

MEPCO SCHLENK ENGINEERING COLLEGE (AUTONOMOUS), SIVAKASI*Affiliated to Anna University, Chennai 600 025.***BTECH ARTIFICIAL INTELLIGENCE AND DATA SCIENCE***MEPCO R2019 Choice Based Credit System*

VISION	MISSION
To emerge as a centre of excellence in the domain of Artificial Intelligence and Data Science technologies with excellence in research, education, and innovation in order to serve the nation	To produce decorated technocrats with Artificial Intelligence and Data Science competence ready for solving collaborative, ethical, social, domain and research specific challenges in order to build the community and transform the nation

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	Apply analytical knowledge to develop intelligent systems by extracting knowledge from data to formulate design and solve real time problems.
PSO2	Apply data science techniques and project development skills to provide solutions for complex problems
PSO3	Employ artificial intelligence & data science techniques for developing innovative solution to any applications addressing the computing needs of the society.

BTECH ARTIFICIAL INTELLIGENCE AND DATA SCIENCE Curriculum and Syllabus

Semester - 1

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	19HS101	TECHNICAL ENGLISH - I (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	3	0	0	3
2	19BS101	MATHEMATICS - I (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	3	2	0	4
3	19BS102	ENGINEERING CHEMISTRY (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	3	0	0	3
4	19GEM01	ENGINEERING GRAPHICS (Common to BAD, BBT, BCI, BCS, BIT)	2	2	0	3
5	19GE101	COMPUTER PROGRAMMING (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	3	0	0	3
Theory Course with Lab Component						
6	19BS181	ENGINEERING PHYSICS (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	3	0	2	4
Core Practical						
7	19GE151	COMPUTER PROGRAMMING LABORATORY (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	0	0	3	1.5
8	19GE152	ENGINEERING PRACTICES LABORATORY (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	0	0	3	1.5
Total			17	4	8	23

Semester - 2

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	19HS201	TECHNICAL ENGLISH - II (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	3	0	0	3
2	19BS201	MATHEMATICS - II (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	3	2	0	4
3	19BS203	MATERIALS SCIENCE (Common to BAD, BBE, BCS, BEC, BEE, BIT)	3	0	0	3
4	19IT201	OBJECT ORIENTED PROGRAMMING USING C++ (Common to BAD, BIT)	3	0	0	3
5	19IT202	DIGITAL LOGIC DESIGN	3	0	0	3
Theory Course with Lab Component						
6	19BS281	ENVIRONMENTAL SCIENCE AND DISASTER MANAGEMENT (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	3	0	2	4
Core Practical						
7	19IT251	OBJECT ORIENTED PROGRAMMING USING C++ LABORATORY (Common to BAD, BIT)	0	0	3	1.5
8	19IT253	DIGITAL LOGIC DESIGN LABORATORY	0	0	3	1.5
9	19HS251	COMMUNICATION SKILLS LABORATORY (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)	0	0	2	1
Total			18	2	10	24

Semester - 3

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	19MA305	MATHEMATICS - III : PROBABILITY AND QUEUEING THEORY	3	2	0	4
2	19IT301	DATA STRUCTURES (Common to BAD, BIT)	3	0	0	3
3	19IT302	DATABASE MANAGEMENT SYSTEMS (Common to BAD, BIT)	3	0	0	3
4	19AD301	PYTHON PROGRAMMING	3	0	0	3
5	19AD302	INTRODUCTION TO AI AND DATA SCIENCE	3	1	0	3.5
Core Practical						
6	19IT351	DATA STRUCTURES LABORATORY (Common to BAD, BIT)	0	0	3	1.5
7	19IT352	DATABASE MANAGEMENT SYSTEMS LABORATORY	0	0	3	1.5

		(Common to BAD, BIT)				
8	19AD351	PYTHON PROGRAMMING LABORATORY	0	0	3	1.5
9	19HSM01	PRESENTATION AND LANGUAGE SKILLS LABORATORY (Common to BAD, BBT, BCI, BCS, BEE, BIT)	0	0	2	1
Special Course						
10	IAS30	INTEGRATED APTITUDE SKILLS - I (LOWER) (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	0	0	0
Total			17	3	11	22

Semester - 4

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	19AD401	STATISTICS FOR DATA SCIENTISTS	3	2	0	4
2	19AD402	DATA ANALYTICS	3	0	0	3
3	19AD403	PROGRAMMING WITH JAVA	3	0	0	3
4	19IT403	ALGORITHMS ANALYSIS AND DESIGN (Common to BAD, BIT)	3	0	0	3
5	19AD404	ARTIFICIAL INTELLIGENCE	3	0	0	3
Theory Course with Lab Component						
6	19AD481	OPERATING SYSTEM PRINCIPLES	3	0	2	4
Core Practical						
7	19AD451	DATA ANALYTICS LABORATORY	0	0	3	1.5
8	19AD452	ARTIFICIAL INTELLIGENCE LABORATORY	0	0	3	1.5
Special Course						
9	IAS40	INTEGRATED APTITUDE SKILLS - II (LOWER) (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	0	0	0
Total			20	2	8	23

