1. Geng, Hwaiyu. "Internet of Things and Data Analytics in the Cloud with Innovation and Sustainability." The Internet of Things & Data Analytics Handbook, 2017.
2. Simone Cirani, Gianluigi Ferrari, Marco Picone, Luca Veltri - "Internet of Things_ Architectures, Protocols and Standards", Wiley ,2018.

Reference Book:

1. Perry Lea, "IoT and Edge Computing for Architects_ Implementing edge and IoT systems from sensors to clouds with communication systems, analytics, and security", 2nd Edition, Packt Publishing, 2020.
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence", 1st Edition, Academic Press, 2014
3. Vijay Madisetti, Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", 1st Edition, VPT, 2014
4. Perry Lea, "Internet of Things for Architects_ Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security", Packt Publishing ,2018
5. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", Wiley Publications, 2013.

Extensive Reading:

- https://www.postscapes.com/internet-of-things-protocols/
- https://www.edx.org/course/iot-networks-and-protocols
- https://www.experfy.com/training/courses/iot-messaging-with-mqtt-coap
- https://swayam.gov.in/nd2_arp19_ap52

23ECH04 CLOUD SERVICES FOR IOT

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To comprehend the cloud architecture and its services
- To illustrate the various sensors and their cloud interfaces
- To learn the cloud platforms of IoT services
- To gain awareness on various cloud service management functionalities for IoT
- To familiarize the security issues in IoT applications.

Course Outcome:

At the end of the course, the students will be able to

- Build an appropriate cloud architecture and identify the cloud services.
- Handle various IoT sensors and actuators and facilitate cloud interfaces.
- Develop IoT applications using open source cloud platforms.
- Integrate the IoT applications into the cloud services.
- Provide robust solutions for the security issues in IoT applications and networks

Unit I CLOUD PLATFORM ARCHITECTURE AND SERVICES 9

Cloud computing and service models: Public, Private and Hybrid clouds-Infrastructure as a service (IaaS)-Platfrom as a service (PaaS)-Software as a service (SaaS) - Architectural design of compute and storage clouds: Layered cloud architectural development - Architectural design challenges.

Unit II CLOUD INTERFACE FOR IOT 9

AWS IoT, Azure IoT, Google Cloud IoT, and Apache Kafka Cloud - Setting up IoT devices on cloud platforms - IoT-cloud interactions: MQTT, CoAP, HTTP - Utilizing cloud storage for IoT-generated data.

Unit III CLOUD PLATFORMS FOR IOT 9

Thinkspeak IoT Cloud Platform, Kaa Open Source Iot Cloud Platform, AWS IoT Cloud Platform –AWS IoT Device SDK. Arduino AWS IoT development. Raspberry Pi 3-AWS IoT development.

Unit IV ESSENTIALS OF CLOUD SERVICE MANAGEMENT 9

Service management in cloud computing - Service Level Agreements (SLAs), Managing IoT data – Looking at Data, Scalability & cloud services, Database & data stores in cloud, Large scale data processing.

Unit V SECURITY AND APPLICATIONS 9

Safety and vulnerability in cloud network- IoT Security and Privacy Preservation - Security and challenges in mobile cloud computing- Fog computing characteristics in IoT security.

Text Book:

1. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, “Distributed and Cloud Computing, From parallel processing to the Internet of Things”, Morgan Kaufmann Publishers, 2012.
2. Raj Kamal, “Internet of Things: Architecture and Design Principles”, McGraw-Hill Education Pvt. Ltd., 2018.

Reference Book:

1. Charalampos Doukas, “Building Internet of Things with the Arduino”, Create Space, April 2002.
2. Agus Kurniawan “Learning AWS IoT”, Packt Publishing (January 29, 2018)
3. Dac-Nhuong Le , Chintan Bhatt , Mani Madhukar “Security Designs for the Cloud, IoT, and Social Networking” John Wiley & Sons (11 October 2019)
4. Honbo Zhou, “The Internet of Things in the Cloud: A Middleware Perspective”, CRC Press, 2013.
5. Marco Schwatrz, “Internet of Things with Arduino Cookbook”, Packt Publications, 2016.
6. Rajkumar Buyya, Christian Vecchiola. S.Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education, 2013.
7. Nick Antonopoulos and Lee Gillam, “Cloud Computing: Principles, Systems and Applications”, Second Edition, Springer, 2017.

Extensive Reading:

- https://azure.microsoft.com/en-in/overview/what-is-cloud-computing/
- https://aws.amazon.com/iot/
- http://postscapes.com/projects
- http://www.theinternetofthings.eu/what-is-the-internet-of-things
- https://www.theinternetofthings.eu/digital-world-iot
- https://cloud.google.com/solutions/iot
- https://swayam.gov.in/nd1_noc20_cs20

23ECH05 BIG DATA ANALYTICS FOR IOT

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To gain exposure to the significance of Big data analytics for IoT.
- To get familiarity on IoT semantics and big data streaming analytics.
- To be aware with the strategies for processing IoT data through data analytics.
- To identify suitable applications that makes use of multimedia Big Data and IoT.
- To implement smart systems using Big Data and IoT.

Course Outcome:

At the end of the course, the students will be able to

- Integrate big data and IoT for IoT analytics
- Extract semantics by processing IoT real-time and linked stream data.
- Process and handle IoT Big data using Apache Hadoop
- Perform analytics with multimedia Big Data and IoT
- Design and implement smart IoT systems with big data.

Unit I BIG DATA INTEGRATION FOR IOT ANALYTICS **9**

IoT data and Big data – Challenges of IoT analytics applications – IoT analytics life cycle and techniques –Searching the Internet of Things: Search Architecture for Social and Physical Sensors - Local Event Retrieval - Using Sensor Metadata Streams to Identify Topics of Local Events in the City – Venue Recommendation

Unit II IOT SEMANTICS AND DATA STREAMING ANALYTICS **9**

Linking data - Real-time & Linked Stream Processing - Semantic-based Distributed Reasoning - Cross-Domain Recommender Systems - Semantic Analytics - Semantic Modelling and Validation Tools - Data Reasoning - Ethical IoT

Unit III PROCESSING OF IOT BIG DATA **9**

Stream processing for handling real-time IoT data - Big data processing frameworks: Apache Hadoop, Apache Spark, Hive, and Vertica. Data stream processing using machine learning.

Unit IV MULTIMEDIA BIGDATA COMPUTING FOR IOT **9**

Characteristics of Multimedia Bigdata – Multimedia Big Data Life Cycle - Processing and analysing images and videos from IoT devices – Processing methods for speech and audio data in IoT environments - Integration of data from multiple modalities in IoT.

Unit V CASE STUDIES OF IOT DATA ANALYTICS **9**

Precision Agriculture and optimized farming – Smart city planning, intelligent transportation system, resource management and smart buildings – Health monitoring and personalized medicine – Predictive maintenance in industries.

Text Book:

1. John Soldatos, “Building Blocks for IoT Analytics”, River Publishers Series In Signal, Image and Speech Processing, 2017.
2. Sudeep Tanwar, Sudhanshu Tyagi, Neeraj Kumar, “Multimedia Big Data Computing for IoT Applications: Concepts, Paradigms and Solutions”, Springer, 2020

Reference Book:

1. Valentina E. Balas, Vijender Kumar Solanki, Raghvendra Kumar, ManjuKhari, “Internet of Things and Big Data Analytics for Smart Generation”, Volume 154.
2. Stackowiak, R., Licht, A., Mantha, V., Nagode, L.,” Big Data and The Internet of Things Enterprise Information Architecture for A New Age”, Apress, 2015.
3. Andrew Minteer, “Analytics for the Internet of Things (IoT): Intelligent analytics for your intelligent devices”, Packt Publishing, first edition, July 2017.
4. Nilanjan Dey, Aboul Ella Hassanien, Chintan Bhatt, Amira S. Ashour, Suresh Chandra Satapathy, “Internet of Things and Big Data Analytics Toward Next-Generation Intelligence”, Springer International Publishing, 2018.

Extensive Reading:

- https://data-flair.training/blogs/data-analytics-tutorial/
- https://www.edureka.co/blog/iot-tutorial/
- https://www.digimat.in/nptel/courses/video/106105166/L01.html
- https://www.guru99.com/iot-tutorial.html
- https://www.sas.com/en_us/insights/analytics/big-data-analytics.html
- https://swayam.gov.in/nd1_noc20_cs92

23EEH41 DIGITAL MEASUREMENTS AND INSTRUMENTATION

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Digital methods of measurements – Current, Voltage and Time measurements.
- Working principle of signal generators and various signal analyzers.
- Concepts of digital display unit and recording devices.
- Concepts of PC based data acquisition system

Course Outcome:

At the end of the course, the students will be able to

- Expound the working of various digital meters for measurements of current, voltage and time.
- Explicate the working of various signal and wave generators.
- Explain the working of various signal and wave analyzers.
- Select suitable digital transducers, display and recording devices for modern electronic systems.
- Design a suitable PC based data acquisition system for accurate measurement of physical quantities.

Unit I DIGITAL METHODS OF MEASUREMENTS **9**

Digital voltmeters and multimeters – Automation and accuracy of digital voltmeters and multimeters – Digital phase meters – Digital tachometers – Digital frequency, period and time measurements – Low frequency measurements – Automatic time and frequency scaling

Unit II SIGNAL GENERATORS **9**

Signal Generators: AF, RF Signal Generators, Sweep Frequency Generators, Pulse and Square wave Generators, Function Generators, Arbitrary Waveform Generator and Specifications.

Unit III SIGNAL ANALYZERS **9**

AF, HF Wave Analyzers, Harmonic Distortion, Heterodyne wave Analyzers, Spectrum Analyzers, Power Analyzers, Capacitance-Voltage Meters, Oscillators. .

Unit IV DIGITAL TRANSDUCERS, DISPLAY & RECORDING DEVICES **9**

Digital Transducers: Shaft Encoders- Optical encoder- Sliding contact encoder- Magnetic encoder- Proximity sensor encoder- Incremental Optical Encoders- Absolute Optical Encoders-Digital storage oscilloscopes – Digital printers and plotters –LCD and LED display.

Unit V DIGITAL DATA ACQUISITION SYSTEM **9**

Digital Data Acquisition System: Interfacing transducers to Electronics Control and Measuring System. Instrumentation Amplifier, Isolation Amplifier. An Introduction to Computer-Controlled Test Systems.IEEE-488 GPIB Bus.

Text Book:

1. Doebelin, 'Measurement System, Application & Design', IV Ed, McGraw-Hill, Fifth Edition, 2018.
2. Modern Electronics Instrumentation & Measurement Techniques, by Albert D.Helstrick and William D.Cooper, Pearson Education, 2016.
3. Bouwens, A.J., "Digital Instrumentation", McGraw Hill, 1997

Reference Book:

1. Sawhney A K, "A Course in Electrical and Electronic Measurement and Instrumentation", DhanpatRai& Sons, New Delhi, 18th Edition, 2012.
2. Gupta J.B., "A Course in Electronic and Electrical Measurements", S. K. Kataria & Sons, Delhi, 2009
3. Kalsi H.S, "Electronic Instrumentation", McGraw Hill Education India, 3rd Edition, 2010

23ECH21 ENERGY AWARE SENSORS

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about low power sensor systems.
- To understand the working of Environmental sensors.
- To learn about the use of energy aware sensors for monitoring applications.

Course Outcome:

At the end of the course, the students will be able to

- Identify the different types of deployment of sensors and their low power circuits.
- Analyze the assembly of sensor node systems.
- Evaluate the different types of network technologies and bus interfaces.
- Select sensors/sensor systems and integrate them into an existing monitoring system, collect sensor data and visualise it.
- Analyze the different case studies on sensor deployment.

Unit I SENSOR DEPLOYMENT **9**

Deployment of sensors - Sensor field Analysis - Power Consumption in Sensors, Energy Reduction Techniques – Low Power Modules - Adaptive Hardware.

Unit II SENSOR NODE SYSTEMS **9**

Sensor nodes- block level description- packaging and assembly- electrical, thermal, mechanical and reliability issueswired sensor nodes- wireless sensor nodes- battery and power issues.

Unit III NETWORKED ENVIRONMENTAL SENSORS **9**

Network technologies and data bus interfaces in use, serial connection, field bus technologies, M-bus, Modbus, BACnet, LON- Wireless Technologies, GPRS, ZigBee, 6LoWPAN- Deployment of wireless sensors, considerations, planning- Commissioning of Networked Sensor Systems, Distributed Sensor Networks, Traffic Analysis on Sensor Network.

Unit IV ENERGY AWARE SENSOR SYSTEMS **9**

Designing Energy Aware for Sensor Systems - Operating Systems and Power Management - Energy Optimization for Data Communications and Micro Sensor Network.

Unit V APPLICATION AND CASE STUDIES **9**

Plant monitoring - Designing Distributed sensors - WSN for target tracking - Key Management in Multi-Hop WSN - Maritime Domain awareness - Environmental Monitoring Applications.

Text Book:

1. S.Sitharama Iyengar , Richard Brooks, “Distributed Sensor Network – Sensor Networking Applications”, CRC Press, 2013.
2. Hermann Merz, Thomas Hansemann, Christof Hübner, , “Building Automation: Communication systems with EIB/KNX, LON and BACnet”, Springer, 2nd Edition,2018

Reference Book:

1. Shengwei Wang, “Intelligent buildings and building automation”, Routledge, 1st edition, 2009
2. Robert Faludi, “Building Wireless Sensor Networks”, O'Reilly Media, 1st edition, Inc.2010
3. Jon S. Wilson, “Sensor technology handbook”, Elsevier Inc., 2005

Extensive Reading:

- https://nptel.ac.in/courses/108/108/108108147/
- https://www.scribd.com/document/151197312/Energy-Aware-Soft

23ECH22 MULTIDISCIPLINARY SENSORS

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about different types of sensors for mechanical and acoustical environment.
- To understand the design of chemical and radiation environment sensors.
- To know about the design of MEMS and Smart Sensors.

Course Outcome:

At the end of the course, the students will be able to

- Analyse the physical quantity measurement and making of sensors and actuators.
- Apply suitable sensors and Actuators for Acoustic environment.
- Select appropriate sensors and actuators for Chemical environment.
- Analyse different types of sensors and actuators used in radiation environment.
- Introduce smartness in sensors and Interface the sensor with other processing devices.

Unit I MECHANICAL SENSORS AND ACTUATORS 9

Force Sensors - Tactile Sensors - Accelerometers - Pressure Sensors - Velocity Sensing – Gyroscopes.

Unit II ACOUSTIC SENSORS AND ACTUATORS 9

Elastic Waves and Their Properties -Microphones - The Piezoelectric Effect - Acoustic Actuators - Ultrasonic Sensors and Actuators - Piezoelectric Actuators - Piezoelectric Resonators and SAW Devices.

Unit III CHEMICAL SENSOR AND ACTUATORS 9

Electrochemical Sensors - Potentiometric Sensors -Thermochemical Sensors - Optical Chemical Sensors – Mass Sensors - Humidity and Moisture Sensors -Chemical Actuation.

Unit IV RADIATION SENSORS AND ACTUATORS 9

Radiation Sensors - Ionization Sensors - Microwave Radiation - Antennas as Sensing Elements - Antennas as Actuators.

Unit V MEMS AND SMART SENSORS 9

MEMS Sensors and Actuators: MEMS Sensors - MEMS Actuators - Smart Sensors and Actuators - Wireless Sensors and Actuator - Modulation and Demodulation - Encoding and Decoding - Sensor Networks.

Text Book:

1. Nathan Ida, “Sensors, Actuators, and their Interfaces: A multidisciplinary introduction (Materials, Circuits and Devices)”, SciTech Publishing,2013

Reference Book:

1. Ilene J.Busch, “Electromechanical Sensors and Actuators”, Springer 1999
2. D. Ballantine, Jr. Robert White, S. Martin Antonio Ricco, E. Zellers, G. Frye ,H. Wohltjen, “Acoustic Wave Sensors: Theory, Design and Physico-Chemical Applications”, Academic Press Ltd., 1996
3. Dan Zang , Bin Wei,” Advanced Mechatronics and MEMS devices II”, , Springer, 2017

Extensive Reading:

- https://nptel.ac.in/courses/108/108/108108147/
- https://www.oreilly.com/library/view/polymeric-sensors-and/9781118547625/OEBPS/c06.htm
- https://iopscience.iop.org/article/10.1088/0022-3727/41/12/123002/meta

23ECH23 ADVANCED SENSOR AND DETECTION MATERIALS

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the use of nano materials in sensor technology
- To know about microwave sintering and mesoporous silica
- To learn about sensor processing instruments

Course Outcome:

At the end of the course, the students will be able to

- Explain the sensors materials and detectors at macroscopic or nanometric scale
- Analyse Sensors materials for Polymeric Nanoparticles and Non-Polymeric Nanoparticles
- Identify Sensor materials for Microwave and Humidity
- Analyse the structure and characteristics of sensor materials
- Use the sensor processing instruments

Unit I SENSORS' NANOTECHNOLOGY AND CONSTRUCTION OF NANOSTRUCTURES 9

Significance of Nanotechnology - Synthesis of Nano structure: Nano particles - Nano wires - Nano tubes - Nano-arrays - Characterization of Nanostructures and Nano materials - Zinc Oxide Quantum Dots and their Applications

Unit II NANOPARTICLES AND MOLECULARLY IMPRINTED POLYMER 9

Inluence of Shape on Biological Process - Different Shapes of Non-Polymeric Nano particles and Polymeric Nano particles - Molecularly Imprinted Chiral Polymers MIP-Based Chiral Sensing Devices

Unit III MICROWAVE SINTERING AND MESOPOROUS SILICA 9

Microwave Material Interactions and Sintering - Microwave Sintering of Ferrites - Garnets and Nanocomposites - Introduction to Mesoporous Silica Materials - Modification and Characterization of Mesoporous Silica - Humidity Sensing and Other Applications of Mesoporous Silica Materials

Unit IV STRUCTURE AND CHARACTERISTICS OF SENSOR MATERIALS 9

Porous Nano structures TiO2 and Au/Ag Nano particles synthesis for Environmental Applications - Photocatalytic Performances of the TiO2-Au/Ag Porous Nano composites for Destroying Water Chemical Pollutants. Glass-Ceramics - Superionic Conduction - NASICON Structure and Properties - Principles of Chemical Sensing by Conducting Nano composite Materials - Synthesis - sensing and Characterization of Graphene and its Nano composites.

Unit V SENSOR PROCESSING INSTRUMENTS 9

Quasi-Elastic Light Scattering (Photon Correlation Spectroscopy) - Scanning Electron Microscopy(SEM) -Transmission Electron Microscopy (TEM) -X-ray Diffraction (XRD) - UV-visible Spectroscopy - FT-IR Spectroscopy - NMR Spectroscopy - Mass Spectrometry - Vibrating Sample Magnetometer

Text Book:

1. Ashutosh Tiwari , Mustafa M. Demir, “Advanced Sensor and Detection Materials”, Scrivener Publishing LLC, 2014

Reference Book:

1. Yasir Beeran Pottathara, Sabu Thomas, Nandakumar Kalarikkal, Yves Grohens, Vanja Kokol, “ Nanomaterials Synthesis: Design, Fabrication and Applications”, Elsevier, 2019
2. Egerton, R.F., “Physical Principles of Electron Microscopy: An introduction to SEM,TEM and AEM”, Springer,2016
3. Gunter Gauglitz, Tuan Vo- Dinh, “Handbook of Spectroscopy”, Wiley, 2003

Extensive Reading:

- https://www.nap.edu/read/4782/chapter/12
- https://www.nap.edu/read/4782/chapter/6

23CSH01 ARTIFICIAL INTELLIGENCE FOR ENGINEERS

Offered by CSE (Emerging Area Course offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about the history of AI and symbolic logic in AI
- To understand the knowledge representation and reasoning mechanisms
- To study uncertainty and searching techniques to solve real-world problems
- To learn AI technologies and expert systems
- To introduce machine learning models and AI in various applications

Course Outcome:

At the end of the course, the students will be able to

- Represent problems in symbolic logic.
- Use the knowledge and the process of inference to derive new facts.
- Formulate a problem and find the solution using search techniques and probabilistic methods.
- Build AI systems using AI technologies and expert systems.
- Design machine learning models for real-world problems.

Unit I INTRODUCTION AND LOGIC **9**

Introduction-History of AI-Applications of AI-Future of AI- Logic-Propositions-Normal Forms-Logical Consequences-Resolution Principle-Predicate calculus- Clausal Form-Rules of Inference- Unification-Resolution

Unit II KNOWLEDGE REPRESENTATION AND REASONING **9**

Procedure for knowledge acquisition-Knowledge Representation-Types of representation schemes-Reasoning-Forward chaining-Backward chaining-Domain Modelling-Semantic nets reasoning systems-Frame based systems

Unit III UNCERTAINTY AND SEARCH TECHNIQUES **9**

Uncertainty-Non monotonic and monotonic reasoning-Bayes theorem-Dempster and Shafer's theory of evidence-Non-classical logics-Default logics-Bayesian networks-Fuzzy logic- Searching- Problem representation-Representation schemes-Blind search techniques-Heuristic search techniques- Game searches

Unit IV AI TECHNOLOGIES AND EXPERT SYSTEMS **9**

Computer vision- Natural language processing-Speech recognition systems- Expert Systems: Basic characteristics-Brief history-Knowledge engineering-inferencing-programming methodology and Expert systems tools

Unit V NEURAL NETWORKS AND APPLICATIONS OF AI **9**

Introduction - Features of Biological neural networks-Learning Algorithms-Different network architecture and their applications-Some simple networks-Comparison of neural networks with rule-based networks and expert systems-AI Applications-AI in E-commerce-AI in E-Tourism-AI in Industry-AI in Medicine

Text Book:

1. Rajendra Akerkar, "Introduction to Artificial Intelligence", PHI Learning Private Limited, Second Edition, 2021

Reference Book:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson education, Fourth edition, 2022.
2. Richard E Neapolitan, "Artificial Intelligence: With an Introduction to Machine Learning", CRC Press, Second Edition, 2018.
3. Nils.J.Nilsson, "Artificial Intelligence: A new synthesis", Elsevier, July 2003.
4. Andries P.Engelbrecht, "Computational Intelligence: An Introduction", John Wiley & Sons, 2nd edition, 2007.
5. John Fulcher, L.C. Jain, "Computational Intelligence: A Compendium, Studies in Computational Intelligence", Vol.115, Springer, 2008.

Extensive Reading:

- https://web.stanford.edu/class/archive/cs/cs221/cs221.1186/
- https://ocw.mit.edu/courses/6-034-artificial-intelligence-spring-2005/pages/lecture-notes/

23CSH02 MACHINE LEARNING USING PYTHON

Offered by CSE (Emerging Area Course offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study the basics of machine learning and NumPy
- To learn linear models and Scikit-learn for SVM
- To understand distance based models and Scikit-learn for k-means algorithm
- To know about tree model, rule based models and Scikit-learn for tree model
- To perform model evaluation and improvement in machine learning algorithms

Course Outcome:

At the end of the course, the students will be able to

- Explore the machine learning concepts and work with Numpy
- Apply the linear modelling technique to solve a problem
- Work with distance based models using scikit learn
- Build tree and rule based models
- Record the model evaluation results for the algorithms and analyze the results

Unit I INTRODUCTION **9**

Machine learning - Task: problems solved with machine learning, Looking for structure, performance evaluation - Models: Geometric models, Probabilistic models, Logical models, Grouping and grading -Features – Working with NumPy- Creating NumPy Arrays-Array indexing-Reshaping Arrays-Array Math

Unit II LINEAR MODELS **9**

Least square method – multivariate linear regression – regularised regression – perceptron –support vector machines- soft margin SVM-Going beyond linearity with kernel methods- Using Scikit-learn for SVM -Plotting the Hyperplane and the Margins -Making Predictions -Kernel Trick - Adding a Third Dimension -Plotting the 3D Hyperplane.

Unit III DISTANCE-BASED MODELS **9**

Distance and measure - Neighbours and exemplars - Nearest neighbour classification - Distance based clustering: K-means algorithm, clustering around medoids –silhouettes – hierarchical clustering – Using K-Means in Scikit-learn- Evaluating Cluster Size Using the Silhouette Coefficient-Calculating the Silhouette Coefficient-Finding the Optimal K

Unit IV TREE AND RULE MODELS **9**

Decision trees – learning decision trees – ranking and probability estimation trees – regression trees – clustering trees – learning ordered rule lists – learning unordered rule lists – Using Decision trees in scikit-learn- Analyzing decision trees- Feature importance in trees

Unit V MODEL EVALUATION AND IMPROVEMENT **9**

Cross-Validation in scikit-learn -Benefits of Cross-Validation -Stratified k-Fold Cross-Validation and Other Strategies - Grid Search-Simple Grid Search-Grid Search with Cross-Validation -Evaluation Metrics and Scoring -Metrics for Binary Classification- Regression Metrics-Using Evaluation Metrics in Model Selection

Text Book:

1. P. Flach, “Machine Learning: The art and science of algorithms that make sense of data”, Cambridge University Press, 2015.
2. Wei-Meng Lee, “Python Machine Learning”, John Wiley & Sons, 2019.
3. Andreas C. Müller and Sarah Guido, “Introduction to Machine Learning with Python- A Guide for Data Scientists”, O’Reilly publications, First edition,2016.

Reference Book:

1. K. P. Murphy, “Machine Learning: A probabilistic perspective”, MIT Press, 2012.
2. C. M. Bishop, “Pattern Recognition and Machine Learning”, Springer, 2007.
3. M. Mohri, A. Rostamizadeh, and A. Talwalkar, “Foundations of Machine Learning”, MIT Press, 2012
4. S.N Sivanandam, S.N Deepa, “Principles of Soft Computing”, Wiley India Pvt.Ltd., 2nd Edition,2011

Extensive Reading:

- http://ocw.mit.edu
- https://www.coursera.org/learn/machine-learning
- http://archive.ics.uci.edu/ml/
- https://www.kaggle.com/

23CSH03 NLP AND ITS APPLICATIONS

Offered by CSE (Emerging Area Course offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explore the fundamental concepts of Natural Language Processing
- To learn the different data pre-processing steps in lexical analysis
- To understand the working of syntactic and semantic analysis using NLTK
- To work with lexical resources and sentiment analysis using python
- To familiar with Question answering and chatbot application in NLP

Course Outcome:

At the end of the course, the students will be able to

- Familiarize with concept of Natural Language Processing
- Pre-process the data from the collected dataset using NLTK
- Extract the features and do the syntactic and semantic analysis using NLTK
- Find the different emotions and sentiment using sentiment analysis with lexical resources
- Apply NLP concepts for question answering system and chatbots

Unit I INTRODUCTION TO NLP **8**

Natural language processing – Phases of natural language processing – Evaluation of NLP systems - Origins and challenges of NLP – Basic English concepts –- Language and Grammar - Processing Indian Languages.

Unit II LEXICAL ANALYSIS USING NLTK **10**

Introduction and installation of NLTK – Regular Expression – Text Normalization: Tokenization – Lemmatization - Stemming – Edit Distance – N-grams – Evaluating Language Models – Smoothing – Kneser-Ney Smoothing - Part of Speech (PoS) Tagging – Named Entities and Tagging– HMM PoS Tagging – Conditional Random Fields – Stop Words Removal – Spelling Correction.

Unit III SYNTACTIC AND SEMANTIC ANALYSIS USING NLTK **9**

Syntactic Analysis: Context-Free Grammar – Grammar Rules for English – Treebanks – Constituency Parsing – CKY Parsing – Neural CKY Parsing – Evaluation.. Semantic Analysis: Vector Semantics and Embeddings – Words and Vectors – Measuring Similarity – Building Bag of Words (BoW) Model – TF-IDF Model – Pointwise Mutual Information (PMI) – Word2vec – Bias and Embeddings.

Unit IV LEXICAL RESOURCES AND SENTIMENT ANALYSIS **10**

Lexical Resources: WordNet – Word Synonyms and Antonyms using NLTK – Word Negation Tracking – Word Sense Disambiguation – WSD algorithms – Semantic Roles – FrameNet – Labeling. Sentiment Analysis: Introduction – Sentiment & Affect Lexicons – Semi-supervised Induction – Supervised learning of word Sentiment – Using Lexicon – Affect Recognition – TextBlob – Training Sentiment Models..

Unit V NLP APPLICATIONS **8**

Question Answering: Information Retrieval – IR based QA – Knowledge based QA – Classic QA Models – Evaluation. Chatbots: Introduction – Rule based chatbot – Corpus based chatbot – GUS – Dialogue State Architecture – Evaluating Chatbot and Dialog system – Dialogue System Design.

Text Book:

1. Ela Kumar, “Natural Language Processing”, I.K International, New Delhi 2011. (Unit I)
2. Daniel Jurafsky and James H Martin, “Speech and Language Processing: An introduction to Natural Language Processing, Computational Linguistics and Speech Recognition”, Prentice Hall, 2nd Edition 2008. (Unit II to Unit V)

Reference Book:

1. Sohom Ghosh, Dwight Gunning, “Natural Language Processing Fundamentals”, Packt Publishing Limited, 2019.
2. Steven Bird, Ewan Klein and Edward Loper, “Natural Language Processing with Python”, O'Reilly Media, 1st Edition, 2009.
3. Tanveer Siddiqui, U.S. Tiwary, “Natural Language Processing and Information Retrieval”, Oxford University Press, 2008.
4. Christopher D. Manning and Hinrich Schutze, “Foundations of Statistical Natural Language Processing”, MIT Press, 2003.

Extensive Reading:

- http://nptel.ac.in/courses/106101007/
- http://www.tutorialspoint.com/artificial_intelligence/artificial_intelligence_natural_language_ processing.htm
- http://nlp.stanford.edu/
- https://www.udemy.com/course/nlp-natural-language-processing-with-python/
-
- https://www.packtpub.com/in/big-data-and-business-intelligence/natural-language-processing-fundamentals

23CSH04 DEEP LEARNING USING TENSOR FLOW

Offered by CSE (Emerging Area Course offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn deep neural network foundation with Tensorflow 2.0.
- To understand convolutional networks and its operations.
- To be familiar with word embeddings and sequential modelling.
- To illustrate the variants of autoencoders.
- To get exposure on different types of Generative Adversarial Networks.

Course Outcome:

At the end of the course, the students will be able to

- Use Multilayer perceptron for recognition kind applications with hyper-parameter tuning.
- Apply convolutional networks for real world applications in Computer Vision domain.
- Design word embedding model and Recurrent Neural Network for text data processing.
- Construct Autoencoders and its variants for reconstruction task.
- Apply the Generative Adversarial Network based deep learning techniques for recent applications.

Unit I NEURAL NETWORK FOUNDATIONS WITH TENSORFLOW 2.0 **9**

Introduction to Tensorflow 1.0 and 2.0 – Introduction to Neural Networks – Perceptron – Multi-layer Perceptron with example – Activation functions – Implementation of hand-written digit recognition and improve the designed network using hyper parameter tuning – Working with Google Colab. Regression -Types – Implementation of regression using Tensorflow Estimators.

Unit II CONVOLUTIONAL NEURAL NETWORKS **9**

Convolutional Networks – Deep Convolutional networks - Convolution operation – Sparse Interactions, Parameter Sharing - Pooling – Basic Convolution function. Implementation of tensorflow based object detection and image classification using convolutional networks. Computer Vision – Classification and Localization – Semantic Segmentation – Instance Segmentation – Transfer Learning

Unit III RECURRENT NEURAL NETWORKS **9**

Word Embedding fundamentals – Distributed Representations – Neural Embeddings – Dynamic Embeddings – Sentence and Paragraph embeddings.

Recurrent Neural Networks: Basic RNN Cell – Backpropagation through time (BPTT) – RNN Cell variants: Long-short term memory – Gated Recurrent Unit. RNN Variants: Bidirectional RNN – Stateful RNN. RNN Topologies - LSTM

Unit IV AUTOENCODERS **9**

Auto encoders: Introduction – Vanilla Autoencoder – Sparse Autoencoder – Denoising Autoencoder – Clearing images using denoising autoencoder - Stacked Autoencoder – Convolutional Autoencoder for removing noise in the images

Unit V GENERATIVE ADVERSARIAL NETWORKS **9**

Working functionalities of GAN – MNIST digit generation using GAN in Tensorflow – Deep Convolutional GAN – DCGAN for MNIST digits – GAN Architectures: SRGAN, CycleGAN, InfoGAN – Applications of GAN.

Text Book:

1. Antonio Gulli, Amita Kapoor, Sujit Pal, “Deep Learning with Tensorflow 2 and Keras”, Second Edition, Packt Publishing, December 2019.

Reference Book:

1. Yoshua Bengio and Ian J.Goodfellow and Aaron Courville, "Deep Learning", MIT Press, 2015.
2. Li Deng, Dong Yu, "Deep Learning: Methods and Applications", now publishers, 2014.

Extensive Reading:

- http://www.deeplearning.net
- https://www.tensorflow.org/tutorials
- https://www.deeplearningbook.org/
- https://developers.google.com/machine-learning/crash-course/ml-intro
- www.cs.toronto.edu/~fritz/absps/imagenet.pdf
- http://neuralnetworksanddeeplearning.com/

23CSH05 METAHEURISTIC OPTIMIZATION TECHNIQUES

Offered by CSE (Emerging Area Course offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basics of nature inspired algorithms
- To know about various evolution-based methods
- To study various swarm intelligence-based techniques
- To learn the science-based approaches and optimization algorithms
- To acquire knowledge on human based methods

Course Outcome:

At the end of the course, the students will be able to

- Formulate objective function for simple problems
- Apply evolution-based methods for real time problems
- Implement various swarm intelligence-based techniques
- Apply various science-based approaches to solve real world problems
- Work with human based approaches for real time applications

Unit I INTRODUCTION **9**

Computation inspired by nature – Biological process – Evolution vs learning – Swarm intelligence – Heuristics, meta heuristics, and hyper-heuristics – Optimization – Performance Indicators

Unit II EVOLUTION BASED METHODS **9**

Genetic algorithms - Genetic programming – Evolutionary strategies – Differential evolution- Estimation of distribution algorithms – Topics in evolutionary algorithms

Unit III SWARM INTELLIGENCE BASED TECHNIQUES **9**

Particle swarm optimization – Artificial immune systems – Ant colony optimization – Bee metaheuristics – Bacterial forging algorithm – Harmony search – Swarm intelligence

Unit IV SCIENCE BASED APPROACHES AND OPTIMIZATION ALGORITHMS **9**

Simulated annealing – Biomolecular computing – Quantum computing - Meta heuristics based on sciences-Dynamic, multimodal, and constrained optimizations – Multiobjective optimization

Unit V HUMAN BASED METHODS AND APPLICATIONS **9**

Memetic algorithms – Tabu search – Scatter search – Search based on human behaviors – teaching learning-based optimization algorithm- Applications in fake news detection, manufacturing operations

Text Book:

1. Ke-Lin Du and M. N. S. Swamy, “Search and Optimization by Metaheuristics,” First Edition, Birkhäuser Cham, Springer, 2016.

Reference Book:

1. David E.Goldberg, “Genetic Algorithms in Search, Optimization, and Machine Learning”, First Edition, Pearson Education, 2009.
2. Marco Dorigo and Thomas Stutzle, “Ant Colony optimization,” First Edition, Prentice Hall of India, 2004.
3. A.P.Engelbrecht, “Fundamentals of Computational Swarm Intelligence”, First Edition, Wiley, 2006.
4. Kalyanmoy Deb, “Multi-Objective Optimization using Evolutionary Algorithms,” Wiley,2010.

Extensive Reading:

- https://nptel.ac.in/courses/103103164
- https://link.springer.com/article/10.1007/BF02823145

23MAH91 NUMBER THEORY FOR INFORMATION SECURITY

Offered by MAT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
2	2	0	3

Course Objective:

To impart knowledge on

- Factorization of numbers in terms of prime numbers.
- Describing the problems in system of congruence equation.
- Primitive roots and quadratic residues.
- Applying the concept of correction, decoding and finite fields.
- Introducing the concept of linear codes, generator matrix and parity-check matrix in information security.

Course Outcome:

At the end of the course, the students will be able to

- Explain about fundamentals in number theory.
- Apply techniques to solve congruences in cryptography.
- Apply quadratic residue concept for solving problems.
- Compare the concept of coding and decoding in information security.
- Evaluate problems in linear code applicable in information security.

Unit I DIVISIBILITY AND PRIMES **9**

Basic group theory - Rings and fields - Division algorithm - Greatest common divisors - The Euclidean algorithm and continued fractions - Fundamental theorem of arithmetic.

Unit II CONGRUENCE **9**

Ring of congruence classes - Linear congruences - Euler's phi function - Chinese remainder theorem - Euler's and Fermat's theorem - Pseudoprimes and Carmichael numbers.

Unit III PRIMITIVE ROOTS AND QUADRATIC RECIPROCITY **9**

Polynomials and primitive roots - Primitive roots to composite moduli - Power residue - Quadratic residue - Quadratic reciprocity law.

Unit IV ERROR DETECTION, CORRECTION AND DECODING, FINITE FIELDS **9**

Communication channels - Maximum likelihood decoding - Hamming distance - Nearest neighbor/minimum distance decoding - Distance of a code - Fields - Polynomial rings - Structure of finite fields.

Unit V LINEAR CODES **9**

Vector spaces over finite fields - Linear codes - Hamming weight - Bases for linear codes - Generator matrix and Parity-check matrix - Equivalence of linear codes - Encoding with a linear code - Decoding of linear codes.

Text Book:

1. Melvyn B. Nathanson, "Methods in Number Theory", Springer, 2011.
2. San Ling and Chaoping Xing, "Coding Theory: A First Course", Cambridge University Press, 2015.
3. Van Lint J.H., "Introduction to Coding Theory", Springer, 3rd Edition, 2012.

Reference Book:

1. David M. Burton, "Elementary Number Theory", McGraw Hill Education, 7th Edition, 2017.
2. Ron M. Roth "Introduction to Coding Theory", Cambridge University Press, 2006.
3. Tom M. Apostol, "Introduction to Analytic Number Theory", Springer, 2010.
4. Mark S. Merkow and Jim Breithaupt, "Information Security: Principles and Practices", Pearson Education, 2nd Edition, 2014.

23CSH21 COMPUTER FORENSICS

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the fundamentals of Computer forensics and Data Acquisition.
- To understand the procedure for processing, analysis, and validation of digital evidence.
- To study the tools and techniques in File System Forensic analysis.
- To gain knowledge on Multimedia forensics, malware analysis and mobile device forensics.
- To become familiar with software and hardware tools
- To learn the tools and techniques in Network and E-mail Forensics

Course Outcome:

At the end of the course, the students will be able to

- Determine how to perform data acquisition.
- Analyze and validate evidences collected from various sources
- Explore the tools and techniques in File System Forensic analysis
- Perform multimedia forensics, malware forensics and mobile device forensics.
- Determine the needs of software tools and identify the issues in E-mail Forensics

Unit I INTRODUCTION, DATA ACQUISITION 9

An Overview of Digital Forensics - Preparing a Digital Forensics Investigation - Procedures for Private-Sector HighTech Investigations- Understanding Data Recovery Workstations and Software- Conducting an Investigation. Data Acquisitions: Understanding Storage Formats for Digital Evidence - Determining the Best Acquisition Method Contingency Planning for Image Acquisitions- Using Acquisition Tools- Validating Data Acquisitions- Performing RAID Data Acquisitions- Using Remote Network Acquisition Tools- Using Other Forensics Acquisition Tools.

Unit II EVIDENCE PROCESSING, DIGITAL FORENSICS ANALYSIS 9

Processing Crime and Incident Scenes: Digital evidence – Identification - Collecting Evidence in private sector incident scenes - Processing law enforcement crime scenes - Preparing for a search - Securing a digital incident - Seizing digital evidence - Storing digital evidence - Obtaining a digital hash - Reviewing a case. Digital Forensics Analysis and Validation: Determining What Data to Collect and Analyze- Validating Forensic Data- Addressing Data-Hiding Techniques.

Unit III FILE SYSTEM FORENSIC ANALYSIS 9

Examining File Systems: Disk Partitioning-Volume Analysis- Examine FAT File Systems- Deleted File Recovery in FAT File Systems -Examining NTFS File Systems- Deleted File Recovery in NTFS File Systems-File Carving: Principles of File Carving-File Carving Tools- File Signature Searching Forensics-Key word Forensics: Forensic Keyword Searching Process- Timeline Analysis: Principles of Timeline Analysis-Timeline Analysis Process-Forensic Timeline Analysis Tools-Data Hiding Detection.

Unit IV MULTIMEDIA FORENSICS, MALWARE ANALYSIS AND MOBILE DEVICE FORENSICS 9

Digital Image Processing Fundamentals-Image Forgery Detection- Steganography and Steganalysis Basics Steganography Techniques and Tools- Malware Analysis: Malware, Viruses and Worms-Essential Skills and Tools for Malware Analysis-Malware Tools and Techniques- Mobile Phone Fundamentals- Mobile Device Forensic Investigation- Subscriber Identification Module- SIM Architecture, Security, Evidence Extraction.

Unit V SOFTWARE AND HARDWARE TOOLS, NETWORK FORENSICS AND E-MAIL FORENSICS 9

Building a Forensics Workstation: The Sleuth Kit and Autopsy Forensic Browser- Validating and Testing Forensics Software, Network Forensics Overview, Performing Live Acquisitions, The HoneyNet project, E-mail Forensics: Role of E-mail in investigations. Role of Client and Server In E-mail Crimes, Investigating E-mail Crimes and Violations, Understanding E-mail Servers, Using Specialized E-mail Forensics Tools.

Text Book:

1. Nelson, Phillips, Steuart, “Computer Forensics and Investigations”, Cengage Learning, Sixth Edition, 2018.
2. Xiaodong Lin,” Introductory Computer Forensics-A Hands on Practical Approach”, Springer 2018.

Reference Book:

1. Dejey, Murugan, “Cyber Forensics”, Oxford University Press, 2018.
2. John R. Vacca, “Computer Forensics”, Firewall Media, New Delhi, 2009.
3. Cory Altheide, Harlan Carvey,” Digital Forensics with Open Source Tools”, Syngress, 2011.
4. Marjie T Britz,” Computer Forensics and Cyber Crime An Introduction”, Pearson, Third Edition, 2013.
5. Thomas J Holt, Adam M Bossler and Kathryn C. SeigFried-Spellar, ”Cyber Crime and Digital Forensics An Introduction”, Routledge, Second Edition, 2018.
6. William J Buchanan,” Introduction to Security and Network Forensics”, CRC Press, 2011.
7. Nihad Ahmad and Hassan, Rami Hijazi,” Data Hiding Techniques in Windows OS A practical approach to investigation and Defense”, Elsevier 2017.

8. Keith J. Jones, Richard Bejtlich, Curtis W. Rose, “Real Digital Forensics”, Addison Wesley Pearson Education, 2005.
9. Christopher L.T. Brown, “Computer Evidence – Collection & Preservation”, Firewall Media, Second Edition, 2009 .
10. Jesus Mena, “Homeland Security – Techniques & Technologies”, Firewall Media, 2007.
11. Robert M. Slade, “Software Forensics Collecting Evidence from the scene of a Digital Crime”, Tata McGraw Hill, 2005.
12. Chad Steel, “Windows Forensics”, Wiley India Edition, 2006.
13. Harlan Carvey, ”Windows Forensics Analysis”, Syngress 2007.
14. Fernando Carbone, “Computer Forensics with FTK”, Packt Publishing, 2014.

Extensive Reading:

- http://www.cyberforensics.in
- http://www.sans.org/course/computer-forensic-investigations-windows-in-depth
- http://www.cftt.nist.gov/
- https://www.emailforensictool.com
- https://prodiscover.com/
- https://www.autopsy.com/

23CSH22 INTRUSION DETECTION AND PREVENTION SYSTEM

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the state of the art of intrusion detection system
- To design and implement Intrusion Detection System
- To understand the classes of attacks on computer systems
- To identify various types of IDS of signature based and anomaly-based techniques to solve problems related to intrusion detection and prevention.
- To employ ID&PS specific feature extraction techniques

Course Outcome:

At the end of the course, the students will be able to

- Realize the principles of anomaly detection and its types
- Categorize the various IDS technologies for effective network security
- Identify the components and architectures of IDS/IPS and their security capabilities.
- Explore different network architectures and agent locations for IDPS deployment.
- Explore IDS tools such as Snort to secure the network

Unit I INTRUSION DETECTION SYSTEMS PRINCIPLES 9

History of Intrusion detection, Audit, Concept and definition, Internal and external threats to data, attacks, Key functions of IDPS technologies - Common Detection methodologies-Signature & Anomaly based Detection, Stateful protocol analysis Types of IDS, Information sources Host based information sources, Network based information sources.

Unit II IDS TECHNOLOGIES 9

Components & Architecture-Typical components, Network Architectures Security capabilities - Information gathering capabilities, logging capabilities, detection & prevention capabilities. Intrusion Prevention Systems, Network protocol based IDS, Hybrid IDS, Analysis schemes, thinking about intrusion. A model for intrusion analysis, techniques Responses requirement of responses, types of responses mapping responses to policy Vulnerability analysis, credential analysis non credential analysis

Unit III NETWORK BASED IDS 9

Networking Overview- OSI layers. Components and Architecture - Typical components, Network architectures and sensor locations. Security capabilities Wireless IDPS – Wireless Networking overview- WLAN standards & components. Components Network Behaviour analysis system.

Unit IV HOST BASED IDS 9

Components and Architecture-Typical components, Network architectures, Agent locations, host architectures. Security capabilities-Logging, detection, prevention and other capabilities. Using & Integrating multiple IDPS technologies-Need for multiple IDPS technologies, Integrating different IDPS technologies-Other technologies with IDPS capabilities, Anti – malware technologies, Firewalls and Routers, Honeypots.

Unit V IDS TOOL : SNORT IDS 9

Introduction to Snort, Working with Snort Rules, Snort configuration, Snort with MySQL, Running Snort on Multiple Network Interfaces, Snort Modes Snort Alert Modes, Snarf with Snort, Agent development for intrusion detection, Architecture models of IDS and IPS.

Text Book:

1. Karen Scarfone,Peter Mell, “Guide to Intrusion Detection and Prevention Systems (IDPS)", NIST special publication, 2007
2. Carl Endorf, Eugene Schultz and Jim Mellander, “Intrusion Detection & Prevention”, Tata McGraw-Hill, 1st Edition,2006

Reference Book:

1. Christopher Kruegel,Fredrik Valeur, Giovanni Vigna , “Intrusion Detection and Correlation Challenges and Solutions”, 1st Edition, Springer, 2005.
2. Kerry J Cox , Christopher Gerg," Managing Security with Snort and IDS Tools", O’Reilly, 2007.
3. Rafeeq Rehman, “Intrusion Detection with SNORT, Apache,MySQL, PHP and ACID” , 1st Edition, Prentice Hall , 2003.
4. Stephen Northcutt, Judy Novak, “Network Intrusion Detection”, 3rd Edition, New Riders Publishing, 2002.

Extensive Reading:

- https://www.juniper.net/documentation/us/en/software/junos/idp-policy/topics/topic-map/security-idp-overview.html
- https://www.paloaltonetworks.com/cyberpedia/what-is-an-intrusion-detection-system-ids
- https://www.fortinet.com/blog/threat-research

23CSH23 CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study basics of blockchain and understand how blockchain works technology.
- To get familiarity with concept of cryptocurrency currencies and Bitcoin.
- To learn the smart contract and Ethereum in blockchain.
- To gain knowledge on Hyperledger frameworks and solidity.
- To implement private and public Blockchain, and smart contract.

Course Outcome:

At the end of the course, the students will be able to

- Explore the working of Blockchain technology.
- Identify major research challenges and technical gaps in crypto currency domain.
- Explore the foundations of smart contract in Blockchain.
- Experiment Ethereum block chain contract using solidity programming.
- Analyse blockchain smart contract in applications.

Unit I INTRODUCTION **9**

Blockchain – Blockchain Solutions- Components of Blockchain – Block in blockchain: Blockchain Transaction-Double spending – Blockchain layers – Pros and Cons of Blockchain - Decentralization and Distribution - Types of blockchain – Consensus Protocol.

Unit II CRYPTOCURRENCY AND BITCOIN **9**

Introduction: Cryptocurrency basics -Types of cryptocurrency-Cryptocurrency Usage. Bitcoin Protocol: Bitcoin P2P Network, characteristics of Bitcoin - Bitcoin Mining – Proof of Work (PoW) - Block Propagation and delay - Bitcoin Script -Transactions in bitcoin.

Unit III SMART CONTRACT AND ETHEREUM **9**

Smart Contract: Smart contract example- How smart contract works – Characteristics – Types of Smart Contract - Ethereum Introduction to Ethereum Components – Mining – Merkle Tree – Architecture of Ethereum – Architecture of Ethereum – Workflow – Ethereum Virtual Machine (EVM) - Bitcoin Vs Ethereum- MetaMask Setup, Ethereum Accounts, Transactions, Receiving Ethers, Smart Contracts.

Unit IV HYPERLEDGER AND SOLIDITY PROGRAMMING **9**

Introduction to Hyperledger, Distributed Ledger Technology & its Challenges, Hyperledger & Distributed Ledger Technology, Hyperledger Fabric, Hyperledger Composer. Solidity - Language of Smart Contracts, Installing Solidity & Ethereum Wallet, Basics of Solidity.

Unit V BLOCKCHAIN APPLICATIONS **9**

Internet of Things – Health Record Management System – Blockchain in Education - Blockchain Use cases – Banking and Finance.

Text Book:

1. Chandramouli Subramanian, Asha A George, Abhilash K A and Meena Karthikeyan, “Blockchain Technology”, University Press, 2021.

Reference Book:

1. Narayanan, J. Bonneau, E. Felten, A. Miller, S. Goldfeder, “Bitcoin and Cryptocurrency Technologies: A Comprehensive Introduction”, Princeton University Press, 2016.
2. Imran Bashir, “Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained”, Packt Publishing, Second Edition, 2018.

Extensive Reading:

- NPTEL online course: https://nptel.ac.in/courses/106/104/106104220/#
- https://www.techopedia.com/how-to/how-to-set-up-a-metamask-wallet
- https://remix-project.org/
- https://www.udemy.com/course/build-your-blockchain-az/

23CSH24 ETHICAL HACKING

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explore the concepts of security testing and the knowledge required to protect against the hacker and attackers.
- To understand reconnaissance and the publicly available tools used to gather information on potential targets.
- To discover the scanning techniques used to identify network systems open ports.
- To identify network system vulnerabilities and confirm their exploitability.
- To explore techniques for identifying web application vulnerabilities and attacks.

Course Outcome:

At the end of the course, the students will be able to

- Familiarize various security tools to assess and predict the vulnerabilities across any computing system using penetration testing.
- Identify prediction mechanism to prevent any kind of attacks using information gathering mechanisms.
- Protect the system using scanning techniques from malicious software and worms.
- Evaluate the wireless network flaws and able to apply security patches with different exploitations.
- Analyse the risk and support the organization for effective security measures

Unit I INTRODUCTION TO HACKING AND PENETRATION TESTING 9

Introduction to Hacking – Need for Security - Important Terminologies – Hacktivism – Computer Crimes and Implications – Legal Perspective (US Federal Law). Penetration Test – Vulnerability Assessments versus Penetration Test – Pre-Engagement – Rules of Engagement – Penetration Testing Methodologies: OSSTMM – NIST – OWASP – Categories of Penetration Test – Types of Penetration Tests – Vulnerability Assessment Summary – Reports

Unit II INFORMATION GATHERING AND SCANNING 9

Information Gathering Techniques: Active Information Gathering – Passive Information Gathering – Sources of Information Gathering – Tracing the Location – Trace route: ICMP, TCP and UDP Trace route – Enumerating and Fingerprinting the Web servers – Google Hacking – Enumerating SNMP – SMTP Enumeration – Target Enumeration and Port Scanning Techniques – Advanced Firewall/IDS Evading Techniques.

Unit III NETWORK ATTACKS 9

Network Sniffing – Types of Sniffing – Promiscuous versus Nonpromiscuous Mode – MITM Attacks – ARP Attacks – MAC flooding - Denial of Service Attacks – Hijacking Session with MITM Attack – SSL Strip: Stripping HTTPS Traffic – DNS Spoofing – ARP Spoofing Attack Manipulating the DNS Records – DHCP Spoofing – Remote Exploitation – Attacking Network Remote Services – Attacking SMTP – Attacking SQL Servers – Testing for Weak Authentication.

Unit IV EXPLOITATION 9

Introduction to Metasploit – Reconnaissance with Metasploit – Port Scanning with Metasploit – Compromising a Windows Host with Metasploit – Client Side Exploitation Methods – E–Mails with Malicious Attachments – PDF Hacking – Social Engineering Toolkit – Browser Exploitation – Post–Exploitation – Cracking the Hashes: Brute force Dictionary Attacks – Password Salts – Rainbow Tables – John the Ripper – Gathering OS Information – Harvesting Stored Credentials.

Unit V WIRELESS AND WEB HACKING 9

Wireless Hacking – Introducing Aircrack– Cracking the WEP – Cracking a WPA/WPA2 Wireless Network Using Aircrack-ng – Evil Twin Attack – Causing Denial of Service on the Original AP – Web Hacking – Attacking the Authentication – Brute Force and Dictionary Attacks – Log-In Protection Mechanisms – Captcha Validation Flaw – Captcha RESET Flaw – Manipulating User-Agents to Bypass Captcha and Other Protection – Authentication Bypass Attacks – Testing for the Vulnerability – Automating It with Burp Suite – Session Attacks – SQL Injection Attacks – XSS (Cross-Site Scripting) – Types of Cross-Site Scripting – Cross-Site Request Forgery (CSRF) – SSRF Attacks.

Text Book:

1. Rafay Baloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.
2. Kimberly Graves, “Certified Ethical Hacker study guide”, Wiley publication, 2010.

Reference Book:

1. Kevin Beaver, “Ethical Hacking for Dummies”, Sixth Edition, Wiley, 2018.
2. Michael Gregg, Certified Ethical Hacker, Pearson publication, 2014.
3. Matt Walker, All-in-one Certified Ethical Hacker Exam Guide, McGraw Hill Edition, 2012.
4. Jon Erickson, “Hacking: The Art of Exploitation”, Second Edition, Rogunix, 2007.

Extensive Reading:

- http://ptgmedia.pearsoncmg.com/images/9780789751270/samplepages/9780789751270.pdf
- https://cert.eccouncil.org/images/doc/CEH-Handbook-v2.0.pdf

23MAH92 MATHEMATICS FOR DATA SCIENCE

Offered by MAT (Emerging Area Course offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To describe the life cycle of Data Science and computational environments for data scientists using Python.
- To describe the fundamentals for exploring and managing data with Python
- To examine the various data analytics techniques for labeled/columnar data using Python
- To demonstrate a flexible range of data visualizations techniques in Python
- To describe the various Machine learning algorithms for data modeling with Python

Course Outcome:

At the end of the course, the students will be able to

- Identify phases involved in the life cycle of Data Science
- Preprocess and manage the data for efficient storage and manipulation in Python
- Realize the various data analytics techniques for labeled/columnar Data using Python Pandas
- Explore a flexible range of data visualizations approaches in Python.
- Analyze various Machine learning algorithms for data modeling with Python

Unit I INTRODUCTION TO DATA SCIENCE 9

Introduction to Data Science and its importance - Data Science and Big data-, The life cycle of Data Science- The Art of Data Science - Work with data – data Cleaning, data Munging, data manipulation. Establishing computational environments for data scientists using Python with IPython and Jupyter.

Unit II TOWARDS DATA SCIENCE USING NUMPY 9

Understanding Data Types in Python - The Basics of NumPy Arrays - Computation on NumPy Arrays: Universal Functions - Aggregations: Min, Max, and Everything in Between Computation on Arrays: Broadcasting-Comparisons, Masks, and Boolean Logic Fancy Indexing-Sorting Arrays

Unit III DATA MANIPULATION WITH PANDAS 9

Installing and Using Pandas, Introducing Pandas Objects,Data Indexing and Selection. Operating on Data in Pandas, Handling Missing Data, Hierarchical Indexing Combining Datasets: Concat and Append, Combining Datasets: Merge and Join. Aggregation and Grouping, Pivot Tables, Vectorized String Operations, Working with Time Series.

Unit IV DATA VISUALIZATION WITH MATPLOTLIB 9

General Matplotlib Tips, Simple Line Plots, Simple Scatter Plots, Visualizing Errors Density and Contour Plots, Histograms, Binnings, and Density, Customizing Plot Legends Customizing Colorbars, Multiple Subplots, Text and Annotation, Customizing Ticks Customizing Matplotlib: Configurations and Stylesheets, Geographic Data with Basemap.

Unit V MACHINE LEARNING USING PYTHON 9

Intro Machine Learning: Categories of Machine Learning algorithms, Dimensionality reduction-Introducing Scikit-Application: Exploring Hand-written Digits. Feature Engineering- Naive Bayes Classification - Linear Regression - k-Means Clustering.

Text Book:

1. Python Data Science Handbook-Essential Tools for Working with Data, Jake Vander Plas, O'Reilly Media, 2016.
2. Data Science from Scratch: First Principles with Python, Joel Grus, O'Reilly, 2015.

Reference Book:

1. Python for Data Analysis, Wes Mckinney, O'Reilly Media, 2013.
2. Field Cady, "Data Science Hand Book", John Wiley & Sons, 2017.
3. Fundamentals of Data Science, Samuel Burns, Amazon KDP printing and Publishing, 2019.
4. Doing Data Science, Straight Talk From The Frontline, Cathy O'Neil and Rachel Schutt. O'Reilly. 2014.
5. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, "Practical Data Science Cookbook", Packt Publishing Ltd., 2014.
6. Nathan Yau, "Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics", Wiley, 2011.
7. Shai Vaingast, "Beginning Python Visualization Crafting Visual Transformation Scripts", Apress, 2nd edition, 2014.

Extensive Reading:

- https://onlinecourses.nptel.ac.in/noc18_cs28/
- http://bigdatauniversity.com/
- http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction

23CSH41 DATA MINING AND ANALYTICS

Offered by CSE (Emerging Area Course offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the basic concepts of pattern discovery and data preparation
- To understand the importance of Association and Correlation Algorithms
- To comprehend and apply various Classifiers
- To work with the foundation for Clustering
- To perform Outlier Analysis and Explore a data mining tool

Course Outcome:

At the end of the course, the students will be able to

- Apply the preprocessing technique before mining of data for patterns.
- Make use of Association and Correlations Algorithms for framing association rules.
- Apply as well as Compare the performance of various classifiers.
- Utilize different Clustering algorithms for generalization.
- Explore different data mining tool to Identify Outliers in the data given.

Unit I DATA MINING INTRODUCTION **9**

Introduction: Kinds of Data - Kinds of Patterns - Data Objects and Attribute Type - Data Visualization - Data Preprocessing: Data cleaning, Data Integration, Data Transformation - Data Discretization and Data Reduction: Attribute Subset Selection-Histograms, Clustering, Sampling.

Unit II ASSOCIATIONS AND CORRELATIONS **9**

Market Basket Analysis –Apriori Algorithm – Mining Frequent Itemsets without Candidate Generation – Mining Frequent Itemsets Using Vertical Data Format – Mining Closed Frequent Itemsets – Mining Multilevel Association Rules – Mining Multidimensional Association Rules – Correlation Analysis – Constraint-Based Association Mining.

Unit III CLASSIFICATION AND PREDICTION **9**

Basic Concepts - Decision Tree Induction - Attribute selection Measures-ID3 and CART algorithms, Tree Pruning-Bayes Classification Methods: Bayes' Theorem, Naive Bayesian Classification - Classification by Backpropagation - Support Vector Machines - Lazy learners: KNN-Metrics for evaluating classifier performance - Techniques to improve classification accuracy - Prediction: Regression Analysis.

Unit IV CLUSTER ANALYSIS **9**

Cluster Analysis: Partitioning Methods - Hierarchical Methods: Agglomerative versus Divisive Hierarchical Clustering - Probabilistic Model based Clustering - BIRCH, DBSCAN, STING, CLIQUE Techniques - Evaluation of clustering Techniques.

Unit V OUTLIERS AND STATISTICAL APPROACHES IN DATA MINING **9**

Introduction to outliers, Challenges in detecting Outliers,Outlier Detection Methods - Supervised, Semisupervised, Unsupervised- Statistical Data Mining approaches - Data mining in Recommender Systems,Data mining for Intrusion Detection, Data Mining for Financial Analysis.

Text Book:

1. Jiawei Han and Micheline Kamber, “Data Mining: Concepts and Techniques”, Morgan KaufmannvPublishers, Third edition, 2011.
2. Ian H.Witten, Eibe Frank, Mark A Hall, Christopher J Pal, “Data Mining-Practical Machine Learning Tools and Techniques”, Morgan Kaufmann Publishers, 4th Edition, 2016.

Reference Book:

1. G. K. Gupta, “Introduction to Data Mining with Case Studies”, Easter Economy Edition, Prentice Hall of India, 2006
2. Mehmed Kantardzic, “Data mining concepts, models, methods and algorithms”, Wiley Inderscience, 2003
3. George M Marakas, Modern Data Warehousing, Mining and Visualization, Prentice Hall, 2003

Extensive Reading:

- https://www.javatpoint.com/data-mining
- https://www.tutorialspoint.com/data_mining/index.htm
- https://www.geeksforgeeks.org/data-analysis-tutorial/
- https://careerfoundry.com/en/tutorials/data-analytics-for-beginners/introduction-to-data-analytics/

23CSH42 DATA SCIENCE FOR ENGINEERS

Offered by CSE (Emerging Area Course offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To comprehend the idea of real-time data representations
- To learn and describe the data for the data science process
- To acquire knowledge about classification and regression models
- To examine the mathematical grounds for data engineering techniques
- To illustrate the many industrial prospects for data science

Course Outcome:

At the end of the course, the students will be able to

- Recognize the facts and data from real-world sources.
- Analyze the data science process
- Use mathematical abilities and machine learning models to depict the pertinent facts
- Ravel the mathematical preliminaries for data engineering
- Elucidate many industry prospects and utilize data modelling for practical applications.

Unit I INTRODUCTION TO DATA SCIENCE 9

Introduction to Data Science – History of Data Science – Relationship between Data Warehouse – Big Data and Data Science –Scope of Data Science – Data Science with other fields – Relationship between Data Science and Information Science. Data: Data Types-Structured Vs. Unstructured data – Quantitative vs. Qualitative data-The four Levels of Data-Data Collection-Data Pre-Processing- Roles and Responsibilities of a data scientist- Data Science concerns.

Unit II DESCRIBING DATA I 9

Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability – range – variance – standard deviation – degrees of freedom – interquartile range – variability for qualitative and ranked data

Unit III DESCRIBING DATA II 9

Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – scatter plots – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2 – multiple regression equations – regression toward the mean

Unit IV INFERENTIAL STATISTICS 9

Populations – samples – random sampling – Sampling distribution- standard error of the mean -Hypothesis testing – z-test – z-test procedure -decision rule – calculations – decisions -interpretations – one-tailed and two-tailed tests – Estimation – point estimate – confidence interval -level of confidence – effect of sample size.

Unit V DATA ANALYTICS, ETHICS AND APPLICATIONS 9

Data analytics – methodologies - CRISP-DM Methodology - SEMMA - Big data life cycle - SMAM - ASUM- DM- Ethical guidelines for Data Scientist – Data Science concerns - Data Privacy and Legal aspects - Rightful use of data science- Applications-Bioinformatics-Education-Engineering-Finance and Economy-Gaming.

Text Book:

1. Chirag Shah, “A Hands-on Introduction to Data Science”, Cambridge University Press, 2020.
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2020.

Reference Book:

1. Nina Zumel, John Mount, “Practical Data Science with R”, dreamtech press, Reprint Edition, 2015.
2. Anand Rajaraman, Juriji Leskovec and Jeffrey Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2012.
3. Foster Provost, Tom Fawcett, “Data Science for Business: What You Need to Know about Data Mining and Data-analytic Thinking”, O’Reilly Media, First Edition, 2013.
4. Trevor Hastie, Robert Tibshirani, Jerome Friedman, “The Elements of Statistical Learning: Data Mining, Inference and Prediction”, Springer, Second Edition, 2008.

Extensive Reading:

- https://www.youtube.com/watch?v=eo2CSgmfO2I 2.
- http://research.microsoft.com/en-us/people/navingo/e0-229.aspx
- http://columbiadatascience.com/about-the-class/
- https://www.coursera.org/course/datasci

23CSH43 PROGRAMMING FOR DATA SCIENCE

Offered by CSE (Emerging Area Course offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To understand the techniques and processes of data science
- To demonstrate the advanced data analytics techniques using R
- To examine the basic data science tasks in Python
- To visualize data with Matplotlib
- To examine various Machine Learning algorithms for Data modeling

Course Outcome:

At the end of the course, the students will be able to

- Identify various techniques to process and manage the data
- Realize the various data analytics techniques in R
- Apply the fundamental data science tasks for data manipulation in Python
- Visualize the data using Matplotlib
- Explore the various Machine Learning algorithms for Data modeling and work with machine leaning frameworks.

Unit I INTRODUCTION **8**

Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleansing, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

Unit II DATA SCIENCE USING R **9**

Overview of R - R data types and objects - Data Transformation with dplyr: filters, select, Adding new variables - Exploratory Data Analysis: variation, Missing variables, covariation - Functions in R, Vectors. Tibbles with tibble, Data Import with readr, Tidy Data with tidyr Spreading, Gathering, Separating and Pull, Missing values, Relational Data with dplyr: Join operation. Strings with stringr, Dates and Times with lubridate, Model Basics with modelr.

Unit III DATA SCIENCE USING PYTHON **10**

Understanding Data Types in Python-The Basics of NumPy Arrays - Computation on NumPy Arrays: Aggregations: Min, Max, and Everything in Between Computation on Arrays: Broadcasting-Comparisons, Masks, and Boolean Logic Fancy Indexing-Sorting Arrays - Installing and Using Pandas - Introducing Pandas Objects - Data Indexing and Selection - Operating on Data in Pandas - Handling Missing Data - Hierarchical Indexing Combining Datasets: Concat and Append, Combining Datasets: Merge and Join - Aggregation and Grouping

Unit IV DATA VISUALIZATION WITH MATPLOTLIB **9**

General Matplotlib Tips - Simple Line Plots - Simple Scatter Plots - Visualizing Errors Density and Contour Plots, Histograms - Binnings, and Density - Customizing Plot Legends Customizing Colorbars - Multiple Subplots - Text and Annotation - Customizing Ticks - Customizing Matplotlib: Configurations and Stylesheet - Geographic Data with Basemap.

Unit V MACHINE LEARNING FOR DATA SCIENCE **9**

Intro Machine Learning: Categories of Machine Learning algorithms - Naive Bayes Classification- Regression - K Nearest neighbor algorithm - Clustering algorithm - Data collection - Modeling / Machine learning: Refining algorithms - Building training sets - Dealing with outliers - Change or remove outliers - Common machine leaning framework: Brainstorm, Apache SINGA - Theano,Accord.NET,Apache Mahout.

Text Book:

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016.
2. Field Cady, The Data Science Handbook, John Wiley & Sons,2017.
3. Hadley Wickham and Garrett Grolemund, R for Data Science, O’Reilly Media, 2016.
4. Jake Vande rPlas, Python Data Science Handbook- Essential Tools for Working with Data, O'Reilly Media, 2016.

Reference Book:

1. Joel Grus, Data Science from Scratch: First Principles with Python, O'Reilly, 2015.
2. Pierre-Andre Cornillon, Arnaud Guyader et al. “R for Statistics”, CRC Press, First Edition 2015.
3. Tony Ojeda, Sean Patrick Murphy, Benjamin Bengfort, Abhijit Dasgupta, “Practical Data Science Cookbook”, Packt Publishing Ltd., 2014.
4. Jure Leskovec, Anand Rajaraman, Jeffrey D. Ullman, “Mining of Massive Datasets”, Cambridge University Press, 2014.
5. Mark Gardener, “Beginning R - The Statistical Programming Language”, John Wiley & Sons, Inc., 2012.
6. W. N. Venables, D. M. Smith and the R Core Team, “An Introduction to R”, 2013.
7. Nathan Yau, “Visualize This: The Flowing Data Guide to Design, Visualization, and Statistics”, Wiley, 2011.
8. ShaiVaingast, “Beginning Python Visualization Crafting Visual Transformation Scripts”, Apress, 2nd edition, 2014.

Extensive Reading:

- https://onlinecourses.nptel.ac.in/noc18_cs28/
- http://www.johndcook.com/R_language_for_programmers.html
- http://bigdatauniversity.com/
- http://home.ubalt.edu/ntsbarsh/stat-data/topics.htm#rintroduction

23CSH44 BIG DATA ANALYTICS USING SPARK

Offered by CSE (Emerging Area Course offered to BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To explore the basics of Apache Spark and deploy spark.
- To perform various basic operations on RDDs.
- To work with storage functions and use external programs to process data in Spark RDDs.
- To use Spark in NoSQL and SQL applications.
- To develop real time event processing system and make better decisions using machine learning.

Course Outcome:

At the end of the course, the students will be able to

- Deploy Spark and provide a fully functional programming and runtime environment.
- Work with basic operations on RDDs.
- Apply suitable storage functions for program optimization, durability, and process data.
- Develop NoSQL and SQL applications using Spark.
- Apply spark streaming and machine learning techniques.

Unit I BIG DATA ANALYTICS AND SPARK FOUNDATIONS 9

Introduction to Big Data: Characteristics – Evolution – Definition – Challenges with Big Data – Other Characteristics of Data – Why Big Data – Traditional Business Intelligence versus Big Data – Data Warehouse and Hadoop Environment.

Big Data Analytics: Classification of Analytics – Challenges – Terminologies used in Big Data Environments.

Apache Spark – Functional Programming using Python – Spark Deployment Modes – Deploying Multi-node Spark standalone cluster – Overview of Cloud - Deploying Spark in the Cloud.

Unit II SPARK ARCHITECTURE AND PROGRAMMING BASICS 9

Anatomy of Spark Application – Spark Applications using standalone scheduler – Deployment modes for spark applications running on YARN – RDDs – Loading data into RDDs – Operations on RDDs.

Unit III ADVANCED PROGRAMMING 9

Shared variables – Partitioning Data – RDD storage options – Processing RDDs – Data Sampling – Cluster Configuration – Optimizing Spark.

Unit IV SQL AND NOSQL PROGRAMMING 9

Spark SQL: HIVE - Spark SQL architecture – DataFrames: caching, persisting, repartitioning, saving DataFrame output – Accessing and using Spark. Spark with NoSQL: NoSQL – HBase – Cassandra – DynamoDB.

Unit V STREAMING, DATA SCIENCE AND MACHINE LEARNING 9

SPARK streaming – Structured streaming – Spark KAFKA. Machine Learning with Spark – Machine Learning Primer – Machine Learning using Spark MLlib: classification, collaborative filtering, implementing recommender.

Text Book:

1. Jeffrey Aven, “Data and Analytics with Spark Using Python”, Pearson Education Inc., 2018.

Reference Book:

1. Seema Acharya, Subhashini Chellappan, “Big Data and Analytics”, Wiley Publications, First Edition, 2015
2. Judith Huruwitz, Alan Nugent, Fern Halper, Marcia Kaufman, “Big data for dummies”, John Wiley & Sons, Inc. (2013)
3. Paul Zikopoulos, “Understanding Big Data: Analytics for Enterprise Class Hadoop and Streaming Data, McGraw Hill 2012
4. Wenqiang Feng, "Learning Apache Spark with Python", 2020.
5. Mike Frampton, “Mastering Apache Spark”, Fourth Edition, O’Reilly Publications, 2015.
6. Holden Karau, Andy Konwinski, Patrick Wendell and Matei Zaharia, “Learning Spark”, O’Reilly Media, Inc., 2015.

Extensive Reading:

- https://spark.apache.org/docs/latest/quick-start.html
- https://www.edureka.co/blog/spark-tutorial/
- https://data-flair.training/blogs/spark-tutorial/
- https://towardsdatascience.com/a-neanderthals-guide-to-apache-spark-in-python-9ef1f156d427/
- https://www.tutorialspoint.com/pyspark/index.htm
- https://supergloo.com/spark-tutorial/spark-tutorials-python/#Spark_Tutorials_WithPython

23ITH01 CRYPTOGRAPHY AND HASHING

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- To introduce the fundamental concepts and techniques in cryptography and network security
- To illustrate the working principles of various Symmetric Ciphers
- To explore knowledge on Asymmetric Ciphers
- To learn the various Hash function
- To realize the Construction

Course Outcome:

At the end of the course, the students will be able to

- Apply essential mathematical concepts to Cryptography and identify the vulnerabilities in Classical cryptosystems
- Experiment Symmetric-Key cipher algorithms
- Apply Asymmetric-Key Cryptographic techniques
- Manipulate the Hash function
- Demonstrate cryptographic Hash function to real-time applications

Unit I INTRODUCTION **9**

Computer Security Concepts- OSI Security Architecture- Security Attacks- Security Services- Security Mechanisms- Model for Network Security- Classical Encryption Techniques- Symmetric Cipher Model- Substitution Techniques- Transposition Techniques- Rotor Machines- Stegnography- Basic Concepts in Number Theory and Finite Fields- Divisibility and the Division Algorithm- Euclidean Algorithm- Modular Arithmetic-Groups, Rings, and Fields- Finite Fields of the Form GF(p)

Unit II MODERN SYMMETRIC CIPHERS **9**

Block Ciphers and the Data Encryption Standard-Block Cipher Principles-The Data Encryption Standard (DES)-Strength of DES-Differential and Linear Cryptanalysis-Block Cipher Design Principles-Advanced Encryption Standard-Block Cipher Modes of Operation- Stream Ciphers-RC4

Unit III ASYMMETRIC CIPHERS **9**

Prime Numbers- Fermat's and Euler's Theorems- Testing for Primality- Chinese Remainder Theorem-Discrete Logarithms- Principles of Public-Key Cryptosystems- RSA Algorithm- Diffie-Hellman Key Exchange- ElGamal Cryptosystem- Elliptic Curve Arithmetic- Elliptic Curve Cryptography

Unit IV HASH FUNCTION **9**

Block cipher Based hash function - Non-Block cipher Based hash function - Design principles - Methods of Attack on Hash function

Unit V CONSTRUCTION **9**

Theoretic Construction - Hard bit and Pseudo random bit generation - strong one-way permutation - UOWHF Construction and PBG -Strong one-way permutation

Text Book:

1. William Stallings, “Cryptography and network Security”, Pearson, Sixth edition, 2013.
2. Alan G. Konheim, “Computer security & cryptography”, John Wiley & Sons, 2007.
3. Josef Pieprzyk Babak Sadeghiyan ,”Design of hashing Algoritms “,Springer-Verlag 1993

Reference Book:

1. Charles P. Pfleeger, Shari Lawrence Pfleeger, “Security in computing”, Prentice Hall of India, Third Edition, 2006.
2. Wade Trappe, Lawrence C Washington, “Introduction to Cryptography with coding theory”, Pearson, Second edition, 2007.
3. Behrouz A.Forouzan, “Cryptography and Network Security”, Tata McGraw Hill, 2010.
4. W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, Second Edition, 2007.

Extensive Reading:

- http://www.interhack.net/pubs/network-security/
- http://docs.sun.com/source/816-6154-10/
- http://www.cgi.com/cgi/pdf/cgi_whpr_35_pki_e.pdf
- http://en.wikipedia.org/wiki/RC4

23ITH02 INTRODUCTION TO DIGITAL CURRENCIES

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study the concepts of Bitcoins
- To study Bitcoin Client and Transactions
- To understand Bitcoin Network and Blockchain
- To understand Storage and Mining
- To study Alternative Chains

Course Outcome:

At the end of the course, the students will be able to

- Implement the basic element of Bitcoins
- Realize Bitcoin Client and Transactions
- Use Bitcoin Network and Blockchain
- Work with Mining techniques
- Work with alternate bitcoin techniques.

Unit I INTRODUCTION **9**

How Bitcoins works-Transactions, Blocks, Mining, and the Blockchain-Bitcoin Transactions-Constructing a Transaction-Bitcoin Mining-Mining transactions in blocks -Spending the transaction-Public key cryptography and crypto-currency-Bitcoin Addresses-Wallets

Unit II THE BITCOIN CLIENT AND TRANSACTIONS **9**

Bitcoin Core - The reference implementation-Using Bitcoin Core's JSON-RPC API from the command line-Alternative clients, libraries and toolkits-Transaction Lifecycle-Structure-Outputs and Inputs-Chaining and Orphan Transactions-Scripts and Script Language-Standard Transactions

Unit III BITCOIN NETWORK AND BLOCKCHAIN **9**

Peer-to-Peer Network Architecture-Nodes Types and Roles-The Extended Bitcoin Network-Network Discovery-Full Nodes-Simplified Payment Verification (SPV) Nodes-Bloom Filters and Inventory Updates-Transaction Pools-Blockchain-Structure of a Block-Block Header-Block Identifiers-Genesis Block-Linking Blocks in the Blockchain-Merkle Trees

Unit IV BITCOIN STORAGE AND MINING **9**

Simple Local Storage - Hot and Cold Storage - Splitting and Sharing Keys - Online Wallets and Exchanges - Payment Services - Transaction Fees - Currency Exchange Markets - Task of Bitcoin Miners – Mining Hardware – Energy Consumption and Ecology – Mining Pools – Mining Incentives and strategies – Anonymity Basics - De-anonymizeBitcoin– Mixing - Decentralized Mixing – Zerocoin and Zerocash

Unit V ALTCOINS **9**

Altcoins: History and Motivation – Few Altcoins - Relationship Between Bitcoin and Altcoins - Merge Mining - Atomic Cross-chain Swaps - Bitcoin-Backed Altcoins, "Side Chains" - Ethereum and Smart Contracts - The Block Chain as a Vehicle for Decentralization - Routes to Block Chain Integration - Template for Decentralization

Text Book:

1. Andreas M.Antonopoulos,"mastering bitcoins" o'reilly media, inc.,2014
2. Arvind Narayanan,"Bitcoin and Cryptocurrency Technologies" Princeton University Press,2016

Reference Book:

1. Chris Dannen, Introducing Ethereum and Solidity: Foundations of Cryptocurrency and Blockchain Programming for Beginners. Apress 2017
2. ChrisBurniske &jack Tatar, cryptoassets The Innovative Inverstor's Guide to Bitcoin and Beyond,McGraw-Hill,2018
3. S Shukla, M. Dhawan, S. Sharma and S. Venkatesan, "Blockchain Technology: Cryptocurrency and Ap.plications", Oxford University Press, 2019.
4. Josh Thompson, "Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming", Create Space Independent Publishing Platform, 2017

Extensive Reading:

- https://blockgeeks.com/guides/what-is-cryptocurrency/
- https://www.coinbase.com/learn
- https://bitcoin.org/en/how-it-works
- https://www.thebalance.com/altcoins-a-basic-guide-391206

23ITH03 BLOCKCHAIN TECHNOLOGIES

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To learn the various cryptography primitives used in blockchain.
- To study the design principles of blockchain.
- To understand the various consensus algorithms.
- To study the blockchain in networking.
- To learn the enhancements of blockchain technologies.

Course Outcome:

At the end of the course, the students will be able to

- Implement the required cryptography primitives for blockchain systems.
- Work with various blockchain design principles.
- Implement with various consensus algorithms.
- Equip networks with the various blockchain techniques.
- Work with blockchain optimization techniques.

Unit I CRYPTOGRAPHY IN BLOCKCHAIN 9

Blockchain Definitions – Blockchain versus Databases – History – Motivation – Characteristics – Types – Overview - Hashing in Blockchain – Linking blocks in blockchain – Linking blocks using SHA256 – Block structure – Blockchain functionality – Creating Blockchain – Byzantine failure problem in blockchain – Digital signatures in blockchain – Blockchain wallets

Unit II BLOCKCHAIN DESIGN PRINCIPLES 9

Networked Integrity – Distributed Power- Value as Incentive – Security – Privacy – Rights Preserved – Inclusion – Centralized Registries versus Distributed Ledgers – Public versus Private Ledgers – Transparency as a Strategic Risk – Transparency as a Strategic Asset - Zero Knowledge Proofs

Unit III CONSENSUS ALGORITHMS 9

Proof of Work – Pure Stake Based Consensus – Proof of Stake - Leased Proof of Stake – Delegated Proof of Stake – Hybrid Form of PoS and PoW – Practical Byzantine Fault Tolerance – Ripple –Tendermint – Proof of Elapsed Time – Proof of Activity – Proof of Burn – Hyperledger Fabric

Unit IV NETWORKING IN BLOCK CHAIN 9

Peer – to –peer Networking – Network Discovery – Block Synchronization – Building a simple Blockchain in P2P Network – Validating new Block – Selecting Longest chain – Block Exchange between Peers – Application Interfaces- Blockchain Networks – Testnet – Regtest – Blockchain in 5G – Blockchain in Social Networking – Blockchain for IoT

Unit V BLOCKCHAIN OPTIMIZATIONS AND ENHANCEMENTS 9

Blockchain Optimizations – Transaction Exchange – Off-chain Transactions – Block size improvements – Blockchain enhancements – Sharding – Evolution of consensus algorithm – Proof of Stake – Proof of Activity – Byzantine Fault Tolerance Consensus Models – Proof of Elapsed Time – Cross-chain Protocol – Privacy Enhancement – Blockchain Security – Transaction Security Model – Decentralized Security Model – Attacks on Blockchain

Text Book:

1. Koshik Raj, “Foundations of Blockchain”, Packt Publishers, 2019.

Reference Book:

1. S. Shukla, M. Dhawan, S. Sharma and S. Venkatesan, “Blockchain Technology: Cryptocurrency and Applications”, Oxford University Press, 2019.
2. Josh Thompson, “Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming”, Create Space Independent Publishing Platform, 2017.
3. Andreas M. Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, Oreilly Media, 1st Edition, 2014.
4. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. “Bitcoin and cryptocurrency technologies: a comprehensive introduction”, Princeton University Press, 2016.

Extensive Reading:

- https://www.coursera.org/learn/cryptocurrency#syllabus
- https://www.coursera.org/learn/wharton-cryptocurrency-blockchain-introduction-digital-currency
- https://www.coursera.org/learn/blockchain-basics

23ITH04 SMART CONTRACTS AND DECENTRALIZED APPLICATIONS

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- Understand how "wallets" hold digital keys that control funds and smart contracts
- Interact with Ethereum clients programmatically using JavaScript libraries and Remote Procedure Call interfaces
- Learn security best practices, design patterns, and anti-patterns with real-world examples
- Interact with Ethereum clients programmatically using JavaScript libraries and Remote Procedure Call interfaces

Course Outcome:

At the end of the course, the students will be able to

- Use "wallets" for holding digital keys that control funds and smart contracts
- Analyze Smart Contracts with Solidity and Vyper
- Create tokens that represent assets, shares, votes, or access control rights
- Build decentralized applications using multiple peer-to-peer (P2P) components
- Implement distributed ledgers with Hyperledger

Unit I WALLET AND TRANSACTIONS **9**

Wallet Technology Overview - Nondeterministic (Random) Wallets - Deterministic (Seeded) Wallets - Hierarchical Deterministic Wallets - Seeds and Mnemonic Codes - Wallet Best Practices. Transaction – Structure - Transaction Nonce - Transaction Gas - Transaction Recipient - Transaction Value and Data - Special Transaction: Contract Creation - Digital Signatures - The Signature Prefix Value and Public Key Recovery - Separating Signing and Transmission - Transaction Propagation

Unit II SMART CONTRACTS **9**

Smart Contract - Life Cycle - Ethereum High-Level Languages - Building a Smart Contract with Solidity - The Ethereum Contract ABI - Programming with Solidity - Contract Definition - Functions - Contract Constructor and selfdestruct - Function Modifiers - Contract Inheritance - Error Handling - Events - Calling Other Contracts - Gas Considerations. Smart Contracts and Vyper : Vulnerabilities and Vyper - Comparison to Solidity - Decorators - Function and Variable Ordering - Compilation - Protecting Against Overflow Errors at the Compiler Level - Reading and Writing Data

Unit III TOKENS **9**

Tokens - Use - Tokens and Fungibility - Counterparty Risk - Tokens and Intrinsicality - Utility or Equity - Tokens on Ethereum - Token Standards - Extensions to Token Interface Standards - Tokens and ICOs

Unit IV DECENTRALIZED APPLICATIONS **9**

Decentralized Applications (DApps) - Basic DApp Example - Decentralizing the DApp - Storing the Auction DApp on Swarm - The Ethereum Name Service (ENS) - History - Specification - Bottom Layer - Middle Layer - Top Layer - Registering a Name - Managing Your ENS Name - ENS Resolvers - Resolving a Name to a Swarm Hash - from App to DApp

Unit V DISTRIBUTED LEDGERS WITH HYPERLEDGER **9**

Exposing Network Assets and Transactions - Building a complete application - Integration with existing systems and processes - Business Networks - Defining business networks - Introducing participants - assets – transactions - Discussing events from the perspective of designing a business network using Composer - Implementing a business network - Business Network Example - letter of credit sample - Analyzing the letter of credit process - description of the business network - model of the business network - Examining the live network - Creating business network APIs

Text Book:

1. Andreas M. Antonopoulos, Gavin Wood, “Mastering Ethereum: Building Smart Contracts”, O'Reilly Media, Inc, 2018
2. Nitin Gaur, Luc Desrosiers, Petr Novotny, Venkatraman Ramakrishna, Anthony O'Dowd, Salman A. Baset “Hands-On Blockchain with Hyperledger”, Packt Publishers, June 2018

Reference Book:

1. Siraj Raval, “Decentralized Applications: Harnessing Bitcoin's Blockchain Technology”, O'Reilly Media, Inc, 2018
2. Roberto Infante, “Building Ethereum DApps: Decentralized Applications on the Ethereum Blockchain”, Manning Publications, 2019

Extensive Reading:

- www.nptel.ac.in
- https://github.com/ethereumbook/ethereumbook

23ITH05 BLOCKCHAIN PLATFORMS

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- To understand the various primitives used in blockchain.
- To implement using Ethereum Platform.
- To understand the various modules in Hyperledger framework.
- To develop using Hyperledger Platform
- To learn about different Blockchain Platforms.

Course Outcome:

At the end of the course, the students will be able to

- Implement the required cryptography primitives for blockchain systems..
- Develop and Deploy using Ethereum Platform.
- Work with various techniques in Hyperledger framework.
- Develop and Deploy using Hyper ledger Platform.
- Work with alternate Blockchain Platforms.

Unit I INTRODUCTION **9**

Decentralized applications-Dapp-Good and bad Dapps-Understanding the blockchain-A deeper look at decentralized applications-Ethereum's history and governance-Connecting to Ethereum through the wallet-Smart contracts: The brain of Dapps-Connecting to Ethereum with geth-Managing accounts with geth

Unit II ETHEREUM **9**

Managing smart contracts with Web3.js-Revisiting deployment through geth's interactive console- Interacting with SimpleCoin through geth's console-Simplifying command-based deployment with Node.js-Deploying on a private network-Making development more efficient by deploying on mock networks-Smoother interaction with SimpleCoin through a web UI-The Ethereum ecosystem-The core components -Decentralized address resolution with ENS-Decentralized content storage-Accessing external data through oracles-Dapp frameworks and IDEs

Unit III HYPERLEDGER FABRIC FRAMEWORK **9**

Exploring Hyperledger Fabric- Hyperledger frameworks, tools, and building blocks-Hyperledger frameworks Hyperledger tools-The building blocks of blockchain solutions-Hyperledger Fabric component design-the Journey of a sample transaction-Hyperledger Fabric explored-Understanding governance in business networks powered by blockchain

Unit IV IMPLEMENTATION IN HYPERLEDGER **9**

The Hyperledger Family-Prerequisites and Setting up a Development Environment –Developing First Business Network and Deploying it -Define your Business Network -Secure your API using Passport and Enable Multi-Use Case Study and Implementation

Unit V DIFFERENT BLOCKCHAIN PLATFORMS **9**

Multichain-Features-Mechanisms-Deployment-R3 Corda-Features-Model-Consensus Mechanism –Use cases-Ripple-Technology-Transection- IOTA-Consensus Mechanism- Implementation-Setup-Real World Implementation

Text Book:

1. Roberto Infante, " Building Ethereum Dapps ", Manning Publications,March 2019, ISBN: 9781617295157
2. Petr Novotny, Nitin Gaur, Luc Desrosiers, Salman A. Baset ,"Blockchain Development with Hyperledger", Packt Publishing, March 2019
3. NiazChowdhury,"Inside Blockchain, Bitcoin, and Cryptocurrencies",CRC press, Taylor & Francis,2020.
4. Ernesto Lee, Sudip Ghosh,"Enterprise Blockchain Development: With Hyperledger Fabric and Composer" , ConsultantsNetwork,2018

Reference Book:

1. Josh Thompson, "Blockchain: The Blockchain for Beginnings Guide to Blockchain Technology and Leveraging Blockchain Programming", Create Space Independent Publishing Platform, 2017.
2. Andreas M. Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", Oreilly Media, 1st Edition, 2014.
3. Austin Grice, Eric Everson Mendes Marins, Garrett Lee Woodworth, Juliana Medeiros Destro, Rahul Gupta, VasfiGucer , "Implementation Guide for IBM Blockchain Platform for Multicloud", IBM Redbooks,2019.

Extensive Reading:

- https://data-flair.training/blogs/blockchain-terminologies/
- https://github.com/anders94/blockchain-demo
- https://anders.com/blockchain/
- www.redbooks.ibm.com › LinuxONE
- https://www.coursera.org/learn/blockchain-platforms

23ITH21 INTRODUCTION TO COMPUTER GRAPHICS

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- To learn the output primitives like line, circle and ellipse using algorithms.
- To study the 2-D and 3-D viewing and transformations.
- To understand various, color models modeling and animation techniques.

Course Outcome:

At the end of the course, the students will be able to

- Apply the line, circle and ellipse drawing algorithms
- Apply the two dimensional geometric transformations and clipping
- Apply the three dimensional geometric transformations
- Work with color and illumination models
- Apply different methods for Modelling

Unit I INTRODUCTION **9**

Introduction-Applications-Graphics systems-Output Primitives-representing Image-Straight Line-Line drawing Algorithms-DDA Algorithm-Bresenhams' Line Algorithm-Circle Generating Algorithm- Bresenhams' Circle Algorithm-Midpoint Circle Algorithm-Ellipse Generating Algorithm-Midpoint Ellipse Algorithm.

Unit II TWO DIMENSIONAL TRANSFORMATIONS **9**

Introduction-Representation of points-Matrix Algebra and Transformation-Transformation of points-Straightlines-Midpoint Transformation-Transformation of parallel lines-Intersecting lines-Rotation,Reflection and scaling of straight lines-Combined Transformations-Translation and Homogeneous Coordinates-Rotation about Arbitrary point-Reflecion about Arbitrary line-Windowing and clipping

Unit III THREE DIMENSIONAL TRANSFORMATION **9**

Introduction-3D Transformation-Rotation about an axis parallel to coordinate Axis-Reflection about an arbitrary axis in space-Reflection through an arbitrary plane-3D Modelling schemes-Projection-Orthographic-Isometric-oblique-perspective-3D clipping

Unit IV COLOR AND ILLUMINATION MODELS **9**

Introduction –colors-Illumination model and light sources-specular Reflection-Intensity Attenuation-Shadow-Reflectivity and refractivity-Radiosity Model-Texturing-Surface-Bump mapping-Environment Mapping-Shading Methods

Unit V MODELLING CONCEPTS AND TECHNIQUES **9**

Introduction-structures and Hierarchial Modelling-Advanced Modelling Techniques-Procedural Models-Fractals-Grammar based Models-Physical based Modelling-Animation-Devices-Computer assisted-video formats-Frame by Frame animation-Real Time Animation Techniques

Text Book:

1. Amarendra N Sinha,Arun D Udai,"Computer Graphics",Tata Mc-Graw Hill ,2008

Reference Book:

1. Foley, van Dam, Feiner and Hughes ,"Computer Graphics Principles and Practice", Addison Wesley,2004
2. D Hearn and P M Baker ,"Computer Graphics", Prentice Hall of India Second Edition,2008
3. F .S. Hill, "Computer Graphics using OPENGL", Second edition, Pearson Education 2003

Extensive Reading:

- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-837-computer-graphics-fall-2003/
- http://www.moshplant.com/direct-or/bezier/
- http://www.cs.mtu.edu/~shene/COURSES/cs3621/NOTES/spline/B-spline/bspline-curve-prop.html
- https://nptel.ac.in/courses/106102065/

23ITH22 INTRODUCTION TO VIRTUAL REALITY

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To understand the basic functioning of virtual Reality systems.
- To understand the concepts of Geometric modeling and Geometrical Transformations
- To learn Animating the Virtual Environment.
- To learn applications of Virtual Environment.
- To understand various types of Hardware's and software's in virtual Reality systems

Course Outcome:

At the end of the course, the students will be able to

- Develop 3D virtual environments.
- Develop 3D interaction techniques.
- Develop immersive virtual reality applications.
- Select types of Hardware's and software's in virtual Reality systems
- Develop and design research ideas and results

Unit I INTRODUCTION **9**

Virtual Reality & Virtual Environment : Introduction – Computer graphics – Real time computer graphics – Flight Simulation – Virtual environments –requirement – benefits of virtual reality- 3D Computer Graphics : Introduction – The Virtual world space – positioning the virtual observer – the perspective projection – Human vision – stereo perspective projection – 3D clipping – Colour theory – Simple 3D modeling – Illumination models – Reflection models – Shading algorithms

Unit II GEOMETRIC MODELING GEOMETRICAL TRANSFORMATIONS **9**

Geometric Modeling: Introduction – From 2D to 3D – 3D space curves – 3D boundary representation - Geometrical Transformations: Introduction – Frames of reference – Modeling transformations – Instances – Picking – Flying – Scaling the VE – Collision detection - A Generic VR system: Introduction – The virtual Environment

Unit III VIRTUAL ENVIRONMENT **9**

Animating the Virtual Environment: Introduction – The dynamics of numbers – Linear and Non-linear interpolation - The animation of objects – linear and non-linear translation - shape & object in betweening – freeform deformation – particle system- Physical Simulation : Introduction – Objects falling in a graphical field –Rotating wheels – Elastic collisions – projectiles – simple pendulum – springs – Flight dynamics of an aircraft

Unit IV VR HARDWARES & SOFTWARES **9**

Human factors : Introduction – the age- the ear- the somatic senses - VR Hardware : Introduction – sensor hardware – Head-coupled displays –Aquatic hardware – Integrated VR systems-VR Software: Introduction – Modeling virtual world –Physical simulation- VR toolkits – Introduction to VRML

Unit V VR APPLICATION **9**

Introduction – Engineering – Entertainment – Science – Training – The Future: Introduction – Virtual environments – modes of interaction

Text Book:

1. John Vince, "Virtual Reality Systems ", Pearson Education Asia, 2002

Reference Book:

1. Adams, "Visualizations of Virtual Reality", Tata McGraw Hill, 2000.
2. Grigore C. Burdea, Philippe Coiffet , "Virtual Reality Technology" , WileyInterscience, Edition,1994.
3. William R. Sherman, Alan B. Craig, "Understanding Virtual Reality: Interface, Application, and Design", Morgan Kaufmann, 1st Edition,2002.

Extensive Reading:

- www.vresources.org
- www.vrac.iastate.edu
- www.w3.org/MarkUp/VRML/

23ITH23 GEOMETRIC MODELLING FOR XR

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To introduce the features of Augmented Reality
- To explore the aspects Virtual Reality modelling
- To learn the design approaches of Virtual Environment
- To study the implementation strategies for Virtual Reality
- To explore the applications of Virtual Reality

Course Outcome:

At the end of the course, the students will be able to

- Discover thefeatures of Augmented Reality
- Use the Solid Modelling and Haptic Interface in VR Technology
- Design new Virtual Environment with different design approaches
- Apply different implementation strategies for Virtual Reality
- Analyze the applications of Virtual Reality

Unit I AUGMENTED REALITY **9**

Introduction-Types of Augmented Reality-Augmented Reality Displays – sensors-Augmented Reality-Marker vs Markerless-User interfaces in Augmented Reality system

Unit II VIRTUAL REALITY MODELLING **9**

VR Technology – Modelling- Solid Modelling in a VirtualReality Environment-Model Representation- Constraint-based Manipulations- Implementation and Results- Interactive Solid Modelling in a Virtual Environment with a Haptic Interface- Solid Modelling Engine- Haptic Rendering and Interfaces-Implementation.

Unit III DESIGN APPROACHES **9**

Motion in Real and Virtual Worlds-Velocities and Accelerations -The Vestibular System -Physics in the Virtual World - Mismatched Motion and Vection-Tracking -Tracking 2D Orientation -Tracking 3D Orientation -Tracking Position and Orientation - Tracking Attached Bodies -3D Scanning of Environments-Interaction-Motor Programs and Remapping - Locomotion -Manipulation - Social Interaction - Additional Interaction Mechanisms

Unit IV IMPLEMENTATION STRATEGIES **9**

Introduction -General Characteristics of Vection -Motion Sickness and Adaptation Phenomena-Multisensory Vection Illusions-Haptic and Tactile Cues-Relevance of Vection for VE System Design and Use-Research Issues-Effect of Visual Frames of Reference on Vection and Orientation-Spatial Knowledge Acquisition-.Navigation Performance Enhancement -Environmental Familiarization-Experiments-Performance Enhancement-Environmental Familiarization

Unit V APPLICATIONS OF VIRTUAL REALITY **9**

Audio -The Physics of Sound -The Physiology of Human Hearing -Auditory Perception-Auditory Rendering –Making the most of Virtual Reality with Audio-Virtual Reality space and beyond-Common terms-Audio Source Component-Add Audio to the Scene-Create Audio Mixture-Adding Mixer groups-Setting audio source to use the Audio mixer groups

Text Book:

1. Jon Peddie ,"Augmented Reality: Where We Will All Live",Springer International Publishing AG 2017
2. Kelly S. Hale,Kay M. Stanney ,"Handbook of virtual environments Design, Implementation, and Applications" , CRC Press Taylor & Francis Group,2015,Second Edition
3. S.K. Ong and A.Y.C. Nee (Eds.) ,"Virtual and Augmented Reality Applications in Manufacturing", Springer-Verlag London 2004
4. Jeff W Murray ,"Building Virtual Reality with Unity and Steam VR ",CRC Press ,2017
5. Steven M. LaValle,"Virtual Reality"Cambridge University Press, 2017.

Reference Book:

1. Max K. Agoston, "Computer Graphics and Geometric Modeling", Springer-Verlag London Ltd, 2005

Extensive Reading:

- https://www.designtechsys.com/articles/computer-geometric-modelling
- https://digitalcommons.fiu.edu/etd/3988/
- http://ecoursesonline.iasri.res.in/mod/page/view.php?id=2482
- https://arc.aiaa.org/doi/abs/10.2514/6.1998-4824

23ITH24 INTERACTIVE 3D DESIGN

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- To understand the concept of Virtual Reality
- To understand the basic modeling concept
- To become familiar with VR programming
- To become familiar with Unity
- To expose various game development techniques

Course Outcome:

At the end of the course, the students will be able to

- Know about virtual reality techniques
- Apply the different Modeling techniques
- Create simple application in VR
- Create simple scenes using unity
- Create world space user Interface

Unit I INTERACTING WITH THE VIRTUAL WORLD 9

User Interface Metaphors – Manipulating a virtual world – Navigating in a virtual world – Interacting with others – Interacting with VR system – Virtual reality experience – Immersion – Rules of the virtual world – substance of the virtual world

Unit II MODELING 9

Kinematics Modeling - Homogeneous Transformation Matrices – Object position – Transformation Invariants – Object hierarchies – Viewing the Three Dimension World – Physical Modeling – Behavior Modeling – Model Management

Unit III VR PROGRAMMING 9

Toolkits and Scene Graphs – WorldToolKit – Java 3D – General Haptics open source Toolkit – PeopleShop – Human factors in VR – Methodology and Terminology – User Performance Studies – VR Health and Safety Issues – VR and Society

Unit IV UNITY BASICS 9

Getting started with unity – creating a simple diorama – measurement tools – using third party content – creating 3d content in VR – setting up the scene – Basic button input – Polling for clicks – Using scriptable objects for input – Using unity events for input – Intractable items

Unit V WORLDSPACE UI 9

Reusable default canvas – Visor HUD – Reticle cursor – Windshield HUD – TextMeshpro – Info bubble – Pointing and clicking with VR components – Building a wrist based menu palette – Using Glide locomotion – Adding comport model locomotion – Techniques for teleportation – Teleportation toolkits – Managing VR motion sickness

Text Book:

1. Grigore C Burdea , Philippe Coiffet "Virtual Reality Technology", second edition, 2006.
2. Jesse Glover, Jonathan Linowes, "Complete Virtual Reality and Augmented Reality Development with Unity", packt 2019
3. William R.Sherman , Alan B.Criag " Understanding Virtual Reality ", first edition ,Elsevier, 2008.

Reference Book:

1. Kothari Dp & Saxena Anshu "Hypermedia From Multimedia to Virtual Reality" , Second Edition ,PHI,2008
2. Bahttacharya, Tapan, "Illusive World of Virtual Reality" , National Book Trust,India,2010
3. Ben Tristem ,Mike Geig, " Unity Game Development",Second Edition ,SAMS 2015

Extensive Reading:

- https://www.lynda.com/3D-Animation-training-tutorials/1-0.html
- https://www.vectary.com/3d-modeling-education/make-your-lessons-more-interactive-with-video-tutorials-729d9ab34f72/
- www.tinkercade.com\learn
- https://www.gamedesigning.org/learn/3d-design/

23ITH25 XR APP DEVELOPMENT

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- Understand the basis of VR and AR
- Study the need for content creation in VR and AR
- Study the need for VR and AR in the wild
- Understand the techniques for implementing app using VR
- Understand the techniques for implementing app using AR

Course Outcome:

At the end of the course, the students will be able to

- Apply the basics of VR and AR
- Implement VR and AR for content creation
- Apply VR and AR in the wild
- Develop app using VR
- Develop app using AR

Unit I DEFINING VIRTUAL AND AUGMENTED REALITY 9

Introducing Virtual Reality and Augmented Reality- Mixed reality - virtuality - Extended reality -Evaluating the Technology Hype Cycle - Exploring the Current State of Virtual Reality - Form Factors - Focusing on Features: Room-scale versus stationary experience - Inside-out tracking - Haptic feedback – Audio - Considering Controllers- Current Issues with VR -Exploring the Current State of Augmented Reality - Form Factors -Considering Controllers - Current Issues with AR

Unit II CREATING CONTENT IN VIRTUAL AND AUGMENTED REALITY 9

Evaluating Your Project - Assessing Your Project's Technology Needs - Choosing Virtual Reality - Choosing Augmented Reality - Planning Your Virtual Reality Project - Defining Your Virtual Reality Project - Exploring Design Principles in Virtual Reality - Planning Your Augmented Reality Project Defining Your Augmented Reality Project - Exploring Design Principles in Augmented Reality - Assessing Design Software - Capturing Real Life - Assessing Development Software - Distributing Your Content .

Unit III VIRTUAL AND AUGMENTED REALITY IN THE WILD 9

Exploring Virtual Reality & Augmented Reality Use Cases. - Art – Education – Entertainment – Healthcare – Gaming - Mobile Apps for Experiencing Augmented Reality - Google Translate - Amazon AR View – Blippar - AR City – Arise - Ingress and Pokémon Go - MeasureKit and Measure – InkHunter - Sketch AR - Find Your Car and Car Finder AR - Future of Virtual Reality and Augmented Reality

Unit IV VR APP DEVELOPMENT 9

Getting Set Up for Unity SteamVR - The SteamVR Interaction System - Building a Main Menu - Advanced Interactions - Making the Most of Virtual Reality with Audio - Building Seated or Static VR Experiences - Hands-On, Practical Techniques for Reducing VR Sickness in Unity

Unit V AR APP DEVELOPMENT 9

Smartphones and AR – Vuforia SDK – Unity 3D - Setting up the AR environment – understanding Vuforia – Trackables and Tracking – Exporting dataset – Advanced AR – AR games

Text Book:

1. Paul Mealy, "Virtual & Augmented Reality for Dummies" 1st Edition. 2018, Wiley Publishers, ISBN-978-1-119-48134-8.
2. Building Virtual Reality with Unity and Steam VR (1st edition), A K Peters/CRC Press, ISBN13: 978-1138033511
3. Dominic Cushnan, Hassan EL Habbak, "Developing AR Games for iOS and Android", Packt publishing, 2013

Reference Book:

1. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", 2005.
2. Doug A Bowman, Ernest Kuijff, Joseph J LaViola, Jr and Ivan Poupyrev, "3D User Interfaces, Theory and Practice", Addison Wesley, USA, 2005.
3. Oliver Bimber and Ramesh Raskar, "Spatial Augmented Reality: Meging Real and Virtual Worlds", 2005.
4. Burdea, Grigore C and Philippe Coiffet, "Virtual Reality Technology", Wiley Interscience, India, 2003.
5. John Vince, "Virtual Reality Systems", Addison Wesley, 1995.
6. Howard Rheingold, "Virtual Reality: The Revolutionary Technology and how it Promises to Transform Society",Simon and Schuster, 1991.
7. William R Sherman and Alan B Craig, "Understanding Virtual Reality: Interface, Application and Design (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, 2002
8. Alan B. Craig, Understanding Augmented Reality, Concepts and Applications, Morgan Kaufmann, 2013.

23ADH01 INTRODUCTION TO WEB DESIGN

Offered by AID (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To gain knowledge on Interactive Web Page development
- To learn Markup languages and Style Sheets for web design
- To study client side applications with CSS
- To understand the box model and positioning and use it.
- To familiarize with Client-Side Programming and host objects

Course Outcome:

At the end of the course, the students will be able to

- Design Simple Web Pages
- Develop web pages with tables and forms
- Apply styles to client side web design
- Use CSS box model and positioning for web pages
- Perform event handling with Java Script

Unit I HTML - INTRODUCTION **9**

working of Web - Internet Versus the Web – Browsers - Web Page Addresses (URLs) - Anatomy of a Web Page - Creating a Simple Page – Content - Document Structure - Text Elements – Image - Change the Look with a Style Sheet - Marking Up Text: Paragraphs, Headings, Lists. Adding Links : href Attribute- Linking to Pages on the Web - Linking Within Your Own Site - Targeting a New Browser Window - Mail Links - Telephone Links

Unit II HTML5 **9**

Adding Images - Image Formats- Window in a Window- Table Markup – Use - Table Structure - Spanning Cells – Accessibility – Forms - form Element - Variables and Content - Form Control - Accessibility Features - Form Layout and Design - Meet the APIs - Video and Audio- Canvas

Unit III CSS FOR PRESENTATION **9**

Cascading Style Sheets : Working of Style Sheets – Concepts - Moving Forward with CSS - Formatting Text - Font Properties - Changing Text Color - Selector Types - Text Line Adjustments - “Decorations” – Capitalization - Spaced Out - Text Shadow - Changing List Bullets and Numbers - Colors and Backgrounds - Color Values – Foreground, Background Color - Playing with Opacity - Pseudo-class Selectors - Attribute Selectors - Background Images - Shorthand background Property – Gradients - External Style Sheets

Unit IV BOX MODEL AND POSITIONING **9**

Element Box: Dimensions - Padding – Borders – Margins - Assigning Display Roles - Adding Drop Shadows to Boxes - Floating and Positioning - Normal Flow - Floating - Positioning Basics - Relative Positioning - Absolute Positioning - Fixed Positioning - Page Layout – Strategies- Techniques - Multicolumn Layouts Using Floats

Unit V JAVASCRIPT FOR BEHAVIORS **9**

Introduction to JavaScript : JavaScript - Anatomy of a Script- Browser Object – Events - Using JavaScript - Meet the DOM- Polyfills - JavaScript Libraries - Web Graphics Basics - Image Sources - Meet the Formats - Image Size and Resolution - Working with Transparency

Text Book:

1. Jennifer Niederst Robbins, “Learning Web Design: A Beginner’s Guide to HTML, CSS, JavaScript, and Web Graphics ” , Fourth Edition, OReilly, 2020

Reference Book:

1. Mark Pilgrim, “HTML5: Up and Running” , O’Reilly,2011.
2. Robert. W. Sebesta, "Programming the World Wide Web", Fourth Edition, Pearson Education, 2007.
3. Deitel, Deitel, Goldberg, "Internet & World Wide Web How To Program", Third Edition, Pearson Education, 2006.

Extensive Reading:

- http://www.w3schools.com
- http://www.w3.org
- http://www.ietf.org/

23ADH02 FRONT END DEVELOPMENT WITH REACT AND TYPESCRIPT

Offered by AID (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To understand the fundamental concepts of React
- To learn React Properties and Components.
- To analyze the Redux and GraphQL.
- To explore TypeScript functions.
- To learn TypeScript and interaction with React.

Course Outcome:

At the end of the course, the students will be able to

- Explore the fundamental concepts of React
- Develop applications in React Framework.
- Develop applications using Redux and GraphQL.
- Design Programs using TypeScript.
- Implement applications using Typescript and React.

Unit I INTRODUCTION TO REACT **9**

Introduction to React - Javascript for React – React DOM – Components – Virual DOM – Constructing Elements with Data –React Components – React.createClass –React.Component –Stateless Functional Components–DOM Rendering – Factories – React with JSX– WepPack – WebPack Loaders

Unit II REACT STATE AND COMPONENTS **9**

React State Management – Building a Star Rating Component – The useState Hook – Refactoring for Advanced Reusability – State in Component Trees – Building Forms – Using Refs – Controlled Components – Creating Custom Hooks – Adding Colors to State – React Context– Enhancing Components with Hooks– Introducing useEffect – The Dependency Array – Deep Checking Dependencies – useLayoutEffect – Rules to Follow with Hooks – Improving Code with useReducer – useReducer to Handle Complex State – Improving Component Performance

Unit III REDUX AND GRAPHQL **9**

Redux – State – Actions – Reducers – Color Reducer – Sort Reducer – Store – Action Creators – Middleware – Explicitly passing the Store –Passing the Store via Context – Presentational Versus Container Components – GraphQL – GraphQL with React

Unit IV INTRODUCTION TO TYPESCRIPT **9**

Introduction – Basic Types – Functions – Declaring and Invoking Functions – Optional and Default Parameters– Rest Parameters – call, apply, and bind – Generator Functions – Iterators – Call Signatures –Contextual Typing – Overloaded Function Types – Polymorphism– Generic Type Inference – Generic Type Aliases – Bounded Polymorphism

Unit V TYPESCRIPT CLASSES AND INTEROPERATING WITH JAVASCRIPT **9**

TypScript Classes – Inheritance – Interfaces –Advanced Types : SubType and Super Type–Type Widening – Refinement – Totality – Advanced Object Types– Advanced Function Types – Interoperating with JavaScript – Gradually Migrating from JavaScript to TypeScript –Type Lookup for JavaScript – Using Third-Party JavaScriptRunning TypeScript on the Server – Running TypeScript in the Browser – Publishing Your TypeScript Code to NPM

Text Book:

1. Alex Banks and Eve Porcello, "Learning React – Modern Patterns for Developing React Apps" , O'Reilly, 2020,Second Edition
2. Boris Cherny, "Programming TypeScript Making Your JavaScript Applications Scale", O'Reilly,2019,First Edition
3. Nate Murray, "Fullstack React with TypeScript", 2019,Learn Publishing

Reference Book:

1. Frank Zammetti Pottstow , "Modern Full-Stack Development - Using TypeScript, React, Node.js, Webpack, and Docker", 2020 , Apress
2. David Choi , "Full-Stack React, TypeScript, and Node", Packt Publishing, 2020
3. Stoyan Stefanov, "React: Up & Running Building Web Applications", O'Reilly,Second Edition,2022

Extensive Reading:

- https://react.dev/
- https://legacy.reactjs.org/
- https://www.typescriptlang.org/

23ADH03 WEB APPLICATION DEVELOPMENT

Offered by AID (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To introduce web development with PHP
- To work with various operations in PHP
- To model the design in a web environment
- To develop a webpage with database
- To test and work with a PHP application

Course Outcome:

At the end of the course, the students will be able to

- Create simple basic PHP programs
- Create programs using functions and strings
- Apply arrays and objects in web application development
- Implement database connectivity with PHP
- Explore security, web services and debugging

Unit I INTRODUCTION **9**

PHP – History and Evolution – Installation – Language Basics – Lexical Structure – Datatypes – Variables – Expression & Operators – Flow Control statements – embedding PHP in web pages

Unit II FUNCTIONS & STRINGS **9**

Calling a function – Defining a function – Variable scope – function parameters – return values – variable functions – anonymous functions – Strings – Quoting string constants – Printing strings – Accessing Individual Characters – cleaning strings – encoding and escaping – comparing strings – manipulating and searching strings – Regular expressions

Unit III ARRAYS & OBJECTS **9**

Indexed versus Associative Arrays – Identifying elements of an array – Storing data in arrays – Multidimensional arrays –Extracting multiple values – Conversion between arrays and variables – Traversing arrays – Sorting – Working with arrays – Arrays to implement data types – Objects – Creation – Accessing Properties and methods – Declaration of class – Introspection – HTTP basics –variables – Server Information – Processing Forms –Setting Response Headers – Maintaining State – SSL

Unit IV DATABASE ACCESS, XML AND JSON **9**

PHP to access a database – Relational databases and SQL – MySQL object interface – SQLite – MongoDB – Generating XML – Parsing XML – JSON – Using JSON – Serializing PHP objects – Writing portable code for Windows and Unix.

Unit V SECURITY, WEB SERVICES AND DEBUGGING **9**

Safeguards – Security Vulnerabilities – Application Techniques – Code Libraries – Templating Systems – Handling Output – Performance Tuning – Web Services – REST Clients – XML - RPC – Debugging PHP – Error Handling – Manual Debugging – Error Logs – IDE Debugging

Text Book:

1. Kevin Tatroe, Peter MacIntyre & Rasmus Lerdorf, “Programming PHP”, Creating Dynamic Web Pages, O'Reilly Media, 4th Edition, 2020

Reference Book:

1. Steven Holzner ,”PHP: The Complete Reference”, McGraw Hill Education,2008
2. Timothy Boronczyk , Martin E. Psinas,”PHP and MYSQL: Create - Modify – Reuse”, Wiley India Private Limited ,2008
3. Matt Doyle,”Beginning PHP 5.3”, Wiley Publishing Inc., 2009

Extensive Reading:

- http://php.net/
- http://www.tutorialspoint.com/php/
- http://www.toves.org/books/php/ch03-first/index.html
- http://www.codecademy.com/en/tracks/php
- http://www.w3schools.com/php/

23ADH04 DEVOPS

Offered by AID (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- To learn the Agile methodology and DevOps principles
- To describe the agile relationship between development and IT operations.
- To understand the skill sets and high-functioning teams involved in DevOps and related methods to reach a continuous delivery capability.
- To explore the fundamental concepts of DevOps with Cloud
- To understand the DevOps Governance and emerging trends

Course Outcome:

At the end of the course, the students will be able to

- Apply Software development models and architectures of DevOps.
- Apply different project management, integration, testing and code deployment tool.
- Investigate different DevOps Software development models.
- Assess various DevOps practices.
- Collaborate and adopt DevOps in real-time projects.

Unit I INTRODUCTION **9**

Agile Vs Waterfall Method - Agile Development – DevOps – benefits – DevOps Principles – 7C's of DevOps Lifecycle – DevOps and Continuous Testing – how to choose right DevOps tools - DevOps core values: CAMS

Unit II DEVOPS PROJECT MANAGEMENT **9**

The need for source code control - The history of source code management - Roles and code - source code management - system and migrations - Shared authentication - Hosted Git servers - Different Git server implementations - Docker intermission – Gerrit - The pull request model - GitLab.

Unit III INTEGRATING THE SYSTEM **9**

Build systems - Jenkins build server - managing build dependencies - Jenkins plugins and file system layout - The host server - build slaves - Software on the host – Triggers - Job chaining and build pipelines - build servers and infrastructure as code - building by dependency order - Build phases - Alternative build servers - Collating quality measures.

Unit IV DEVOPS WITH CLOUD **9**

DevOps and Cloud Adoption – Benefits of using DevOps along with Cloud – best practices for DevOps in the cloud – DevOps in IBM cloud – Bluemix – DevOps with VSTS and Azure – pivotal Cloud foundry – AWS – OpenShift – Application security

Unit V DEVOPS GOVERNANCE AND EMERGING TRENDS **9**

DevOps Governance and controls – Implement DevOps Governance – DevOps Governance benefits – implementing DevOps controls – DevOps playbook – developing a playbook – implementing DevOps playbook – DevOps best practices – Emerging Trends – Strategy Trends – Technology Trends

Text Book:

1. Joakim Verona. Practical Devops, Second Edition. Ingram short title; 2nd edition (2018). ISBN 10: 1788392574.
2. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications (2019). ISBN: 9788126579952.

Reference Book:

1. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley, 2016.
2. Jennifer Davis and Katherine Daniels, "Effective DevOps", O'Reilly, First Edition
3. Billy Yuen, Jesse Suen, Alex Matyushentsev, Todd Ekenstam, "GitOps and Kubernetes", O'Reilly, April 2021
4. John Schnidt and Kirit Basu, "DataOps: The Authoritative Edition", Sept 2019
5. Geradus Blokdyk, "DevSecOps: A Complete Guide", 2019 Edition

Extensive Reading:

- https://azure.microsoft.com/en-in/solutions/devops/tutorial/
- https://developer.ibm.com/devpractices/devops/
- https://aws.amazon.com/devops/what-is-devops

23ADH05 MERN STACK

Offered by AID (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- To learn the basics of MERN stack
- To study the role of React in designing front-end components
- To develop the backend components using Node.js and Express
- To understand the significance of using MongoDB as a database system
- To study the advanced features of MERN stack development.

Course Outcome:

At the end of the course, the students will be able to

- Use the basics of MERN stack
- Design front-end components using React
- Design backend components using Node.js and Express
- Use MongoDB for database systems
- Apply the advanced features and deploy MERN stack applications

Unit I BASICS OF MERN STACK AND NODE JS **9**

MERN Components - React - Node.js - Express - MongoDB - Need for MERN - Server-Less Hello World - Server Setup - nvm - Node.js – npm - Node.js basics - Local and Export Modules - Node Package Manager - Auditing Package Security - Deduplication and Pruning - Node.js web server - Node.js File system - Node Inspector - Node.js EventEmitter – Node.js Event loop

Unit II REACT **9**

React Introduction - React ES6 - React Render HTML - React JSX - Components -React Classes - Composing Components - Passing Data - Dynamic Composition - React state - Initial State - Async State Initialization - Event Handling Communicating from Child to Parent - Stateless Components - Designing components- React Forms - React CSS - React SaaS- Use Case Hook

Unit III NODE.JS – EXPRESS FRAMEWORK **9**

Frameworks for Node.js – Node.js Buffers – Node.js Streams – Node.js Scaling Applications – Callbacks Concept - Express.js Web App - Serving static Resource - Node.js Data Access - Express REST APIs - REST - Resource Based - HTTP Methods as Actions - JSON- Express - Routing - Handler Function - Scaffolding – Authentication- Middleware - The List API - Automatic Server Restart - Testing - The Create API - Using the List API - Using the Create API- Error Handling - Template Engine.

Unit IV MONGODB **9**

MongoDB - MongoDB Basics - Documents - Collections - Query Language - Installation - The mongo Shell - Schema Initialization - MongoDB Node.js Driver - Reading from MongoDB - Writing to MongoDB - CRUD operations - projections - Indexing - Aggregaton - Replication - Sharding - Creating backup – Deployment.

Unit V ADVANCED FEATURES **9**

Modularization and Webpack - Routing with React Router - Forms - More Filters in the List API - UI Components - Update API - Delete API - React-Bootstrap - Bootstrap Installation - Navigation - Table and Panel - Forms - Alerts - Modals -Server Rendering - Basic Server Rendering - Handling State - MongoDB Aggregate - Pagination - Higher Order Components - Search Bar - Google SignIn - Session Handling

Text Book:

1. Vasan Subramanian, “Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node”, A Press Publisher, 2019

Reference Book:

1. Greg Lim, “Beginning MERN Stack, Build and Deploy a Full Stack MongoDB, Express, React, Node.js App”, 2021
2. Shama Hoque, “Full-Stack React Projects: Learn MERN stack development by building modern web apps using MongoDB, Express, React, and Node.js”, 2nd Edition, Packt
3. Eddy Wilson Iriarte Koroliova, “MERN Quick Start Guide: Build web applications with MongoDB, Express.js, React, and Node”, Packt
4. Frank Zammetti , “Modern Full-Stack Development Using TypeScript, React, Node.js, Webpack, and Docker”, A Press Publisher, 2020

Extensive Reading:

- http://tutorialsteacher.com
- https://reactjs.org/
- https://nodejs.org
- www.Expressjs.com
- www.mongodb.com

23CEH01 URBAN AND REGIONAL PLANNING REGULATIONS

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Urban planning concepts, settlements and role of urban planner.
- Types of urban area and the factors responsible for evolution of urban areas.
- Concepts of regional planning and theories.
- Formulation of different regional planning methods.
- Different types of development plans.

Course Outcome:

At the end of the course, the students will be able to

- Plan the urban area with underlying concepts and theories.
- Propose the development of any urban area with required elements.
- Use the different theories of regional planning during the city level planning.
- Formulate the regional planning process as per the standards and norms.
- Prepare the different types of plans.

Unit I INTRODUCTION TO URBAN PLANNING **9**

Evolution in planning and physical form - Definition of Human settlement - Differentiation between rural and urban settlement - Concept of town - Evolved and Created Town Characteristics - Features of urban planning process - Role of urban planner - Genesis of urban form - Social, Geographical and Cultural impacts - Positive and negative impacts of urbanisation.

Unit II URBAN AREA CLASSIFICATION **9**

Elements of town structure - Town classification - Functional and geographical - City Centre - Walled city and Urban Fringe areas- Urban growth - Urban sprawl - Urban renewal and community development - Urban design - Types of cities - Case studies of Chandigarh and Gandhinagar.

Unit III REGIONAL PLANNING CONCEPTS **9**

Concept of regional planning - Nature, objectives, levels and aims - Concept of a region, types, and regionalization - Delineation techniques for various types of regions - Regional interaction - Rank size rule - Settlement patterns - Central place theory - Loschian theory - Regional networks.

Unit IV REGIONAL PLANNING METHODS **9**

Regional planning processes - Identification of plan objectives – Collection, classification and analysis of data - Norms and standards for regional planning - Formulation of alternative plan proposals -Regional planning efforts in India - Critical appraisal case studies in regional development - District planning - Metropolitan regions -National capital region - Mumbai metropolitan region.

Unit V TYPES OF PLANS **9**

Definition of development plan - Introduction to types of development plans - Master plan - City development plan - Structure plan - District plan - Action area plan - Subject plan - Comprehensive planning - Zonal plans.

Text Book:

1. M.Pratap Rao, “Urban Planning: Theory and practice”, CBS Publishers & Distributors, 2009. 2.
2. Peter Hall, Mark Tewdwr-Jones., “Urban and Regional planning”, Routledge; 5th edition, 2010.
3. A.K. Jain, “Town planning: Principles, Process and Practice”, Khanna Publishing; 1st edition 2019.

Reference Book:

1. S.K.Kulshrestha, “Urban and Regional Planning in India”, SAGE Publications India Pvt Ltd, 2012.
2. Arthur B. Gallion, “The Urban Pattern” 5thedition, CBS Publishers & Distributors, 2003.
3. AEJ Morris, “History of Urban Form before the Industrial Revolution”, 2013.
4. Aidan Southall, “The City in Time and Space”, Cambridge University Press, 1998.
5. R. Ramachandran, “Urbanization and urban systems in India”, Oxford University Press, 1991.

Extensive Reading:

- “Urban and Regional Development Plans Formulation & Implementation Guidelines”, Ministry Urban Affairs & Employment, Govt. of India, New Delhi, 2014.
- Town and Country Planning organization in India - http://tcpo.gov.in/.
- Ministry of Housing and Urban Affairs Government of India http:/.moud.gov.in
- Tamil Nadu Town and Country Planning Act 1971, and Rules made thereunder, Government of Tamil Nadu, Chennai

23CEH02 URBAN CLIMATE CHANGE AND ADAPTATION

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Basics and patterns of global climate change.
- Impacts of climate change on various sectors.
- Climatic changes due to urbanization.
- Climate change adaptation and mitigation measures for the climate change.
- Need for climate resilient cities.

Course Outcome:

At the end of the course, the students will be able to

- describe various dimensions of climate change in India.
- identify the various impacts of climate change in different sectors.
- Plan and manage urban growth based on the climate change.
- Prepare the management plan for climate change adaptation and mitigation measures.
- Develop the climate resilient cities as per the need.

Unit I GLOBAL CLIMATIC CHANGE 9

Basics of Climate Change- Greenhouse Gases, Carbon Cycle - Global Warming, key associated planning terms- Phenomenon of climate change -Factors influencing climate change - Changes in patterns of temperature, precipitation and sea level rise - Case studies of Changes in Climate on a Global Scale and in India.

Unit II IMPACTS OF CLIMATE CHANGE 9

Impacts of Climate Change on various sectors – Agriculture, Forestry and Ecosystem –Water Resources – Human Health – Industry - Settlement and Society –Projected Impacts for Different Regions– Uncertainties in the Projected Impact of Climate Change– Risk of Irreversible Changes - Impact of climate change on cities -Need for mainstreaming climate change in city development strategies

Unit III URBANIZATION AND CLIMATE CHANGE 9

Urbanization and its impact on microclimates - Urban heat islands – Causes and effects -Energy consumption in cities - Climate variability - Exposure - Mitigation, resilience, adaptation- Sustainable Development Goals

Unit IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES 9

Adaptation Strategies in various sectors - Key Mitigation Technologies and Practices -Clean Development Mechanism – Carbon Trading - Eco- Friendly Plastic – Alternate Energy – Hydrogen – Bio fuel – Solar Energy – Wind – Hydroelectric Power – Mitigation Efforts in India and Adaptation funding.

Unit V CLIMATE RESILIENT CITIES 9

Urban vulnerability to climate change - Need for city resilience -Paradigm shift to resilient cities –- Carbon neutral cities -Eco-efficient cities - Sustainable transport cities - Case studies on climate resilience in cities of the world.

Text Book:

1. Dash Sushil Kumar, “Climate Change – An Indian Perspective”, Cambridge University Press India Pvt. Ltd, 2007.
2. Harriet Bulkeley, “Cities and Climate change”, Routledge, 2013.

Reference Book:

1. Mohsen M. Aboulnaga, Amr F. Elwan, Mohamed R. Elsharouny, “Urban Climate Change Adaptation in Developing Countries: Policies, Projects and Scenarios”, Springer books, 2019.
2. Jan C. van Dam, “Impacts of Climate Change and Climate Variability on Hydrological Regimes”, Cambridge University Press, 2003.
3. Velma. I. Grover “Global Warming and Climate” Change. Vol-I and II. Science Publishers, 2005.
4. Thomas E, Lovejoy, Lee Hannah., “Climate Change and Biodiversity”, TERI publishers, 2005.

Extensive Reading:

- Mainstreaming climate change adaptation in India, https://www.slurc.org/uploads/1/0/9/7/109761391/climate_change_adaptation_in_indian_cities.pdf.-
- Urban climate change adaptation - https://doi.org/10.1016/j.cities.2018.01.014.

23CEH03 IOT PLATFORM FOR SMART CITY PLANNING

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Concepts of Internet of Things.
- IoT Architecture and Terminologies.
- IoT working platform for different system.
- IoT standards for smart city planning.
- IoT applications on different sectors.

Course Outcome:

At the end of the course, the students will be able to

- Analyze the different concepts and theories of Internet of Things.
- Assess the various components of IoT architecture.
- Perform the IoT applications in programming platform.
- Adopt the IoT standards for smart city planning.
- Apply the understandings of IoT in different sectors of smart city planning.

Unit I INTRODUCTION TO IOT **9**

Overview and Introduction - Internet of Things (IoT) - Web of Things (WoT) - Cloud of Things - Need for IoT on Cloud - Services in the Cloud for the Internet of Things - Applications of IoT – Detailed Domain Model.

Unit II IOT ARCHITECTURE **9**

IoT Architecture - Sensor Layer - Gateway and Network Layer - Management Service Layer - Application Layer - IoT Enabling Technologies - Addressing Schemes - Data Storage and Analytics – Visualization - Connected Domains – Connected Home -Connected Worker - Connected Automobile - Connected Industry.

Unit III IOT PLATFORMS DESIGN METHODOLOGY **9**

IoT Systems – Intel IoT Framework - Qualcomm IoT Framework - Microsoft IoT Framework - ARM IoT Framework - Logical Design - Programming IoT platform (eg: Python, Mono C# , Objective-C, Ruby), Raspberry Pi - Program for Firmware – Case Studies.

Unit IV IOT STANDARDS **9**

Need for the IOT standards - IOT and Smart City Standards and Policies: Global perspective – Policy Research and Standardization in Europe – Indian Standards formulation – Sectional committee and composition – Challenges in standardization - Digital infrastructure.

Unit V IOT APPLICATIONS **9**

Lighting as service – Smart Parking -Smart metering – Smart water management- Smart energy– Smart solid waste management - Smart mobility – Smart governance- Challenges in IoT Management.

Text Book:

1. Olivier Hersent, David Boswarthick and Omar Elloumi, “The Internet of Things: Key Applications and Protocols”, Second Edition, Wiley Publisher, 2012.
2. Uckelmann, Dieter, Mark Harrison, and Florian Michahelles, “Architecting the Internet of Things”. Springer Science & Business Media, 2011.

Reference Book:

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-on Approach”, 2014.
2. Doukas, Charalampos, Building internet of things with the Arduino, CreateSpace Independent Publishing Platform, 2012.
3. Lu, Yan, Yan Zhang, Laurence T. Yang, Huansheng Ning. “The Internet of Things: From RFID to the Next-Generation Pervasive Networked Systems”, CRC Press.
4. Massimo Banzi, “Getting Started with Arduino (Make: Projects)”, O'Reilly Media. 2008.
5. Samuel Greengard, “The Internet of Things (The MIT Press Essential Knowledge series)”, MIT Press, 2015.

Extensive Reading:

- Is the Internet of Things the Future for Smart India? https://iot.electronicsforu.com/content/tech-trends/smart-india-iot-future.
- IoT policy Document. https://meity.gov.in/sites/upload_files/dit/files/Draft-IoT-Policy%20%281%29.pdf.

23CEH04 INTELLIGENT TRANSPORT SYSTEMS

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Fundamentals of intelligent transport systems.
- Concepts of ATIS and its operations.
- Basics of predictive route guidance system.
- Concepts of APTS and its operations.
- General issues related to ITS and environment.

Course Outcome:

At the end of the course, the students will be able to

- Analyze the various types of traffic and suggest ITS.
- Plan and design the ATIS.
- Plan the predictive route guidance system.
- Analyze the traffic data and able to suggest suitable APTS.
- Manage the issues arising out of the introduction of ITS.

Unit I ITS FUNDAMENTALS **9**

Introduction to Intelligent Transportation Systems (ITS) –Definition of ITS and Identification of ITS Objectives - Historical Background - Benefits of ITS - ITS Data collection techniques –Detectors - Automatic Vehicle Location (AVL) - Automatic Vehicle Identification (AVI)

Unit II ADVANCED TRAVELLER INFORMATION SYSTEMS **9**

Basic concepts - Models - Simulation - LOS of transportation systems - Static, real time and dynamic information - Value of information - Topology - Where and When to receive data - Information flows - Travel support - Dynamic routing.

Unit III PREDICTIVE ROUTE GUIDANCE **9**

ITS - Applications - Issues- Information types - Impact on route guidance - Case studies.

Unit IV ADVANCED PUBLIC TRANSPORTATION SYSTEMS (APTS) **9**

Scope - Components of APTS - Advantages- Limitations of APTS - Case studies - Issues

Unit V ITS AND ENVIRONMENT **9**

ITS and Flexibility - ITS and Customer-centricity - ITS and the Environment - General issues and Case studies - Overview of ITS implementations in developed countries.

Text Book:

1. Pradip Kumar Sarkar, Amit Kumar Jain, “Intelligent Transport Systems”, Paperback, PHI Learning, 2018.

Reference Book:

1. Paolo Baggano, “Intelligent transport Systems Good practices to standards”,CRC press,2016.
2. ITSHand Book 2000: Recommendations for World Road Association (PIARC)by Kan Paul Chen, John Miles.
3. Sussman, J. M., Perspective on ITS, Artech House Publishers, 2005.
4. National ITS Architecture Documentation, US Department of Transportation, 2007 (CD-ROM).

Extensive Reading:

- Delhi Integrated Multi-Modal Transit System Ltd. - https://www.dimts.in/Services_Transportation_Intelligent_Transport_System.aspx

23CEH05 INTEGRATED URBAN WATER MANAGEMENT

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Basic concepts of integrated urban water management.
- Urban water resources and its infrastructure system.
- Urban wastewater treatment systems and policy.
- Automation in water supply management.
- Software used in water and wastewater management system.

Course Outcome:

At the end of the course, the students will be able to

- Implement the basic concepts of integrated urban water management.
- Apply the various urban water resource management concepts.
- Analyze the various methods and techniques in the design urban wastewater systems.
- Plan the city level smart water technology system.
- Utilize the different software for urban water drainage and distribution networks

Unit I INTRODUCTION **9**

Concept of Integrated Urban Water Management - Influencing Factor and associated issues for the rapid urbanizations - Principles of IUWM –Introduction to water supply and sanitation - Storm / Flood - Overview and challenges to urban areas.

Unit II URBAN WATER RESOURCES MANAGEMENT **9**

Water in urban ecosystem – Urban Water Cycle - Storm water management practices – Water quality and treatment options - Water harvesting Structures – IWRM concepts and applications to Urban Water management - Integrated urban water planning– Water Resources management models - Water policy of Developed nations- National water Policy - Water Pricing – Case studies.

Unit III URBAN WASTEWATER MANAGEMENT **9**

Status of Wastewater treatment and disposal - Impacts on ecosystem - Eco friendly treatment systems- Concept of decentralization – Bio remediation - Phytoremediation- Wastewater management policy - Models of Developed nations –Eco restoration of rivers – Case studies.

Unit IV SMART WATER MANAGEMENT TECHNOLOGY **9**

Core Elements of smart water management - Automation in water supply – Smart metering - Real time monitoring and control – SCADA - Case studies of water treatment plant automation - Automation in distribution systems - Concept of Smart Water Supply System for Indian cities – Case studies.

Unit V DRAINAGE AND WATER DISTRIBUTION NETWORKS **9**

Storm water drainage system – SWMM software applications - Sectorization of distribution networks - DMA Demarcation – Urban flooding and control methods - Recent Initiatives in smart wastewater systems – Case studies.

Text Book:

1. Peavy, Rowe and Tchobanoglous., “Environmental Engineering” McGraw-Hill, 2015.
2. Neil S. Grigg., “Urban Water Infrastructure: Planning, Management and Operations”, Krieger Publishing Company, 1992.

Reference Book:

1. Policy brief note “Integrated Urban Water Management (IUWM): Toward Diversification and Sustainability”, Global Water Partnership, 2013.
2. Report on “Integrated Urban Water Management (IUWM) in Peninsular Malaysia”, Academy of Sciences, 2018.
3. UNU/IAS Report, “Defining an Ecosystem Approach to Urban Management and Policy Development” March 2003.
4. Zhifeng Yang, “Eco- Cities: A Planning Guide (Applied Ecology and Environmental Management)” CRC Press, 2017.

Extensive Reading:

- Urban Water Management in India https://www.waterworld.com/international/wastewater/article/16201696/urban-water management-in-india - Adopting Integrated Urban Water Management, Poland.
- http://nwm.gov.in/sites/default/files/6.%20%20adopting-integrated-urban-water-management.pdf ToolKit-1 https://www.indiawaterportal.org/sites/indiawaterportal.org/files/tool kit_for_integrated_urban_water_management_volume_1_tools_irap_2010.pdf –ToolKit
- https://www.indiawaterportal.org/sites/indiawaterportal.org/files/tool-kit_for_integrated_urban_water_management_volume_2_technical_report_irap_2010.pdf -

23CEH21 MATERIAL PROCUREMENT AND MANAGEMENT

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Importance of material management.
- Material classification, coding and purchasing procedure.
- Methods of effective inventory management.
- Quality control and store management.
- Project planning and procurement processes.

Course Outcome:

At the end of the course, the students will be able to

- Recognize the need and role of material management.
- Classify materials, identify sources of procurement and conduct vendor analysis.
- Perform effective management of inventory control.
- Manage stores and exercise quality control on materials.
- Apply MMS in planning, procurement, inventory, and cost control, evaluate projects and manage risks.

Unit I INTRODUCTION **9**

Importance of material management and its role in construction industry – Scope - Objectives and function- Integrated approach to materials management - Role of materials manager.

Unit II CLASSIFICATION AND CODIFICATION OF MATERIALS CONSTRUCTION **9**

ABC, FSN, VED, SOS analysis - Procedure and its use - Standardization in materials and their management – Procurement- Identification of sources of procurement - Vendor analysis - Concept of Material requirement planning and purchase procedure - Legal aspects.

Unit III INVENTORY MANAGEMENT **9**

Store Purchase Manual - Contractors Obligation- Inventory Control techniques – EOQ-Advantages and limitation of use of EOQ - Periodic ordering- Order point control -Safety stock - Stock outs- Concept of (JIT) - Just in time management - Indices used for assessment of effectiveness of inventory management.

Unit IV STORES MANAGEMENT **9**

Receipt and inspection- Care and safety in handling -Loss on storage, wastage - Bulk purchasing - Site layout and site organization - Scheduling of men, materials and equipment - Quality Control – Conventional methods of quality control of Construction materials - Statistical method of quality control -sampling techniques.

Unit V PROJECT PROCUREMENT PROCESSES **9**

Use of Materials Management Systems (MMS) in materials planning, procurement, inventory control, cost control - Project evaluation- Project delivery methods - Competitive bidding - Risk allocation and management - Integrated project delivery - Contract negotiation.

Text Book:

1. Peter Holm Andreasen, “Dynamics of Procurement Management – A Complexity Approach”, Copenhagen Business School, 2012.
2. Chitale A.K. and R.C. Gupta, “Material Management – Text and Cases”, Prentice Hall of India Pvt. Ltd., 2011.

Reference Book:

1. "A Guide to the Project Management Body of Knowledge (PMBOK Guide)”- Sixth Edition, An American National Standard, ANSI/PMI, 2017.
2. Joseph Philips, PMP, “Project Management and Professional” (Certification Study Guides), McGraw Hill Publication, 2013.
3. Jhamb L.C., “Inventory Management”, Everest Publishing house, 2005.
4. Ministry of Rural Development, GOI, “Procurement Manual”, National Rural Livelihoods Project, 2010.
5. Peter Baily, David Farmer, Barry Crocker, David Jessop & David Jones, “Procurement Principles and Management”, Pearson, 2015.
6. Denise Bower, “Management of Procurement”, Construction Management Series, Thomas Telford Publishing, 2003.

Extensive Reading:

- Purchasing and Materials Management - http://www.ddegjust.ac.in/2017/Uploads/11/POM-325.pdf.
- Procurement Management - https://opentextbc.ca/projectmanagement/chapter/chapter-13-procurement-management-project-management/

23CEH22 STRATEGIC PLANNING FOR INFRASTRUCTURE SECTORS

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Basic concepts of infrastructure development of different sectors.
- Importance of privatization in infrastructure projects.
- Risks and challenges in infrastructure planning
- Different strategies for effective project implementation.
- Sustainable infrastructure planning for major projects.

Course Outcome:

At the end of the course, the students will be able to

- Relate the basic concepts of infrastructure management.
- Evaluate the benefits and problems with infrastructure privatization.
- Assess the various risks and execute the infrastructure projects in successful manner.
- Prepare different strategies and risk management plans for infrastructure projects
- Analyze the strategy for sustainable infrastructure development.

Unit I BASIC CONCEPTS RELATED TO INFRASTRUCTURE 9

Introduction to infrastructure- Definition and types - An overview of the Power sector- Water supply and Sanitation sector - Road, rail, air and port transportation sectors - Telecommunications sector - Urban infrastructure- Rural infrastructure in India - An introduction to special economic zones - Credit rating of infrastructure projects - Credit allocation framework for infrastructure projects.

Unit II PRIVATE INVOLVEMENT IN INFRASTRUCTURE 9

Infrastructure privatization - Benefits of infrastructure privatization- Problems with infrastructure privatizationChallenges in privatization of water supply - Challenges in privatization of power - Privatization of infrastructure in India - Privatization of road transportation infrastructure in India.

Unit III INFRASTRUCTURE PLANNING AND IMPLEMENTATION 9

Mapping and facing the landscape of risks in infrastructure projects - Economic and Demand risks-Political risks - Socio-Environmental risks - Cultural risks in international infrastructure projects - Legal and contractual issues in infrastructure - Challenges in construction and maintenance of infrastructure.

Unit IV STRATEGIES FOR PROJECT IMPLEMENTATION 9

Risk management framework for infrastructure projects - Shaping the planning phase of infrastructure projects to mitigate risks - Designing sustainable contracts -Introduction to fair process and negotiation - Negotiation with multiple stakeholders on infrastructure projects.

Unit V SUSTAINABLE DEVELOPMENT OF INFRASTRUCTURE 9

Sustainable Development - Information technology and systems for successful infrastructure management Innovative design and maintenance of infrastructure facilities- Capacity building and improving the Governments role in infrastructure implementation - An integrated framework for successful infrastructure planning and management.

Text Book:

1. Sidney Levy, “Project Management in Construction”, McGraw Hill Series, 7th edition,2018.
2. Jeffrey L. Beard, Edward C. Wundran, Michael C. Loulakis, “Design, Build: Planning through development”, McGraw Hill Series, 2001.

Reference Book:

1. David I. Cleland and Roland Gareis, “Global Project Management Handbook: Planning, Organization and Controlling International Projects”, 2nd edition, McGraw Hill Series, 2006.
2. Richard Lambeck, John Eschemuller, “Urban Construction Project Management”, McGraw Hill Series, 2008.
3. Twelfth five year plan (2012-2015) Document. “VISION –TAMILNADU 2023”-Strategic plan for Infrastructure Development in Tamilnadu.

23CEH23 GEOTECHNIQUES FOR INFRASTRUCTURE

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Different foundations for infrastructure
- Construction of deep foundation techniques
- Suitability of retaining walls
- Characteristics of soft soil and ground improvement techniques
- Special foundations for infrastructure projects.

Course Outcome:

At the end of the course, the students will be able to

- Select appropriate construction methods for Rafts, Piles, Caissons and Diaphragm walls.
- Analyze the method of construction of deep foundations for Infrastructures.
- Analyze the stability of retaining wall.
- Execute appropriate ground remediation work with the use of Geotextiles and other techniques.
- Recommend the suitable foundations for special structures.

Unit I CONSTRUCTION OF SHALLOW FOUNDATIONS 9

Excavations for Foundations in soft soils – Recommendations – Types of Raft - Construction of Raft Foundations – Design requirements of shallow foundation used for infrastructure projects – Construction of Diaphragm walls – Codal provisions.

Unit II CONSTRUCTION OF PILE FOUNDATIONS 9

Introduction - Construction aspects of bored and driven Piles – Micro Piles – Pile groups – Design aspects of piles and pile cap - Berthing structures and Jetties –Piled raft foundation – Case studies.

Unit III EARTH REINFORCEMENT 9

Earth reinforcement – Principles and basic mechanism of reinforced earth – Construction of reinforced earth retaining walls – Stability analysis of gravity, cantilever retaining walls.

Unit IV FOUNDATIONS ON WEAK SOILS 9

Engineering properties of soft, weak, and compressible deposits - Soil improvement - Foundation Techniques for compressible and expansive soils - Geotextiles – Classification and applications - Methods of soil improvement using mechanical, chemical, Thermal, electrical methods.

Unit V SPECIAL FOUNDATIONS FOR INFRASTRUCTURE 9

Bridge substructures – Forces acting and design considerations – Marine substructures - Types – Design loads - Recent trends in infrastructure projects - Soil nailing, gabion walls – Case studies.

Text Book:

1. S.Swami saran, “Analysis and Design of Substructures: Limit State Design”, Oxford & IBH Publishing Co Pvt.Ltd, 2nd edition, 2018.
2. Purushothama Raj, P., “Ground Improvement Techniques”, Laxmi Publications (P) Ltd. New Delhi, 2007.

Reference Book:

1. Venkataramaiah C., “Geotechnical Engineering”, New Age International Publishers, New Delhi, 2018.
2. Das, B.M., “Principles of Foundation Engineering”, Fourth Edition, PWS Publishing, 2013.
3. Varghese P.C., “Foundation Engineering”, Prentice Hall of India Pvt. Ltd., New Delhi, 2012.
4. M.J.Tomlinson., John Woodward., “Pile Design and Construction Practice”, Fourth Edition, E & FN SPON, an imprint of Chapman & Hall, 2008.

23CEH24 PROJECT FORMULATION AND IMPLEMENTATION

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Project formulation and report preparation process.
- Project performance and appraisal procedures.
- Financing of infrastructure projects.
- Contracts, bidding process and implementation types.
- Impacts of private sector participation.

Course Outcome:

At the end of the course, the students will be able to

- Formulate the project for the approval of various authorities.
- Evaluate the project performance and analyse the risks involved.
- Analyse the key financial indicators in project financing.
- Implement the infrastructure projects based on the different types of contract.
- Interpret the aspects of PPP in Infrastructure development projects.

Unit I PROJECT FORMULATION **9**

Project – Concepts – Project identification – Preparation of Initial Screening Report (ISR) – Approval of ISR and Project by Government / Owner / Statutory Authorities – Project Development Studies – Preliminary Analysis, SWOT analysis, Market, Technical, Financial, Economic and Ecological - Pre-Feasibility Report and its Clearance, Project Estimates and Techno-Economic Feasibility Report, Detailed Project Report – Different Project Clearances required.

Unit II PROJECT PERFORMANCE AND APPRAISAL **9**

Economic evaluation - NPV – BCR – IRR – ARR – Urgency –Pay Back Period – Assessment of Various Methods – Indian Practice of Investment Appraisal – International Practice of Appraisal – Analysis of Risk – Different Methods – Selection of a Project and Risk Analysis in Practice.

Unit III PROJECT FINANCING **9**

Project Financing –Means of Finance – Financial Institutions – Special Schemes – Key Financial Indicators and Ratios.

Unit IV PROJECT IMPLEMENTATION **9**

Tender Document – Terms and Conditions – Bidding Process – Contracts – Terminology in Contracts – Types of Contracts – BOO, BOT, DBOT,DBOOT, BOOT, EPC & Turnkey – Project Planning – Mobilization of resources - Work Flow Execution.

Unit V PRIVATE SECTOR PARTICIPATION AND PPP **9**

Private Sector participation in Infrastructure Development Projects –Public Private Partnership Projects - Technology Transfer and Foreign Collaboration – Scope of Technology Transfer- Case studies.

Text Book:

1. W.Ronald Hudson, Ralph Haas, Waheed Uddin, “Infrastructure Management: Integrating, Design, Construction, Maintenance, Rehabilitation and Renovation”, McGraw Hill Publisher, 2013.
2. Raina V.K, “Construction Management Practice – The inside Story”, Tata McGraw Hill Publishing Limited, 2009.

Reference Book:

1. Leslie Feigenbaum, “Construction Scheduling With Primavera Project Planner”, Prentice Hall, 2002.
2. Prasanna Chandra, “Projects – Planning, Analysis, Selection, Implementation Review”, Tata McGraw Hill Publishing Company Ltd., New Delhi. 2019.

Extensive Reading:

- Project management for managers - https://nptel.ac.in/courses/110/107/110107081/

23CEH25 HIGH RISE BUILDINGS

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Basic principles of high-rise building.
- Behavior of various structural systems.
- Materials handling and mechanization for tall buildings.
- Various building service systems required by tall buildings.
- Safety aspects of high-rise buildings.

Course Outcome:

At the end of the course, the students will be able to

- Calculate various load acting on the structural systems.
- Consciously choose the structural system for a particular project.
- Expertise to choose the appropriate equipment for the project.
- Execute various services in tall buildings.
- Adopt suitable safety measures while executing the project.

Unit I BASIC PRINCIPLES **9**

Development of High-Rise Structures – General Planning Considerations – Materials used for Construction – Loading - Bye laws and legislation relevant to tall buildings.

Unit II STRUCTURAL SYSTEMS **9**

Factors affecting growth, Height and Structural form - High rise behaviour of Various structural systems – Rigid frames, braced frames, Infilled frames, shear walls, coupled shear walls, wall frames - Tubular structures, cores, outrigger – Braced and hybrid mega systems.

Unit III MATERIALS HANDLING AND MECHANISATION **9**

Materials handling - Mechanization - Earth moving - Horizontal and vertical movement - Factors affecting selection and location of tower cranes.

Unit IV SERVICES FOR TALL BUILDINGS **9**

Express elevators – Sky lobbies – Local elevators, Service floors etc. - Water supply systems – Skip stage pumping – Energy conservation methods – Location and sizing of water tanks - Electrical and communication systems - Disposal of Garbage - Multilevel Car Parking.

Unit V SAFETY AND HEALTH **9**

Accident prevention - Acts and regulations - Risk management and assessment - Design for safety, construct for safety - Falls of person and objects - Confined space - Electrical installations, excavation, fire safety - Lifting operations.

Text Book:

1. Chew Yit Lin, Michael “Construction Technology for Tall Buildings”, World scientific Publishing Ltd. 2017.
2. Bungale S. Taranath, “Structural Analysis and Design of Tall Buildings - Steel and composite construction”, Mc Graw Hill co., 2016.

Reference Book:

1. Bryan stafford Smith and Alex Coull, “Tall Building structures- Analysis and Design”, John Wiley & Sons, 1991.
2. Wolf gang Schuller, “High rise building structures”, John Wiley & Sons, 1977.
3. Lynn.S.Beedle, “Advances in Tall Buildings”, CBS Publishers and Distributers, New Delhi,1986.
4. Guy Nordenson, “Tall Buildings”, Thames & Hudson publishers, 2003.
5. Feng Fu, “Design and Analysis of Tall and Complex Structures”, Butterworth-Heinemann imprint, 2018.

Extensive Reading:

- Compendium of High Rise Buildings - CPWD- https://cpwd.gov.in/Publication/Compendium_of_High_Rise_Buildings_December_2019.pdf

23CEH41 MODERN CONSTRUCTION MATERIALS

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The properties of special concretes.
- The application of metals and its alloys.
- The various types of composites.
- New construction materials for waterproofing and insulation.
- Smart and intelligent materials.

Course Outcome:

At the end of the course, the students will be able to

- Use the special concrete based on the needs in the field.
- Employ the correct metal as per prevailing weather conditions.
- Select the appropriate composites for panel constructions.
- Choose suitable waterproofing and insulating materials for effective construction.
- Utilize the state of art of energy efficient and self - healing materials.

Unit I SPECIAL CONCRETES **9**

Concrete and its behaviour - Properties, advantages and applications - High Strength Concrete - High Performance Concrete - Fiber Reinforced Concrete - Self-Compacting Concrete - Waste-material based Concrete – Geopolymer Concrete - Materials for fire, thermal, electrical and explosive resistance.

Unit II METALS **9**

Types of Steel - Properties and manufacturing process - Advantages of new alloy steels - Properties and advantages of aluminium and its products - Types of coatings to reinforcement - Applications of coatings - Physical descriptions of Asbestos sheets, GI sheets, Tubes and Lightweight Roofing Materials.

Unit III COMPOSITES **9**

Types of plastics - Properties and manufacturing process - Advantages of reinforced polymers - Types of FRP - FRP on different structural elements - Applications of FRP - Applications of metal, ceramics and polymer matrix composites.

Unit IV SPECIAL MATERIALS **9**

Types and properties of waterproofing compounds - Properties of geo-synthetics and geo-membrane - Conventional and Modern insulating materials - Thermal, Sound and Electrical insulating materials - Materials for 3D printing structures.

Unit V SMART AND INTELLIGENT MATERIALS **9**

Smart and intelligent materials - Special features and its types - Piezoelectric material and shape memory alloys - Energy harvesting material - Self healing polymer - Case studies on the applications of smart and intelligent materials - Sensor to detect structural cracks and health of structures.

Text Book:

1. Shan Somayaji, “Civil Engineering Materials”, Prentice Hall Inc., 2010.
2. Shetty M.S, “Concrete Technology: Theory and Practice”, S. Chand & Company Ltd., 2016.

Reference Book:

1. ACI Report 440.2R-02, “Guide for the design and construction of externally bonded RP systems for strengthening concrete structures”, American Concrete Institute, 2012.
2. Ashby, M.F. and Jones.D.R.H.H. “Engineering Materials 1: An introduction to Properties, applications and designs”, Elsevier Publications, 2015.

Extensive Reading:

- http://www.theconstructor.org
- https://nptel.ac.in/courses/105/106/105106053/

23CEH42 CONSTRUCTION EQUIPMENT MANAGEMENT

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Planning and managing the equipment as per the field requirement.
- The equipment types and its operations.
- The procurement of equipment.
- The maintenance of equipment.
- The safety of equipment employed in different conditions.

Course Outcome:

At the end of the course, the students will be able to

- Become an expertise in analyzing equipment characteristics and planning them effectively.
- Select appropriate equipment with respect to construction works and ground conditions.
- Get sound knowledge on construction equipment procurement process.
- Employ and practice appropriate techniques for effective equipment maintenance.
- Engage in suitable training and choose correct safety method while handling equipment.

Unit I PLANNING AND MANAGEMENT OF EQUIPMENT 9

Importance and role of equipment management in construction field - Identification - Planning - Replacement - Cost control of equipment - Depreciation analysis - Replacement of equipment - Replacement analysis.

Unit II EQUIPMENTS IN CONSTRUCTION 9

Types of equipment and its operations - Earth moving, pile driving, road construction, concrete placing, materials handling, off-site and on-site fabrication and repair works, mechanical and electrical equipment installation - Tunnelling - Techniques adopted - Performance characteristics related to the jobs in hand.

Unit III EQUIPMENT PROCUREMENT MANAGEMENT 9

Construction equipment - Purchase Order - Indents - Marketing - Registration of sellers - Selection and placement of Order - Follow up - Physical training - Physical Inspection and verification - Fixation of the re-order level - Buying / Leasing / Hiring Option – Owner's tools and Plants.

Unit IV EQUIPMENT MAINTENANCE MANAGEMENT 9

Selection based on equipment performance - Equipment operations - Maintenance - Organize maintenance team - Training - Scheme for maintenance - Monitoring and effectiveness of management - Log book.

Unit V EQUIPMENT SAFETY MANAGEMENT 9

Training - Identification of needs - Training methods – Programmes, seminars, conferences and competitions - Safety training - Role of government agencies and private consulting agencies - Safe practices - Method of promoting equipment safety - Motivation, communication, creating awareness, awards, celebrations, safety posters, safety displays, safety pledge, safety incentive scheme and safety campaign - Domestic safety and training.

Text Book:

1. Peurifoy, R.L., Ledbetter, W.B. and Schexnayder, C. "Construction Planning, Equipment and Methods", 6th Edition, Tata McGraw-Hill, New Delhi, 2013
2. Sharma S.C., "Construction Equipment and Management", Khanna Publishers, New Delhi, 2017

Reference Book:

1. Dr.S. Seetharaman, "Construction Engineering and Management", Umesh Publications, 5th Edition, 2015.
2. Dr. Mahesh Varma, "Construction Equipment and its planning and Application", Metropolitan Book Company, New Delhi. 2010
3. Deodhar, S.V., "Construction Equipment and Job Planning", Khanna Publishers, New Delhi, 2017.

Extensive Reading:

- https://basiccivilengineering.com/2015/04/type-of-equipment-use-in-construction.html
- https://nptel.ac.in/courses/105/104/105104161/

23CEH43 ENERGY CONSERVATION METHODS IN CONSTRUCTION

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The facts and ideas on energy conservation concepts in buildings.
- The scientific concepts of solar heating and cooling.
- The materials which improve daylighting and electrical lighting in the rooms.
- The natural ventilation and design effective heat control systems in buildings.
- The different design concepts and methods with respect to different climatic zones.

Course Outcome:

At the end of the course, the students will be able to

- Employ the different energy conservation methods during building construction.
- Design passive solar heating and cooling systems in large buildings.
- Construct buildings with enhanced daylight and electrical lighting facilities.
- Design and construct buildings with natural ventilation and thermal control techniques
- Become expertise in designing and construct energy efficient buildings for the special climatic zones.

Unit I ENERGY CONSERVATION **9**

Energy required in buildings - Heat transfer - Thermal storage - Greenhouse effect - Psychrometric chart - Thermal comfort - Site planning and development - Temperature - Humidity - Wind - Optimum site location - Sun protection - Types of shading devices - IGBC's rating systems - Indoor environmental quality.

Unit II PASSIVE SOLAR HEATING AND COOLING **9**

Passive solar heating - Principles - Key design elements - Trombe walls, water walls, convective air loops - Concepts - Passive cooling - Principles - Radiation - Evaporation and de-humidification - Mass effect - Load control - Air filtration and odour removal.

Unit III DAYLIGHTING AND ELECTRICAL LIGHTING **9**

Materials, components and details - Insulation - Optical materials - Radiant barriers - Glazing materials - Daylighting - Building design strategies - Electric lighting - Light distribution - Illumination requirement - Supplementary artificial lighting design.

Unit IV HEAT CONTROL AND VENTILATION **9**

Requirements - Heat transmission through building sections - Thermal performance of building sections - Orientation of buildings - Thermal design of buildings - Influence of design parameters - Mechanical controls - Ventilation - Requirements - Minimum standards - Energy conservation in ventilating systems - Design for natural ventilation.

Unit V DESIGN FOR CLIMATIC ZONES **9**

Energy efficiency - Overview of design concepts and architectural interventions - Energy efficient buildings for various zones - Cold and cloudy, cold and sunny, composite, hot and dry, moderate, warm and humid - Case studies - Energy audit - Certification.

Text Book:

1. Umberto Desideri and Francesco Asdrubali, "Handbook of Energy Efficiency in Buildings: A Life Cycle Approach", Butterworth-Heinemann, 1st edition, 2019.
2. Brown, GZ, "Sun, Wind and Light: Architectural design strategies", John Wiley,3rd edition, 2014.

Reference Book:

1. Matthew R. Hall, " Materials for Energy Efficiency and Thermal Comfort in Buildings", Woodhead Publishing Ltd.,2010.
2. Waters J.R, "Energy Conversation in Building: A Guide to part L of the building regulations", Black well publishing, 2003.

Extensive Reading:

- https://www.conserve-energy-future.com/energy-conservation-techniques.php
- https://nptel.ac.in/courses/105/102/105102175/

23CEH44 INTELLIGENT BUILDING TECHNIQUES

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Intelligent materials and buildings.
- Building comfort systems and its components.
- Modern safety systems in buildings.
- Electronics and communication systems in modern buildings.
- Factors influencing the performance of buildings.

Course Outcome:

At the end of the course, the students will be able to

- Choose materials and technology for intelligent buildings.
- Choose appropriate comfort systems and fabricate HVAC system efficiently and effectively.
- Identify safety measures that are required for the building in order to avert building accidents.
- Select appropriate electronic components and construct a state-of-art built-in electronic system.
- Improve the performance of buildings in terms of energy efficiency, clean environment and air pollution.

Unit I INTELLIGENT BUILDINGS **9**

Basic concepts - Intelligent building automation - Cost analysis - Smart materials and embedded sensor technology - Building management system and energy savings - Benefits

Unit II INTELLIGENT COMFORT SYSTEMS **9**

Basic HVAC system - Human comfort - Sensor - Occupancy sensors and temperature sensors - Energy efficient HVAC systems - Thermal energy storage - Under floor air distribution - Chilled beams - Other emerging HVAC technologies for high performance buildings - Automated car parking management

Unit III INTELLIGENT SAFETY SYSTEMS **9**

Life safety factors - Intrusion sensors - Space sensors - Closed circuit television and surveillance systems - Access control management system - Portrait id, swipe card access control, biometric access control - Fire protection systems - Smoke detection, automatic fire alarm detection, sprinklers, hose reels hydrants, foam systems - Microprocessor based alarm - Emergency control of elevator, doors, HVAC systems - Security and alarm system

Unit IV BUILDING ELECTRONICS **9**

Microprocessor based control - Programmable logic controller - Communication principles - Telephone systems - Communal aerial broadcasting - Satellite communication - Fibre optic system

Unit V PERFORMANCE BUILDINGS **9**

High performance buildings - Control theory - Market trends - Energy efficiency - Environmental and greenhouse gas emission reduction - Clean development Mechanism - Practical benefits - Smart home - Smart office.

Text Book:

1. Shengwei Wang, “Intelligent Buildings and Building Automation”, Spon Press, London, 2010.
2. Derek Clements Croome, “Intelligernt Building: Design, Management and Operations”, 3rd edition, Telford ICEP Publishers, London, 2014.

Reference Book:

1. Ehrlich, C., “Intelligent Building Dictionary: Terminology for Smart, Integrated Green Building Design, Construction, and Management”, San Francisco, Handson-Guide, 2007.

Extensive Reading:

- https://www.iofficecorp.com/blog/intelligent-building-examples
- https://nptel.ac.in/courses/105/102/105102195/

23CEH45 QUALITY CONTROL IN CONSTRUCTION

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The concepts of quality in construction site.
- The quality improvement process.
- The quality inspection program.
- The concept of quality management system.
- The quality management system and environment management system.

Course Outcome:

At the end of the course, the students will be able to

- Carry out the quality check, audit and inspection
- Employ different quality improvement techniques.
- Execute quality inspection in the various construction works.
- Adopt different quality management techniques, assurance and control techniques in construction industries.
- Employ ISO 9000 and ISO 14000 based on the functional nature of industries.

Unit I QUALITY **9**

Introduction - Quality Contributors at a Construction Site - Quality plan, quality audits, quality manual, PDCA cycle - Factors influencing construction quality - Quality plan - Inspection procedures - Total QA/ QC programme.

Unit II QUALITY IMPROVEMENT TECHNIQUES **9**

Excavation, Backfilling and Compaction - Tiling - Plastering - Waterproofing - Factors affecting Quality and Reliability - Quality control, tests and checklist - Quality in Execution - Good practices and Precautions - Remedial measures - Documentation

Unit III QUALITY INSPECTION PROGRAM **9**

Concrete Mix Design - Concrete Quality - Formwork: Types, Quality control, checklist -pre, during and after, compliance - RCC Works: Coordinate checks, Pre & post pour checks - Defects in RCC Work, Precautions, Good practices, documentation - Brickwork and Blockwork Check for quality and compliance - Remedial measures, documentation - Inspection - Purpose - Reports and records

Unit IV QUALITY MANAGEMENT **9**

Objectives - Authority and responsibilities - Quality management guidelines - Quality councils and circles - Quality system documents - Quality related training - Implementing a quality system - Third party certification

Unit V QUALITY STANDARDS **9**

Quality standards - Quality of cement, bricks, steel and concrete - Provisions of Indian standards - ISO 9000 and ISO 14000 standards.

Text Book:

1. Abdul Razzak Rumane, “Quality Management in Construction Projects”, CRC Press, 2nd edition, 2018.
2. O'Brien, James J, “Construction Inspection Handbook - Total Quality Management”, Springer, 3rd edition, 2012.

Reference Book:

1. Hutchins.G, ISO 9000 : A Comprehensive Guide to Registration, Audit Guideline and Successful Certification, Viva Books Pvt. Ltd.,
2. Juran Frank, J.M. and Gryna, F.M. “Quality Planning and Analysis: From Product development through use”, McGraw Hill, 6th edition, 2010.

Extensive Reading:

- https://www.planradar.com/quality-control-in-construction/
- https://www.designingbuildings.co.uk/wiki/Quality_control_for_construction_works

23EEH01 CONVENTIONAL AND ALTERNATE ENERGY SOURCES

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- operational practices of thermal power plants, gas turbine and Diesel electric power plants
- the importance and process involved in harnessing power from solar, wind, ocean, geo-thermal resources and Bio-mass resources

Course Outcome:

At the end of the course, the students will be able to

- Explain the process of power generation from Thermal power plants
- Explain the process of power generation from Gas turbine and Diesel power plants
- Explicate the importance of alternate energy resources and explain the power harnessing methods from solar and wind resources
- Spell out the concept behind ocean and geo-thermal energy resources
- Expound the process involved in the generation of power from Bio-mass

Unit I THERMAL POWER PLANT **9**

Types of thermal power plants, Steam power plant based on fossil fuels, Thermal power plant equipment: boilers, superheaters, re-heaters, economiser, condensers and gas loops, turbines etc. Performance of steam power plant and its components

Unit II GAS TURBINE AND DIESEL ELECTRIC POWER PLANT **9**

Gas turbine power plant: different components, operating principles and design of Gas Turbine power plant, Gas Turbine-Steam Turbine combined cycle power plant.

Diesel electric power plant: different components, operating principles and design of Diesel electric power plant.

Unit III SOLAR ENERGY AND WIND ENERGY **9**

Fundamentals of Solar Photo Voltaic Conversion, Solar Cells, Solar PV Power Generation, Solar PV Applications.

Wind Energy Estimation, Types of Wind Energy Systems, Performance, Site Selection, Details of Wind Turbine Generator.

Unit IV OCEAN ENERGY AND GEOTHERMAL ENERGY **9**

Ocean Thermal Energy Conversion (OTEC), Principle of operation, development of OTEC plants, Tidal and wave energy, Potential and conversion techniques, mini-hydel power plants.

Geothermal Energy Resources, types of wells, methods of harnessing the energy, scope in India.

Unit V BIO-MASS ENERGY **9**

Principles of Bio-Conversion, Anaerobic/aerobic digestion, types of Bio-gas digesters, gas yield, combustion characteristics of bio-gas, utilization for cooking

Practical Course **-1**

Text Book:

1. Khan B.H, Non-Conventional Energy Resources, Second Edition, Tata McGraw Hill Education Private Limited, New Delhi, 2011.
2. Sawhney G.S, Non-Conventional Energy Resources, First Edition, PHI Learning Private Limited, Delhi, 2019
3. Nag P. K, Power Plant Engineering, Fourth Edition, McGraw Hill Education, India, 2014.
4. Tiwari G.N and Ghosal M.K, Renewable energy resources: Basic Principles and Applications, Narosa Publishing House, New Delhi, 2004.
5. Rai G.D, Non-Conventional Energy Sources, Sixth Edition, Khanna Publication, New Delhi

Reference Book:

1. John Twidell and Tony Weir, Renewable Energy Sources, 3rd Edition, CRC Press, USA, 2006
2. Sukhatme S.P,Solar Energy, 3rd Edition, Tata McGraw-Hill Publication, New Delhi, 2008.
3. Mittal K M, Non-Conventional Energy Systems, 3rd Edition, A H WheelerPublishing Co Ltd., India, 2006.
4. Ramesh.R, UdayKumar.K and Anandakrishnan.M,Renewable Energy Technologies: Ocean Thermal Conversion and Other Sustainable Energy Options, Narosa Publishing House, New Delhi, 1997.
5. Sergio Capareda, Introduction to Biomass Energy Conversions, 1st Edition, CRC Press, USA, 2013.
6. Veatch B. Drbal, Lawrence.F, Boston P.G, Westra K.L and Erickson R.B, Power Plant Engineering, CBS HB Publication, 2005.

23EEH02 INTRODUCTION TO SMART GRID AND ELECTRIC VEHICLES

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- the basics and characteristics of smart grid
- the various Smart Grid Technologies
- the types. Architecture and impact of Electric vehicle on electric utilities

Course Outcome:

At the end of the course, the students will be able to

- Describe the benefits of smart grid and smart energy resources
- Explain the importance of smart sub stations and Transmission systems
- Enumerate the significance of smart meters for smart grid environment
- Narrate the significance of Electric vehicle to the environment and utility
- Spell out the worthiness of Electric vehicle and its impact on Electricity demand

Unit I OVERVIEW OF SMART GRID **9**

Introduction to conventional Grid- Smart Grid- Need for smart grid-Smart grid Smart grid drivers– Barriers of Smart Grid- Difference between conventional grid & smart grid- key characteristics of smart grid – Benefits of smart grid: Utility benefits, consumer benefits & Environmental benefits – Architecture of Smart Grid

Unit II SMART GRID TECHNOLOGIES - I **9**

Microgrid: Introduction, Components, Classifications- Islanding: Overview about different Islanding Techniques, Impedance based Islanding Technique-Standards for smart grid system- Role of FACTS and HVDC in smart grid-Wide Area Monitoring System (WAMS)-Phasor Measurement Systems-Applications of WAMS- Intelligent Electronic Devices (IEDs), Digital Fault Recorder, Digital Protective Relays

Unit III SMART GRID TECHNOLOGIES - II **9**

Demand Side Management-Demand Response Management- Volt/VAR control- Fault Detection, Isolation and Restoration-Outage Management System- Smart Meters: Introduction to Smart Meters, Advanced Metering infrastructure (AMI), AMI drivers and benefits, AMI Components

Unit IV INTRODUCTION TO ELECTRIC VEHICLE **9**

Introduction to Electric Vehicle- Advantages and Limitation of Electric Vehicle-Comparison of Energy efficiency, and energy density of EV and ICE vehicle-Classification of EVs-Different architecture of Electric Vehicle-Architecture of Hybrid vehicle: Series hybrid, Parallel hybrid, Series-parallel hybrid, Complex Hybrid

Unit V ELECTRIC VEHICLE:ARCHITECTURE, STORAGE & IMPACT ON SYSTEM DEMAND **9**

Motor Drive Technologies: Requirements of motors for EV and HEV, Overview about different Motors used in EV and HEV- Overview of different energy storage Technologies, Battery Parameters: Capacity, Charging Rate, SoC and SoH-Battery pack design using series and parallel connection- Battery Charging Technologies- Battery Swapping- Vehicle to Grid and Grid to Vehicle Technologies- Parameters affecting electricity demand due to EV charging- impact of electric vehicle integration on the grid

Text Book:

1. Stuart Borlase “Smart Grid: Infrastructure, Technology and Solutions”, CRC Press, 2012.
2. JanakaEkanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, “Smart Grid: Technology and Applications”, John Wiley & Sons, March 2012.
3. Iqbal Husain, " Electric and Hybrid Vehicles: Design Fundamentals, Third Edition, CRC Press, 2021
4. Mehrdad Ehsani, Yimin Gao, Stefano Longo, Kambiz Ebrahimi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles”, , Third Edition, CRC Press, 2018

23EEH03 DATA MANAGEMENT FOR SMART GRID

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Fundamentals of Database
- management systems in smart grid applications
- features of structured query language
- Contemporary logical design methods and tools for database transactions
- query processing and optimization

Course Outcome:

At the end of the course, the students will be able to

- Draw the ER diagram for smart grid applications
- Design smart grid databases using relational model
- Query the smart grid database using SQL
- Apply normalization techniques on the database
- Perform transaction and concurrency control techniques

Unit I DATABASE FUNDAMENTALS **9**

Purpose of Database Systems – View of Data - Database System Architecture – Database Users and Administrators – Data Models – Structure of Network Model – Structure of Hierarchical Model – Entity Relationship Model – Constraints – Entity Sets – Attributes – Keys – E-R Diagrams - Design Issues – Entity Relationship diagram for Smart Grid applications.

Unit II RELATIONAL DATABASE MODEL **9**

Introduction of Relational Model – Structure of Relational Databases – Schema Diagrams – Relational Query Languages - Relational Algebra – Selection – Projection – Join – Relational database model for Smart Grid applications.

Unit III STRUCTURED QUERY LANGUAGE **9**

Overview of SQL query language – SQL Data definition – Basic Structure of SQL Queries – Additional Basic Operations – Set Operations – Null values – Aggregate Operations –Views – Integrity Constraints – Authorization

Unit IV NORMALIZATION **9**

Functional Dependencies – Non-loss Decomposition – Dependency Preservation - First, Second, Third Normal Forms – Boyce Codd Normal Form

Unit V TRANSACTION AND CONCURRENCY CONTROL **9**

Transaction Model – ACID properties – Transaction States – Serializability – Conflict Serializability – View Serializability – Testing Serializability. Concurrency Control – Lock Based Protocols – Deadlocks – Multiple Granularity – Time Stamp Based Protocols – Validation Based Protocols.

Practical Course **0**

Text Book:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, “Database System Concepts”, McGraw Hill, Sixth Edition, 2011.
2. C.J.Date, A.Kannan and S.Swamynathan, ”An Introduction to Database Systems”, Pearson Education, Eighth Edition, 2006.

Reference Book:

1. R. Elmasri, S.B. Navathe, “Fundamentals of Database Systems”, Pearson Education/Addison Wesley, Sixth Edition, 2014.
2. Thomas Cannolly and Carolyn Begg, “Database Systems, A Practical Approach to Design, Implementation and Management”, Pearson Education, Fifth Edition, 2009.
3. Raghu Ramakrishnan, Johannes Gehrke, “Database Management Systems”, McGraw Hill, Third Edition, 2004.

Extensive Reading:

- https://ieeexplore.ieee.org/document/5981411
- https://online.stanford.edu/courses/xeiet137-smart-grid-sensing-data-analytics-and-control
- http://www.1keydata.com/datawarehousing/data-modeling-levels.html
- http://www.cs.uwaterloo.ca/~gweddell/cs448/Arch.pdf
- http://www.sql-tutorial.net/SQL-tutorial.asp

23EEH04 IOT FOR SMART GRIDS

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- the emerging area of Internet of Things.
- the concept of application of IoT in Smart Grid.

Course Outcome:

At the end of the course, the students will be able to

- Describe the concepts of Internet of Things.
- Explain the IoT communication technologies.
- Explicate the applications IoT in Smart Grid.
- Spell out the suitable architectures for IoT aided Smart grid systems.
- Apply existing prototypes of IoT in smart grid.

Unit I INTRODUCTION TO SMART GRID AND IOT 9

Internet of Things - Smart Grid- Importance of Smart Grid in Smart Cities-Integration of the Internet of Things into a Smart Grid

Unit II IOT TECHNOLOGIES, COMMUNICATION TECHNOLOGIES AND STANDARDIZATION 9

IoT Technologies – Communication Technologies: Home Area Network (HAN) - Neighbourhood Area Network (NAN)- Wide Area Network (WAN) - Standardization: Activities in IoT, Smart Grid and IoT aided Smart grid systems

Unit III APPLICATIONS OF IOT IN SMART GRID SYSTEMS 9

HAN applications: Smart Home – Electric vehicle – AMI – Integration of DERs – Power demand management- NAN applications: Smart Distribution – smart patrol – WAN applications: Transmission tower protection – monitoring of power transmission lines

Unit IV ARCHITECTURES FOR IOT AIDED SMART GRID SYSTEMS 9

Smart Grid Architecture Model – Three layered architecture – Four layered architecture – Cloud based architecture – Web enabled smart grid architecture – Last meter smart grid architecture

Unit V PROTOTYPES FOR IOT AIDED SMART GRID SYSTEMS 9

A Simple Prototype for Energy Efficiency- Integration of Renewable and Non Renewable energy Sources at Home- In Home Appliance Monitoring Implementation- Real time Monitoring of Medium Voltage Grid – Open issues & challenges

Text Book:

1. P. Waher, Learning Internet of Things. Packt Publishing, 2015.
2. N. Ramesh Babu, Smart Grid Systems: Modeling and Control, CRC Press,2018.
3. F. P. Sioshansi, Smart Grid: Integrating Renewable, Distributed and Efficient Energy, Academic Press, 2011

Reference Book:

1. D. Kellmereit, The Silent Intelligence: The Internet of Things. DnD Ventures, 2013..
2. A. McEwen and H. Cassimally, Designing the Internet of Things. John Wiley & Sons, 2013.
3. S. Borlase, Smart Grids: Advanced Technologies and Solutions, Second Edition. CRC Press, 2017.
4. J. A. Momoh, Smart Grid: Fundamentals of Design and Analysis. John Wiley & Sons, 2012.

23EEH05 POWER ELECTRONIC INTERFACES FOR SMART GRID

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The importance of Power Electronic devices for smart grid environment
- The basic concepts of Power flow control.
- The concept, benefits and the applications of Power Electronic Interface Devices, i.e., FACTS devices.

Course Outcome:

At the end of the course, the students will be able to

- Illustrate the importance of Power Electronic Interface for Generation
- Demonstrate the concept of basic power flow control and compensation techniques
- Explain the working principle, control strategies and applications of shunt connected FACTS devices
- Narrate the importance of series compensation FACTS devices
- Describe the functionality of advanced FACTS devices and Power Electronic Interface for Distribution

Unit I POWER ELECTRONIC INTERFACE FOR SOLAR PV AND WECS **9**

Power Electronic Interface for Solar PV: Concept of MPPT-MPPT algorithms: P&O and incremental conductance algorithm-Power Electronics Interface for DC stand alone load and Battery using Buck, Boost and Buck-boost converter- Single stage and double stage Power converter for interfacing Solar PV to grid- Power Electronic Interface for Wind Energy Conversion System- Type-A, B, C and D based WECS –Concept of LVRT.

Unit II POWER FLOW CONTROL & OVERVIEW OF FACTS CONTROLLERS **9**

Basics of power transmission networks-Control of power flow in AC transmission line - Benefits with FACTS controllers – Overview of different FACTS devices - Analysis of uncompensated AC Transmission line - Passive reactive power compensation: Effect of series and shunt compensation on power transfer capacity Introduction to Voltage source converter based Controller.

Unit III SVC & STATCOM **9**

SVC: Operation of TCR, FC-TCR based SVC,TSC-TCR based SVC – Applications of SVC: Transient stability enhancement, Augmentation of Power System damping

STATCOM: Principle of operation, V-I curve

Unit IV TCSC & SSSC **9**

Concepts of Controlled Series Compensation – Operation of TCSC –VI-characteristics of TCSC– Applications of TCSC: Improvement of system stability limit - Enhancement of system damping – Voltage collapse prevention

SSSC: Principle of operation, control system –Power flow control using SSSC.

Unit V ADVANCED FACTS DEVICES AND POWER ELECTRONIC INTERFACE FOR DISTRIBUTION **9**

Principle of operation of Advanced FACTS devices: UPFC: modes of operation – IPFC: Basic Operational concept

Power Electronic Interface for Distribution: Overview of Different Power Quality Issues – Custom Power Devices for Power Quality mitigation: Operating principle of DSTATCOM, DVR, UPQC

Text Book:

1. NarainG.Hingorani, Laszio. Gyugyi, “Understanding FACTS Concepts and Technology of Flexible AC Transmission System”, Standard Publishers, Delhi 2001.
2. Mohan Mathur, R., Rajiv. K. Varma, “Thyristor Based FACTS Controllers for Electrical Transmission Systems”, IEEE press and John Wiley & Sons, Inc., 2002
3. Chetan Singh Solanki, “Solar Photovoltaics: Fundamentals, Technologies and Applications”, PHI Learning Private Limited, 2015
4. Frede Blaabjerg and Zhe Chen, “Power Electronics for Modern Wind Turbines”, Springer, 2006

Reference Book:

1. V.K.Sood, “HVDC and FACTS controllers- Applications of Static Converters in Power System”, Kluwer Academic Publisher, 2004.
2. K.R.Padiyar, “FACTS Controllers in Power Transmission and Distribution”, New Age International (P) Ltd., Publishers, New Delhi, Reprint 2009.
3. Janaka Ekanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, “Smart Grid Technology and Applications”, John Wiley & Sons Ltd, 2012.
4. Bin Wu, Yongqiang Lang, Navid Zargari and Samir Kouro, “Power Conversion and Control of Wind Energy Systems”, Wiley-IEEE Press, 2011
5. S.N.Bhadra, D. Kastha, & S. Banerjee “Wind Electrical Systems”, Oxford University Press, 2009

23EEH21 OBJECT ORIENTED PROGRAMMING USING JAVA FOR ELECTRICAL ENGINEERS

Offered by EEE

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Object Oriented Programming.
- basic characteristics of Java Programming.
- principles of Inheritance, Exceptions, and interfaces.
- exceptions and using I/O streams.
- developing java programs for Electrical Applications.

Course Outcome:

At the end of the course, the students will be able to

- Explain the concept of Object Oriented Programming.
- Write simple Object Oriented Programs using Java.
- Write GUI based programming using Applets also know about multithreading.
- Write java programs for solving electrical circuits and networks.

Unit I OBJECT ORIENTED PROGRAMMING 9

Object Oriented Programming – objects and classes – Abstraction – Encapsulation - Inheritance – Polymorphism. OOPs in Java – Characteristics, Advantages of Java – Java Virtual Machine – Java Source File Structure – Compilation, Fundamental Programming Structures in Java. Data Types, Variables, Operators, Control Statements, Loops, Arrays and functions.

Unit II INTRODUCTION TO JAVA PROGRAMMING 9

Objects and classes in Java - defining classes - methods - access specifiers - static members - constructors - Interface, Defining an Interface, implementing interface, differences between classes and interfaces–Strings - String Buffer - String Tokenizer.

Unit III INHERITANCE AND EXCEPTION HANDLING 9

Inheritance - class hierarchy - final keyword - polymorphism - dynamic binding - abstract classes - inner classes- Exceptions - exception hierarchy - throwing and catching exceptions - Try-with Catch Block Handling Multiple Exceptions.

Unit IV MULTITHREADING AND APPLETS 9

Multi-threaded programming - thread states - thread life cycle - thread properties - thread synchronization - Inter thread Communication - Suspending, Resuming, and Stopping Threads. Introduction to Applet - Applet Life Cycle - Event handling in Applets.

Unit V APPLICATIONS IN ELECTRICAL ENGINEERING 9

JAVA Program for solving electrical circuits problems using Ohm's Law – Kirchhoff's laws. Program for the solution of DC and AC Circuits – Resistors in series and parallel circuits– Network Theorems- Thevenin's and Norton's Theorem – Superposition – Maximum power transfer Theorem. Programs for the solution of two port networks.

Text Book:

1. E.BalaGurusamy, "Programming with java A Primer", Tata McGraw, Hill Education, Fourth Edition, 2009.

Reference Book:

1. P.J.Deitel&H.M.Deitel, "Java: How to Program Java 2", Prentice Hall, Seventh Edition, 2011.
2. Herbert Schildt, "Java The Complete Reference",TataMcgrawHill, Eight Edition, 2011.
3. Y.Daniel Liang " Introduction to Java Programming" 7th Edition, Pearson Education,2013.

Extensive Reading:

- http://docs.oracle.com/javase/tutorial/java/
- http://www.java2s.com/Tutorial/Java/CatalogJava.htm
- http://www.javatpoint.com/java-swing/
- https://docs.oracle.com/javase/tutorial/collections/intro/
- http://way2java.com/java-versions-2/jdk-1-8-features/

23EEH22 DATA ANALYSIS USING PYTHON FOR ELECTRICAL ENGINEERS

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Fundamentals of Object Oriented Programming in Python.
- Python data types Lists, Tuples and Dictionaries.
- Functions in Python.
- OOP's programming Objects and Classes in Python.
- I/O and Error handling methods in Python.

Course Outcome:

At the end of the course, the students will be able to

- Explain the fundamental concepts of python programming.
- Explicate python data types Lists, Tuples and Dictionaries.
- Describe python functions.
- Write simple python code using classes and objects.
- Implement I/O and Error handling concepts in Python.

Unit I INTRODUCTION TO PYTHON 9

Introduction to Python: Overview of Python as a programming language, its features, and use cases. - Installation and Setup: Steps to install Python and the necessary development environment - Python Syntax: Basic syntax, indentation, variables, data types, and operators - Input and Output: Working with user input, displaying output, and formatting.

Unit II CONTROL STRUCTURES AND FUNCTIONS 9

Conditional Statements: Using if-else and nested if-else statements for decision-making - Looping Constructs: Working with for loops, while loops, and loop control statements - Functions: Defining and using functions, function arguments, return values, and recursion - Error Handling: Introduction to exception handling using try-except blocks

Unit III DATA STRUCTURES AND MANIPULATION 9

Lists: Working with lists, indexing, slicing, list methods, and list comprehensions - Strings: Manipulating strings, string methods, formatting, and regular expressions - Dictionaries: Understanding dictionaries, accessing values, adding and deleting entries - Tuples: Working with tuples, tuple packing and unpacking, and immutable data structures

Unit IV FILE, DATA HANDLING AND MODULES 9

File Operations: Reading from and writing to files, file modes, and file handling techniques - Working with Modules: Importing and using built-in and external modules/packages - Standard Libraries: Exploring common Python libraries, such as math, random, datetime, and os - Numerical computing and data handling using NumPy and Pandas libraries and data visualization using Matplotlib and Seaborn - Creating Modules: Building and utilizing user-defined modules for code organization and reusability.

Unit V INTRODUCTION TO OBJECT-ORIENTED PROGRAMMING (OOP) 9

OOP Concepts: Understanding the principles of object-oriented programming - Classes and Objects: Creating classes, defining attributes and methods, and working with objects - Inheritance and Polymorphism: Implementing inheritance, method overriding, and polymorphism.

Applications: Analysis of AC and DC Circuits: Using Python to perform DC and AC circuit analysis, calculate circuit parameters, and analyze transient response

Text Book:

1. Y. Daniel Liang, "Introduction to Programming Using Python", Pearson Education 2013.
2. Shivkumar V. Iyer, "Simulating Nonlinear Circuits with Python Power Electronics - An Open-Source Simulator Based on Python", 2018.

Reference Book:

1. Jason Cannon, "Python Programming for Beginners", O,Reilly, 2010.
2. David Beazley, Brain K Jones, "Python Cook Book", Third edition,2013.
3. Chun, Wesley J, "Core Python Programming", Pearson Education, 2012.
4. Guttag, John V, "Introduction to Computation and Programming Using Python", PHI Learning Private Limited, New Delhi, 2014.
5. Allen B. Downey, ``Think Python: How to Think Like a Computer Scientist'', 2nd edition, updated for Python 3' O'REILLY Shroff Publishers & Distributors Pvt. Ltd, 2016
6. Guidovan Rossum and Fred L. Drake Jr, "An Introduction to Python – Revised and updated for Python 3.2, Network Theory Ltd., 2011.

Extensive Reading:

- http://www.tutorialspoint.com/python/
- http://www.learnpython.org/
- http://www.codecademy.com/en/tracks/python
- http://www.pyschools.com/
- http://www.youtube.com/watch?v=cpPG0bKHYKc&noredirect=1
- http://www.python-course.eu/python3_course.php

23EEH23 COMMUNICATION AND DATA SECURITY IN ELECTRICAL ENGINEERING

L	T	P	C
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Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

Course Objective:

To impart knowledge on

- computer network models
- Network access control and Transport level security
- Wireless security and Email security
- IP level security and Firewall
- Program security

Course Outcome:

At the end of the course, the students will be able to

- brief architecture of the computer network models
- explain the threats in Network access control and Transport level security
- explicate the concept of Wireless security measures and Email security
- expound the IP level security and Firewall
- elucidate the security measures at Program level

Unit I COMMUNICATION **9**

Data Communications - Networks – Networks models – OSI model – Layers in OSI model – TCP / IP protocol suite - Architecture of Wireless LAN – IEEE802.11 Wireless LAN – Bluetooth architecture

Unit II NETWORK ACCESS CONTROL AND TRANSPORT-LEVEL SECURITY **9**

Network Access Control and Cloud Security- Network Access Control- Extensible Authentication Protocol- IEEE 802.1X Port-Based Network Access Control- Cloud Computing- Cloud Security Risks and Countermeasures- Data Protection in the Cloud- Cloud Security as a Service

Transport-Level Security: Web Security Consideration- Transport Layer Security- HTTPS- Secure Shell (SSH).

Unit III WIRELESS NETWORK SECURITY & ELECTRONIC MAIL SECURITY **9**

Wireless Network Security: Wireless Security- Mobile Device Security- IEEE 802.11 Wireless LAN Overview- IEEE 802.11i Wireless LAN Security

Electronic Mail Security: Internet Mail Architecture- E-mail Formats- E-mail Threats and Comprehensive E-mail Security- S/MIME- Pretty Good Privacy- Domainkeys Identified Mail.

Unit IV IP SECURITY AND FIREWALLS **9**

IP Security: IP Security Overview- IP Security Policy- Encapsulating Security Payload- Combining Security Associations- Internet Key Exchange

Intruders - Intrusion Detection - Password Management -Firewalls: The Need for Firewalls-Firewall Characteristics and Access Policy-Types of Firewalls-Firewall Basing-Firewall Location and Configurations.

Unit V PROGRAM SECURITY **9**

Secure programs – Non-malicious program errors – Viruses – Targeted malicious code – Controls against program threat – Control of access to general objects – User authentication – Secure coding practices – Vulnerabilities in web applications

Practical Course **0**

Text Book:

1. William Stallings “Network Security Essentials: Applications and Standards”, Sixth Edition, Pearson Education, 2016.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger, “Security in Computing”, Pearson Education,Fifth Edition, 2015.

Reference Book:

1. Shuangbao Wang, Robert S.Ledley, “Computer Architecture and Security: Fundamentals of Designing Secure Computer Systems”, Wiley, 2013.
2. Joachim Biskup,”Security in Computing Systems: Challenges, Approaches and Solutions”, Springer-Verlag,2009.
3. Brook S.E.Schoenfield, “Securing Systems: Applied Security Architecture and Threat Models”,CRC Press 2015.
4. William Stallings, “Cryptography and Network Security: Principles and Practices”, Prentice Hall, Fifth Edition,
5. 2010.
6. Matt Bishop, “Introduction to Computer Security”, Addison-Wesley, 2004.

23EEH42 INDUSTRIAL INSTRUMENTATION

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- various measuring techniques for acceleration, vibration, force, pressure, temperature, level and flow
- various methods of acceleration, vibration, force and pressure measurement practiced in industries.
- different temperature measurement techniques and its selection.
- different electrical methods of level and flow measurement practiced in industries and to select appropriate sensor.

Course Outcome:

At the end of the course, the students will be able to

- Perform characteristics analysis of the various Transducers used in Industries.
- Explain the instruments used for measurement of acceleration, vibration and force.
- Describe the instruments used for measurement of pressure and calibrate the measuring instruments.
- Expound the instruments used for measurement of temperature, and design a signal conditioning circuits for RTD transducers.
- Explicate the instruments used for measurement of level and flow and select the instruments according to the application.

Unit I CHARACTERISTICS, ERRORS & STANDARDS OF INSTRUMENTS 9

Functional elements of generalized instrumentation systems- Static and dynamic characteristics of measuring instruments- Absolute, gross, systematic, random and limiting errors in measurements - Statistical estimation of measurements data:- Arithmetic mean, Average deviation, Standard deviation, Variance and Probable error of mean – Standards and calibration.

Unit II MEASUREMENT OF ACCELERATION, VIBRATION AND FORCE 9

Accelerometers: LVDT, Piezoelectric and Strain gauge type accelerometers - Seismic instruments as accelerometer - Vibration sensor. Different types of load cells: Hydraulic, Pneumatic, Strain gauge and Piezoelectric load cells.

Unit III PRESSURE MEASUREMENT 9

Units of pressure – Elastic type pressure gauges: Bourdon tube, bellows and diaphragms - Capacitive type pressure gauge – Piezo-resistive pressure sensor- Thermal conductivity gauges – Ionization gauge - calibration of pressure gauges. Dead weight tester.

Unit IV LOW AND HIGH TEMPERATURE MEASUREMENT 9

Different types of filled in system thermometers - Bimetallic thermometers-Calibration of thermometers - RTD - characteristics and signal conditioning- 3 lead and 4 lead RTDs – Thermistors. Thermocouples and their type's compensation techniques -Radiation methods of temperature measurement - Total radiation pyrometers – Optical pyrometers.

Unit V ELECTRICAL TYPE LEVEL AND FLOW MEASUREMENT 9

Electrical types of level measurement:– Principle and constructional details of Conductivity sensors – Capacitive Sensors – Ultrasonic gauge -Differential pressure transmitter-Principle and constructional details of Electromagnetic flow meter – Ultrasonic flow meters – Target flow meter.

Text Book:

1. Doebellin, E.O. and Manik D.N., "Measurement systems Application and Design", Special Indian Edition, Tata McGraw Hill Education Pvt. Ltd, 2018.
2. Jones. B.E," Instrument Technology", Vol.2, Butterworth-Heinemann, International Edition, 2003.
3. A. K. Sawhney, Puneet Sawhney, "Course in Mechanical Measurements and Instrumentation and Control", Dhanpat Rai & Sons, New Delhi, 2013

Reference Book:

1. Liptak, B.G., "Instrumentation Engineers Handbook (Measurement)", CRC Press, 2005
2. Patranabis,D., "Principles of Industrial Instrumentation", 3rd Edition, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2010.
3. Eckman D.P., "Industrial Instrumentation", Wiley Eastern Limited, 2003.
4. S.K.Singh., "Industrial Instrumentation and Control", 3rd Edition, Tata McGraw - Hill Education, 2008.
5. Jain, R.K., "Mechanical and Industrial Measurements", Khanna Publishers, Delhi, 1999.

23EEH43 PROCESS CONTROL

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Dynamics of various processes.
- the features associated with Industrial type PID controller.
- characteristics, selection, sizing of control valves.
- various PID tuning methods.
- different types of control schemes such as cascade control, feed forward control and Model Based control schemes.

Course Outcome:

At the end of the course, the students will be able to

- Build the mathematical model of Simple systems
- Analyze system design and implement control schemes for various processes.
- Select suitable Final control elements for process control applications.
- Tune the PID Controllers to achieve desired performance for various processes
- Narrate simple control methods with multi-loop control.

Unit I PROCESS DYNAMICS **9**

Need for process control – Mathematical model of Flow, Level, and Thermal processes – Interacting and non-interacting systems –Continuous and batch processes –Servo and regulatory operations – Heat exchanger.

Unit II CONTROL ACTIONS **9**

Characteristic of on-off, proportional, single speed floating, integral and derivative controllers – Proportional plus Integral (PI), Proportional plus Derivative (PD) and Proportional plus Integral plus Derivative (PID) Control modes – Electronic PID controllers – Auto transfer - Reset windup.

Unit III FINAL CONTROL ELEMENTS **9**

Current to Pressure (I/P) converter – Pneumatic, Hydraulic and Electric actuators – Valve Positioner – Control Valves – Characteristic of Control Valves: - Inherent and Installed characteristics, Control Valve Sizing, Control Valve selection.

Unit IV CONTROLLER TUNING **9**

Tuning of PID Controllers – Process reaction curve method – Continuous-cycling method – Damped oscillation method, Introduction to Auto tuning of PID controllers.

Unit V MULTILOOP CONTROL **9**

Methods of process control – Feed-forward control – Ratio control – Cascade control – Inferential control, Introduction to multivariable control– Model Predictive Control.

Text Book:

1. Myke King, “Process Control: A Practical Approach”, John Wiley & Sons, 2016
2. D. Patranabis, “Principles of Process Control,” Tata McGraw Hill Education, 2012.

Reference Book:

1. Bequette, B.W., “Process Control Modeling, Design and Simulation”, Prentice Hall of India, 2004.
2. Stephanopoulos, G., “Chemical Process Control - An Introduction to Theory and Practice”, Prentice Hallof India, 2005.
3. Dale E. Seborg, Duncan A. Mellichamp, Thomas F. Edgar, Francis J. Doyle, “Process Dynamics and Control”, Technology & Engineering – 2010.
4. Sudheer S. Bhagade, Govind Das Nageshwar, “Process Dynamics and Control”, PHI Learning Pvt. Ltd., 2011.
5. Curtis D. Johnson “Process Control Instrumentation Technology”, eighth Edition, Pearson, 2006.
6. Seborg, D.E., Edgar, T.F. and Mellichamp, D.A., “Process Dynamics and Control”, Wiley John andSons, second Edition, 2003.

23EEH44 MEMS SENSORS AND ACTUATORS

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- the concept of MEMS technology and the materials used.
- new fabrication methods used in MEMS technology.
- differentiating MEMS sensors and actuators based on electrostatic and thermal principles.
- the design of new MEMS devices based on various principles.

Course Outcome:

At the end of the course, the students will be able to

- Explain the concept of MEMS technology and MEMS materials.
- Express the different fabrication methods used of MEMS technology and issues related to packaging and reliability.
- Differentiate MEMS sensors and actuators based on electrostatic and thermal principles.
- Find suitable applications of MEMS sensors and actuators working based on thermal principles.
- Explicate the design of new MEMS devices based on various principles.

Unit I MICRO-FABRICATION, MATERIALS AND ELECTROMECHANICAL CONCEPTS 9

Overview of Micro-fabrication Silicon and other material based fabrication processes- conductivity of semiconductors-crystal planes and orientation-stress and strain-flexural beam bending analysis-torsional deflections-Intrinsic stress-resonant frequency and quality factor-photolithography

Unit II ELECTROSTATIC SENSORS AND ACTUATION 9

Principle-material-design and fabrication of parallel plate capacitors as electrostatic sensors-capacitive pressure sensor- comb drive -micro motors- actuators-.Applications.

Unit III THERMAL SENSING AND ACTUATION 9

Principle-material-design and fabrication of thermocouples- thermal bimorph sensors- thermal resistor sensors-actuators- Applications

Unit IV PIEZOELECTRIC SENSING AND ACTUATION 9

Piezo-electric effect - cantilever piezo electric actuator model - properties of piezo-electric materials- Applications.

Unit V CASE STUDIES 9

Acceleration sensors - gyroscopes-piezo-resistive sensors-magnetic actuation-micro fluids applications-medical applications- optical MEMS.

Text Book:

1. Chang Liu, “Foundations of MEMS”, Pearson International Edition, 2012.
2. Tai-Ran Hsu, “MEMS and Microsystems Design and Manufacture”, McGraw Hill, 2002.

Reference Book:

1. Stephen Senturia, “Microsystems Design”, Springer, 2006.
2. Marc Madou, “Fundamentals of micro fabrication”, CRC Press, 1997.
3. Boston, “Micro machined Transducers Sourcebook”, WCB McGraw Hill, 1998.
4. M.H.Bao, “Micromechanical Transducers: Pressure sensors, accelerometers and gyroscopes”, Elsevier, New York, 2000
5. Mohamed Gad-el-Hak, editor, “The MEMS Handbook”, CRC press Baco Raton, 2001.
6. NadimMaluf,“ An Introduction to Micro Electro Mechanical System Design”, Artech House, 2000

23MEH01 INTRODUCTION TO PRODUCT DESIGN

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Design a product with an understanding of product life cycle
- Be familiar with the basic concepts of Engineering Design
- Apply systematic design procedure in new product design and development

Course Outcome:

At the end of the course, the students will be able to

- Able to apply problem solving tools in the process of design.
- Able to judiciously make correct decision while designing products.
- Able to adopt modularity in Product architecture.
- Conscious of Environmental issues in design.
- Able to appreciate Legal and ethical aspects in design.

Unit I INTRODUCTION AND PROBLEM DEFINITION **9**

Design as a Discipline-Cost reduction & Higher Sophistication-The Morphology of Design (seven phases) - Product Life Cycle.

Problem Definition & Need Identification-Identifying customer needs-Establishing the engineering characteristics-Quality Function Deployment-Product Design Specifications-Case studies.

Unit II INNOVATION **9**

Time management – Problem Solving tools: Pareto charts, Cause and effect diagrams, Force field analysis – Planning and Scheduling – Tools for Planning and Scheduling: Gantt charts, critical path method. Case Studies.

Criticality of data in design – Data sources: Library sources, Government sources, Internet sources, Information from Intellectual property rights – Company centered information.

Unit III DECISION MAKING **9**

Creative thinking methods – Generating design concepts – Functional decomposition and synthesis – Inventive problem solving – Axiomatic design.

Concept Evaluation: Pugh Concept Selection Method-Measurement Scales, Weighted Decision Matrix, Analytic Hierarchy Process – Concept Selection.

Unit IV EMBODIMENT DESIGN **9**

Product Architecture – configuration design and best practices – Parametric design – Design for Assembly - Failure Mode Effect Analysis.

Design for Environment – DFE Scoring Methods- Role of Prototyping in design – Concept of Rapid Prototyping-Detail design – Design communication-Bill of Materials-Common challenges in Technical Writing.

Unit V ECONOMIC DESIGN **9**

Cost evaluation – Methods of developing cost estimates – Make or Buy decision – Design to Cost: Order of magnitude estimates, Costing in Conceptual Design.

Legal and ethical issues in design – Tort Law - Product liability – Protecting intellectual property – Solving Ethical conflicts - Economic decision making: benefit cost analysis.

Text Book:

1. George E. Dieter & Linda C. Schmidt, “Engineering Design” 6th edition, McGraw-Hill, 2022

Reference Book:

1. Nigel Cross, “Engineering Design Methods – Strategies for Product Design”, 5th edition, Wiley, 2021.
2. Philip Kosky, George Wise& Robert Balmer, “Exploring Engineering an Introduction to Engineering and Design”, 4th edition, Academic Press, 2015.
3. Ernst Eder, StanislavHosnedl, “Introduction to Design Engineering: Systematic creativity and management”, 1st edition, CRC Press, 2017.
4. Prasant Kumar, “Product Design-Creativity, Concepts and Usability”, PHI LearrningPvt. Ltd., New Delhi, 2012.

Extensive Reading:

- http://meche.mit.edu/research/design
- http://www.everyspec.com
- http://www.engineeringtoolbox.com

23MEH02 ADDITIVE MANUFACTURING PROCESSES

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about the general additive manufacturing process.
- To study the different additive manufacturing processes.
- To know postprocessing and finishing steps for each AM process.

Course Outcome:

At the end of the course, the students will be able to

- Understand the basics of Additive Manufacturing.
- Describe the various Vat polymerization and powder bed fusion systems.
- Illustrate about extrusion and material jetting-based systems.
- Expound sheet lamination and directed energy deposition processes.
- List out the post processing techniques and explain the various software issues.

Unit I BASIC PRINCIPLES OF ADDITIVE MANUFACTURING 9

Additive Manufacturing (AM) – additive vs subtractive manufacturing processes – Generic AM Process – Benefits – Related and associated Technologies – Classification of AM Processes (Liquid Polymer, Discrete Particle, Molten Material and Solid Sheet systems) – Metal system – Variations of different processes – Maintenance and material handling issues – Design considerations.

Unit II VAT PHOTOPOLYMERIZATION AND POWDER BED FUSION PROCESSES 9

Vat Photopolymerization – Materials and photopolymer chemistry – reaction formulation and mechanisms – Reaction rates – Laser Scan Vat Photopolymerization –Modeling– Irradiance and Exposure – vector scanning – scan patterns – Mask Projection systems – Two-Photon Vat Photopolymerization – Process Benefits and Drawbacks.

Powder bed fusion – Materials– Powder Fusion Mechanisms – Process Parameters – Powder Handling – Process Variants – Process Benefits and Drawbacks.

Unit III EXTRUSION AND JETTING SYSTEMS 9

Extrusion – Basic principles – Plotting and Path Control – Materials– Fused Deposition Modeling, limitations – Bioextrusion – Contour Crafting and non-planar systems.

Material jetting– materials and processes – Material Jetting Machines – Process Benefits and Drawbacks – Binder jetting – materials –BJ Machines– Process Variations – Process Benefits and Limitations.

Unit IV SHEET LAMINATION AND DIRECTED ENERGY DEPOSITION PROCESSES 9

Sheet lamination – Gluing or Adhesive Bonding, Bond-Then-Form and Form-Then-Bond Processes – Materials and processing – process parameters – Ultrasonic additive manufacturing (UAM) – Effect of micro-structures – UAM Applications

Directed Energy Deposition Processes – Description – Material Delivery – Laser and electron beam Based Metal Deposition – Process parameters – Materials and Micro-structure – Benefits of DED.

Unit V POST PROCESSING, SOFTWARE CHALLENGES AND APPLICATIONS 9

Need for post processing – Support structure removal – Surface Texture Improvement – Accuracy Improvement – Aesthetic Improvement – Preparation for Use as a Pattern – Property Enhancements Using Non–thermal Techniques and Thermal Techniques.

Software Issues in AM – Preparation of CAD Models – STL File Format – Problems with STL Files – STL File Manipulation – STL file with multiple materials – STL for machining – newer file formats and their capabilities – Applications in Medical, Aerospace, Automotive fields

Text Book:

1. Ian Gibson, David Rosen and Brent Stucker, “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing”, Third Edition, Springer, 2021.

Reference Book:

1. Chee Kai Chua, “3D Printing and Additive Manufacturing: Principles and Applications”, World Scientific, Fifth Edition, 2017.
2. Jyothish Kumar, “3D Printing and Additive Manufacturing Technologies”, Springer, 2019.
3. Manu Srivastava, “Additive Manufacturing: Fundamentals and Advancements”, CRC Press, 2019.Michael L. Pinedo, “Scheduling: Theory, Algorithms, and Systems”, Springer, 2008.

23MEH03 DESIGN FOR ADDITIVE MANUFACTURING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- The basics of design for additive manufacturing.
- Part consolidation and tooling design
- The design requirements for Metal AM and Polymer AM technique.
- Implication of part design on build time and material strength
- The concept of the post processing treatments in AM

Course Outcome:

At the end of the course, the students will be able to

- Understand the basics of need for Design for Additive Manufacturing.
- Exhibit the details about Part consolidation and Tooling Design
- Describe design considerations for metal and ceramic based Additive Manufacturing.
- Know the design guidelines for polymer based AM and other AM.
- Comprehend the post processing treatments and Future of AM.

Unit I STRATEGIC DESIGN IN ADDITVE MANUFACTURING 9

Design for additive manufacturing (DfAM) – Value addition with AM – General Guidelines for Designing AM parts – Design to Avoid Anisotropy – Design to Minimize Print Time – Design to Minimize Post–processing – Topology Optimisation.

Design Analysis for AM – Considerations for Analysis of AM Parts – role of mesh, topology and size optimization – Build process simulation.

Unit II PART CONSOLIDATION AND TOOLING DESIGN 9

Part Consolidation – Design for Function – Material Considerations – Number of Fasteners - Conventional DFM/DFA principles to DfAM – Assembly Considerations – Design of Moving Parts

AM Tooling Design – Mounting Fixtures and Guides – Conformal Cooling – Coolant Flow Strategies – Coolant Channel Shape and Spacing – Steps to minimise Print Time in Tooling.

Unit III DESIGN CONSIDERATIONS FOR METAL AM 9

Designing for Metal Powder Bed Fusion – Metal Powder Production – Powder Morphology – Powder Size Distribution – Other Powder Considerations – Potential Defects in AM Materials – Topology Optimisation – Lattice Structures – Overhangs and Support Material

Designing to Reduce Residual stress and Stress Concentrations – General Part Positioning Guidelines - Design for Laser Powder Bed Fusion, Electron Beam Melting and Metal Binder Jetting.

Unit IV DESIGN FOR POLYMER AM PROCESS AND OTHER AM CONSIDERATIONS 9

Design considerations due to Anisotropy, Wall Thickness, Overhangs and Support Material, Holes, Ribs, fonts and intricate details – Design guidelines for Material Extrusion, Vat Photopolymerisation and Polymer Powder Bed Fusion.

Designer Machine Operator Cooperation – Health and Safety – prevention of explosion – AM Part Certification.

Unit V POST PROCESSING AND FUTURE OF AM 9

Post Processing: Support Material Removal - Polymer Surface Treatments - Metal Surface Treatments - Gluing and Welding AM Parts – Heat Treatment and Aging

Future of AM: Functionally Graded Materials – Bio printing - Printed Electronics - Nano Printing - Food Printers.

Text Book:

1. Olaf Diegel, “A Practical Guide to Design for Additive Manufacturing”, Springer, 2019.
2. Martin Leary, “Design for Additive Manufacturing”, Elsevier, 2019.

Reference Book:

1. Ben Redwood, “The 3D Printing Handbook: Technologies, Design and Applications”, 3D Hubs, 2017.

23MEH04 REVERSE ENGINEERING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about reverse engineering systems
- To know the selection process for reverse engineering systems
- To understand reverse engineering and additive manufacturing
- To study the application of reverse engineering in additive manufacturing
- To know the legal issues in reverse engineering

Course Outcome:

At the end of the course, the students will be able to

- Understand the various reverse engineering techniques.
- Select a suitable reverse engineering system for a given application.
- Describe the combination of reverse engineering and additive manufacturing systems.
- List out the key application areas of reverse engineering.
- Illustrate the legal issues and the barriers to reverse engineering

Unit I TECHNIQUES FOR REVERSE ENGINEERING 8

Reverse Engineering – Need for Reverse Engineering – The Generic Process – Scanning – Point Processing – Application Geometric Model Development – Computer-aided Reverse Engineering – Computer Vision and Reverse Engineering – Structured-light Range Imaging – Scanner Pipeline.

Unit II SELECTION OF REVERSE ENGINEERING SYSTEMS 10

Reverse Engineering Hardware and Software – Selection Process for a Reverse Engineering system – Point Capture Devices – Triangulation Approaches – Ranging Systems – Structured-light and Stereoscopic Imaging Systems – Tracking Systems – X-ray Tomography – Probe positioning – Post processing the Captured Data – Handling Data Points – Inspection Applications.

Unit III REVERSE ENGINEERING AND ADDITIVE MANUFACTURING 9

Modeling Cloud Data in Reverse Engineering – Data Processing for Rapid Prototyping – Integration of RE and AM for Layer-based Model Generation – Adaptive Slicing Approach for Cloud Data Modeling – Planar Polygon Curve Construction – Determination of Adaptive Layer Thickness – Application Examples.

Unit IV APPLICATION AREAS 9

Reverse Engineering-Workflow for Automotive Body Design – Virtual NASCAR Engine Block – Ferrari reverse engineering CFD simulations – Reverse Engineering for Better Quality.

Reverse Engineering in the Aerospace Industry – Reducing Costs of Hard Tooling – Digitizing a NASA Space Vehicle – Inspection in Half the Time.

Reverse Engineering in Medical Industry – Orthodontics – Digital Dentistry – Hearing Instruments – Knee Replacement – Total Artificial Heart – Mass Customization.

Unit V LEGAL ISSUES AND BARRIERS TO REVERSE ENGINEERING 9

Copyright Law and Reverse Engineering – Case studies – Fair Use Statutory Defense – Barriers to adopting reverse engineering technology – Understanding the user needs for reverse engineering – Challenges in reverse Engineering.

Text Book:

1. Vinesh Raja, Kiran J. Fernandes, “Reverse Engineering, An Industrial Perspective”, Springer, London, 2008.
2. Wang W, “Reverse Engineering: Technology of Reinvention”, CRC Press, 2010.

Reference Book:

1. Ian Gibson, “Advanced Manufacturing Technology for Medical Applications: Reverse Engineering, Software Conversion and Rapid Prototyping”, Wiley, 2006.
2. David Kadavy, “Design for Hackers: Reverse Engineering Beauty”, Wiley, 1st edition, 2011.

23MEH05 BUSINESS VALUE ENHANCEMENT WITH ADDITIVE MANUFACTURING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The business value enhancement in different industries with additive manufacturing
- The operational values of additive manufacturing and their impact in various processes
- The business values of additive manufacturing and their key application areas

Course Outcome:

At the end of the course, the students will be able to

- Understand the need for sustainable manufacturing and realize how AM helps in that direction.
- Explain Business value improvement with additive manufacturing.
- Describe the value addition due to reduced operations.
- Expound strategic alignment of additive manufacturing.
- List out the applications of AM for value addition in key application areas.

Unit I SUSTAINABILITY WITH ADDITIVE MANUFACTURING 9

Sustainable manufacturing – Economic Sustainability with AM – Environmental Sustainability – Impacts on Energy Consumption resources and pollution – Societal Sustainability with AM – Destructive implications and counter measures.

Unit II BUSINESS VALUE 9

AM as a Driver for Business Competitiveness, new services, creativity and Innovation – Impact on Manufacturing Paradigms, Product Lifecycle and Operational Costs and Supply Chain Management – Mass customization – Strategic Challenges and Barriers Ahead of AM.

Unit III OPERATIONS VALUE 9

Impact of AM on the Product Development Process – Evolution in Design Methodologies – Design Freedom – Impact on Production Process, Product Quality, Manufacturing Costs and Material Waste – Impact on Inventory Turnover, Spare Part Supply Chain and 3DP Online Platforms Supply Chain.

Unit IV STRATEGIC ALIGNMENT OF ADDITIVE MANUFACTURING 9

Framework for Strategic Alignment – Contingency Factors Driving AM Performance – Organizational Factors, Operational Factors and Product Characteristics – Economic Analysis – Technology Analysis – Selecting AM Technology – Organizational, Operational and Supply Chain Changes for implementation of AM.

Unit V BUSINESS VALUE IN KEY APPLICATION AREAS 9

The Role of Additive Manufacturing and business value in Industry of the Future – Industrial Diffusion – Business value addition in Healthcare, Automotive, Aerospace, Consumer Goods, Architecture, Food Industry and Research and Education industries – Case Studies.

Text Book:

1. Mojtaba Khorram Niaki, Fabio Nonino, “The Management of Additive Manufacturing: Enhancing Business Value”, (Springer Series in Advanced Manufacturing), Springer, 2018.
2. David M. Dietrich, Michael Kenworthy,Elizabeth Cudney, “Additive Manufacturing Change Management: Best Practices”, CRC Press, 1st edition, 2019.

Reference Book:

1. Subramanian Senthilkannan,” Handbook of Sustainability in Additive Manufacturing”, Springer, 2016.
2. Olaf Diegel, Axel Nordin, Damien Motte “A Practical Guide to Design for Additive Manufacturing”, Springer, 2019.

23MEH21 FUNDAMENTALS OF ROBOTICS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Develop a knowledge in basics of robotics
- Understand the basic homogeneous transformation matrices
- Study the forward and inverse kinematics
- Identify the various sensors and actuators
- Know the velocity and force feedback

Course Outcome:

At the end of the course, the students will be able to

- Understand the fundamentals of robotics
- Elucidate Explain about rigid body transformations
- Depict Describe the forward and inverse kinematics
- Explain about various robotic sensors and actuators
- Illustrate end effector motion with an example

Unit I ROBOT FUNDAMENTALS **9**

Classification of Robots - History of Robotics - Robot Components - Robot Joints and Degrees of Freedom – Coordinates and Reference Frames - Robot Workspace – Applications - Social Issues.

Unit II RIGID MOTIONS AND HOMOGENEOUS TRANSFORMATIONS **9**

Representation of Positions and rotations in matrix form - Rotational Transformations - Rotation with respect to the current coordinate frame - Rotation with respect to a fixed frame - Parameterizations of Rotations - Euler Angles - Roll, Pitch, Yaw Angles - Axis/Angle Representation - Homogeneous Transformations.

Unit III FORWARD AND INVERSE KINEMATICS **9**

Forward Kinematics - Kinematic Chains - DenavitHartenberg Representation - Assigning the coordinate frames - Inverse Kinematics - Kinematic Decoupling - Inverse Position - Inverse Orientation - Degeneracy and Dexterity.

Unit IV ROBOTIC SENSORS AND ACTUATORS **9**

Sensor Characteristics – Position, Velocity, Acceleration Sensors - Force and Pressure Sensors - Torque Sensors - Visible Light and Infrared Sensors - Touch and Tactile Sensors - Proximity Sensors - Range Finders – other sensors
Characteristics of Actuating Systems - Comparison of Actuating Systems - Hydraulic Actuators - Pneumatic Devices - Electric Motors and their types - Control of Electric Motors (PWM control and direction control with H bridge) - Magnetostrictive Actuators - Shape-Memory Type Metals – MEMS based actuators

Unit V MOTIONS AND VELOCITIES **9**

Differential Motions and Velocities - Differential Relationships – Jacobian - Differential Motions of a Frame - Calculation of the Jacobian - Inverse Jacobian – Force feedback (elementary)– case study

Text Book:

1. Saeed Benjamin Niku," Introduction To Robotics: Analysis, Control, Applications", John Wiley & sons, 2011
2. Mark W. Spong," Robot Dynamics and Control", Wiley,2005

Reference Book:

1. Paul Sandin ,"Robot mechanisms and mechanical devices illustrated", McGraw-Hill, 2003
2. Jorge Angeles, "Fundamentals of Robotic Mechanical Systems: Theory, Methods, and Algorithms", Springer International, 2014

23EEH91 ROBOT MANIPULATOR CONTROL

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- State space modelling of robot manipulator arm.
- robot manipulator dynamics.
- computed torque control.
- Robust control of robot manipulator
- adaptive and adaptive robust control of robot manipulator

Course Outcome:

At the end of the course, the students will be able to

- Form the state space representation of the robot manipulator.
- Derive the Robot Dynamical Equations.
- Describe computed torque control of Robotic Systems.
- Designate and Compare robust and adaptive control of robot manipulator arm.
- Describe adaptive robust control of robot manipulator arm.

Unit I MATHEMATICAL PRELIMINARIES OF ROBOT MANIPULATOR 9

Introduction – structure of robot manipulator – Mathematical modelling – Transfer function approach - State variable representation, Lyapunov stability - The Concept of Equilibrium - Definitions of Stability - Lyapunov Functions - Lyapunov's Direct Method.

Unit II ROBOT MANIPULATOR DYNAMICS AND PROPERTIES 9

Lagrange's Equations of Motion - Dynamic Model in Compact Form - Robots with Friction - Robots with Actuators, Properties of the Dynamic Model - Inertia Matrix - Centrifugal and Coriolis Forces Matrix - Gravitational Torques Vector - Residual Dynamics

Unit III POSITION CONTROL OF ROBOT MANIPULATOR 9

Introduction, Proportional Control plus Velocity Feedback and PD Control - Robots without Gravity Term, PD Control with Gravity Compensation - Lyapunov Function for Global Asymptotic Stability, PID Control - Lyapunov Function - Asymptotic Stability

Unit IV MOTION CONTROL OF ROBOT MANIPULATOR 9

Introduction - Computed-torque Control - PD Control with Compensation - Feedforward Control - PD Control plus Feedforward.

Unit V ADAPTIVE ROBUST CONTROL OF ROBOT MANIPULATOR 9

Introduction - P"D" Control with Gravity Compensation, Parameterization of the Dynamic Model - Linearity in the Dynamic Parameters, Adaptive Robot Control - Parameterization of the Adaptive Controller - Stability and Convergence,

Text Book:

1. Rafael Kelly , Victor Santibáñez Davila , Antonio Loría "Control of Robot Manipulators in Joint Space", Springer-Verlag London Limited 2005

Reference Book:

1. Frank L Lewis, Darren M. Dawson, Chaouki T.Abdallah," Robot Manipulator Control – Theory and Practice", Marcel Dekker Inc., 2004
2. Lorenzo Sciavicco and Bruno Siciliano, "Modelling and Control of Robot Manipulators" Springer, Second edition, 6 December 2012.
3. Reza N. Jazar, "Theory of Applied Robotics- Kinematics, Dynamics, and Control ", Springer International, 2007
4. Moshe Shoham"A Text book of Robotics – Structure Control and Operation" EshedRobotec, 1984

23ECH91 ROBOT OPERATING SYSTEM AND PROGRAMMING

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Robotics Operating System Architecture and its commands.
- The ROS concepts and Programming.
- Simulation of Robotic systems.
- Move a robot and navigate it through the environment using navigation stack.
- Application of ROS to develop robots.

Course Outcome:

At the end of the course, the students will be able to

- Analyze the functions of the components in Robotics Operating Systems and commands used in ROS.
- Develop programming for ROS concepts.
- Develop Robots in Simulation tools.
- Analyze components in ROS Navigation stack.
- Develop ROS based Robotic application.

Unit I INTRODUCTION TO ROS **9**

ROS: components, ecosystem, history and distributions – Configuring ROS Development Environment–Preliminaries –ROS Commands – ROS tools – ROS architecture: ROS file system level, ROS computational graph level, ROS community level.

Unit II ROS CONCEPTS AND PROGRAMMING **9**

ROS Concepts: Message Communication –Coordinate Transformation –Client Library –Communication between Heterogeneous Devices– Debugging and visualization – Basic ROS Programming using C++ and python: C++ and python classes in ROS, Publisher and Subscriber Nodes, Service and Client Nodes, Parameters– using roslaunch.

Unit III ROBOTIC SIMULATION IN ROS **9**

Simulators: Stage, simple two-dimensional robot simulator (STDR), Gazebo, MORSE, MATLAB and V-REP –Simulation in ROS –Robotic arm simulation model for Gazebo– Robot Arm Kinematics – Mobile Robots – Making a Robot Fly – Sensing and Visualization in ROS – Point Cloud Processing – Vision Sensors using ROS, Open-CV and PCL.

Unit IV ROS MOVEIT AND NAVIGATION STACK **9**

Manipulation with MoveIt – Simple motion planning – Motion planning with point clouds – Navigation stack in ROS –Navigation Components – Navigation Theory: Cost map, AMCL, DWA– Navigation Practice – SLAM Practice and Application.

Unit V ROS BASED APPLICATION DEVELOPMENT **0**

ROS for Industrial Robots –Industrial Manipulator – Pick and place task – Service Robot –ChefBot Application Example: Hardware block Diagram, Speech recognition system, Applying Artificial Intelligence, Designing a GUI using Qt and Python, Calibration and Testing.

Text Book:

1. YoonSeokPyo, HanCheol Cho, RyuWoon Jung, TaeHoon Lim, “ROS Robot Programming”, ROBOTIS, 2017.
2. Morgan Quigley, Brian Gerkey, William D. Smart, "Programming Robots with ROS ", Shroff Publishers & Distributors Pvt Ltd, 2015.
3. Wyatt S. Newman, “A Systematic Approach to Learning Robot Programming with ROS”, CRC press, 2018.

Reference Book:

1. Mahtani Anil, “Effective Robotics Programming with ROS”, Third edition, Packt Publishing Limited, 2016.
2. Fairchild Carol, “ROS Robotics By Example”, Second edition, Packt Publishing Limited, 2016.
3. Lentin Joseph, “Learning Robotics Using Python”, Packt Publishing Limited, 2015.
4. Martinez Aaron, ” Learning ROS for Robotics Programming”, Packt Publishing Limited, 2013.
5. Lentin Joseph, “Mastering ROS for Robotics Programming”, Packt Publishing Limited, 2015.

Extensive Reading:

- http://wiki.ros.org/ROS/Tutorials
- https://www.udemy.com/course/ros-essentials/
- https://www.edx.org/course/hello-real-world-with-ros-robot-operating-system

23ECH92 ARTIFICIAL INTELLIGENCE AND REINFORCEMENT LEARNING

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Importance of AI in problem solving.
- Basics of AI logics and develop plan using AI.
- Probability in AI for decision making.
- Basics of Reinforcement Learning and use it for untrained learning.
- The applications using AI and RL.

Course Outcome:

At the end of the course, the students will be able to

- Solve problem usingAI.
- Develop AI logics and plan.
- Develop AI based Decision Making.
- Analyze various RL algorithms.
- Develop AI and RL based System.

Unit I ARTIFICIAL INTELLIGENCE BASED PROBLEM SOLVING 9

Intelligent Agents, Problem Formulation, Uninformed Search Strategies, Heuristics Search Strategies (A*), Local Search Algorithms and optimization problems, Problem Decomposition (AO*) and Rule Based Systems.

Unit II KNOWLEDGE AND PLANNING 9

Logic and inferences: Logic Agents, First Order Logic, Forward and Backward chaining.
Planning: Forward and Backward Search, Goal Stack Planning.

Unit III REASONING AND DECISION MAKING 10

Reasoning: Quantifying Uncertainty and Probabilistic Reasoning–Semantics and Inference in Bayesian Networks, Probabilistic Reasoning over time – Hidden Markov Models, Kalman filters.
Decision Making: Sequential Decision Problems, Value Iteration, Policy Iteration, Markov Decision Process (MDP).

Unit IV REINFORCEMENT LEARNING 9

Forms of Learning, Elements of Reinforcement Learning (RL), Agent - Environment Interface, Passive RL, Active RL, Multi- armed Bandit, Monte Carlo Method, Temporal Difference Learning, Eligibility Traces, DQN & Policy Gradient Approaches.

Unit V AI AND RL APPLICATION 8

Future of AI, RL applications and Case study: Alpha Go, Universal Robots - cobots, Mars Curiosity Rover and Sophia.

Text Book:

1. Russell, S.J. and Norvig, P., “Artificial intelligence – A modern approach”, 3rd edition, Pearson, 2015.
2. Richard S. Sutton, Andrew G Barto, “Reinforcement Learning – An Introduction”, MIT Press, 2018.

Reference Book:

1. M. Nagenevtsky, “Artificial Intelligence – a guide to intelligent systems” Addision Wesley, 3rd Edition, 2011.
2. Sebastian Thrun, Wolfram Burgard, & Dieter Fox, “Probabilistic Robotics” MIT Press. 2005.
3. Deepak Khemani, “A First Course in Artificial Intelligence”,McGraw Hill Education; 1st edition (1 July 2017).
4. Csaba Szepesvari, “Algorithms for Reinforcement Learning”, Morgan and Claypool Publishers; 1st edition, 2010.

Extensive Reading:

- https://nptel.ac.in/courses/106106126/
- https://nptel.ac.in/courses/106106143/
- https://towardsdatascience.com/qrash-course-deep-q-networks-from-the-ground-up-1bbda41d3677
- http://pure.au.dk/portal/files/118986058/feo_arenis.pdf
- https://www.grammatech.com/sites/default/files/grammatech-nasa-curiosity-case-study.pdf

23MEH22 AUTONOMOUS ROBOTS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Learning the basics of autonomous robot control.
- Learning about the kinematics of the mobile robots.
- Understanding the various methods in localization, planning and navigation.

Course Outcome:

At the end of the course, the students will be able to

- Understand the fundamentals of robotic locomotion.
- Explain about rigid body transformations.
- Describe the sensors and methods for robotic perception.
- Explain about robot position estimation with localization and map generation.
- Use an algorithm to plan the path of an autonomous robot.

Unit I LOCOMOTION **9**

Types of locomotion - Key issues for locomotion - Legged Mobile Robots – examples - Wheeled Mobile Robots – wheel configurations – stability and maneuverability – Case studies

Unit II MOBILE ROBOT KINEMATICS **9**

Kinematic Model Constraints – Representation of robot position - Forward kinematic model - Wheel kinematic constraints - Robot kinematic constraints - differential-drive robot example - omnidirectional robot example - Mobile Robot Maneuverability - Motion Control (open loop and feed back control)

Unit III PERCEPTION **9**

Sensors for Mobile Robots - sensor performance – challenges due to error in mobile robotics - Heading sensors - Ground-based beacons - Active ranging sensors - Laser rangefinder - Triangulation-based active ranging - Motion Speed sensors - Vision-based sensors - Statistical representation - Feature Extraction – Edge detection

Unit IV ROBOT LOCALIZATION **9**

Localization - Challenge of Localization: Noise and Aliasing - Localization-Based Navigation versus Programmed Solutions - Belief Representation - Map Representation - Probabilistic Map-Based Localization – case study – Kalman filter - Autonomous Map Building

Unit V PLANNING AND NAVIGATION **9**

Competences for Navigation: Planning and Reacting - Path planning - Obstacle avoidance - Navigation Architectures – Episodic planning - Case study.

Text Book:

1. Roland Siegwart, Illah Reza Nourbakhsh and Davide Scaramuzza,"Introduction to Autonomous Mobile Robots", MIT Press, 2011
2. Nikolaus Correll, "Introduction to Autonomous Robots: Kinematics, Perception, Localization and Planning", 2nd edition, 2016.

Reference Book:

1. George A. Bekey," Autonomous Robots: From Biological Inspiration to Implementation and Control", MIT. Press, 2017
2. Farbod Fahimi, "Autonomous Robots: Modeling, Path Planning, and Control", Springer, 2008

23MEH41 FUNDAMENTALS OF ELECTRIC AND HYBRID VEHICLES

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To know the fundamental of electric and hybrid vehicle.
- To understand working principle of electric propulsion system.
- To know the energy storage techniques for electric and hybrid vehicles.
- To know the concept of regenerative braking system.
- To understand concept of fuel cell vehicle.

Course Outcome:

At the end of the course, the students will be able to

- Understand the configurations and performance of electric vehicle
- Classify hybrid electric vehicle and its importance
- Analyse the different types of electric propulsion systems
- Distinguish different concept of energy storage and regenerative braking.
- Understand the importance and working of fuel cell technologies.

Unit I ELECTRIC VEHICLES **9**

Introduction - Configurations of Electric Vehicles, Performance of electric vehicles – Traction motor characteristics, - tractive effort, transmission requirements, vehicle performance, Tractive Effort in Normal Driving, energy-consumption, advantage and limitations – Autonomous Vehicles.

Unit II HYBRID ELECTRIC VEHICLES **9**

Introduction - Need for HEV - Architectures of Hybrid Electric Drive Trains- Series Hybrid Electric Drive Trains- Parallel Hybrid Electric Drive Trains - Torque coupling, speed coupling and both – Electric and hybrid vehicles-comparison – Case studies.

Unit III ELECTRIC PROPULSION SYSTEMS **9**

DC motor drives- Principle of Operation and Performance- induction motor drives- Basic Operation Principles & Steady-State Performance - Permanent magnetic BLDC motor drives - Basic Principles & Construction and Classification - switched reluctance motor drives - Basic Magnetic Structure, Torque Production, SRM Drive Converter, Modes of Operation.

Unit IV ENERGY STORAGES AND REGENERATIVE BRAKING **9**

Basics of Electrochemical batteries - Ultra-capacitors- Ultra High-Speed Flywheels - Regenerative braking - Braking energy consumed in urban driving – braking energy vs vehicle speed, braking power, vehicle speed, vehicle deceleration rate – braking energy on front and rear axles – brake system of EV, HEV and FCV.

Unit V FUEL CELLS **9**

Principles of Fuel Cells-Fuel Cell Technologies- Proton Exchange Membrane, Alkaline, Phosphoric Acid, Molten Carbonate, Solid Oxide, Direct Methanol fuel cells - Fuel Supply- Hydrogen Storage, Hydrogen Production- Non hydrogen Fuel Cells

Text Book:

1. MehrdadEhsani, YiminGao, Stefano Longo Kambiz M. Ebrahimi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles”, 3rd Edition, CRS Press, 2018

Reference Book:

1. Iqbal Husain “Electric and Hybrid Vehicles: Design Fundamentals” 3rd Edition CRC Press, 2021
2. SerefSoylu “Electric Vehicles - The Benefits and Barriers” InTech Publishers, Croatia, 2011.
3. AuliceScibioh M. and Viswanathan B “Fuel Cells – Principles and Applications” University Press, India, 2008.
4. Barbir F “PEM Fuel Cells: Theory and Practice” Academic Press, Cambridge, 2012.
5. James Larminie and John Loury “Electric Vehicle Technology-Explained” John Wiley & Sons Ltd.,2nd Edition, 2012.

23EEH92 INTELLIGENT AND AUTONOMOUS VEHICLES

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Driver assistance and Autonomous vehicles concept.
- Advanced vision system in vehicles and Intelligent Transportation System.

Course Outcome:

At the end of the course, the students will be able to

- Explain the intelligent vision system used in Electric Vehicles Transportation.
- Elucidate the communication system used in Electric Vehicle Transportation
- Explicate the architecture of intelligent transportation system
- Outline the adaptive control techniques of an autonomous vehicle
- Narrate the successful autonomous vehicle projects

Unit I INTRODUCTION TO INTELLIGENT VISION SYSTEM 9

Vision based Driver Assistance System- Non Contact ground velocity detecting Sensor, Road Surface Recognition Sensor-Vehicle Sensors for Electronic Toll Collection System-Components of a Vision Sensor System, Driver Assistance on Highways –Lane Recognition, Traffic Sign Recognition, Driver Assistance in Urban Traffic-Stereo Vision, Shape base analysis and Pedestrian Recognition

Unit II VEHICLE INFORMATION SYSTEM AND INTELLIGENT TRANSPORTATION 9

Intelligent Transportation System (ITS) – Vision for ITS Communications, Multimedia communication in a car – Current ITS Communication Systems and Services - Vehicle to Vehicle and Road to Vehicle Communication Systems - Inter Vehicle Communication system.

Unit III CONTROL TECHNIQUES FOR INTELLIGENT VEHICLES 9

Automatic Control of Highway Traffic and Moving Vehicles- Adaptive Control of Highway Traffic and Moving Vehicles- Adaptive Control – Gain Scheduling- Model Reference Adaptive Control - Self Tuning Adaptive Control - Design of Self Tuning Controllers –Generalized Minimum Variance (GMV) Control and Fuzzy control systems-theoretical background.

Unit IV DECISIONAL ARCHITECHTURES FOR AUTONOMOUS VEHICLES 9

Control Architectures and Motion Autonomy – Deliberative Architectures, Reactive Architectures, Hybrid Architectures – Sharp control and decisional Architecture – Overview, Models of the Vehicles - Concepts of Sensor based Manoeuvre - Experimental run of Trajectory Following, Parallel Parking, Platooning manoeuvre.

Unit V AUTONOMOUS VEHICLE AND CASE STUDIES 9

DARPA Challenge Case Study- ARGO Prototype Vehicle- Gold System - Inverse Perspective Mapping , Lane Detection, Obstacle Detection, Vehicle Detection, Pedestrian Detection - Software systems architecture, Computational Performances- ARGO Prototype vehicle Hardware – Functionalities, Data acquisition System, Processing System and Control System.

Text Book:

1. Ljubo Vlacic, Michel Parent and Fumio Harashima,“Intelligent Vehicle Technologies”, Butterworth-Heinemann publications, Oxford, 2001-ISBN 0 7506 5093 1
2. Ronald K Jurgen, “Automotive Electronics Handbook ”, Automotive Electronics Series, SAE, USA, 1998.

Reference Book:

1. Nicu Bizon,Lucian D Ascalescu And Naser Mahdavit Abatabaei “Autonomous Vehicles Intelligent Transport Systems And Smart Technologies”,Nova Publishers-2014–ISBN-978-1-63321-326-5

23MEH42 ENERGY STORAGE AND MANAGEMENT FOR ELECTRIC VEHICLES

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about the energy storage systems for electric vehicle
- To study the various techniques for battery electric management
- To study the various techniques for battery thermal management
- To study the basics of battery testing and recycling process
- To know the legal issues in battery charging systems and infrastructure

Course Outcome:

At the end of the course, the students will be able to

- Understand the energy storage system.
- Select the Effective battery electric management system.
- Able to select suitable thermal management application for the Electric vehicle.
- List out the possible ways for testing and disposal of Battery.
- Illustrate the legal issues and the barriers on electric Vehicle charging systems

Unit I ENERGY STORAGE DEVICES **9**

Batteries: Fundamental principles- Technical Description – Electrical Performance – Environmental safety of Lead Acid Battery- Nickel based batteries- Sodium based batteries- Lithium based batteries – Li-ion & Li-poly- Metal Air Battery; other forms of Energy – Comparison - Battery parameters

Unit II BATTERY ELECTRIC MANAGEMENT SYSTEM **9**

High voltage Battery systems - Components of HV battery packs - Requirements of HV battery packs - Cell balancing, Types, causes, and effects of imbalances in battery cells- Balancing methods- battery state Estimation, and safety aspects of battery management systems for electric vehicles.

Unit III BATTERY THERMAL MANAGEMENT **9**

Motivation for battery thermal management - Heat sources, sinks, and thermal balance- Design aspects of thermal management systems - Air-cooled systems - Dielectric liquid-based systems- Indirect liquid-cooled systems Refrigerant-based systems- Thermoelectric elements- Phase change material- Operational aspects - Battery aging overview.

Unit IV BATTERY TESTING AND RECYCLING **9**

Standards applicable to EVs- Testing procedures for EV batteries- Testing for battery life- Testing for battery safety Future trends in battery testing- Battery recycling - General operational loop for EV battery saving - Recycling technologies - Lithium-Ion Battery Recycling Process- Sorting- Dismantling and separation Acid leaching - Recent developments

Unit V CHARGING INFRASTRUCTURE AND REGULATIONS **9**

Mobility behaviour and charging infrastructure- Driving behaviour – Pause times – Parking Location - Classification of battery charging systems and infrastructure – Plug Types - Safety considerations during charging - Standards and regulations - Licensing regulations for electric vehicles: legal requirements regarding rechargeable energy storage systems – E Waste Management Rule 2018

Text Book:

1. Scrosati, Bruno, JurgenGarche, and Werner Tillmetz, eds. Advances in battery technologies for electric vehicles. Woodhead Publishing, 2015

Reference Book:

1. Larminie, James, and John Lowry. Electric vehicle technology explained. John Wiley & Sons, 2nd Edition, 2012.
2. Link, Albert N., Alan C. O'Connor, and Troy J. Scott. Battery Technology for electric vehicles: Public science and private innovation. Routledge, 2015.
3. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press,3rd Edition, 2021
4. SerefSoylu “Electric Vehicles - The Benefits and Barriers” InTech Publishers, Croatia, 2011

23MEH43 VEHICLE DYNAMICS AND CONTROL

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To learn about the design of vehicle control system, traction and brake, ride and handling dynamics for each vehicle are needed.
- To learn about the fundamental theory of vehicle dynamics, vehicle performance as well as related tests.
- To learn about the application of the dynamic modeling and analysis approach in vehicle design.
- To develop students' capabilities of analysis, evaluation and design based on their acquisition of skills in modeling dynamic equation and performance analysis.

Course Outcome:

At the end of the course, the students will be able to

- The students will understand the fundamentals of vehicle dynamics and its controls
- The students will know the tyre and rim fundaments and the tyre mechanism.
- The students will know vehicle mechanism, steering and suspension mechanism.
- The students will know the vertical dynamics of road vehicles and to simulate and analyze vehicle performance as well.
- The students will understand the concept and anlaysis of vibration and control of the vehicle system

Unit I INTRODUCTION TO VEHICLE DYNAMICS AND CONTROL **9**

Definition of the vehicle, virtual four-wheel vehicle model, control of motion, driver assistance systems, active stability control systems, ride quality, technologies for addressing traffic Congestion. Forward vehicle dynamics: packed car on a level road, packed car on a level road, accelerating car on a level road, accelerating car on an inclined road, parked car on a banked road, optimal drive and brake force distribution, vehicles on a crest and dip. Driveline dynamics: engine dynamics, driveline and efficiency, gearbox and clutch dynamics, gearbox design, vehicle equations of motion, vehicle steady-state cornering.

Unit II TYRE MECHANICS **9**

Tyre and Rim fundamentals: Tyre and sidewall information, Tyre components, Tyre and side-slip angle, Radial and non-radial tyres, Thread, Hydroplaning, tyreprint, wheel and rim, vehicle classifications. Tyre Dynamics: Tyre Coordinate Frame and Tyre Force System, Tyre Stiffness, Tyreprint Forces, Effective Radius, Rolling Resistance, rollover index , rollover prevention , Longitudinal Force, Lateral Force, Camber Force, Tyre Forces, Deformation of tyre with side slip and lateral force, Tyre camber and lateral force, tyre cornering characteristics, traction, braking, and cornering characteristics, dynamic characteristics, vehicle dynamic characteristics. Tyre models, Tyre Road Friction Measurement.

Unit III VEHICLE MECHANISMS AND CONTROL **9**

Applied mechanics: Four-Bar Linkage, Slider-Crank Mechanism, inverted Slider-Crank Mechanism, Instant Center of Rotation, Coupler Point Curve, Universal Joint Dynamics. Steering Dynamics: Kinematic Steering, Ackerman mechanism, Langensperger steering, rear-wheel steering, Vehicles with More Than Two Axles, Vehicle with Trailer, Steering Mechanisms & types, Four wheel steering, Trailer-Truck Kinematics, Suspension Mechanisms: Solid Axle Suspension, active, semi-active, and passive suspension, Independent Suspension, Roll Center and Roll Axis, Car Tyre Relative Angles, Toe-in and toe-out, Suspension Requirements and Coordinate, Frames, Caster Theory. Lateral systems under commercial development: Lane departure warning, Lane keeping systems, Yaw stability control systems.

Unit IV VEHICLE DYNAMICS **9**

Applied dynamics: Force and Moment of vehicle, Rigid Body Translational Dynamics, Rigid Body Rotational Dynamics, Mass Moment of Inertia Matrix, Lagrange's Form of Newton's Equations of Motion, Lagrangian Mechanics, Vehicle Planar Dynamics: Vehicle Coordinate Frame, Rigid Vehicle Newton-Euler Dynamics, Force System Acting on a Rigid Vehicle, Steady-State Turning, Linearized Model for a Two-Wheel Vehicle, Time Response. Vehicle Roll Dynamics: Vehicle Coordinate and DOF, Equations of Motion, Vehicle Force System, Two-wheel Rigid Vehicle Dynamics, Steady-State Motion, time response. Lateral and longitudinal dynamics.

Unit V VIBRATION AND VEHICLE CONTROL **9**

Applied Vibrations: Mechanical Vibration Elements, Newton's Method and Vibrations, Frequency Response of Vibrating Systems, Time Response of Vibrating Systems. Vehicle Vibrations: Lagrange Method and Dissipation Function, Quadratures, Natural Frequencies and Mode Shapes, Bicycle Car and Body Pitch Mode, Half Car and Body Roll Mode, Full Car Vibrating Model. Vehicle control: Steering control, Longitudinal controls, anti-lock brake systems, adaptive cruise control, control architectures, automated highway systems, electronic stability control, steer-by-wire systems, need for slip angle control.

Text Book:

1. Reza N.Jazar, "Vehicle dynamics: Theory and application", Springer. 2008.

Reference Book:

1. Masato Abe, “Vehicle handling dynamics, Theory and applications”, Butterworth-Heinemann of Elsevier. First Edition, 2009.
2. Rajesh Rajamani, Vehicle Dynamics and Control, Second Edition, Mechanical Engineering Series book series (MES), Springer, 2012.
3. Hans B. Pacejka , Tyre and vehicle dynamics”, Butterworth-Heinemann of Elsevier, second edition, 2006.

23MEH44 ELECTRIC VEHICLE DESIGN

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To model and design of electric vehicle technology with high efficiencies
- To Evaluate Various choices available to designers to optimise their vehicle design
- To analyse various electric drives and controller suitable for electric vehicles.
- To design and choice of ancillaries such as the heating and cooling system
- To investigate the need for further research in promising areas.

Course Outcome:

At the end of the course, the students will be able to

- Understand the given design specification and model the various components required for electrical vehicles with high performance.
- Choose proper drives and control for developing a new electric vehicle
- Describe the behaviour of electric vehicle by sophisticated mechanical and mathematical knowledge.
- To evaluate an electrical vehicle design
- Identify the choice of ancillaries such as the heating and cooling system

Unit I ELECTRIC VEHICLE MODELLING **9**

Tractive Effort - Rolling resistance force - Aerodynamic drag - Hill climbing force - Acceleration force - Total tractive effort - Modelling Vehicle Acceleration – Acceleration performance parameters - Modelling the acceleration of a small car - Modelling Electric Vehicle Range - Driving cycles - Range modelling of battery electric vehicles - Constant velocity range modelling - Range modelling of fuel cell vehicles - Range modelling of hybrid electric vehicles

Unit II ELECTRIC VEHICLE DESIGN CONSIDERATIONS **9**

Transmission Efficiency - Consideration of Vehicle Mass - Electric Vehicle Chassis and Body Design - Body/chassis requirements - Body/chassis layout - Body/chassis strength, rigidity and crash resistance - Designing for stability - Suspension for electric vehicles - Chassis used in modern fuel cell electric vehicles

Unit III SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN **9**

Operation Patterns - Control Strategies - maximum state-of-charge of peaking power source (PPS) - Thermostat Control Strategy (Engine-On–Off) - Sizing of the Major Components - Power Rating Design of the Traction Motor - Power Rating Design of the Engine/Generator - Design of PPS - Power Capacity of PPS - Energy Capacity of PPS

Unit IV PARALLEL HYBRID ELECTRIC DRIVE TRAIN DESIGN **9**

Control Strategies of Parallel Hybrid Drive Train - Maximum State-of-Charge of Peaking Power Source (Max. SOC-of-PPS) Control Strategy - Engine Turn-On and Turn-Off (Engine-On–Off) Control Strategy Design of Drive Train Parameters - Design of Engine Power Capacity - Design of Electric Motor Drive Power Capacity - Transmission Design - Energy Storage Design

Unit V ANCILLARY SYSTEMS AND THE ENVIRONMENT **9**

Heating and Cooling Systems - Design of the Controls – stick controller - Power Steering - Choice of Tyres - Electric Vehicle Recharging and Refuelling Systems - Vehicle Pollution in context with conventional vehicles - Quantitative Analysis - Alternative and Sustainable Energy

Text Book:

1. James Larminie and John Lowry, “Electric Vehicle Technology Explained “ John Wiley & Sons, 2013
2. Mehrdad Ehsani, Yimin Gao, Stefano Longo Kambiz M. Ebrahimi, “Modern Electric, Hybrid Electric, and Fuel Cell Vehicles”, CRS Press, 2018.

Reference Book:

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, CRC Press, 2011
2. Seref Soylu “Electric Vehicles - The Benefits and Barriers” InTech Publishers, Croatia, 2011
3. Amir Khajepour, M. Saber Fallah, Avesta Goodarzi “Electric and hybrid vehicles technologies, modeling and control: a mechatronic approach” John Wiley & Sons Ltd 2014.

23MEH61 BIO ENERGY

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Bio energy and its thermodynamic behaviour.
- Understanding the different conversion technologies for bio energy.
- Government policies and bio market.

Course Outcome:

At the end of the course, the students will be able to

- Understand the fundamentals of bio energy and thermodynamic functions.
- Understand the different feeds of bio fuel production and its processing.
- Apply the fundamentals and understand different biological conversion technologies.
- Apply the fundamentals and understand different thermal conversion technologies.
- Understand the bio energy system analysis using TEA and LCA.

Unit I INTRODUCTION TO BIO ENERGY **9**

Introduction to Bio Energy – Energy and Heat – Volume-Mass Relationship - Henry Law – Mass Balance – Enthalpy – Energy Balance – Properties of Biomass – Thermodynamics and Kinetics of basic chemical reactions

Unit II BIO ENERGY FEEDSTOCKS **9**

Growing Condition, Yield for the Production of Biofuel Production – Plantation Harvesting and Storage of Feedstock like Corn – Sweet Potato – Cassava – Soybean – Palm - Jatropha. Biomass Size Reduction, Briquetting, Drying, Storage and Handling of Biomass.

Unit III BIOLOGICAL CONVERSION TECHNOLOGIES **9**

Pre-treatment – Physical, Thermochemical – Enzymatic hydrolysis of carbohydrates –Ethanol fermentation, Substrate and factors affecting – anaerobic digestion– Biogas cleaning, upgrading, utilization and digestate – Microbial fuel cell, Electron transfer process, Electrical power and energy generation.

Unit IV THERMAL CONVERSION TECHNOLOGIES **9**

Biomass Furnaces, Biomass Co-Firing with Coal – Bio Refinery – Sugar Based – Stoichiometry – Sugarcane, Sweet Sorghum, Sugar Beet Ethanol Production – Starch Based Ethanol – Pyrolysis Reactions and Mechanism – Bio-Oil – Bio-Oil Refining.

Unit V BIO ENERGY SYSTEM ANALYSIS **9**

Techno-Economic Analysis, Steps, Tools, Software and Data sources – Life Cycle Assessment, Procedure, Tools – Bio Energy Market – Government Policy and Implications.

Text Book:

1. Yebo Li and Samir Kumar Khanal “Bioenergy: Principles and Applications” Wiley-Blackwell, 1st Edition, 2016.

Reference Book:

1. VenkataRamana P and Srinivas S.N, “Biomass Energy Systems”, Tata Energy Research Institute, 1997.
2. Khandelwal. K. C. and Mahdi S. S, “Bio-Gas Technology”, Tata McGraw-Hill Pub. Co. Ltd, 1986.
3. Mital K.M, “Biogas Systems: Principles and Applications”, New Age International publishers (P) Ltd., 1996.
4. S P Sukhatme, J K Nayak, “Solar Energy Paperback” McGraw Hill Education; Fourth edition, 2017.
5. Bioenergy and Biofuel from Bio wastes and Biomass edited by Samir Kumar Khana, ASCE Publications, 2010.

23MEH62 ALTERNATE ENERGY FUELS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Different types of alternate fuels.
- The suitability of various alternate fuels in IC engines

Course Outcome:

At the end of the course, the students will be able to

- Understand the Need for Alternative Fuels
- Understand about alcohol fuels
- Apply the usage of bio diesel and synthetic fuels
- Understand the usage of Hydrogen as a substitute fuel
- Use Gaseous fuels in Internal Combustion engines

Unit I NEED FOR ALTERNATIVE FUELS **9**

Effects of constituents of Exhaust gas emission on environment (N2, CO2, CO, NOx, SO2, O2)-Impact of pollution in atmosphere -Greenhouse effect, Factors affecting greenhouse effect- Study of Global Carbon Budget, Carbon foot print and Carbon credit calculations-Emission norms as per Bharat Standard up to BS – VI and procedures for confirmation on production.

Unit II ALCOHOL AS FUEL SUBSTITUTE **9**

Feedstock of Methanol and Ethanol, methods of its production-Properties of methanol & ethanol as engine fuels, Use of alcohols in S.I. and C.I. engines, performance of blending methanol with gasoline-Emulsification of alcohol and diesel. Dual fuel systems-Improvement / Change in emission characteristics with respect to Blend percentage of Alcohol.

Unit III BIO DIESEL AND SYNTHETIC FUELS **9**

Feedstock for production of Bio Diesel (Karanji oil, Neem oil, Sunflower oil, Soyabean oil, Mustard oil, Palm oil, Jatropha seeds)-Process of separation of Bio Diesel. Properties-Diesel blended with vegetable oil, Various Vegetable oils for Engines – Esterification, performance and emission characteristics of Engine. Algae Biodiesel, DiMethyl Ether (DME), P-Series, and Eco-Friendly Plastic fuels (EPF).

Unit IV HYDROGEN **9**

Hydrogen - Properties, sources and methods of production, Storage and Transportation. Economics of Application and Advantages of hydrogen (Liquid hydrogen) as fuel for IC engine/ hydrogen car. Layout of a hydrogen car.

Unit V GASEOUS FUELS FOR IC ENGINES **9**

Introduction to Bio gas system-Process during gas formation-Factors affecting bio gas formation-Usage of Bio gas in SI engine & CI engine-LPG &CNG: Properties of LPG & CNG as engine fuels-fuel metering system -effect on performance, emission, cost and safety

Text Book:

1. S. S. Thipse, “Alternative Fuels”, Jaico Publications, 1st Edition, 2010.

Reference Book:

1. Ganesan V, “Internal Combustion Engines “, McGraw Hill HED Publications, 4th edition, 2017
2. John Heywood, “Internal Combustion Engine Fundamentals”, McGraw Hill Education; 1st edition, 2017.
3. Viswanathan, “Fuel Cells: Principles and Applications”, Universities Press; 1st edition, 2006.

23MEH63 COMBUSTION ENGINEERING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Different types of fuels
- The basics of combustion process and appliances

Course Outcome:

At the end of the course, the students will be able to

- Understand the fundamentals of solid fuels and its processing
- Understand the production , processing , storage and handling of liquid fuels
- Apply the fundamentals and understand types, cleaning and purification of gaseous fuels.
- Understand about the principles behind Combustion stoichiometry and kinetics
- Apply the basic knowledge and understand the concepts of flame and combustion appliances

Unit I SOLID FUELS **9**

Biomass – Peat – Lignite – sub bituminous coal - Bituminous coal – Semi anthracite – Anthracite – Cannel coal and boghead coal – Natural coke – Coal – Composition – Analysis and properties – action of heat – oxidation – hydrogenation – classification – Processing of solid fuels – Coal preparation – storage – Carbonisation – Briquetting – Gasification – Liquefaction of solid fuels

Unit II LIQUID FUELS **9**

Petroleum – Production – composition – processing – distillation – breakdown processes – rebuilding – purification – clay treatment – Deasphalting – Dewaxing – Deoiling- Petroleum products – Liquid fuels from sources other than petroleum – Storage and handling of liquid fuels

Unit III GASEOUS FUELS **9**

Types of gaseous fuels – Natural gas- Methane from coal mines- producer gas-water gas-carburetted water gas-complete gasification of coal-coal gas- blast furnace gas- gases from biomass- refinery gases- Cleaning and purification of gaseous fuels

Unit IV COMBUSTION PROCESS **9**

Combustion stoichiometry – rapid methods – Combustion process – nature and types – Mechanism of combustion reactions – spontaneous ignition temperature - Kinetics of solid and liquid fuel combustion - Ignition delay

Unit V FLAMES AND COMBUSTION APPLIANCES **9**

Limits of in flammability - Velocity of flame propagation – Flame structure - Flame stability – Laminar flame theory - Turbulent premixed flames - Lean flame Reactions - Gas burners – Oil burners – Coal burning equipment

Text Book:

1. Samir Sarkar, “Fuels & Combustion”, Universities Press; 3rd edition, 2009

Reference Book:

1. S.P. Sharma & Chander Mohan, “Fuels & Combustion”, Tata McGraw Hill Publishing Co.Ltd., 1984
2. Kenneth K. Kou. “Principles of Combustion”, Wiley India Pvt Ltd; 2nd edition, 2012
3. Shaha A.K., “Combustion Engineering and Fuel Technology”, Oxford and IBH, 1974.
4. O. P. Gupta, “Elements of Fuels, Furnaces & Refractories”, Khanna Publishers , 6th edition, 1989.

23MEH64 ANALYSIS AND DESIGN OF AIR CONDITIONING SYSTEMS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- the operation principles of different air conditioning systems and calculation methods of duct design, heating and cooling loads

Course Outcome:

At the end of the course, the students will be able to

- know about the working of various air conditioning systems
- identify various standards in indoor air quality
- learn the procedures in calculation of heating and cooling loads
- know about the piping system fundamentals and piping design
- understand the design of building air distribution

Unit I AIR-CONDITIONING SYSTEMS 9

System selection and arrangement, All air systems - Single zone system, Reheat system, Variable volume system, Dual duct system, Multi zone system, Air and water systems, All water systems, Decentralised cooling and heating, Heat pump systems, Heat recovery systems.

Unit II INDOOR AIR QUALITY 9

Comfort – physiological considerations and environmental indices, comfort conditions, ventilation for acceptable indoor air quality, common contaminants, methods to control humidity and contaminants.

Unit III HEATING AND COOLING LOAD 9

Space heating load – outdoor and indoor design conditions, transmission heat losses, infiltration, heat losses from air ducts, heat gain, cooling load and heat extraction rate, application of cooling load calculation procedures, design conditions, internal heat gains, overview of the heat balance method

Unit IV PIPING DESIGN 9

Piping system fundamentals, air elimination, control of heating and cooling coils, system design, light and large commercial systems, steam heating systems, spray chambers, cooling towers.

Unit V BUILDING AIR DISTRIBUTION 9

Fan performance and selection, fan installation, field performance testing, fans and variable-air-volume systems, air flow in ducts and fittings, duct design – general and sizing.

Text Book:

1. Faye.C.McQuiston, Jerald.D.Parker, Jeffrey.D.Spitler,"Heating, Ventilating, and Air Conditioning – Analysis and Design", Wiley India (P) Ltd, 7th edition, 2011.

Reference Book:

1. N.C.Gupta, "Comprehensive HVAC system design", Viva books private limited, 2016.
2. Edward.G.Pita, "Air conditioning principles and systems", Pearson India education services pvt. Ltd, 4th edition, 2018.
3. P.N.Ananthanarayanan, "Basic refrigeration and air conditioning", McGraw Hill education (India) pvt. Ltd, 4th edition, 2013.

23MEH65 ENERGY AUDIT AND ENVIRONMENT MANAGEMENT

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the various components and their energy saving opportunities.
- To study the importance of different modes of environment management.

Course Outcome:

At the end of the course, the students will be able to

- Know the basics of energy audit and management in electric motors, lightings and electric load management.
- Gain knowledge on boilers and industrial furnaces.
- Know the energy saving strategies on fans, blowers and cooling towers.
- Know the conservative usage of pumps and pumping systems, Refrigeration and Air conditioning
- Know about the fundamentals of clean energy audit and environment management.

Unit I ENERGY CONSERVATION **9**

Initiatives in India – Potential for energy conservation-Barriers – Energy audit –Economic analysis. Electric motors – selection and application, Efficiency, Losses, Performance and Energy conservation. Lighting- Principles, Quality, Types of source, Efficiency and maintenance. Electric Load Management – Transformers, Section of a transformers, Reduction of losses – Power factor. Energy Management Information system – Components and Design.

Unit II BOILERS AND INDUSTRIAL FURNACES **9**

Boilers- Classification, Efficiency, Energy conservation, Waste heat recovery, Performance. Industrial furnaces- Classifications, Efficiency, Energy conservation measures. Electrical, Induction furnaces- Energy saving measures. Compressed air network – Types of compressor, Selection of compressor, Performance monitoring and compressed air-distribution system.

Unit III FANS, BLOWERS AND COOLING TOWERS **9**

Fans- Classification, Selection of fans, Flow control methods, Performance curves, Efficiency. Cooling tower – Classification, Selectin and Usage, Performance evaluation at site, Factors affecting cooling tower performance and Energy saving opportunities.

Unit IV PUMPING SYSTEMS, REFRIGERATION AND AIR CONDITIONING **9**

Pumps and Pumping systems - Classification, Performance, Factors affecting pump performance, characteristic, Efficiency and Flow control strategies. Refrigeration and Air Conditioning – Vapour compression system, Vapour absorption system, Measurement and field testing, Performance evaluation, Air washer and Energy conservation methods.

Unit V ENVIRONMENT MANAGEMENT **9**

Water audit and conservation – Need for water conservation, Effective conservation methods, Integrated water management. Solar Energy options for industries – Energy, Climate change and clean development mechanism.

Text Book:

1. Abbi Y. P. and Shashank Jain, " Handbook on energy audit and environment management". The Energy and Resources Institute (TERI), 2009.

Reference Book:

1. Rao. P. SasiBhushana and PM Rao PSB Rao, "Environment Management and Audit" Deep and Deep Publications, 2000.
2. Turner Wayne C and Steve Doty, "Energy management handbook". The Fairmont Press, Inc., 2007.
3. Klemes, Jiri, Robin Smith, and Jin-Kuk Kim, "Handbook of water and energy management in food processing". Elsevier, 2008.
4. Beggs Clive, "Energy: management, supply and conservation". Routledge, 2010.
5. Thollander, Patrik,." Introduction to Industrial Energy Efficiency: Energy Auditing, Energy Management, and Policy Issues". Academic Press, 2020.

23MEH81 SCHEDULING ALGORITHMS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To enhance students' knowledge in the basics of scheduling theory using the concepts of scheduling functions and sequencing etc.,
- To impart knowledge on various scheduling algorithms applicable to single machine, parallel machines, flow shop and job shop models.

Course Outcome:

At the end of the course, the students will be able to

- Learn the introductory aspects of scheduling theory using the concepts of scheduling functions and sequencing etc.,
- Learn the methods of single machine scheduling using various algorithms.
- Design and analyse parallel machine scheduling using McNaughton's algorithm and Hu's algorithm etc.,
- Design and analyse flow shop scheduling.
- Design and analyse job shop scheduling.

Unit I SCHEDULING THEORY **9**

Scheduling background – Scheduling function – Sequencing – Ready time – Flow time – Tardiness - Weighted flow time – Inventory – Regular measures of performance – Dominant schedules – Shortest Processing Time (SPT), Earliest Due Date (EDD), Weighted shortest processing time (WSPT) sequences – Scheduling Theorems.

Unit II SINGLE MACHINE SCHEDULING **9**

Pure sequencing model – Hodgson's algorithm – Smith's rule – Wilkerson Irwin algorithm – Neighbourhood search – Dynamic programming technique – Branch and Bound algorithm – non-simultaneous arrivals – Minimizing makespan, flow time, and tardiness for dependent jobs – Sequence-dependent setup times.

Unit III PARALLEL MACHINE SCHEDULING **9**

Preemptive jobs: McNaughton's algorithm – non-pre-emptive jobs – Heuristic procedures – Minimizing makespan, flow time, and tardiness – H1 &Hm heuristics – Dependent jobs: Hu's algorithm – Muntz Coffman algorithm.

Unit IV FLOW SHOP SCHEDULING **9**

Characteristics – Johnson's algorithm – Extension of Johnson's rule – Campbell Dudek Smith algorithm – Palmer's method – Start lag, stop lag – Mitten's algorithm – Ignall Schrage algorithm - Dispatch index heuristic.

Unit V JOB SHOP SCHEDULING **9**

Characteristics – Graphical tools – Jackson's algorithm – Feasible, Semi-active, and Active schedules – Single pass approach – non-delay schedule – Priority dispatching rules – Heuristic schedule generation – Open shop scheduling.

Text Book:

1. Kenneth R. Baker, "Introduction to sequencing and scheduling", John Wiley & Sons, New York, 2000.

Reference Book:

1. Richard W. Conway, William L. Maxwell and Louis W. Miller, "Theory of Scheduling", Dover Publications, 2003.
2. Michael L. Pinedo, "Scheduling: Theory, Algorithms, and Systems", Springer, 2008.

23MEH82 LEAN AND AGILE MANUFACTURING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To make the students acquire the basic knowledge in lean six-sigma
- To make them understand the various phases involved in the implementations of six-sigma.
- To understand how lean management today represents a profound change in the competitive business culture and a leading indicator of excellence in the organization.
- To understand the tools required for Lean six-sigma.
- To understand how by implementing lean management organizations can improve product & processes without adding any more money, people, equipment, inventory or space and aim for perfection

Course Outcome:

At the end of the course, the students will be able to

- Develop a comprehensive set of skills that will allow students to function effectively by using Lean six- sigma for quantitative analysis.
- Understand issues & challenges in implementing & developing lean manufacturing techniques & its contribution for improving organizational performance.
- Apply lean techniques to bring competitive business culture for improving organization performance
- Analyse how lean techniques can be applied to manufacturing & service industry.
- Analyse how lean technique can create value generation for organization.

Unit I INTRODUCTION TO LEAN AND SIX-SIGMA 9

Introduction to Lean- Definition, Purpose, features of Lean; top seven wastes, Need for Lean, Elements of Lean Manufacturing, Lean principles, the lean metric, Hidden time traps. Introduction to quality, Definition of six-sigma, origin of six-sigma, six-sigma concept, and Critical success factors for six-sigma. Evolution of lean six-sigma, the synergy of Lean and six sigma, Definition of lean six-sigma, the principles of lean six-sigma, Scope for lean six sigma, Features of lean six- sigma, the laws of lean six-sigma, Benefits of lean six-sigma.

Unit II INITIATION, RESOURCE AND PROJECT SELECTION FOR LEAN SIX SIGMA 9

Top management commitment – Infrastructure and deployment planning, Process focus, organizational structures, Measures – Rewards and recognition, Infrastructure tools, structure of transforming event, Launch preparation. Resource and project selection, Selection of Black belts, Selecting projects – Benefit/Effort graph, Process mapping, value stream mapping and Balanced score card for project identification, project suitable for lean six sigma.

Unit III TEAM BUILDING AND THE DMAIC PROCESS 9

Predicting and improving team performance, nine team roles, Team leadership, Team building & Team exercise. DMAIC process and toll gate reviews.

Unit IV THE TOOLS FOR LEAN SIX- SIGMA 9

Define tools- Project Definition Form(PDF) and SIPOC; Measure tools- Process mapping, Pareto chart, cause and effect matrix, FMEA, Brain-storming, NGT, Multi-voting, Cause & Effect diagram, Check sheets, Gauge R&R, Run charts, Control charts and process capability analysis; Analyze tools- scatter plots, ANOVA, Regression analysis and time trap analysis; Improve tools- Mistake proofing, KAIZEN, Reducing congestions and delays, SMED, TPM, Design of Experiments and the pull system; Control tools-SPC.

Unit V AGILE MANUFACTURING 9

The Agile Production Paradigm- History of Agile Manufacturing- Agile Manufacturing Vs Mass Manufacturing, Agile Manufacturing Vs Mass Customization- Agile Manufacturing Research Centers- Agile Practices- Agile practice for product development - Manufacturing agile practices - understanding the value of investing in people, Concept models of Agile Manufacturing -Infusing managerial principles for enabling agility.

Text Book:

1. Forrest W. Breyfogle III, Implementing Six Sigma: Smarter solutions Using Statistical Methods, John Wiley & Sons; 2nd edition, 2003.
2. James P. Womack, Daniel T. Jones, Lean Thinking, Simon & Schuster, 2003.

Reference Book:

1. Chee Kai Chua, “3D Printing and Additive Manufacturing: Principles and Applications”, World Scientific, Fifth Edition, 2017.
2. Jyothish Kumar, “3D Printing and Additive Manufacturing Technologies”, Springer, 2019.
3. Manu Srivastava, “Additive Manufacturing: Fundamentals and Advancements”, CRC Press, 2019.Michael L. Pinedo, “Scheduling: Theory, Algorithms, and Systems”, Springer, 2008.

23MEH83 SYSTEMS SCIENCE AND ENGINEERING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- This course is intended to introduce the students to the systems engineering process used to create multi-disciplinary solutions to complex problems.

Course Outcome:

At the end of the course, the students will be able to

- Understand the functions, capabilities and limitations of systems engineering in the context of large developmental programs.
- Design a system or process to meet desired needs within realistic constraints such as economic, environmental, ethical, health and safety and sustainability.
- Design and conduct experiments, as well as to analyze and interpret data.
- Use the techniques, skills and modern engineering tools necessary for engineering practice.
- Apply system engineering practices for management conceptions.

Unit I SYSTEMS SCIENCE CONCEPTS **9**

System as a function of system-hood and thing-hood, Systems thinking, Evolution of systems movement, Framework of deductive and inductive approaches, classification systems models, Methodological paradigms, Laws of systems science, Organized complexity, Systems simplification.

Unit II SYSTEMS ENGINEERING PROCESSES **9**

Life cycles-Phases-Steps, Formulation of Issues: Problem Identification – Scoping – Bounding, Problem definition – Identification of needs, alterables, constraints; Value System Design: Objectives and objective measures; Generation of Alternatives/ system synthesis – Identification of activities and activity measures; Functional decomposition and analysis.

Unit III ANALYSIS OF ALTERNATIVES **9**

Uncertain/ Imperfect information; Cross-impact analysis - an alternative way of qualitative analysis, Hierarchical inference, logical reasoning inference; Structural modeling; System Dynamics.

Unit IV INTERPRETATION OF ALTERNATIVES AND DECISION MAKING **9**

Types of decisions – descriptive, prescriptive, normative; Decision assessment efforts types – under certainty, probabilistic uncertainty, probabilistic imprecision, information imperfection, conflict and cooperation; Prescriptive normative decision assessments; Utility theory; Group decision making.

Unit V SYSTEMS ENGINEERING MANAGEMENT CONCEPTS **9**

Organizational structures, Systems Engineering management plan; Network based systems planning and management methods; Cognitive factors in Systems Engineering - cognitive analysis and cognitive design – Advantages and Limitations.

Text Book:

1. Andrew P Sage and James E Armstrong, Introduction to Systems Engineering, Wiley-Interscience; 1st edition (2008).
2. George J Klir, Facets of Systems Science, Kluwer Academic/Plenum Publishers; 2nd ed. 2001 edition (2001).

Reference Book:

1. Alexander Kossiakoff, William N. Sweet, Samuel J. Seymour, Systems Engineering Principles and Practice, Wiley; Second edition (2016).

23MEH84 SERVICES OPERATIONS MANAGEMENT

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To enhance the students' understanding of the nature and importance of the service sector in the economy.
- To improve the students' analytical abilities in solving problems that service managers' face.

Course Outcome:

At the end of the course, the students will be able to

- Understand the impact of services in global economy
- Appreciate the role of information and globalization
- Design a service enterprise
- Make effective decisions in the management of a service organization
- Use various tools for a service industry

Unit I INTRODUCTION TO SERVICES **9**

Manufacturing and Services, Definition of Service, Role of Service in the economy, History of service, Characteristic of Service, Nature of Services, Classification of Services, Importance of Activity, Impact of technology - service concept as a strategic tool, focused and unfocused service operations.

Unit II INFORMATION AND GLOBALIZATION **9**

Role of information in services, Data privacy, Virtual value chain, E-markets, Types of Globalized Services, Outsourcing, Growth and Expansion strategies, issues in Globalization, Service strategies - strategy formulation and development, sustaining a strategy.

Unit III DESIGNING A SERVICE ENTERPRISE **9**

Service process design, Customer value equations, Internet and Automation, Scalability, Estimating geographic demand, Facility location techniques, Geographic Information System, Strategies for managing capacity and demand, Tools for service design

Unit IV SERVICE QUALITY AND PRODUCTIVITY **9**

Service quality – importance - measuring service quality, Quality service by design, Stages in quality development, Audit, Continuous Improvement, Quality tools for analysis and development, managing customer service encounter – Issues in Productivity Measurement.

Unit V TOOLS FOR SERVICES AND SERVICE MANAGEMENT **9**

Waiting Lines, Analysis of waiting lines, psychology of waiting, Single and multiple server model, Data Envelopment Analysis – Vehicle Routing models, Resource utilization, Networks, performance and information Applications – Case study. (Qualitative Approach only)

Text Book:

1. Fitzsimmons, J.A. and Fitzsimmons, M.J. Service Management, Tata Mc Graw Hill India, 2006.

Reference Book:

1. Haksever C, Render B, Russell RA and Murdick RG ,Service Management and Operations, Prentice Hall International, USA, 2000

23MEH85 QUALITY ENGINEERING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the basic concept of Quality and its influence on the productivity and relibility of a material.
- To introduce the concept of Sampling plan, acceptance sampling and control measure for monitoring the process capability.

Course Outcome:

At the end of the course, the students will be able to

- Acquire knowledge on basis of quality control and Quality assurance and cost of quality.
- Know the various tools for controlling the quality parameters.
- Understand the various control charts used in monitoring the quality parameters.
- Acquire the knowledge on machine capability and process capability.
- Understand the various types of sampling techniques Operating Characteristic curves.

Unit I INTRODUCTION **9**

Statistical concepts for quality- Fundamentals of quality- history, Quality definitions, Quality dimensions, Quality terminology- Inspection, Quality control, SQC, Quality Assurance, Quality planning- policies & objectives, Quality costs – Economics of quality, Quality loss function, Quality Vs productivity, Quality Vs reliability.

Unit II STATISTICAL PROCESS CONTROL **9**

Process variation, Control charts for variables- X , R and S charts- preliminary decisions, computation of control limits, Construction and interpretation, Relation between process in control and specification limits, modified and warning control limits, O.C. curve for X chart, Control procedure, adjustment for trend in process mean

Unit III SPECIAL CONTROL PROCEDURES **9**

Control charts for attributes- p, np, c and u charts, demerits control chart, O.C curve for p-chart, Control charts for individual measurements- X-chart, moving average and moving range charts, cumulative-sum and exponentially weighted moving average control charts, multi-vari chart.

Unit IV PROCESS AND MEASUREMENT SYSTEM CAPABILITY **9**

Process stability, process capability analysis using a Histogram or normal probability plot and control chart, process capability indexes, Gauge capability studies, setting specification limits.

Unit V ACCEPTANCE SAMPLING **9**

Acceptance sampling, Economics of sampling, Single sampling plan for attributes- O.C. curve, design, double sampling- O.C. curve, multiple and sequential sampling plans, sampling plans for variables.

Text Book:

1. Douglas C Montgomery, Introduction to Statistical Quality Control, Sixth Edition, John Wiley & sons, Inc., 2009.
2. Joseph A.Defeo, Juran’s Quality Handbook, McGraw-Hill Education; 7 edition, 2016

Reference Book:

1. E.L. Grant and R.S. Leavenworth, Statistical Quality Control, Seventh Edition,TMH, 2017
2. Bertrand L.Hansen & Prabhakar M.Ghare, Quality Control & Applications, Prentice Hall of India,2004
3. Dale H.Besterfield, Carol Besterfield-Michna, Glen H.Besterfield and Mary Besterfield-Sacre, Total Quality Management, Prentice Hall, 3rd edition,2002

23BTH01 HUMAN PHYSIOLOGY

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart comprehensive understanding of the cell and tissue organization
- To expand on the understanding of cardiovascular and respiratory physiology
- To impart knowledge on the function of the brain, central nervous system and autonomic nervous system
- To provide a complete understanding of the digestive and excretory system
- Make student to understand the physiological regulations of metabolism and reproductive system by various gland and the hormones

Course Outcome:

At the end of the course, the students will be able to

- Acquire an enhanced knowledge and appreciation of cell and tissue organization
- Explain the functions of important physiological systems such as the cardiovascular and respiratory systems
- Explain the functioning of central nervous system and neurophysiology
- Explain the physiological processes associated with the digestive and excretory system
- Explain the role of glands and hormones in the regulation of metabolism and the reproductive system

Unit I CELL AND TISSUE ORGANIZATION 9

Cells – interaction with extracellular environment, diffusion and osmosis, carrier mediated transport, membrane potential, cell signaling and cell respiration. Primary tissues- Muscle, Nervous, Epithelial and Connective Tissues, origin & function; organs, body-fluid compartments. Body planes, homeostasis and feedback control- negative & positive feedback, neural and endocrine regulation, feedback control of hormone secretion.

Unit II CARDIOVASCULAR AND RESPIRATORY PHYSIOLOGY 9

Functions and components of the cardiovascular system; Blood-Composition, cells, plasma proteins and lipoproteins. Buffer systems, hemostasis, Mechanism of blood clotting and anticoagulants; Structure of heart, blood vessels and lymphatic system. Cardiac output, blood flow, blood pressure and its regulation. The respiratory system - structure, thoracic cavity; physical aspects of ventilation, mechanism of breathing – gas exchange in the lungs; Regulation of breathing, haemoglobin and oxygen transport – effect of pH, temperature and 2-DPG and muscle myoglobin; CO2 transport; Acid base balance of the blood; Exercise and high altitude on respiratory function.

Unit III NEUROPHYSIOLOGY 9

Nervous system – Neurons and supporting cells, axons- Conduction of nerve impulse, origin of resting membrane potential and action potential - Electrophysiology of ion channels, synapse, neurotransmitters – types and functions and synaptic integration; Structure of the Brain, spinal cord and nerves; Autonomic nervous system – sympathetic and parasympathetic, functions. Sensory physiology – characteristics of sensory receptors, taste and smell, ears and hearing, eyes and vision. Neural control of skeletal muscles.

Unit IV DIGESTION AND EXCRETION PHYSIOLOGY

Introduction to the digestive system – mouth to stomach, small intestine, large intestine, liver, gall bladder and pancreas; Regulation of digestive system, digestion and absorption of foods. Structure and function of the kidneys; glomerular filtration; reabsorption of salt and water; renal plasma clearance; renal control of electrolyte and acid-base balance; diuretics and renal function tests.

Unit V ENDOCRINE AND REPRODUCTIVE PHYSIOLOGY

Endocrine glands and hormones – classification of hormones, hormone interactions, neural and endocrine regulation, mechanism of hormone action; pituitary gland, Adrenal gland, thyroid and parathyroid glands, pancreas and other endocrine glands; paracrine and autocrine regulation. Regulation of metabolism by hormones. Sexual reproduction, endocrine regulation of reproduction.

Text Book:

1. Stuart, I.F., Human Physiology, Mc Graw Hill, 17th edition, 2017.
2. John, H.E., Guyton and Hall Text book of Medical Physiology, W B Saunders and Company, 13th Edition, 2015.

Reference Book:

1. Gerad, J. T., Sandra, R.G., “Principles of Anatomy and Physiology - Control systems of human body, Vol-3”, Wiley and Sons, 10th Edition, 2006.
2. Barett, K.E., Barman, S.M., Boitans, S., Brook, H., Ganong’s Review of Medical physiology, Tata McGrawHill, 23rd Edition (Lange basic science), 2009.

23BTH02 ENZYME - COENZYME CHEMISTRY

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- To provide a detailed overview of enzymes and coenzymes.
- To impart knowledge on the various enzyme kinetics and mechanisms.
- To provide students with a complete understanding of the catalytic strategies followed by various classes of enzymes.
- To guide students in differentiating the regulatory strategies followed by various catalytic processes.
- To demonstrate students with models and case studies on electro-enzymology and coenzyme regeneration.

Course Outcome:

At the end of the course, the students will be able to

- Define enzyme structure, differences between enzymes and normal catalytic substances, cofactor and coenzymes
- Explain catalytic centre, define factors that affect enzyme activity and kinetics such heat, pH, concentration
- Explain conformational changes in enzymes, allosteric enzymes, activators and inhibitors
- Explain the various catalytic and regulatory strategies of different enzymes.
- Demonstrate electric-field control of enzymes and coenzyme regeneration and coenzyme cycling.

Unit I ENZYMES AS CATALYSTS **9**

Classification – nomenclature & general properties of the enzyme. Factors affecting enzyme action: pH, temperature, ions, substrate concentration, enzyme concentration, inhibitors. Thermodynamic models of catalysis; protein dynamics in enzyme catalysis. Coenzymes – role in enzyme catalysis; Thiamine pyrophosphate, Flavin adenine nucleotide, Nicotinamide adenine dinucleotide, Pyridoxal phosphate, Coenzyme A (CoA), Biotin, 5'-Deoxyadenosyl cobalamin and Tetrahydrofolate. Role of metals in enzyme catalysis: Zn2+, Mg2+, Ni2+, Mo, Se, Mn and K+.

Unit II ENZYME KINETICS **9**

Enzyme activity; effect of temperature–Arrhenius equation and its application. Determination and application of Vmax, Km, turnover number (Kcat), inhibition constant (KI), dissociation constant (KD), standard free energy change (G), Kinetics of single substrate enzyme catalyzed reactions-the Haldane relationship for reversible reactions, relaxation kinetics, rate equation by King and Altman method, Kinetics of multisubstrate enzyme catalyzed reaction-rate equation of Alberty and Dalziel, inhibition and activation of enzymes, Binding of ligands to proteins-Hill equation, Adair equation. Scatchard plot and their application, sigmoid kinetics and allosteric enzymes.

Unit III CATALYTIC STRATEGIES **9**

Catalytic strategies: Covalent catalysis – proteases; acid-base catalysis – chymotrypsin, carbonic anhydrate and myosin, role of catalytic triads; catalysis by approximation – hydrolases; metal-ion catalysis – EcoRV. Abzymes and ribozymes.

Unit IV REGULATORY STRATEGIES

Regulatory strategies: Allosteric control - aspartate transcarbamoylase (ATCase); multiple forms of enzymes – Lactate dehydrogenase; covalent modification – protein kinases, proteins phosphatases and RNA polymerase; proteolytic activation – trypsin, chymotrypsin and pepsin, blood clotting factors; metabolic regulation – glycogen phosphorylase; transcriptional control of enzyme activity – β-galactosidase.

Unit V ELECTRO-ENZYMOLOGY AND COENZYME REGENERATION

Bioelectrocatalysis; electrode-bound enzymes, electric and electric-field control of enzyme activity, conductive enzyme membrane, electrochemical control of enzyme activity, electroanalytical application of enzymes, electrochemical enzymatic assay. Coenzyme regeneration: methods, chemically modified co-enzymes, enzyme processes with coenzyme cycling, Bioreactor systems with continuous coenzyme cycling.

Text Book:

1. Palmer, T., Enzymes: Biochemistry, Biotechnology & Clinical Aspects Chichester, Horwood Pub. West Sussex, England, 2001
2. T.D.H. Bugg, T. D.H., Introduction to enzyme and coenzyme chemistry, John Wiley & Sons, Ltd., 3rd edition, 2012.
3. K. Nakamura, K., Aizwa, M., Miyawaki, O., M. Aizawa O. Miyawaki, Electro-enzymology and Coenzyme regeneration (Biotechnology Monographs), Springer-Verlag Berlin Heidelberg, 1988.

Reference Book:

1. Berg, J. M., Tymoczko, J. L., Stryer, L.,Biochemistry, W. H. Freeman and Company, New York, 2012.
2. Copeland, R. A., Enzymes-A practical introduction to structure, mechanism and data analysis, John Wiley & Sons, 2nd Edition, 2008.

23BTH03 INTRODUCTION TO ECOLOGY AND EVOLUTION

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Major evolutionary radiations.
- Phylogenetics and taxonomy.
- Diversification process over the course of evolution in various ecosystems.
- Population dynamics, abundance, distribution and regulation with in the ecosystem.
- Various interaction between communities and ecosystems.

Course Outcome:

At the end of the course, the students will be able to

- Demonstrate broad-based knowledge of the major evolutionary radiations.
- Develop skills in phylogenetics and taxonomy.
- Explain the diversification process over the course of evolution in various ecosystems.
- Explain population dynamics, abundance, distribution, and regulation within the ecosystem.
- Explain various interactions between communities and ecosystems.

Unit I THE EVOLUTIONARY RADIATIONS 9

Origin of life: early Earth conditions; self-replicators; RNA world. Geologic timeline, Origin of single celled and multicellular organisms and colonization of land, Bacterial radiation: early Archaean metabolic diversification. Eukaryote radiation. Archaea-Bacteria symbiosis; sex; Metazoan radiation: Ediacaran and Burgess faunas; Body organization – Homeobox and Hox genes. Terrestrial radiation: land animals and plants.

Unit II MODERN DIVERSITY 9

The universal phylogentic tree: relationships among major groups. Taxonomy: categories of organisms. Bacteria – Archaea, Endosymbiosis theory, Protist diversity, Basal eukaryotes - euglenids - stramenopiles. Green plants-chlorophytes - rhodophytes. Vascular and non-vascular plants, Plants colonization on land – Fungi – Classification, phylogeny, Fungal diversity, amoebas. Animals.

Unit III DIVERSIFICATION 9

The branching process: quasispecies, webs and trees. Phylogenetics: cladistics; estimation of phylogenetic trees. Species diversification, Speciation, Pattern of speciation, Allopatric and Sympatric, Selection and adaptation: rate of directional change, Natural selection, micro and macroevolution, Hybrid zones, Reproductive barriers, Cladogenesis: species and speciation; diversity of modern and extinct clades. Adaptive radiation: specialists and generalists; plasticity. Comparative method: valid inference from comparative data.

Unit IV ABUNDANCE AND DISTRIBUTION 9

Abundance and distribution, Biotic and abiotic factors, Biomes – Aquatic biomes, Climate and terrestrial biomes, Population Ecology, Population dynamics: Patterns of dispersion, Life tables and survivorship curves, Growth models - exponential and logistic model, density-regulated populations, Population dynamics, Population cycles, Abundance and rarity: ecological niches. Species distributions: range dynamics, barriers; metapopulations. Biogeography.

Unit V COMMUNITIES AND ECOSYSTEMS 9

Community diversity: species-area; major geographical patterns. Coexistence: diversity and environmental heterogeneity. Productivity and disturbance: diversity and ecological processes. Interaction and instability: predator-prey, host-parasite dynamics. Food-webs: characteristics of trophically complex communities. Ecosystems: flows of material and energy between compartments. Eutrophication, Consequences of diversity loss.

Text Book:

1. Lisa Urry, Michael Cain, Steven Wasserman, Peter Minorsky, Jane Reece,"Campbell's Biology-Concepts & Connections" 11th Ed. 2017
2. Krebs, C.J., Ecology, Benjamin Cummings, 6th edition,2008.
3. Hall, B.K., Evolution: Principles and Processes, Jones and Bartlett Publishers 1st edition,2010
4. Levin, A.S., The Princeton Guide to Ecology, Princeton University Press, 1st edition,2009.
5. Losos, J.B., The Princeton Guide to Evolution, Princeton University Press, NJ, 1st edition, 2013

Reference Book:

1. Eugene P. Odum, Gary, W. Barrett 2004 Fundamentals of Ecology, Brooks/Cole; 5th Revised edition
2. David T. Krohne 2017 Ecology: Evolution, Application, Integration, Oxford Univ Press; 2 edition

23BTH04 REGULATORY ISSUES IN PRODUCTION OF BIOLOGICALS

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Characteristics of biologicals
- Regulatory process in biologicals approval
- Features of regulatory science
- Biosimilars
- Sample guidelines

Course Outcome:

At the end of the course, the students will be able to

- Explain the characteristics of biologicals.
- Elaborate the steps involved in regulatory process.
- Comprehend the features of regulatory science.
- Summarize the features and regulatory aspects of biosimilars.
- Explain the guidelines for biologics.

Unit I CHARACTERISTICS OF BIOLOGICALS 9

Biologicals definition, Discovery and Development, Genetically engineered products, Biological products : Examples, Characteristics of drugs and biologics, Protein molecular complexity, Concept of aggregates and Risks of degradation, Post-translational modifications, Analytical Challenge to evaluate the purity and impurity profile of Insulin glargine: Circular dichorism, ELISA, Peptide mapping and Mass spectrometry; Production process challenge, Center for Biologics Evaluation and Research- Organizational chart

Unit II REGULATORY PROCESS 9

International Harmonization, Pre-IND, Guidance from regulators in advance of a Clinical trial application, Clinical trials approvals and Investigational New Drug Applications, Marketing authorization processes, Special regulatory programs, Post-Marketing changes to an approved application or variations, Compliance and Inspections, Central Drugs Standard Control Organization, Introduction to Global Regulatory Authority - European Medicines Agency, US FDA, WHO.

Unit III REGULATORY SCIENCE 9

Preclinical safety and toxicology, Animal use Ethics, Genetically modified organisms and Institutional Biosafety Committees (IBSC), Independent Review Board, Risk Assessments, Chemistry, Manufacturing and Controls Information (CMC) and Process validation, Analytics, Analytical validation, Lot release, and National Control Laboratories; Regulator's goals for Regulatory Science to 2025 (EMA approach)

Unit IV BIOSIMILARS 9

Biosimilars – Definition, Regulatory Challenges: Brief History of Biosimilar Regulation, Controversial Regulatory Concepts- Extrapolation, Switching vs Interchangeability, Biosimilar Barriers to Entry, Biosimilar Regulatory Pathways - Local and Global Regulatory guidelines for Biosimilars.

Unit V GUIDELINES FOR BIOLOGICS 9

Regulatory guidelines for submission of applications for manufacturing of IND and Marketed Biologics - Gene therapy product, vaccine- blood or blood products, allergenics, cellular and tissue-based product, xenotransplant, Monoclonal antibodies for in vivo use, Immunomodulators, Most proteins for therapeutic use including cytokines, enzymes, hematopoietic factor, and growth factors, plant- or animal-derived or recombinant in nature

Text Book:

1. Sheets, R., Fundamentals of Biologicals Regulation- Vaccines and Biotechnology Medicines 1st Edition, Academic Press, 2017.
2. Gutka, H.J., Yang H., Kakar, S., Biosimilars- Regulatory, Clinical and Biopharmaceutical development, 1st Edition, Springer Nature Switzerland AG, 2018.
3. Pisano, D.J., Mantus, D.S., FDA Regulatory Affairs- A Guide for Prescription Drugs, Medical Devices, and Biologics, 2nd Edition, Informa Health care, 2008.

Reference Book:

1. Prugnaud, J.L., Trouvin, J.H., Biosimilars- A New Generation of Biologics, 1st edition, Springer, 2013.
2. Pacifici ,E., Bain S., An Overview of FDA Regulated Products: From Drugs and Cosmetics to Food and Tobacco, Academic Press, 1st edition, 2018.

Extensive Reading:

- https://www.fda.gov/vaccines-blood-biologics/guidance-compliance-regulatory-information-biologics/biologics-guidances
- https://www.fda.gov/vaccines-blood-biologics/general-biologics-guidances/biosimilars-guidances

- https://www.ema.europa.eu/en/similar-biological-medicinal-products
- Hines et al., The EMA's goals for regulatory science to 2025, Nature Reviews Drug Discovery Vol 18, June 2019, p403-404
- https://www.ema.europa.eu/en/documents/regulatory-procedural-guideline/ema-regulatory-science-2025-strategic-reflection_en.pdf
- https://cdsco.gov.in/opencms/opencms/en/biologicals/
- http://www.nib.gov.in/NIB-DBT2016.pdf

23BTH05 GENE EDITING TECHNOLOGIES

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Overview of genome editing techniques
- Biology of CRISPR-Cas systems
- Vector design principles of CRISPR-Cas system
- Strategies for delivery of genome editing components
- Applications of CRISPR-Cas systems

Course Outcome:

At the end of the course, the students will be able to

- Explain different techniques used for gene editing
- Describe the biology of gene editing by CRISPR-Cas systems
- Identify the components critical for the function of CRISPR-Cas systems
- Explain the various approaches used for the delivery of genome editing components
- Comprehend the applications of gene editing techniques

Unit I GENOME EDITING TECHNIQUES **9**

Brief history of genome-editing; Targeted Nucleases: Zinc-finger nucleases (ZFNs): Zinc finger protein, FokI catalytic domain; Homing; Transcription activator-like effector nucleases (TALENs): TALE repeat arrays, Custom TALE DNA-binding domains, Nuclease-mediated alterations; Clustered regularly interspaced short palindromic repeats (CRISPR)-CRISPR-associated protein 9 (Cas9) endonucleases or meganucleases

Unit II CRISPR-CAS SYSTEMS – BIOLOGY **9**

Adaptation - detection, Protospacer selection and processing, spacer integration; crRNA maturation- class I and class II maturation pathway; Interference - Class I interference machinery : Type I and Type III systems; Class II interference machinery : Type II (Cas9), Type V (Cas 12), Type VI (Cas13) ; Limitations; Enhancing Specificity with Nickases and High Fidelity Enzymes.

Unit III CRISPR-CAS SYSTEMS – DESIGN PRINCIPLES **9**

The design principle for Genetic Manipulation: Selection of Expression System, Target Sequence and Design of gRNA based on predicted on-target and off-target activity: Techniques and tools to Detect Off-Target Effects, Validation of genetic modification.

Unit IV DELIVERY OF GENOME-EDITING COMPONENTS

Viral delivery of genome-editing systems: In vitro and ex vivo approaches - Integrase-defective lentiviral vectors, Adenoviral and AAV vectors, CAR T cell therapy; In vivo approaches - ZFN systems, CRISPR Cas systems Non-viral delivery of genome-editing systems: In vitro and ex vivo approaches - Physical methods (Electroporation, Micro-injection), Nanoparticle-mediated delivery (Lipids, Polymer); In vivo approaches - Physical and combinational methods, Nanoparticle-mediated delivery, Embryonic injection. Barriers to delivery of genome-editing components (DNA, mRNA, single guide RNA (sgRNA) and/or protein) or nanoparticle.

Unit V APPLICATIONS

CRISPR/Cas in disease diagnosis: detection of Zika virus, Dengue virus, SARS-Cov2 using SHERLOCK (specific high sensitivity enzymatic reporter unlocking) technology, HPV detection using DETECTR (DNA Endonuclease-Targeted CRISPR Trans Reporter); Therapeutic Genome Editing: Gene disruption, Gene addition, Gene correction, HIV treatment using ZFN, B-cell leukemia, Muscular dystrophy and β-thalassemia treatment using CRISPR/Cas; Challenges in therapeutic targeting; Gene editing in Plants: Crop improvement, Resistance to biotic and abiotic stress; gene regulation by CRISPR/Cas; CRISPR interference; Ethical concerns.

Reference Book:

1. Krishnarao Appasani, “Genome Editing and Engineering from TALENs, ZFNs and CRISPRs to Molecular Surgery”, Cambridge University Press, 1st Edition, 2018.
2. Weeks D.P., and Yang B “Progress in Molecular Biology and Translational Science: Gene editing in plants”, Volume No.149, Academic Press, 1st Edition, 2017.
3. Vijai Singh and Pawan K. Dhar, “Genome Engineering via CRISPR-Cas9 System”, Academic Press, 1st Edition, 2020

Extensive Reading:

- Yin H, Kauffman K.J., Anderson D.G. Delivery technologies for genome editing. Nature Reviews Drug Discovery, 16(6):387-399. 2017.
- Joung J.K., Sander J.D., TALENs: a widely applicable technology for targeted genome editing. Nat Review Molecular Cell Biology. 14(1):49-55, 2013.
- Urnov, F.D., Rebar E.J., Holmes, M.C., Zhang, H.S., Gregory, P.D. Genome editing with engineered zinc finger nucleases. Nature Review Genetics,11(9):636-646,2010.

- Jiang, F., Doudna, J.A. CRISPR–Cas9 Structures and Mechanisms. Annual Review of Biophysics, 46(1), 505–529. 2017.
- Gaj T, Sirk S.J., Shui S.L., Liu J. Genome-Editing Technologies: Principles and Applications. Cold Spring Harb Perspect Biol., 8(12), 2016.
- Gootenberg J.S., Abudayyeh O.O., Lee J.W., et al. Nucleic acid detection with CRISPR- Cas13a/C2c2. Science. 356: 438-42, 2017.
- Chen J.S. et al. CRISPR-Cas12a target binding unleashes indiscriminate single-stranded DNase activity. Science. 360: 436-439, 2018.
- Li, H., Yang, Y., Hong, W. et al. Applications of genome editing technology in the targeted therapy of human diseases: mechanisms, advances and prospects. Sig Transduct Target Ther 5, 1, 2020.

23BTH21 MOLECULAR TOXICOLOGY

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
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Course Objective:

To impart knowledge on

- Impart knowledge on the tissue types, response of various tissue types to injury and toxicity.
- Demonstrate omics techniques for the study of toxicity.
- Demonstrate methods for the evaluation of toxicity.
- Impart knowledge on the animal models and genotoxicity measurements.
- Make students understand the mechanisms of carcinogenesis.

Course Outcome:

At the end of the course, the students will be able to

- Demonstrate multiplicity and properties of biotransformation enzymes, and their role in bioactivation and bio-inactivation of drugs and other chemicals.
- Demonstrate the experimental approaches used to identify individual biotransformation enzymes involved in bioactivation and inactivation reactions using omics techniques.
- Demonstrate experimental approaches to identify and quantify metabolites, reactive intermediates and adducts to cellular target molecules.
- Explain the risk factors for susceptibility to drugs and other chemicals, including genetic polymorphisms, drug-drug interactions, and environmental factors.
- Explain the oncogenes and the process of carcinogenesis.

Unit I INTRODUCTION **9**

Tissues and their maintenance, tissue damage, tissue response to injury, key concepts in toxicology, toxicogenetics and genomics, genotyping and phenotyping, polymorphic xenobiotic metabolism. Cell signaling and receptor mediated toxicity- Ion channels: Receptors linked to protein kinases and phosphatases, intracellular receptors; Second messengers: Signaling to the nucleus, general overview of mechanisms of cell death; Calcium- mediated toxicity: Excitory amino acid toxicity; Cytokines toxicity: Steroid hormone induced toxicity

Unit II OMICS TECHNIQUES FOR THE STUDY OF TOXICITY **9**

Toxicogeneomics, Transcriptomics: Expression profiling in prediction of toxicity; Proteomics – methodology; Metabolomics/metabonomics – MS-based, NMR-based; Integrating omics data – 'omics' in drug discovery and omics profile as biomarkers of toxicity.

Unit III METHODS FOR EVALUATING TOXICITY **9**

In vitro toxicology, acute toxicity in vitro, repeated dose toxicity, reproductive toxicity, stem cell-derived systems. In vitro bioassays: Predictive and mechanistic toxicology, different cell lines their use and limitations, apoptosis assays, caspase activity assays, comet assay, modified Salmonella assay, core in vitro test, assessment of genotoxicity for regulatory purpose - in vitro micronucleus assay, chromosome aberration test.

Unit IV ANIMAL MODELS AND GENOTOXICITY MEASUREMENT **9**

Animal models in toxicology, ADME models-, Reporter models – Genotoxicity testing, animal models for short-term carcinogenicity bioassays.

Unit V ONCOGENES AND IDENTIFICATION OF HUMAN CARCINOGENS **9**

Identification of human carcinogens, genetic changes in cancer – methods for detecting activated oncogenes, in vitro transformation assays. Non-genotoxic carcinogenesis.

Text Book:

1. David Josephy 2006 Molecular Toxicology, Oxford University Press; 2 edition.
2. L.A. Stanley 2014 Molecular and Cellular Toxicology-An Introduction, Wiley Blackwell
3. James C. Fishbein 2001 Advances in Molecular Toxicology, Elsevier Science; 1 edition
4. Daniel Acosta 2017 Cellular and Molecular Toxicology and In Vitro Toxicology, CRC Press; 1 edition

Reference Book:

1. Jos Kleinjans (Edt) 2014 Toxicogenomics-Based Cellular Models: Alternatives to Animal Testing for Safety Assessment, Academic Press; 1 edition.
2. Urs A. Boelsterli 2017 Mechanistic Toxicology: The Molecular Basis of How Chemicals Disrupt Biological Targets, CRC Press; 2 edition.

23BTH22 BIO-TRANSPORT PHENOMENA

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Transport of conserved quantities of relevance to the human body
- Mass transport principles with a focus on oxygen transport in the human body and relevant other biological systems
- Momentum transport principles with a focus on flows in the human body and relevant other biological systems
- Heat transport principles with a focus on the human body and relevant other biological systems
- Charge transport principles with a focus on the human body and relevant other biological systems
- Pharmacokinetic analysis.

Course Outcome:

At the end of the course, the students will be able to

- Apply principles of mass transport. momentum transport, heat transport and charge transport to the human body processes and relevant other biological systems
- Clarify oxygen transport in biological systems.
- Use mass transfer concepts in biomolecule transport.
- Explain the physical properties of the body fluids and the cell membrane.
- Explain action potentials and axial current through charge transport across a neural membrane
- Relate drug transport with the help of pharmacokinetic analysis.

Unit I REVIEW OF MASS CONSERVATION AND THE CONCEPTS IN THERMODYNAMICS 9

Mass conservation - material balances - first law of thermodynamics - second law of thermodynamics - thermodynamic property relations – chemical potential – activity coefficient - phase equilibrium – Clausius-Clapeyron equation.

Unit II MASS TRANSPORT CONCEPTS WITH APPLICATIONS TO THE HUMAN BODY 9

Mass flux – diffusive velocities - Fick's laws of diffusion – diffusivity – diffusion of a solute across the cell membrane– diffusion of solutes (say oxygen) across a capillary wall to transport a solute between a capillary and the surrounding tissue space (including oxygen-hemoglobin dissociation curve) - tissue oxygenation – diffusion of solutes (oxygen/carbon dioxide) across the alveolar wall-Mass transfer coefficient – Irreversible thermodynamics of membrane transport - oxygen transport in blood oxygenators, bio-artificial organs, and tissue engineered constructs – kLa in bioreactors- Extracorporeal devices(Hemodialysis, Blood oxygenators, Immobilized enzyme reactors, Affinity adsorption).

Unit III MOMENTUM TRANSPORT CONCEPTS AND APPLICATIONS TO THE HUMAN BODY 9

Review of the following concepts: Rheology – types of flows (laminar/turbulent) – momentum transport – laminar flow in a circular tube – friction factor approach Body fluid compositions – blood rheology – capillary flow principles – blood flow in capillary - capillary plasma protein retention - osmotic pressure - filtration flow across a membrane - predicting the hydraulic conductance – net capillary filtration rate - blood flow into the capillary - capillary filtration flow rate - lymphatic system – friction factor for blood flow through a stenosis- Ion pumps maintain nonequilibrium state of the cell.

Unit IV HEAT TRANSPORT AND CHARGE TRANSPORT CONCEPTS WITH APPLICATIONS TO THE HUMAN BODY

Heat transport principles – conduction – temperature profile in a muscle - convection – heat transfer coefficient - Charge transport – ion transport across a membrane - ions in solution – electroneutrality – charge relaxation – Debye length - action potential – axial current - Ion pumps.

Unit V PHARMACOKINETIC ANALYSIS

Pathways of drug metabolism(Phase I & Phase II reaction) - Lipinski's rule of 5- Entry routes for drugs- Pharmacokinetic modelling approaches- Factors that affect drug distribution- Drug clearance- drug absorption and elimination models – Continuous infusion of a drug(control release of drugs from from transdermal patches& implantable devices - Two-compartment models (intravenous injection , drug absorption from a transdermal patch & implantable device)Economics and regulatory aspects(Pharma pricing policy,Schedule M-GMP).

Text Book:

1. Fournier, R.L., Basic Transport Phenomena in Biomedical Engineering, CRC press, Taylor & Franscis group, 4th edition, 2018
2. Suraishkumar G. K., Continuum Analysis of Biological Systems: Conserved Quantities, Fluxes and Forces,Springer Publishing, Heidelberg, 2014

Reference Book:

1. Charm, S.E., Kurland G.S., Blood Flow and Microcirculation, New York: John Wiley & Sons, 1974
2. Bird, R.B., Stewart, W.E., Lightfoot, E.N., Transport Phenomena, New York: John Wiley & Sons, 2nd edition,2002.

3. Gibaldi, M., Perrier, Pharmacokinetics, New York: Marcel Dekker, Inc., 2nd edition, 1982.

23CSH91 COMPUTER FUNDAMENTALS FOR BIOLOGICAL DATA REPRESENTATION

L	T	P	C
3	0	0	3

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

Course Objective:

To impart knowledge on

- To understand data in biology
- To explore concepts of database
- To learn fundamentals of data structures
- To understand concepts of trees and graphs
- To know elementary concepts of algorithm development

Course Outcome:

At the end of the course, the students will be able to

- Identify, define and utilize the data in biology
- Design a entity relationship model
- Collate data as stacks and order them
- Draw relationship between data
- Develop algorithms for data analysis

Unit I COMPUTERS IN BIOLOGY AND FEATURES OF BIOLOGICAL DATA 9

Historical perspective of computers in biology; Biological Information: data in discovery process, nature of biological data - diversity, variability, databases are autonomous, dynamic, heterogeneous; data integration approaches – federation, mediator, data warehouse; meta-data specification, data provenance and accuracy, ontology, web presentation

Unit II DATABASE MANAGEMENT 9

Fundamental database concepts: data, database, database system, purpose of database system, view of data, relational databases, database architecture, transaction management - Entity-Relationship model: Database design and ER Model: overview, ER-Model, Constraints, ER-Diagrams, ERD Issues, weak entity sets, Codd's rules, Relational Schemas - Relational Model: Logical view of data, keys, integrity rules – Relational Database Design: features of good relational database design. Case study: Design of ER model for biological data

Unit III DATA STRUCTURE: BASICS 9

Data Structures Basics: Structure and Problem Solving, Data structures, Data structure Operations, Algorithm: complexity, Time- space tradeoff. Linked lists: Introduction, Representation of linked lists in Memory, Types of linked list; Stack and Queue: Introduction, Array Representation of Stack, Linked List Representation of stack, Application of stack, Queue, Array Representation of Queue, Linked List Representation of Queue.Case study: choosing appropriate linear data structure for biological data – Position of a residue in a sequence

Unit IV DATA STRUCTURE: TREES & GRAPHS 9

Trees: Definitions and Concepts, Operations on Binary Trees, Representation of binary tree; Graphs: Matrix Representation of Graphs, List Structures, Directed Graphs Types of Directed Graphs; Binary Relation As a Digraph; Euler's Digraphs; Matrix Representation of Digraphs. Applications of Graphs: Topological Sorting, Shortest-Path Algorithms.Case study: choosing appropriate non-linear data structure for biological data – interaction of atoms in a molecule in 3D space

Unit V ALGORITHMS 9

Algorithm: definition, notation, pseudocode, characteristics of an Algorithm, building blocks of algorithms, expressing algorithms – arithmetic, conditional, array access;Biological vs Computational algorithm, correct vs incorrect algorithm, iterative vs recursive algorithm, fast vs slow algorithm, Big-O-Notation; algorithm design techniques – exhaustive, branch-and-bound, greedy algorithm, dynamic programming, divide-and-conquer. Example of an Algorithm applicable for biological domain - most probable k-mer(Motif) in a sequence using Greedy Algorithm.

Text Book:

1. Goodrich, M. T. and Tamassia R., (2013), Data Structures and Algorithms in Python, Wiley; 1st edition. ISBN: 978-1118290279
2. Cormen, T. H., Leiserson, C. E., Rivest, R. L., Stein, C., (2009) Introduction to Algorithms, 3rd Edition (The MIT Press), ISBN: 9780262033848
3. Silberschatz, A., Korth, H. and Sudarshan, S. (2020), Database System Concepts 7th Edition. ISBN: 9780078022159

Reference Book:

1. Karumanchi , N. (2016). Data Structures and Algorithms Made Easy: Data Structures and Algorithmic Puzzles, 5th Edition, ISBN: 9788193245279
2. Miller and David Ranum, D. (2013), Problem Solving with Algorithms and Data Structures using Python, Franklin Beedle & Associates, 2nd edition, ISBN: 978-1590282571
3. Wirth N. (1998), Algorithms + Data Structures = Programs, Prentice Hall India Learning Private Limited, 2nd

Edition, ISBN: 978-8120305694

23CSH92 PYTHON AND R PROGRAMMING FOR BIOTECHNOLOGISTS

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand basic elements of python and concepts on controlling program flow
- To solve problems by writing functions and using objects
- To explore fundamentals of biopython
- To handle data using R program
- To perform statistical analysis of biological data

Course Outcome:

At the end of the course, the students will be able to

- Write programs handling data input and control the data flow
- Solve simple problems using a program
- Write python programs with inbuilt functions from biopython package
- Solve analytic data using R program
- Perform statistical analysis of biological data using R

Unit I ELEMENTS OF PYTHON PROGRAMMING: DATA, FLOW AND CONTROL 9

Introduction to Python: source code, text editors, whitespace, syntax and syntax errors, Python versions – Lists: lists and arrays – Dictionaries: paired data types, hashing, key uniqueness, argument unpacking and tuples – Working with files: objects and classes, paths and folders, relationships between variables and values, text and binary files, newlines - Loops: blocks and indentation, variable scoping, iteration, ranges - Conditions:Truth and falsehood, Boolean logic, identity and equality, evaluation of statements, branching. Case study: Biological data representation: Organization of a gene sequence file and relationship between data

Unit II PROBLEM SOLVING 9

Comprehension: List and Dictionary - Writing functions: nuts and bolts of writing functions: argument passing, encapsulation, data flow through a program – Classes and objects: classes, instances, methods vs. functions, self, constructors, magic methods – Object-oriented programming: inheritance and class hierarchies,method overriding, superclasses and subclasses, polymorphism, composition, multiple inheritances. Case study: Object representation of biological data: Defining features of a system (eg., organism) and using them to identify the organism.

Unit III BIOPYTHON 9

Python libraries: using standard modules and creating a new module; Biopython: introduction, installation,important components like seq, seqIO, alignIO, BLAST, ClustalW, PDB, SwissProt etc., parsing output.Case study: Use of python libraries for biological application: using BioSeq to change information content from DNA to RNA to protein

Unit IV R PROGRAMMING ESSENTIALS 9

Fundamentals: Constants, operators, functions, variables, Random numbers, Vectors and vector indexing, Simple descriptive stats, Loops, Conditional expressions - Datatypes: Levels of measurement (nominal, ordinal, interval, ratio scale), Vector types, Characteristics of tidy data (missing values), data imputation,duplicates, outliers, spelling, Create new variables in a data.frame - Filter rows and columns - Merging datasets.Case study:Representation of Biological data in R: Plotting data obtained from field trials to identify relationship between attributes.

Unit V STATISTICAL DATA ANALYSIS USING R 9

Basic Statistics: mean, median, standard deviation, variance, correlation, covariance - Linear regression: simple linear regression, introduction to multiple linear regression - Classification: logistic regression, decision trees, SVM - Ensemble methods: bagging, random forests, boosting - Clustering: K-means, Hierarchicalclustering, X-means.Case study: Deployment of R in Biological data analysis: Statistical data analysis of field trial data for experimental significance.

Text Book:

1. Stevens, T.J. and Boucher, W. (2005) Python Programming for Biology: Bioinformatics and Beyond, Cambridge University Press; 1st edition, ISBN: 978-0521720090
2. Kinser, J., (2009), Python for Bioinformatics, Jones and Bartlett Learning, ISBN: 978-0763751869
3. Gardener, M., (2012). Beginning R: The Statistical Programming Language Wiley Publications(Wrox), ISBN: 978-1-118-22616-2
4. Gries, O, Montojo, J., and Campbell, J., (2017), Practical Programming: An Introduction to Computer Science Using Python 3.6, Pragmatic Bookshelf 3rd Edition ISBN: 978-1680502688
5. Libeskind-Hadas, R. and Bush, E. (2014), Computing for Biologists: Python Programming and Principles Cambridge University Press 1st edition. ASIN: B00O0RKC02
6. Jones, M. (2013), Python for Biologists: A complete programming course for beginners CreateSpace
7. Independent Publishing Platform 1st edition. ISBN: 978-1492346135

Reference Book:

1. Jones, M. (2014), Advanced Python for Biologists. CreateSpace Independent Publishing Platform 1st edition. ISBN: 978-1495244377
2. Downey A. B. (2012), Think Python O'Reilly Media 1 edition ISBN: 978-1449330729
3. MacLean, D., R Bioinformatics Cookbook: Use R and Bioconductor to perform RNAseq, genomics, data visualization, and bioinformatic analysis, Packt Publishing, ISBN: 978-1789950694
4. Pilgrim M, (2009), Dive into Python 3 Apress ISBN: 978-1430224150
5. Hartvigsen, G., (2014), A Primer in Biological Data Analysis and Visualization Using R. Columbia University Press 1st Edition ISBN: 978-0231166997
6. https://devguide.python.org/

23BTH41 COMPUTER-AIDED DRUG DESIGN

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Process of drug discovery.
- Elements of small molecules and representations.
- Approaches of modeling molecular motion.
- Analog-based drug design.
- Structure-based drug design.

Course Outcome:

At the end of the course, the students will be able to

- Recall the process of drug discovery pipeline.
- Represent and prepare small molecules for drug design.
- Apply appropriate mathematical and statistical methods defining molecular motion.
- Relate structural and functional data for molecule-based drug design.
- Prepare and define active site for structure-based drug design.

Unit I DRUG DISCOVERY PROCESS 9

Targets: Enzymes, Membrane proteins, DNA and RNA; Target Identification and Validation: computational analysis of nucleic acid sequence, protein sequence and structure, expression databases and functional pathway data contained in databases; Lead molecule, lead identification: from trial and error to high throughput screening, assay development and qualities of screening assay; lead optimization: functional assays; pre-clinical drug development.

Unit II CHEMOINFORMATICS 9

Small molecules in drug discovery, chemical structures and representations, chemical databases and data sources, reaction databases; search methods: representation and substructure search; descriptors, physical and chemical data, applications of chemoinformatics in drug discovery – compound selection, in-silico ADMET, problems in insilico predictions.

Unit III MOLECULAR MECHANICS & DYNAMICS 9

Molecular structure, conformation, energy minimization, quantum mechanics: ab-initio methods, semi-empirical methods, Born-Oppenheimer approximation for force field calculation, classical force fields; algorithms for energy minimization: simplex, steepest descent, conjugate gradients and Newton-Raphson, advantages and limitations of force-field approach; Molecular Mechanics: algorithms – Verlet Leap Frog & Beeman, approximations – periodic boundary conditions (PBC), stochastic boundary conditions (SBC); limitations of molecular dynamics.

Unit IV ANALOG BASED DRUG DESIGN 9

Pharmacophores 3D database searching, conformation searches, deriving and using 3D Pharmacophore, constrained systematic search, Genetic Algorithm, clique detection techniques, maximum likelihood method; Structure Activity Relationship: physiochemical properties (descriptors) – logP, number of rotatable bonds, polar surface area, substituents and stereochemistry, QSAR: CoMFA, CoMSIA.

Unit V STRUCTURE BASED DRUG DESIGN -13

Docking: definition, target and ligand format conversion; searching methods in docking: searching conformational space – before and during docking, incremental docking; Score, scoring methods/functions: categories are empirical, force field, knowledge, consensus scoring; factors affecting docking score; softwares in docking; role of Hbonds in target-drug interaction; De Novo Drug Design: principle and types of design methods – Connection Methods, Sequential Grow, Fragment Placements, Virtual screening.

Text Book:

1. Gundertofte, K., Jorgensen, F. S., Molecular Modeling and Prediction of Bioactivity, Springer, 1st edition, 2000.
2. Höltje, H.D., Folkers, G., Mannhold, R., Kubinyi, H., Timmerman, H., Molecular Modeling - Basic Principles and Application, Wiley-VCH, 3rd edition, 2008.
3. Norman, P., Ruud, K., Saue, T., Principles and Practices of Molecular Properties: Theory, Modeling, and Simulations, Wiley, 1st edition, 2018.
4. Roy, K., Kar, S., Das, R.N., A Primer on QSAR/QSPR Modeling Fundamental Concepts, Springer Briefs in Molecular Science, 1st edition, 2015.
5. Jensen, J.H., Molecular Modeling Basics, CRC Press, 1st edition, 2010.

Reference Book:

1. Zhang, W., (2016). Computer-Aided Drug Discovery (Methods in Pharmacology and Toxicology), Methods in Pharmacology and Toxicology Humana Press, 1st Edition. ISBN: 978-1493935192
2. Reynolds, C. H., Holloway, K. M., Cox, H. K.(Editors), Computer-Aided Molecular Design: Applications in Agrochemicals, Materials, and Pharmaceuticals (ACS Symposium Series) Wiley-VCH ISBN: 978-0841231603

23BTH42 MATHEMATICAL MODELING IN BIOLOGY

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Data representation and behavior
- Models defining data interaction
- Fundamentals of modeling molecular evolution
- Mathematical and statistical analysis of population data
- Disease progression models

Course Outcome:

At the end of the course, the students will be able to

- Handle biological data for scientific representation
- Fit the data with appropriate models
- Identify and perform representation of relationship tree
- Perform elementary statistical analysis of population data
- Identify and model disease progression

Unit I BIOSTATISTICS FOR MODELING 9

Measurement, Variables, variability in data, central tendency of data, spread of data, population and sample data, mean, Probability, conditional probability, correlation, regression, curve-fitting, measures of error, method of least squares, model, linearity, non-linearity, cob-web plot, scalar, vectors; matrices: identity, inverse, square, basic operations.

Unit II LINEAR & NON-LINEAR MODELS 9

Creating a linear model, cobwebbing, analyzing a non-linear model, transients, equilibrium and stability, linearization, influence of oscillations, bifurcations and chaos in a logistic model, structured models – Leslie model, Usher model; a simple predator – prey model, positive and negative interactions.

Unit III MODELING MOLECULAR EVOLUTION 9

Matrix models of base substitution, Markov models – Jukes-Cantor Model (1-parameter), Kimura Model (2-parameter), measuring phylogenetic distances; phylogenetic trees – operational taxonomic unit, lateral gene transfer, root, vertex, leaf, topological trees, metric trees, Fitsch-Margoliash algorithm, optimality criteria - Maximum Parsimony, bootstrapping.

Unit IV MODELING POPULATION GENETICS 9

Mathematical interpretation of genetic concepts: Laws of Mendel, Mendelian genetics, probability distributions in genetics, chi-square distribution, linkage, mapping, recombinants and parental type, gene frequency in a population, Hardy-Weinberg equilibrium, random mating, fitness and selection, genetic drift.

Unit V INFECTIOUS DISEASE MODELING 9

Elementary epidemic models – homogenous mixing, population as susceptible, infective and removed class, S I R model – threshold-values, critical parameters, severity and duration of epidemics, limitations; infectious disease models – S I and S I S models, contact rate and contact number, modeling for immunization strategies; modelling cases with multiple population and differentiated infectivity.

Text Book:

1. Allman, E.S. and Rhodes, J. A. (2004), Mathematical Models in Biology: An Introduction, Cambridge University Press; 1st edition. ISBN: 978-0521525862
2. Bailey, N. T. J (2012), Statistical Methods in Biology, Cambridge University Press, 3rd Edition. ISBN: 9781139170840
3. Ingalls, B. (2012), Mathematical Modeling in Systems Biology: An Introduction, The MIT Press; 1st edition. ISBN: 978-0262018883
4. Vynnycky, E. and White, R. G. (2010), An Introduction to Infectious Disease Modeling, Oxford University Press, USA; 1st edition. ISBN: 978-0198565765

Reference Book:

1. Chou, C-S., and Friedman, A. (2010), Introduction to Mathematical Biology Modeling, Analysis, and Simulations. Springer Undergraduate Texts in Mathematics and Technology. ISBN: 978-3-319- 29636-4
2. Demin, O. and Igor Goryanin, I. (2008), Kinetic Modelling in Systems Biology, Chapman & Hall/CRC Mathematical and Computational Biology ASIN: B00866HCKQ

23BMH01 MEDICAL DEVICE DESIGN

Offered by BME (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the introduction to medical device standards and requirements.
- To describe the design procedure of medical devices.
- To familiarize the quality assessment in design of medical devices.
- To explain the validation and verification of various medical devices.

Course Outcome:

At the end of the course, the students will be able to

- Understand the medical equipment design procedures
- Discuss the medical devices standards and its regulatory schemes.
- Describe the concept of medical device development.
- Implement the engineering design and Project metrics.
- Summarize the testing and validation of medical equipment.

Unit I MEDICAL PRODUCT DESIGN **9**

Definition, History and Modern Practice – Designs; Design and Product Life Cycle; Design Process; Understanding the innovation cycle, Good Design Practice. Understanding, analyzing and validating user needs, Screening Needs, Technical Requirements.

Unit II REGULATORY SCHEMES **9**

Design Control & Regulatory Requirements, Documentation in Medical Devices, Regulatory pathways, Biomedical Evaluation of Medical Devices -ISO Medical Devices – Applications of Risk Management to Medical Devices (ISO 14971), Electrical Safety Standard - IEC60601-1, IEC60601-2, IEC60601-6, Protection of Electrical and Electronic Parts, Assemblies and Equipment's (ESD S20.20-2014).

Unit III CONCEPT GENERATION AND SELECTION **9**

Ideation and Brainstorming – concept screening, concept selection. Operating plan and financial model – Business plan development, funding sources, licensing and alternate pathways.

Unit IV DEVELOPMENT STRATEGY AND PLANNING **9**

Intellectual property strategy, research and development strategy, clinical strategy, regulatory strategy – quality and process management, reimbursement strategy, marketing and stakeholder strategy, sales and distribution strategy.

Unit V TESTING AND VALIDATION **9**

Basis and types of testing, Hardware verification and data analysis, software verification and data analysis.

Text Book:

1. Matthew Bret Weinger, Michael E. Wiklund, Daryle Jean Gardner-Bonneau, "Handbook of Human Factors in Medical Device Design", CRC press,2010.
2. Peter Ogrodnik, "Medical Device Design Innovation from Concept to Market", Elsevier, 2013.

Reference Book:

1. Zenios, Makower and Yock, "Biodesign – The process of Innovating Medical Technologies", Cambridge University Press, 2010
2. Richard C. Fies, "Handbook of Medical Device Design", CRC Press, 2000.
3. Dr.JagdishChaturvedi, "Inventing medical devices: A perspective from India", Create Space Independent Publisher, 1st edition, 2015.
4. Beth Ann Fiedler, "Managing medical devices within a regulatory framework", Elsevier, 2017.

Extensive Reading:

- https://www.futurelearn.com/courses/medtech-trends-and-product-design
- https://www.udemy.com/course/iso-134852016-design-and-development-of-medical-devices/
- https://in.coursera.org/specializations/healthcare-marketplace

23BMH02 ROBOTIC SYSTEM PROGRAMMING

Offered by BME (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the ROS concepts and its Programming.
- To simulate ROS using various simulator tools.
- To familiarise the applications of ROS.

Course Outcome:

At the end of the course, the students will be able to

- Explore the functions of ROS components.
- Develop programming for ROS file handling concepts.
- Analyse various commands and tools in ROS.
- Develop programs using simulation tools.
- Build ROS based Robotic application.

Unit I FUNDAMENTALS OF ROS **9**

Introduction - Robot Software Platform, Need for Robot Software Platform, Meta-Operating System - Objectives of ROS - Components of ROS - ROS Ecosystem - ROS Versions - Version Rules, Version Release Period, Selecting a Version. ROS services - C++ Classes In ROS - Creating Library Modules in ROS - Action Servers and Action Clients - Parameter Server.

Unit II CONCEPTS OF ROS **9**

ROS terminologies, Message Communication – Topic, Service, Action, Parameter, Message Communication Flow, Message - msg File, srv File, action File - Name - Coordinate Transformation - Client Library - Communication between Heterogenous Devices - File System - File Configuration, Installation folder, Workspace Folder - Build System- Creating a Package, Modifying the Package Configuration File, Modifying the Build Configuration File, Writing Source Code, Building the Package and Running the Node.

Unit III ROS COMMANDS AND TOOLS **9**

ROS Command List - ROS Shell Commands - ROS Execution Command - ROS Information Commands - ROS Catkin Commands - ROS Package Commands. ROS Tools - 3D Visualization Tool (RViz) and ROS GUI Development Tool.

Unit IV ROS PROGRAMMING AND SIMULATION **9**

Publisher and Subscriber Nodes- Building nodes, running publisher and Subscriber, Communication Status of running nodes, Server and Client Nodes- Writing Server node, Running Service client, ROS launch-Using ROS launch, launch tag, TurtleBot Development Environment- TurtleBot3 Simulation using Rviz, TurtleBot3 Simulation using Gazebo.

Unit V APPLICATIONS OF ROS **9**

Navigation stack-creating transforms -odometer – IMU – laser scan – base controller – robot configuration – cost map – base local planner – global planner – localization – sending goals – TurtleBot – the low-cost mobile robot, Embedded system-OpenCV, Ros-serial, TurtleBot3 Firmware.

Text Book:

1. Yoonseok Pyo, Hancheol Cho, RyuWoon Jung, TaeHoon Lim, “ROS Robot Programming”, ROBOTIS, 2017.
2. Wyatt Newman, “A Systematic Approach to learning Robot Programming with ROS”, CRC Press, 2017.

Reference Book:

1. Lentin Joseph, “Robot Operating Systems (ROS) for Absolute Beginners”, Apress, 2018.
2. Aaron Martinez, Enrique Fernandez, “Learning ROS for Robotics Programming”, Packt Publishing Ltd, 2013.
3. Jason M O'Kane, “A Gentle Introduction to ROS”, Create Space, 2013.
4. AnisKoubaa, “Robot Operating System (ROS) – The Complete Reference”, (Vol.3), Springer, 2018.
5. Kumar Bipin, “Robot Operating System Cookbook”, Packt Publishing, 2018.
6. Patrick Gabriel, “ROS by Example: A do it yourself guide to Robot Operating System”, Lulu, 2012.

Extensive Reading:

- http://wiki.ros.org/ROS/Tutorials
- https://www.udemy.com/course/ros-essentials/
- https://www.edx.org/course/hello-real-world-with-ros-robot-operating-system
- https://nptel.ac.in/courses/107106090

23BMH03 MICRO AND NANO MEDICAL ROBOTICS

Offered by BME (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To familiarize the principles of micro and nano medical robots.
- To learn tracking technologies in imaging and capsule robots.
- Analyze the applications of robots in cardiovascular and cancer treatment.

Course Outcome:

At the end of the course, the students will be able to

- Explore the fundamentals of micro and nano medical robots.
- Paraphrase the tracking technologies of robots in imaging.
- Apply robotics concept in cardiovascular treatment.
- Illustrate the technologies in capsule robot.
- Elucidate various robotic technologies in cancer treatment.

Unit I MEDICAL MICRO AND NANO ROBOTS 9

Introduction, Medical microscale nanorobots versus microrobots, Actuation- Magnetic propulsion, Bacterial propulsion, Steering and navigation of microrobots-Magnetotaxis based steering, Positioning and tracking of nanorobots.

Unit II TRACKING OF ROBOTS IN IMAGING TECHNOLOGIES 9

Characterization of motion- In aqueous environment, In complex environment, Tracking technologies-Fluorescence imaging, MRI Technology, Radionuclide imaging, Ultrasonic imaging.

Unit III ROBOTS FOR CARDIOVASCULAR TREATMENT 9

Thrombus- Tubular microrobot, MMNM/PM nanorobots, PDA nanorobot, Atherosclerosis- NIR driven microrobot, Carrier free trehalose based nanorobot, Cerebral apoplexy-H_2Powered Mg based microrobots.

Unit IV CAPSULE ROBOTS IN GI TRACT 9

Robotic capsule technology, Conceptual design of capsule robot- Design principles, Conceptual design, In vivo imaging and localization of microrobots, Navigation and control of capsule robot- Operating modes, Behavior based robot programming, Webot 3D robotic simulator.

Unit V MICRO AND NANO ROBOTS FOR CANCER TREATMENT 9

Cancer diagnosis- Monoclonal antibody functionalized micro robots, Nano wire robot, Magnetic fluorescence nano robots, DNA nanorobots, Targeting and delivery, Treatment- Treatment mechanism, Chemotherapy, Metabolic therapy, Gas therapy, Bio therapy, Immuno therapy.

Text Book:

1. Chun Mao, Mimi Wan , “Biomedical Micro- and Nanorobots in Disease Treatment - Design, Preparation, and Applications”, Hardcover, 2023.
2. Klaus D Sattler, “Handbook of nanophysics - Nanomedicine and nanorobotics”, Taylor & Francis, 2009.

Reference Book:

1. Yi Guo (auth.), Yi Guo (eds.), “Selected Topics in Micro_Nano-robotics for Biomedical Applications” Springer-Verlag New York 2013.
2. Yu Sun, Xian Wang, Jiangfan Yu, “Field-Driven Micro and Nanorobots for Biology and Medicine”, Springer 2021.
3. Ki-Taek Lim, Kamel A. Abd-Elsalam, “Nanorobotics and Nanodiagnostics in Integrative Biology and Biomedicine”, Springer 2022.

Extensive Reading:

- https://www.frontiersin.org/articles/10.3389/fbioe.2018.00170/full
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9584632/
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7407549/
- https://nptel.ac.in/courses/112105249

23BMH04 ROBOTICS IN BIOPROSTHETICS

Offered by BME (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explore the concepts of Bio prosthetics and its materials.
- To assess the gait for prosthetic fabrication.
- To develop improved prosthetic devices for amputated limbs.
- To design different automated prosthetic models.

Course Outcome:

At the end of the course, the students will be able to

- Explore the concept of Bio-prosthesis.
- Analyse the normal and pathological Gait.
- Analyse the materials used for prosthetic fabrication.
- Illustrate advanced prosthetics technologies.
- Develop Bio Robots for various clinical applications

Unit I BIO-PROSTHETICS 9

Introduction- History of Prosthetics Early years and Modern Times. Prosthetic components - Prescription criteria, Ankle/Foot Mechanism, disarticulation, Transtibial and Transfemoral Prosthesis, Hip disarticulation/Transpelvic. Bilateral Amputation. Lower Extremity Prosthetics Management – Prosthetic fitting decisions, transtibial and transfemoral prosthetics evalutation, transtibial and transfemoral gait analysis, Donning the prosthesis, Prosthetic training. Prosthetic replacements for the hand,wrist and forearm, prosthetic fitting

Unit II GAIT & PROSTHETICS 9

Normal Gait, Kinetic and Kinematic Descriptors of human walking, Gait Cycle - weight acceptance, single limb support, limb advancement. Describing Pathological Gait - common gait deviations observed during stance and swing. Qualitative gait assessment. Instrumented gait analysis - technology in gait assessment, Function based assessment. Clinical Examples of Gait Deficiencies: Impact of Functional Tasks During Gait.

Unit III MATERIALS AND FABRICATION PROCESS 9

Materials used for prosthesis, Prescription Guidelines- Prosthetic prescription. Fabrication process – Measurement, Fabricating and modifying the positive model. Computer-aided design/ computer-aided manufacture - Data acquisition, shape-manipulation software, milling and production. Central fabrication and mass production. Technologies Poised to Transform Prosthetics and Rehabilitation .Maintenance of prostheses.

Unit IV PROSTHETIC AND ROBOTIC MECHANISM 9

Mechatronic Hands- Myoelectrically controlled hands, Components, Mechanisms and actuators, Power sources, Prosthetic socket. Mechanisms- Materials, Simple clamps, Curling fingers and pulleys, one four-bar linkage, two four-bar linkages. Sensors- Forces sensors, Slip and texture sensors, Position (angle). Control - Finger position, Object slip. Hand assessment – Procedure, Calculations, Manufacture, Standardisation, Reliability and validity.

Unit V APPLICATIONS OF ROBOTICS IN BIO PROSTHESIS 9

Bionic Arm- Kinematics of AdeptThree Robot Arm, Robotic Grasping of Unknown Objects, Object-Handling Tasks Based on Active Tactile and Slippage Sensations. Robot Arm to Intentional Agent: The Articulated Head - Inter-Component Communication and Sensing, Attention model. Bio-inspired control for robot arms.

Text Book:

1. Bella J. May, “Amputations and Prosthetics A Case Study Approach”, Second Edition. Jaypee Brothers Medical Publishers (P) Ltd New Delhi, 2002
2. Kevin K.Chui, “Orthotics and Prosthetics in Rehabilitaion”, Fourth Edition by Elsevier, 2020.

Reference Book:

1. Jacob Rosen, Blake Hannaford and Richard M. Satava , Editors, “Surgical Robotics Systems Applications and Visions”, Springer 2011
2. Satoru Goto ,”Robot Arms”, InTech Publisher 2011.
3. Robert Schilling, “Fundamentals of Robotics-Analysis and control”, Prentice Hall, 2018.
4. J.J.Craig, “Introduction to Robotics”, Pearson Education, 2017.
5. Staugaard, Andrew C,”Robotics and Artificial Intelligence: An Introduction to Applied Machine Learning”, Prentice Hall Of India, 1987.

Extensive Reading:

- http://www.springer.com/engineering/biomedical+engineering/book/978-1-4419-1125-4
- http://onlinelibrary.wiley.com/journal/10.1002/%28ISSN%291478-596X (The International Journal of Medical Robotics and Computer Assisted Surgery)
- http://medrobotics.ri.cmu.edu/node/128439 (Medical Robotics at CMU)
- http://robotics.eecs.berkeley.edu/medical/ (Medical Robotics at UC Berkeley)

- https://nptel.ac.in/courses/112107289

23ECH41 ADVANCED DIGITAL SYSTEM DESIGN

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To synthesize Race and Hazard free sequential circuits and memories
- To study FPGA architectures and analyze faults in digital circuits
- To design digital systems using Verilog HDL

Course Outcome:

At the end of the course, the students will be able to

- Design Race free and Hazard free sequential circuits
- Design sequential circuits using PLDs and memories
- Analyze the characteristics of Programmable ASIC Interconnects.
- Identify and analyze faults in digital circuits.
- Synthesize digital logic circuits using Verilog HDL.

Unit I RACE FREE AND HAZARD FREE LOGIC DESIGN 9

Review of synchronous and Asynchronous sequential circuits design - Realization of Time Delays - Elimination of Glitches, Design of race free and hazard free circuits - Hold Time Violation in Asynchronous Circuits - data synchronizers-Mixed operating mode asynchronous circuits

Unit II DESIGN OF MEMORIES AND ARITHMETIC CIRCUIT 9

Review of synchronous sequential circuit design using PLDs – Design of On-chip Dual Address ROM - Design Single Address ROM - On-Chip Dual RAM - External Memory Controller - Digital Pipelining- Partitioning of a Design - Signed Adder, Multiplier Design.

Unit III PROGRAMMABLE ASIC INTERCONNECTS 9

Actel ACT -Xilinx LCA - Xilinx EPLD - Altera MAX 5000 and 7000 - Altera MAX 9000 - Altera FLEX –Design systems - Logic Synthesis - Half gate ASIC -Schematic entry, Low level design language - PLA tools -EDIF- CFI design representation.

Unit IV FAULT TOLERANCE IN DIGITAL CIRCUITS 9

Fault table method - Path sensitization method- Boolean difference method- D algorithm - Tolerance techniques- The compact algorithm - Fault in PLA- Test generation - Fault avoidance and fault tolerance - Techniques of fault tolerance: Static, Dynamic and Hybrid redundancy - Fault tolerance in memories.

Unit V DIGITAL DESIGN USING VERILOG 9

Review of Combinational circuits and Sequential circuits using verilog - Sequence generators – Sequence detectors, Programming of PLD. Case Study: Vending machine controller - Design of Instruction decoder, memory bank units of a Microcontroller.

Text Book:

1. Charles H.RothJr “Fundamentals of Logic Design” Thomson Learning 2004.
2. M.J.S .Smith, "Application - Specific Integrated Circuits", Pearson Education, 2013.
3. T. R. Padmanabhan and B. Bala Tripura Sundari, “Design through Verilog HDL”,WSE, IEEE Press, 2004.
4. Samir Palnitkar, “Verilog HDL a guide to digital design and Synthesis”, Sun Microsystems,Inc.2003.

Reference Book:

1. Donald G Givone, “Digital Principles and Design”, Tata McGraw Hill edition, 2012.
2. Parag K.Lala, “Fault Tolerant and Fault Testable Hardware Design” ,B S Publications, 2002

Extensive Reading:

- https://nptel.ac.in/courses/106105165
- https://ocw.mit.edu/courses/6-884-complex-digital-systems-spring-2005/pages/lecture-notes/
- https://archive.nptel.ac.in/courses/108/106/108106177/

23ECH42 PHYSICAL DESIGN OF VLSI CIRCUITS

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To design the VLSI circuits using Computer Aided Design (CAD) VLSI design tool.
- To design the standard cell based synthesis methodologies for partitioning, floor planning and placement principles.
- To effectively implement the timing constraints in Physical IC Design

Course Outcome:

At the end of the course, the students will be able to

- Realize the EDA design flow and Partitioning algorithms
- Apply the floor planning algorithms
- Apply the Global and detailed Placement algorithms
- Apply the Global and detailed Routing algorithms
- Comprehend the special routing and timing closure.

Unit I NETLIST AND SYSTEM PARTITIONING 9

VLSI Design Flow - VLSI Design Styles - Layout Layers and Design Rules - Physical Design Optimizations - Algorithms and Complexity - Graph Theory Terminology – Terminology of Partitioning - Partitioning Algorithms, Kernighan-Lin (KL) Algorithm, Fiduccia-Mattheyses (FM) Algorithm

Unit II FLOOR PLANNING 9

Terminology - Floorplan Representations, Constraint-Graph Pair, Sequence Pair - Floorplanning Algorithms, Floorplan Sizing, Simulated Annealing - Pin Assignment -Power and Ground Routing, Planar Routing, Mesh Routing

Unit III GLOBAL, DETAILED PLACEMENT AND GLOBAL ROUTING 9

Optimization Objectives - Global Placement, Min-Cut Placement, Analytic Placement, Simulated Annealing, Modern Placement Algorithms.

Terminology and Definitions of Routing - The Global Routing Flow - Single-Net Routing - Full-Netlist Routing

Unit IV DETAILED ROUTING 9

Horizontal and Vertical Constraint Graphs - Channel Routing Algorithms, Left-Edge Algorithm, Dogleg Routing - Switchbox Routing - Over-the-Cell Routing Algorithms, OTC Routing Methodology

Unit V SPECIALIZED ROUTING AND TIMING CLOSURE 9

Area Routing - Net Ordering in Area Routing - Basic Concepts in Clock Networks - Problem Formulations for Clock-Tree Routing. Constructing Trees with Zero Global Skew - Zero-Slack Algorithm - Timing-Driven Placement - Timing-Driven Routing

Text Book:

1. Andrew B. Kahng, Jens Lienig, Igor L. Markov, Jin Hu, “VLSI Physical Design: From Graph Partitioning to Timing Closure”, Springer Dordrecht Heidelberg London New York, 2011
2. S.H. Gerez, "Algorithms for VLSI Design Automation", John Wiley & Sons, 2006.
3. N.A. Sherwani, "Algorithms for VLSI Physical Design Automation", Kluwer Academic Publishers, 2002.

Reference Book:

1. Andrew B. Kahng, Jens Lienig, Igor L. Markov, Jin Hu, “VLSI Physical Design: From Graph Partitioning to Timing Closure”, Springer International Publishing, 2022
2. Sung Kyu Lim, "Practical Problems in VLSI Physical Design Automation", Springer Netherlands, 2008
3. Sadiq M. Sait, Habib Youssef, "VLSI Physical Design Automation - Theory and Practice", World Scientific, 1999

Extensive Reading:

- www.facweb.iitkgp.ernet.in/~isg/CAD/
- https://nptel.ac.in/courses/106106088
- www.engr.uconn.edu/~tehrani/teaching/cad

23ECH43 LOW POWER VLSI DESIGN

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To identify sources of power in an IC.
- To apply the power reduction techniques based on technology-independent and technology-dependent methods.
- To analyze suitable techniques to reduce power dissipation.
- To estimate power dissipation of various MOS logic circuits
- To develop algorithms for low-power dissipation

Course Outcome:

At the end of the course, the students will be able to

- Find the power dissipation of MOS circuits
- Design and analyze various MOS logic circuits
- Apply low-power techniques for power reduction.
- Estimate the power dissipation of ICs
- Develop algorithms to reduce power dissipation.

Unit I POWER DISSIPATION IN CMOS **9**

Hierarchy of Limits of Power – Sources of Power Consumption – Physics of Power Dissipation in CMOS FET Devices – Basic Principle of Low Power Design.

Unit II POWER OPTIMIZATION **9**

Logic Level Power Optimization – Circuit Level Low Power Design – Gate Level Low Power Design –Architecture Level Low Power Design – Low Power Design VLSI Subsystem Design of Adders, Multipliers.

Unit III DESIGN OF LOW POWER CMOS CIRCUITS **9**

Computer Arithmetic Techniques for Low Power System – Reducing Power Consumption in Combinational Logic, Sequential Logic, Memories – Low Power Clock – Advanced Techniques – Special Techniques, Adiabatic Techniques – Physical Design, Floor Planning, Placement and Routing.

Unit IV POWER ESTIMATION **9**

Power Estimation Techniques: Circuit Level, Gate Level, Architecture Level, Behavioural Level, – Logic Power Estimation – Simulation Power Analysis –Probabilistic Power Analysis

Unit V SYNTHESIS AND SOFTWARE DESIGN FOR LOW-POWER CMOS CIRCUITS **9**

Synthesis for Low Power – Behavioural Level Transform –Algorithms for Low Power – Software Design for Low Power- A case study of low-power embedded system - a touchscreen interface, IoT Applications.

Text Book:

1. J.Rabaey, “Low Power Design Essentials (Integrated Circuits and Systems)”, Springer, 2009.
2. Kaushik Roy and S.C.Prasad, “Low Power CMOS VLSI Circuit Design”, Wiley, 2000.

Reference Book:

1. J.B.Kulo and J.H Lou, “Low Voltage CMOS VLSI Circuits”, Wiley 1999.
2. James B.Kulo, Shih-Chia Lin, “Low Voltage SOI CMOS VLSI Devices and Circuits”, John Wiley and Sons, Inc. 2001
3. Wayne Wolf, “Modern VLSI Design: System-on-Chip Design”, Prentice Hall, 3rd Edition,2008.
4. A.Bellaowar & M.I.Elmasry, “Low power Digital VLSI Design, Circuits and Systems”, Kluwer,1996.

Extensive Reading:

- https://archive.nptel.ac.in/courses/106/105/106105034/
- https://www.synopsys.com/glossary/what-is-low-power-design.html

23ECH44 ANALOG VLSI DESIGN

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the operation of MOS devices.
- To analyze the CMOS amplifiers and its frequency response.
- To study the different biasing circuits and design of opamp.

Course Outcome:

At the end of the course, the students will be able to

- Realize the concepts of Analog MOS devices.
- Design different configuration of Amplifiers.
- Analyze the characteristics of frequency response of the amplifier.
- Realize the concepts of Biasing and Reference Circuits.
- Design and analyze the performance of two-stage opamp.

Unit I BASICS OF MOSFET DEVICE **9**

General Considerations, MOSFET Characteristics - Threshold voltage, I/V characteristics, Transconductance. Second-order effects, MOSFET Device models - MOS Device capacitances, MOS small signal model, MOS SPICE models.

Unit II CMOS AMPLIFIERS **9**

Single Stage Amplifiers - Common source amplifier with resistive load, diode load, constant current load, Source degeneration Source follower, Common gate amplifier - Differential Amplifiers - differential and common mode response, Input swing, gain, diode load, and constant current load.

Unit III FREQUENCY RESPONSE OF AMPLIFIERS **9**

Frequency Response of Amplifiers - General Considerations, Common Source Stage, Source Followers, Common Gate Stage, Cascode Stage, Differential Pair.

Unit IV BIASING AND REFERENCE CIRCUITS **9**

MOS Current Mirrors - Simple, Cascode, Wilson and Widlar current source - Bandgap reference – Supply-Independent Biasing, Temperature-Independent References, PTAT Current Generation, Constant Gm Biasing.

Unit V OPERATIONAL AMPLIFIER **9**

One stage Op-Amp, Two-stage Op-Amp, Gain Boosting, Slew Rate, Power Supply Rejection. Basic Frequency compensation, Compensation of Two-Stage Op-Amps.

Text Book:

1. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata McGraw Hill, 2001, 33rd re-print, 2016.

Reference Book:

1. Gray, Meyer, Lewis, Hurst, “Analysis and design of Analog IC’s”, Fifth Edition, Willey International, 2009.
2. Phillip E.Allen, Douglas R. Holberg, “CMOS Analog Circuit Design”, Third Edition-Oxford University Press-2011
3. Grebene, “Bipolar and MOS Analog Integrated circuit design”, John Wiley & sons, Inc.,2003

Extensive Reading:

- https://onlinecourses.nptel.ac.in/noc22_ee37
- https://archive.nptel.ac.in/courses/117/106/117106030/

23ECH45 VLSI SIGNAL PROCESSING

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To analyze various VLSI–DSP algorithms in FIR and IIR filters
- To know about the bit level architectures for multipliers in DSP Architectures
- To learn the Asynchronous and Wave pipeline concepts in DSP Architectures

Course Outcome:

At the end of the course, the students will be able to

- Analyze parallel and pipelining concept in DSP systems
- Analyze the optimization techniques using VLSI-DSP algorithms
- Analyze convolution operation hardwares using VLSI DSP algorithms
- Synthesize novel architectures for FIR and IIR filters using VLSI DSP Techniques.
- Analyze Architectures for decimators

Unit I DSP SYSTEMS **9**

DSP algorithms, Data flow and Dependence graphs – Critical path, Loop bound, iteration bound, Pipelining and Parallel processing of FIR filters –Pipelining and Parallel processing for low power.

Unit II RETIMING, FOLDING AND UNFOLDING **9**

Retiming –Definitions and properties –Solving system of inequalities-Retiming Techniques, Unfolding and properties of unfolding –Critical path, Folding -Register Minimization – Delay optimization by folding - Folding of Multirate systems.

Unit III CONVOLUTION AND ALGORITHM STRENGTH REDUCTION **9**

Fast convolution – Cook–Toom algorithm, Winograd Algorithm, Parallel FIR filters, DCT and IDCT, pipelining in first order IIR filters, Parallel processing of IIR filters –Combined pipelining and parallel processing of IIR filters.

Unit IV DESIGN OF FIR AND IIR FILTERS **9**

Multiply Accumulator and Sum of Products, CORDIC Architectures, FIR- Direct design window and Equiripple method, Constant Coefficient FIR design, Hardware efficient 2-parallel FIR filters, IIR filter Implementation , Fast IIR method

Unit V MULTIRATE SIGNAL PROCESSING **9**

Hogenauer CIC filters - Multistage decimator - Frequency sampling filters - Sampling rate converters - Filter banks - Wavelets

Text Book:

1. Keshab K. Parhi, “VLSI Digital Signal Processing Systems, Design and implementation “, John Wiley & Sons, 2012
2. Uwe Meyer Baese, “Digital Signal Processing with Field Programmable Gate Arrays (Signals and Communication Technology)”, 4th Edition, Springe, 2014.

Reference Book:

1. R.G. Lyons, Understanding Digital Signal Processing, Pearson Education, 3rd edition, 2011.
2. G. Chung and Keshab K. Parhi, ”Pipelined Lattice and Wave Digital Recursive Filters”, Kluwer Academic Publishers, 2012
3. Mahesh Mehendale and Sunil D. Sherlekar,,VLSI Systhesis of DSP Kernels: Algorithms and Architectural Transformations, Boston, Kluwer Academic publishers, 2001.

Extensive Reading:

- www.ece.umn.edu/~parhi/
- www.ece.umn.edu/users/parhi/SLIDES/chap13.pdf
- www.ece.umn.edu/users/parhi/SLIDES/chap8.pdf
- https://swayam.gov.in/nd1_noc20_ee44/

23ECH61 MIMO AND MULTICARRIER SYSTEMS

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the MIMO system model and channel propagation effects.
- To develop space time block codes
- To learn about multi carrier modulation and its performance in the wireless channel

Course Outcome:

At the end of the course, the students will be able to

- Analyze the effects of fading and various propagation effects of MIMO systems
- Analyze the MIMO wireless channel performance with known channel state information
- Develop space time block codes
- Elucidate the multicarrier systems and its sensitivity behaviour.
- Analyze the peak average power problems in a multicarrier systems

Unit I CHANNEL PROPAGATION AND FADING 9

Radio wave propagation- Large scale fading –Free-space propagation, outdoor propagation models: Okumara and Hata – small-scale fading: Microscopic fading: Doppler Spread Time selective, Delay spread Frequency selective, Rician K-factor, Angle spread space selective – Microscopic fading measurements: Direct pulse, Spread-spectrum sliding correlator channel sounding , frequency domain channel sounding – antenna diversity: Selection combining, MRC and EGC

Unit II THE MIMO WIRELESS CHANNEL 9

Multi antenna systems and concepts – MIMO system model- MIMO system capacity- Channel known to the transmitter – Water-pouring principle – Capacity calculation – SIMO – MISO – Ergodic capacity – Outage capacity – Influence of fading Correlation on MIMO capacity – Influence of LOS on MIMO capacity.

Unit III SPACE-TIME BLOCK CODING 9

Delay diversity scheme- Alamouti space – time code – Maximum likelihood decoding – Maximum ratio combining – Transmit diversity – Space-time block codes – STBC for real signal constellations – Decoding of STBC-OSTBC – Capacity of OSTBC channels

Unit IV ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING 9

Introduction – generation of subcarriers using the IFFT- guard time and cyclic extension- windowing-implementation complexity- synchronization – sensitivity to phase noise, frequency offset, timing errors – synchronization using the cyclic extension, special training symbols- optimum timing in the presence of multipath.

Unit V THE PEAK POWER PROBLEM 9

Introduction- distribution of the peak-to-average power ratio- clipping and peak windowing-peak cancellation- PAP reduction techniques – generating complementary codes, minimum distance of complementary codes, maximum likelihood decoding of complementary codes, suboptimum decoding of complementary codes, large code lengths – symbol scrambling.

Text Book:

1. Mohinder Janakiraman, “Space-time codes and MIMO Systems”, Universal Personal Communications, Artech House, 2004.
2. Richard van Nee and Ramjee Prasad, “ OFDM for Wireless Multimedia Communications”, Artech House, 1999.

Reference Book:

1. Ye (Geoffrey) Li and Gordon L. Stuber, Orthogonal Frequency Division Multiplexing for Wireless Communications, Springer, 2006.
2. Bahai, Saltzberg and Ergen, Multi-Carrier Digital Communications, Theory and Applications of OFDM, Second Edition, Springer, 2004

Extensive Reading:

- https://archive.nptel.ac.in/courses/117/105/117105132/
- https://www.electronics-notes.com/articles/antennas-propagation/mimo/space-time-block-alamouti-codes-coding.php
- https://personal.utdallas.edu/~hxm025000/TWJul03RobustSync.pdf
- https://www.globalspec.com/reference/72232/203279/chapter-6-the-peak-power-problem.

23ECH62 LONG TERM EVOLUTION TECHNOLOGIES

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To gain knowledge on LTE Radio Access Network Architecture
- To be exposed to OFDM and SCFDMA transceiver algorithms in LTE
- To know different protocols and functions in LTE
- To be familiar with multiple antenna techniques in LTE

Course Outcome:

At the end of the course, the students will be able to

- Conceptualize LTE Radio Access Network Architecture
- Implement the OFDM and SCFDMA transceiver in LTE
- Analyze synchronization and channel estimation issues
- Analyze the protocols and functions in LTE
- Analyze the transmit and receive diversity techniques in LTE

Unit I LTE STANDARDS **9**

LTE Radio Access Network Architecture - Network Elements and Functions - The eNodeB ,Mobility Management Entity- Serving Gateway - Packet Data Network Gateway- Interfaces and Reference Points – Requirements, Targets and Technologies for the LTE System - Deployment Cost and Interoperability - Multiple Antenna Technology - Packet-Switched Radio Interface - User Equipment Capabilities

Unit II OFDM AND SCFDMA IN LTE **9**

Duplex Methods , Multiple Access Methods, OFDM Principles and Modulation , Multiple Access in OFDM – OFDMA – PAPR , CFO and Timing offset issues in OFDM, Resource Blocks, SC-FDMA Principles and Modulation

Unit III SYNCHRONIZATION AND CHANNEL ESTIMATION **9**

Synchronization Sequences and Cell Searching LTE - Coherent Versus Non- Coherent Detection - Design of Reference Signals in LTE - RS-Aided Channel Modelling and Estimation – Channel Estimation: Frequency Domain , Time-Domain & Spatial Domain

Unit IV PHYSICAL DATA AND CONTROL CHANNELS **9**

Uplink Slot Structure –Uplink and Downlink Data – Transporting Channels-,Physical Broadcast Channel - Physical Downlink Shared Channel– Physical Multicast Channel – Downlink Control Channels - Requirements for Control Channel Design, Structure and Operation – Scheduling Process Link Adaptation and Feedback Computation, CQI Feedback - Channel Coding for Data Channels and Control Channels

Unit V MULTIPLE ANTENNA TECHNIQUES, SCHEDULING AND CELL SEARCH **9**

MIMO Signal Model, Single – User MIMO Techniques, Multi-User Techniques, MIMO Schemes, Physical-Layer MIMO Performance - Resource Allocation Strategies - Scheduling Algorithms - Ergodic Capacity Delay- Limited Capacity Performance of Scheduling Strategies - Interference Coordination and Frequency Reuse - Cell Search: LTE, UMTS, GSM, LTE Measurements, Handover to: LTE, UMTS, GSM.

Text Book:

1. Stefania Sesia, IssamToufik, Matthew Baker, “LTE-The UMTS Long Term Evolution From theory to practice”, John Wiley & Sons Ltd., Second Edition,2011

Reference Book:

1. 3GPP TS 36.211: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation", 2011
2. 3GPP TS 36.212: "Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding". 2011
3. 3GPP TS 36.213: "Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures". 2011
4. Ralf Kreher and Karstengaenger “LTE Signaling, Troubleshooting, and Optimization” John Wiley & Sons Ltd, First Edition, 2011.
5. David Tse and PramodViswanath, “Fundamentals of Wireless Communications”, Cambridge University Press, First Asian Edition, 2006.
6. Andrea Goldsmith, “ Wireless Communications”, Cambridge University Press, First Edition,2005
7. A.Paulraj, R. Nabar and D Gore, “Introduction to Space-Time Wireless Communications”, Cambridge University Press, First Edition, 2008.
8. Ayman ElNashar, Mohamed El-Saidny, Mahmoud Sherif, “Design, Deployment and Performance of 4G-LTE Networks: A Practical Approach”, Wiley-Blackwell, First Edition, 2014.

Extensive Reading:

- http:// www.3gpp.org
- https://onlinecourses.nptel.ac.in/noc20_ee61
- https://nptel.ac.in/courses/117104099

23ECH63 SIGNAL PROCESSING FOR 5G MILLIMETER WAVE COMMUNICATION

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the various components of mmWave Communications system.
- To know the antenna design at mmWave frequencies.
- To learn the concept of MIMO-OFDM in mmWave and Beamforming technology

Course Outcome:

At the end of the course, the students will be able to

- Explain the mmWave characteristics and implementation challenges faced.
- Comprehend MIMO channel model
- Design antenna for mmWave frequencies
- Explain the various implementation aspects of mmWave MIMO systems.
- Narrate the concept of MIMO-OFDM in mmWave and Beamforming technology.

Unit I RADIO WAVE PROPAGATION FOR MILLIMETER WAVE 9

Millimeter Wave Characteristics -Large scale propagation channel effects - small scale channel effects - Outdoor and Indoor channel models- Development of Millimeter Wave Standards

Unit II MILLIMETER WAVE CHANNEL MODEL 9

Basics of mmwave spectrum- angle of arrival (AoA) and angle of departure (AoD),3D concepts, -channel gain-mmWave channel model with RX beaming-single antenna beamforming in mmWave-Details of beamforming in mmWave: Concept of antenna many fold vector, beam parameters, efficiency of beams pattern

Unit III ANTENNAS FOR MILLIMETER WAVE SYSTEMS 9

Antenna beamwidth- polarization- advanced beam steering and beamforming- mm wave design consideration- On-chip and In package mm wave antennas- Techniques to improve gain of on-chip antennas- Implementation for mmwave in adaptive antenna arrays-Device to Device communications over 5G systems- Design techniques of 5G mobile

Unit IV MILLIMETER WAVE MIMO 9

MIMO Beamforming -.Different Levels : Beamforming in Transmitter side, Receiver side- Data detection and mathematical description of MIMO beamforming - Equalizer based detector -Optimization of design parameters

Unit V MIMO-OFDM WITH MILLIMETER WAVE BEAMFORMING AND PARAMETER ESTIMATION 9

OFDM data model - OFDM data detection - OFDM spectrum and CFO -MIMO OFDM Structure -MIMO OFDM decode and beamforming - Parameter estimation in mmWave system (LMMSE based).

Text Book:

1. K.C. Huang, Z. Wang, "Millimeter Wave Communication Systems", Wiley-IEEE Press, March 2011.
2. Robert W. Heath, Robert C. Daniel, James N. Theodore S. Rappaport, Murdock, "Millimeter Wave Wireless Communication", Prentice Hall, 2014

Reference Book:

1. Xiang, W; Zheng, K; Shen, X.S; "5G Mobile Communications", Springer, 2016.
2. David Tse, Pramod Viswanath, "Fundamentals of wireless communication", Cambridge University Press,2005

Extensive Reading:

- 3GPP document 38.211/212
- https://ieeexplore.ieee.org/document/5751614
- https://onlinecourses.nptel.ac.in/noc21_ee102

23ECH64 SOFTWARE DEFINED NETWORKING

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explain the building blocks, tools, platforms and components of SDN.
- To apply emerging trends in SDN to current applications.
- To learn security challenges of SDN.

Course Outcome:

At the end of the course, the students will be able to

- Compare the functionality of building blocks that make a SDN with its traditional counterpart.
- Apply SDN concept to data center applications.
- Evaluate the working of different SDN controller implementations.
- Work with SDN development tools, platforms, languages and frameworks.
- Relate emerging trends of SDN with current applications.

Unit I SDN COMPONENTS AND BUILDING BLOCKS **9**

Evolution of networking and the need for SDN- SDN principles and architecture - Comparison with traditional networking approaches- Fundamental Characteristics of SDN - SDN Operation- SDN Devices - SDN Controller

Unit II SDN IN DATA CENTERS **9**

Multitenant and Virtualized Multitenant Data Center - SDN solutions for data center networking : VLANs, EVPN, VxLAN, NVGRE, SD-WAN

Unit III SDN CONTROLLERS **9**

SDN via APIs- SDN via Hypervisor based overlays- SDN via opening up the device- Drawbacks of open SDN - SDN controllers: MININET, VMware

Unit IV SDN PROGRAMMING AND DEVELOPMENT **9**

Programming SDN applications - OpenDaylight and ONOS platforms - SDN development tools and languages: OpenFlow - Juniper and IETF SDN Frameworks

Unit V SDN APPLICATIONS **9**

Intent-based networking - Network automation and orchestration - Network Functions Virtualization (NFV) - Container networking and SDN

Text Book:

1. Paul Goransson and Chuck Black, “Software Defined Networks: A Comprehensive Approach”, Second edition, Morgan Kaufmann Publications, 2016

Reference Book:

1. Thomas D. Nadeau & Ken Gray, “SDN - Software Defined Networks” O'Reilly, 2013
2. SiamakAzodolmolky, “Software Defined Networking with OpenFlow”, Packet Publishing, 2013

Extensive Reading:

- https://nptel.ac.in/courses/108107107

23BAH01 MANAGEMENT OF ORGANISATIONS

Offered by MBA (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Different organizations and the ways to manage them
- What does a manager do (planning, organizing, staffing, leading, controlling)
- The skills and competencies of a manager

Course Outcome:

At the end of the course, the students will be able to

- Identify the differences among various Organizations
- Know the different skills required for planning by managers
- Learn about organization architecture
- Understand the essentials of Staffing in an organization
- Comprehend the fundamental of Leading and controlling an organization

Unit I INTRODUCTION **9**

Management: Science, Theory, and Practice- Evolution of Management Thought, Various approaches to the Management Process, Functions of Managers, Management and Society: The External Environment, Social Responsibility and Ethics - Technological, Ecological Environment, Social Responsibility and Ethics in Managing, Global, Comparative, and Quality Management- Country Alliances and Economic Blocs, Porter's Competitive Advantage of Nations.

Unit II PLANNING **9**

Essentials of Planning and Managing by Objectives – Types and Steps in Planning, Objectives, MBO, Strategies, Policies, and Planning Premises - Strategic Planning Process, TOWS Matrix, Blue Ocean Strategy, Portfolio Matrix, Porter's Industry Analysis model, Decision Making - Heuristics in Decision Making, Evaluation and selection of Alternatives.

Unit III ORGANIZING **9**

The Nature of Organizing, Entrepreneuring, and Reengineering - Formal and Informal Organization, Organizational Division, Organizational Levels and the Span of Management, Structure and Process of Organizing, Organization Structure: Departmentation, Matrix Organization, SBU, Line/Staff Authority, Empowerment, and Decentralization- Empowerment, Line/Staff Concepts and Functional Authority, Decentralization and Delegation of Authority, Effective Organizing and Organization Culture- Organizational flexibility, Avoiding Conflict.

Unit IV STAFFING **9**

Human Resource Management and Selection - Staffing, Systems Approach to HRM, Systems Approach to Selection, Job Design, Selection Process, Performance Appraisal and Career Strategy - Choosing Appraisal Criteria, Team Evaluation Approach, Rewards and Stress of Managing, Managing Change through Manager and Organization Development- Approaches to Manager Development, Organizational Conflict, Organization Development.

Unit V LEADING AND CONTROLLING **9**

Human Factors and Motivation – Theories on motivation Job Enrichment, A Systems and Contingency approach to Motivation, Leadership -Ingredients of Leadership, Leadership Behaviour and Styles, Different approaches to Leadership, Committees, Teams.

Group Decision Making- Nature, Uses, Limitation, Communication - Communication Process, Effective communication, The System and Process of Controlling – Control process, Control of Overall Performance, Different control mechanisms, Control Techniques and Information Technology - Budget as a Control Device, Balanced Scorecard, Use of computers.

Text Book:

1. Heinz Weihrich, Mark V.Cannice, Harold Koontz, "Management: A Global, Innovative, Entrepreneurial Perspective", (15th ed.), McGraw Hill Education, New Delhi, 2020.
2. Thomas S Bateman and Scott A Snell, "Management: Leading & Collaborating in the Competitive World", (13th ed.), McGraw Hill, 2018.
3. Richard L. Daft, "Management", (11th ed.), Cengage Learning, New Delhi, 2013.

Reference Book:

1. Peter F. Drucker, "The Practice of Management", Haper Collins, New Jersey, 2006
2. Peter F. Drucker, "Management: Tasks, responsibilities, Practices", Allied publishers, New Delhi, 2016
3. Harold Koontz, Heinz Weihrich, Mark V. Cannice, "Essentials of Management: An International and Leadership Perspective", (11th ed.), Tata McGraw Hill, 2020.

23BAH02 UNDERSTANDING BUSINESS ENVIRONMENT

Offered by MBA (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Develop an in depth understanding of the policy environment in which business operates.
- Appreciate the impact of culture on business activities.
- Analyse the interaction of technology and business decisions.
- Understand the linkages between business and the political environment.

Course Outcome:

At the end of the course, the students will be able to

- Recognise the importance of environmental analysis of business
- Detail the impact of macro environments on business decisions.
- Understand the impact of business on the society.
- Detail the interaction of financial system and business decisions.
- Understand the role of international agencies in business

Unit I BUSINESS ENVIRONMENT-AN INTRODUCTION **9**

Types of environment, internal environment, external environment, micro environment, macro environment, competitive structure of industries, competitor analysis, environmental analysis, strategic management, classification of business, classification of industries, characteristics of business, goals of business, techniques for environmental analysis, approaches, environmental forecasting, forecasting techniques, benefits, limitations of forecasting

Unit II MACRO ENVIRONMENT **9**

Nature of economy, structure of economy, economic policies, economic conditions, functions of state, economic roles of government, legal environment, economic roles of government of India, constitutional environment, technological leadership, followership, competitive advantage, technology adaptation, transfer of technology, population size, changing age structure, migration, ethnicity

Unit III BUSINESS AND SOCIETY **9**

Objectives, importance of business, professionalization, business ethics, business and culture, culture and organisational behaviour, technological development and social change, social orientation of business, factors affecting social orientation, social audit, consumer rights, consumerism, consumer protection, consumerism in India, corporate governance meaning and importance

Unit IV FINANCIAL SYSTEM **9**

Monetary policy, money policy, instruments of monetary policy, fiscal policy, union budget, state budget, importance of budget, credit market, foreign exchange market, debt market, derivatives market, bancassurance, money market: constituents and functions, Indian money market, capital markets: nature, constituents, importance, capital market in India

Unit V GLOBAL ENVIRONMENT **9**

GATT/WTO: functions and features, WTO and developing countries, WTO and India, foreign investments, types of foreign investments, growth of foreign investment, foreign investment in India, foreign investment by Indian companies, multinational corporations, globalisation of world economy, pros and cons of globalisation, FERA and FEMA

Text Book:

1. Francis Cherunilam, “Business Environment - Text and Cases”, Himalaya Publishing House (30th ed.), 2023

Reference Book:

1. Gupta CB, “Business Environment”, Sultan Chand & Sons,2022
2. Ruddar Dutt, K.P.M. Sundaram, “Indian Economy, (73rd ed.) S.Chand, 2022

23BAH03 ECONOMICS FOR BUSINESS DEVELOPMENT

Offered by MBA (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To make them to know the various microeconomic aspects to be considered by the manager for effective decision making.
- To expose the students to the economic concepts and tools that aids the managers for decision making in different business situations and
- To make the students to equip themselves in managing a business in an economic environment by understanding the market economics.

Course Outcome:

At the end of the course, the students will be able to

- Understand the significance of economic environment and recognize its relevance to the Business practices.
- Become familiar in the market forces such as demand and supply to any business.
- Demonstrate and apply the various theories of market structure.
- Understand and apply the suitable cost concepts and pricing strategies.
- Relate the implications of breakeven point and profit volume analysis in profit planning

Unit I INTRODUCTION TO ECONOMICS **9**

Definition, Nature and Scope of Managerial Economics – Factors influencing Managerial Decisions – Managerial Economics and other disciplines - Basic Economic Concepts and theories used in Managerial Economics - Incremental Principle – Opportunity Cost Principle – Concept of Contribution – Risk and uncertainty – Discounting principle – Market Forces: Demand - Types of demand – Determinants of Demand – Law of Demand.

Unit II DEMAND FORECASTING **9**

Purpose of forecasting demand – Steps involved in forecasting – Methods of Demand Forecasting – Opinion polling method – Delphi Technique – Trend projection or mechanical extrapolation technique – Market Forces: Supply – Supply Curve – Law of supply – Theories of Production – Economies of Scale – Internal Economies of Scale – External Economies of Scale – Diseconomies of Scale

Unit III MARKET STRUCTURE - DIVERSITIES AND IMPLICATIONS **9**

Perfect Competition – Determination of Price – Consequence of Pure Competition – Monopoly – Causes of Monopoly – Revenue, cost and profits of monopolists – Disadvantage of monopoly market structure – Monopsony – Monopolistic Competition – Price determination under monopolistic competition – Oligopoly Market Structure – Pricing under oligopoly

Unit IV COST CONCEPTS AND PRICING STRATEGIES **9**

Significance of cost in managerial decision making – Cost concepts and types – Determinants of Cost – Cost output relationships – Price determinants – Pricing under different objectives – Price determination under different market structure – Pricing Methods in practice – Cost –oriented pricing – Competition oriented pricing – Pricing based on the other economic conditions – Other Pricing strategies

Unit V PROFIT PLANNING AND CONTROL - BREAK EVEN ANALYSIS **9**

Break Even Analysis – Break Even Point (BEP) – Determination of the Break Even Point – Break Even points in terms of Quantity, sales value – Break Even Chart – Assumptions underlying the Break Even Analysis – Managerial use of Break Even Analysis – Limitations of Break Even Analysis – Profit Volume (P/V) Analysis

Text Book:

1. B. Senthil Arasu, J.Praveen Paul, “Engineering Economics and Financial Accounting”, Scitech Publications (India) Pvt. Ltd., 2022

Reference Book:

1. Craig H. Petersen, W. Chris Lewis, and Sudhir k. Jain, “Managerial Economics”, Pearson, Ninth impression 2012.
2. Gregory Mankiw N, “Principles of Economics”, (6th ed.), Cengage Learning, New Delhi, Reprint 2013.
3. Richard Lipsey and Alee Charystal, “Economics”, (12th ed.), Oxford University Press, New Delhi, 2011.
4. William Boyes and Michael Melvin, “Textbook of Economics”, (6th ed.), Biztantra, 2006.
5. Karl E. Case and Ray C. Fair, “Principles of Economics”, (8th ed.), Pearson Education Asia, New Delhi, 2007

23BAH04 MARKETING FOR BUSINESS DEVELOPMENT

Offered by MBA (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The basics of Marketing Management as a functional area of an organisation.
- The basic elements that makes up the marketing function.
- The functions of a marketing department.
- The importance of marketing to an organisation

Course Outcome:

At the end of the course, the students will be able to

- Describe the major trends and forces that are changing the marketing landscape
- Discuss how companies can react to the marketing environments.
- Identify the ways to match the customer requirements with market offerings.
- Appreciate the different methods of promotion and distribution of goods and services.
- Recognise how companies adopt their marketing strategies for international markets.

Unit I MARKETING & MARKETING PROCESS **9**

Marketing definition, market place and customer values, value driven marketing strategy & plan, engaging customers, managing customers, capturing value from customers, changing market landscape, company- wide strategic planning, business portfolio, marketing with other functions, integrated marketing mix, managing the marketing effort, measuring marketing ROI, managing marketing ROI

Unit II MARKET PLACE & CONSUMER VALUE **9**

Micro environment, macro environment, demographic environment, economic environment, natural, political and legal, socio-cultural environment, responding to the marketing environment, marketing information, marketing research, customer relationship management, ethics in marketing research, segmentation, targeting, positioning

Unit III MARKETING MIX – I **9**

Product: meaning, levels, classification, product line decision, product mix decision, services- characteristics, services marketing mix, service profit chain, new product development, product life cycle, product decision and social responsibility, Price: meaning, major pricing strategies, factors affecting pricing, new product pricing, product mix pricing, price adjustments, price changes

Unit IV MARKETING MIX – II **9**

Nature and importance of marketing channels, channel design decision, channel decision management, promotion mix, need for marketing communication, developing effective communication, advertising, personal selling, managing sales force, personal selling process, sales promotion, direct marketing, social media and mobile marketing, public relations

Unit V EXTENDING MARKETING **9**

Competitor analysis, competitive strategies, elements of global marketing environment, deciding how to enter the market, global marketing program, global marketing organisation, sustainable marketing, social criticisms on marketing, consumer actions, business actions, marketing ethics

Text Book:

1. Philip Kotler, Gray Armstrong, Prafulla Agnihotri, “Principles of Marketing”, Pearson, (17th Edition), 2018.
2. Marilyn A. Stone, John Desmond, “Fundamentals of Marketing” (Special Indian Edition), Routledge, Taylor & Francis Group, 2014.

Reference Book:

1. William J. Stanton, Michael J. Etzel, Bruce J. Walter, “Fundamentals of Marketing”, (10th ed.), TMH, 1994.
2. Philip Kotler, “Marketing Management: A South Asian Perspective”, (14th ed.), Pearson India, 2012.

23BAH05 CORPORATE FINANCE

Offered by MBA (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand how "Finance" is Managed in a company
- To impart knowledge of managing assets of the company
- To make an in depth analysis of various sources of long term financing as well as short term financing.
- To educate the need for working capital financing

Course Outcome:

At the end of the course, the students will be able to

- Identify the key decisions of financial management and demonstrate how they are connected to the objective of financial management
- Demonstrate the effect of fixed charges obligation on the value of firm and selecting an optimal capital structure
- Evaluate the alternative investments by applying capital budgeting methods and assess the working capital requirements
- Analyse the effect of dividend policies by discussing the dividend theories.
- Outline the determinants of working capital requirements of a firm and the various ways of sourcing it.

Unit I KEY DECISIONS & OBJECTIVES OF FINANCIAL MANAGEMENT 9

Overview of Financial Management – Finance its interface with other disciplines Planning Environment – Key Decision of Finance management – Investment Decision, Financing Decision, Dividend Decision and Liquidity Decision – Emerging Role of Finance manager

Unit II FINANCING DECISIONS 9

Analysis of Financial Leverage – EBIT and EPS analysis – Analysing alternative financial plans – Cost of Capital – Cost of Debt, Preference share and Equity shares – Overall cost of capital – Weighted Average Cost of Capital (WACC) – Determinants of Capital Structure.

Unit III INVESTMENTS DECISIONS 9

Investment Decisions – Capital Budgeting Techniques – Payback period, Accounting Rate of Return, Net Present Value, Profitability Index, Internal Rate of Return –Evaluation of investment alternatives under the five capital budgeting techniques – Decision rule for mutually exclusive projects and independent projects – Capital Rationing

Unit IV DIVIDEND DECISION 9

Definition of dividend – Forms of Dividend – Advantages and Disadvantages – Dividend and Retention policies – Practical Considerations in Dividends Policy – Dividend Theories – Relevance and Irrelevance of Dividends – Walter's Model, Gordon's Model, MM Approach.

Unit V LIQUIDITY DECISION AND SOURCES OF FUNDS 9

Liquidity Decision – Definition of Gross working capital and Net Working Capital – Determinants of Working Capital Requirements – Sources of Long-term Funds – Equity Share, Preference Share, Debentures/Bonds – Sources of Short-term Funds – Spontaneous sources – Bank Finance and other sources.

Text Book:

1. I. M. Pandey, "Financial Management", (10th ed.), Vikas Publishing House Pvt. Ltd., 2013.
2. James C. Vanhorne, "Fundamentals of Financial Management", (13th ed.), PHI Learning, 2014.

Reference Book:

1. Braily Meyers: Corporate Finance, McGraw Hill, 2006
2. Khan MY & Jain PK Financial Management, Text, Problems and Cases McGraw Hill, 2004
3. Khan MY & Jain PK Basic Finance Management, Mc Graw Hill., 2006
4. John Hampton, Financial Decision making, Problems, text and cases, Prentice Hall of India, 1999

23MIH01 ENTREPRENEURIAL DYNAMICS AND OPPORTUNITIES

Offered by MIC (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on the concept of Entrepreneurship and relevant roles.
- To learn entrepreneurial plan including project feasibility and appraisal.
- To understand the nature of international entrepreneurship through relevant case studies.

Course Outcome:

At the end of the course, the students will be able to

- To analyse different roles in new business ventures.
- Apply creativity and entrepreneurial plans in problem-solving of critical challenges.
- Implement corporate entrepreneurship and issues related to corporate entrepreneurship.
- Explore the possibility of traditional and generic enterprises.
- Utilize global entrepreneurship opportunities effectively.

Unit I ENTREPRENEURSHIP **9**

Definition of Entrepreneur, Internal and External Factors, Functions of an Entrepreneur, Entrepreneurial motivation and Barriers, Classification of Entrepreneurship, Theory of Entrepreneurship, Concept of Entrepreneurship, Development of entrepreneurship; Concept of entrepreneur, Manager, and Intraprenuer (differences in their roles, responsibilities and Career Opportunities).

Unit II CREATIVITY AND ENTREPRENEURIAL PLAN **9**

Business plan as an entrepreneurial tool, Contents of a business plan, Idea Generation, Screening and Project Identification, Creative Performance, Feasibility Analysis: Economic, Marketing, Financial and Technical; Project Planning: Evaluation, Monitoring and Control segmentation. Creative Problem Solving: Heuristics, Brainstorming, Synectics, Value Analysis, Innovation. Project Feasibility and Project Appraisal.

Unit III CORPORATE ENTREPRENEURSHIP **9**

Introduction, Flavors of corporate entrepreneurship, Corporate venturing, Intrapreneurship, organizational transformation, Industry rule-bending, Need for corporate entrepreneurship, the domain of corporate entrepreneurship, conditions favourable for Corporate entrepreneurship, benefits of Corporate entrepreneurship, issues related to Corporate entrepreneurship.

Unit IV FAMILY, FIRST GENERATION & WOMEN ENTREPRENEURS **9**

Role of Professionals, Professionalism vs family entrepreneurs, Role of Woman entrepreneur, Factors influencing women entrepreneur, Challenges for women entrepreneurs, Growth and development of women entrepreneurs in India.

Unit V INTERNATIONAL ENTREPRENEURSHIP OPPORTUNITIES **9**

The nature of international entrepreneurship, Importance of international business to the firm, International versus domestic entrepreneurship, Stages of economic development. Institutional support for new ventures: Supporting Organizations; Incentives and facilities; Financial Institutions and Small scale Industries, Govt. Policies for SSIs. Case studies on Indian Start ups.

Text Book:

1. Vasant Desai, “Dynamics of Entrepreneurship Development”, Himalaya Publication house Ed.2011.
2. David Holt, “Entrepreneurship, New Venture Creation”, Prentice Hall India Ed.2016.
3. S.S. Khanka, “Entrepreneurial Development”, S.Chand & Company Ltd. New Delhi Ed.2013.
4. Peter F. Drucker, “Innovation and Entrepreneurship”, Butterworth-Heinemann Ed.2006.

Reference Book:

1. Donald F Kuratko, “Entrepreneurship – Theory, Process and Practice”, Cengage Learning 12th Edition, 2016.
2. Rajeev Roy, “Entrepreneurship”, Oxford University Press, 2nd Edition, 2011.
3. Mathew J , Manimala, “Entrepreneurship theory at cross roads: paradigms and praxis”, Dream tech, 2 Edition, 2005.
4. Hisrich R D, Peters M P, “Entrepreneurship”, Tata McGraw-Hill, 8th Edition, 2013.

23MIH02 PROBLEM SOLVING AND INNOVATION MANAGEMENT

Offered by MIC (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn creative problem-solving approaches in starting new enterprise.
- To understand creative intelligence for working in Creativogenic Environment.
- To explore micro and macro perspectives of innovation.

Course Outcome:

At the end of the course, the students will be able to

- To apply creativity for leveraging economic sustainability of business ventures.
- Effective implementation of various models and mechanisms of creative problem solving.
- Analyse creative intelligence abilities and thinking strategies.
- Formulate appropriate innovative ideation methods and theories of outsourcing.
- Identify the system approach to Micro and Macro Perspective of Innovation.

Unit I THE CREATIVITY PHENOMENON **9**

Creative Cerebration- Creative Personality and Motivation - Creative Environment- Creative Technology - Creativity Training - Puzzles of Creativity - Spiritual and social roots of creativity- Essence, Elaborative and Expressive Creativities- Quality of Creativity Existential, Entrepreneurial and Empowerment Creativities - Criteria for evaluating Creativity Credible Evaluation- Improving the quality of our creativity.

Unit II MASTERING CREATIVE PROBLEM SOLVING **9**

Structuring of ill - defined problems – Creative Problem solving - Models of Creative problem solving - Mechanisms of Divergent thinking - Useful mechanisms of convergent thinking - Techniques of Creativity Problem solving.

Unit III CREATIVE INTELLIGENCE **9**

Creative Intelligence abilities - A model of Creative Intelligence - Convergent thinking ability - Traits Congenial to creativity - Creative Personality and forms of creativity Motivation and Creativity- Blocks to creativity- fears and Disabilities - Strategies for Unblocking Energy for your creativity- Designing Creativogenic Environment.

Unit IV INNOVATION MANAGEMENT **9**

Concept of Innovation - Levels of Innovation – Incremental vs Radical Innovation-Inbound and Outbound Ideation - Open and Other Innovative Ideation Methods - Theories of outsourcing New Product Development: Transaction Cost, Resource Based, Resource Dependence, Knowledge Based Theories.

Unit V MICRO AND MACRO PERSPECTIVES OF INNOVATION **9**

Systems Approach to Innovation - Innovation in the context of Emerging Economies - Organizational factors affecting innovation at the firm level Leadership and Innovations - Open Innovation - Innovation Framework - Innovations developed by Open Technology Communities.

Text Book:

1. Pradip N Khandwalla, Lifelong Creativity, An Unending Quest, Tata McGraw Hill, 2011.
2. Innovation Management, C. S. G. Krishnamacharyulu, R. Lalitha, Himalaya Publishing House, 2017.

Reference Book:

1. Vinnie Jauhari, SudanshuBhushan, Innovation Management, Oxford Higher Education, 2014.
2. A.DaleTimpe, Creativity, Jaico Publishing House, 2003.
3. Brian Clegg, Paul Birch, Creativity, Kogan Page, 2009.
4. P. N. Rastogi, Managing Creativity for Corporate Excellence, Macmillan 2009.

23MIH03 CREATIVE DESIGN APPROACH FOR PRODUCT DEVELOPMENT

Offered by MIC (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn novel design approaches for product and service development.
- To explore interactive design and collaborative design tools.
- To discuss the methods of implementing design upon strategic innovations in the real world.

Course Outcome:

At the end of the course, the students will be able to

- Collaborate effectively in multidisciplinary teams to implement design thinking processes.
- Generate innovative and user-centric ideas through modern tools in the development process.
- Create prototypes and iterate on design solutions based on user feedback and evaluation.
- Communicate and recommend design concepts to stakeholders in a clear and compelling manner.
- Apply design thinking principles and methodologies to effectively identify and address user needs,

Unit I DESIGNING OF MINIMUM VIABLE PRODUCT **9**

Shared model in team-based design – Theory and practice in Design thinking– Problem Framing and Definition – Explore presentation signers across globe - Minimal Viable Product (MVP) - Prototyping and Iterative Design.

Unit II INTERACTIVE DESIGNING **9**

Real-time design interaction capture and analysis – Enabling efficient collaboration in digital space – Empathy for design – Prototyping Tools - Visualization and Communication Tools - Collaboration in distributed Design.

Unit III USER CENTRED DESIGN **9**

Business Process Modelling – Agile in Virtual collaboration environment – Scenario based Prototyping - User-Centered Interface Design - UX Evaluation and Optimization - Design Thinking in Project Management.

Unit IV DESIGNING OF STRATEGIC INNOVATIONS **9**

Growth – Story telling representation – Strategic Foresight - Change – Sense Making - Maintenance Relevance – Value redefinition - Extreme Competition – experience design - Standardization – Humanization - Creative Culture – Rapid prototyping, Strategy and Organization – Business Model Design.

Unit V DESIGN THINKING APPROACH AND CASE STUDIES **9**

Empathy and User Research, Problem Definition, Ideation and Brainstorming, Prototyping, Testing and Iteration, Implementation and Execution, Action plan for applying design thinking in future projects. Case studies: Airbnb, Warby Parker, and IDEO redesigned shopping cart.

Text Book:

1. John.R.Karsnitz, Stephen O'Brien and John P. Hutchinson, "Engineering Design", Cengage learning (International edition) Second Edition, 2013.
2. Roger Martin, "The Design of Business: Why Design Thinking is the Next Competitive Advantage" Harvard Business Press , 2009.
3. Hasso Plattner, Christoph Meinel and Larry Leifer (eds), "Design Thinking: Understand – Improve– Apply"Springer, 2011
4. Idris Mootee, "Design Thinking for Strategic Innovation: What They Can't Teach You at Business or Design School"John Wiley & Sons 2013.

Reference Book:

1. Nigel Cross, "Design Thinking: Understanding How Designers Think and Work", 2019
2. Yousef Haik and Tamer M.Shahin, "Engineering Design Process", Cengage Learning, Second Edition, 2011.
3. Jeanne Liedtka, Andrew King, Kevin Bennett, "Solving Problems with Design Thinking - Ten Stories of What Works", Columbia Business School Publishing, 2013

23MIH04 ENTREPRENEURIAL FINANCE AND ACCOUNTING

Offered by MIC (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the importance of financial management.
- To explore the various sources of investment for strengthening entrepreneurs.
- To know the basic essentials of accounting terminologies.

Course Outcome:

At the end of the course, the students will be able to

- To carry out feasibility analysis while managing new venture.
- Analyze the various sources of investment and also know the support provided by the state and central government for entrepreneurship.
- Appreciate the importance of financial management while managing a new venture.
- Determine the various financial support schemes provided different institutions to the entrepreneurs.
- To prepare financial statements such as trail balance and profit & loss statements.

Unit I FINANCING AND MANAGING NEW VENTURE **9**

Importance of Financial Management as an integral part of Entrepreneurship -Conducting a feasibility analysis - What lenders and investors look for in a business plan - Strategic cost management.

Unit II SOURCES OF FINANCE **9**

Various sources of Investment - Basics of Venture Capital and Angel Investment - Start-up Culture - Various measures of encouragement and support being provided by the State and Central Government for strengthening the Entrepreneurial Culture.

Unit III INSTITUTIONAL FINANCIAL SUPPORT **9**

Schemes and functions of rate of Industries - District Industries Centres (DICs) - Industrial Development Corporation (IDC) - State Financial Corporation (SFC) - Small Scale Industries Development Corporations (SSIDCs) -Khadi and Village Industries Commission (KVIC) - Technical Consultancy Organisation (TCO) - Small Industries Service Institute (SISI) - National Small Industries Corporation (NSIC) - Small Industries Development Bank of India (SIDBI).

Unit IV BOOK KEEPING AND ACCOUNTANCY **9**

Meaning, Definition, nature & scope of accounting-Branches of accountancy-Basic Accounting terminologies-users of accounting information and their needs-Concepts & Conventions-Double entry system of Accounting.

Unit V RECORDING OF TRANSACTION & PREPARATION OF FINANCIAL STATEMENTS **9**

Origin of transactions-source documents (invoice, case memo, pay in slip, cheque), preparation of vouchers-cash (debit and credit) and non cash (transfer). Book of original entry: format and recording-Journal, Cash book, other day books. Preparation of final statements-Trail balance, Need & adjustments, trading and profit & loss account, Balance Sheet.

Text Book:

1. Vasant Desai, “Dynamics of Entrepreneurship Development”, Himalaya Publication house Ed.2011.
2. Lall, Madhurima, and ShikhaSahai, "Entrepreneurship", Excel Book, Ed.2008.
3. Charantimath, Poornima, "Entrepreneurship Development and Small Business Enterprises", Pearson Education, Ed.2018.
4. ArunaKaulgud, "Entrepreneurship Management", Vikas publishing house, Ed.2009.

Reference Book:

1. Robert Hisrich,& Michael Peters, "Entrepreneurship", Tata Mc-Graw –Hill, New Delhi, Ed.2019.
2. Dollinger, "Entrepreneurship", Pearson, Ed.2009

23MIH05 SOCIAL ENTREPRENEURSHIP

Offered by MIC (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- To understand the models and activities of social entrepreneurship.
- To understand fund raising management and sustainability of social enterprises.
- To explore the use cases on the impact of social entrepreneurship.

Course Outcome:

At the end of the course, the students will be able to

- Effectively utilize the social responsible activities of social entrepreneurs.
- Prepare feasibility analysis for the promising ideas.
- Prepare business plan for the chosen business ideas.
- Carry out market research for product / services
- Analyse socio-economic impacts of social enterprises.

Unit I INTRODUCTION TO SOCIAL ENTERPRISE 9

Overview of social entrepreneurship, Individual as a social entrepreneur, challenges and future prospects of social entrepreneurship, Type of social enterprises, models of social enterprises, Support of corporate social responsibility activities for social enterprise.

Unit II UNDERSTANDING ENVIRONMENT AND CREATING SOCIAL ENTERPRISE 9

Idea generation for social enterprise, social innovation and inclusion, Need identification of product/service of social enterprise, Appraising the idea formation though feasibility analysis, Achieving social objectives with commercial ventures.

Unit III MOBILIZING RESOURCE AND NETWORKING FOR SOCIAL ENTERPRISE 9

Society and social problems as opportunities, Creating Business model and writing business plan, Source of capital for social enterprise, Different fundraising strategies and models.

Unit IV MANAGING GROWTH AND PERFORMANCE 9

Strategic framework analysis of social enterprise, crafting alliances between non-profit business & government organizations, different growth models, social enterprise management and sustainability of social enterprise, social audits, Skill development and enhancement, Market research for product/service of social enterprise.

Unit V SOCIO-ECONOMIC IMPACT OF SOCIAL ENTERPRISE 9

Profiling the Social Entrepreneur and their Social ventures, Benefits and rewards of social enterprise, Impact of social enterprise on community and stakeholders, Case discussion Bangladesh Gramin Bank, Sulabh International, AMUL, Rangsutra, Jaipur Rugs Foundation, Desi Crew, Pipal Tree, Goonj etc.

Text Book:

1. K.G. Karmakar , “Microfinance in India ”, Microfinance in India, Ed.2008.
2. S.B Verma& Y.T Pawar, Rural Empowerment through SHGs, NGOs and PRIs, Deep and Deep Publications Pvt Ltd, Ed.2005
3. C.B Gupta & N.P Srinivasan, Enterpreurship Development in India, Sultan Chand and Sons, Ed.2017

Reference Book:

1. Prahalad C.K, "The Fortune at the Bottom Of The Pyramid, Eradicating Poverty through Profits”, Dorling Kindersley Pvt Ltd, Kindle edition, 2013.
2. Bronstein David, How to change the world: Social Entrepreneurs and the birth of new Idea, OUP USA, Ed.2007.
3. Yunus Muhammad, Creating the world without Poverty:Social Business and Future of Capitalism, Perseus Books Group, Ed.2009.