Semester - 5

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	19AD501	COMPUTER NETWORKING PRINCIPLES	3	0	0	3
2	19AD502	MACHINE LEARNING ESSENTIALS	3	0	0	3
Theory Course with Lab Component						
3	19AD581	NO SQL DATABASES	3	0	2	4
Core Elective						
4		Core Elective-1 (BAD)	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	19AD551	COMPUTER NETWORKING LABORATORY	0	0	3	1.5
8	19AD552	MACHINE LEARNING TECHNIQUES LABORATORY	0	0	3	1.5
9	19HSM02	CAREER PLANNING AND PROFESSIONAL ESSENTIALS LABORATORY (Common to BAD, BBT, BCI, BCS, BEE, BIT)	0	0	2	1
Special Course						
10	IAS50	INTEGRATED APTITUDE SKILLS - I (HIGHER) (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	0	0	0
Total			20	0	10	23

Semester - 6

S.No	Code	Name of the Course	L	T	P	C
Core Theory						
1	19AD601	DEEP LEARNING	3	0	0	3
2	19AD602	FULL STACK DEVELOPMENT	3	0	0	3
Theory Course with Project Component						
3	19AD691	PRINCIPLES OF SOFTWARE ENGINEERING	3	0	2	4
Core Elective						
4		Core Elective-2 (BAD)	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	19AD651	DEEP LEARNING LABORATORY	0	0	3	1.5
8	19AD652	FULL STACK DEVELOPMENT LABORATORY	0	0	3	1.5
Special Course						
9	IAS60	INTEGRATED APTITUDE SKILLS - II (HIGHER) (Common to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)	2	0	0	0
Total			20	0	8	22

Core Elective-1 (BAD)

S.No	Code	Name of the Course	Offered
1	19ADC01	DATA ENGINEERING USING R	AID
2	19ADC02	INFORMATION RETRIEVAL AND WEB SEARCH	AID
3	19ADC03	PRINCIPLES OF COMPUTER ARCHITECTURE	AID
4	19ADC04	RANDOMIZED ALGORITHMS	AID
5	19ADC05	PRINCIPLES OF COMPUTER GRAPHICS	AID

Core Elective-2 (BAD)

S.No	Code	Name of the Course	Offered
1	19ADC06	SOFTWARE DEFINED NETWORKS	AID
2	19ADC07	WEB MINING	AID
3	19ADC08	PARALLEL COMPUTING	AID
4	19ADC09	MACHINE LEARNING DESIGN PATTERNS	AID
5	19ADC10	DIGITAL IMAGE ANALYTICS	AID
6	19ADC11	COMPILER DESIGN	AID
7	19ADC12	RECOMMENDER SYSTEMS	AID

UG Open Elective-1

S.No	Code	Name of the Course	Offered
1	19ADP01	DATA ANALYTICS IN BIOINFORMATICS	AID
2	19ADP02	TEXT ANALYTICS	AID
3	19ADP03	KNOWLEDGE REPRESENTATION AND REASONING	AID
4	19ADP04	ARTIFICIAL INTELLIGENCE IN FINANCE	AID
5	19ADP05	ETHICS AND VALUES IN INTELLIGENT COMPUTING	AID
6	19ADP06	INFORMATION AND NETWORK SECURITY	AID
7	19BMP01	MEDICAL PHYSICS	BME
8	19BMP02	ENGINEERING OF NANOMATERIALS	BME
9	19BTP01	BIOSENSOR TECHNOLOGY	BT
10	19BTP02	IMAGING IN BIOLOGY AND MEDICINE	BT
11	19CEP01	ARCHITECTURE	CIV
12	19CEP02	BASICS OF CLIMATE SCIENCE AND POLICY	CIV
13	19CEP03	FUNDAMENTALS OF URBAN PLANNING	CIV
14	19CEP04	GEOINFORMATICS	CIV
15	19CEP05	INSTRUMENTATION FOR ENGINEERS	CIV
16	19CSP01	FREE OPEN SOURCE SOFTWARE	CSE
17	19CSP02	VIRTUAL REALITY AND AUGMENTED REALITY	CSE
18	19CSP03	INTRODUCTION TO GENETIC ALGORITHMS	CSE
19	19ECP01	NANO ELECTRONICS	ECE
20	19ECP02	IMAGING MODALITIES	ECE
21	19ECP03	CONSUMER ELECTRONICS	ECE
22	19ECP04	ARTIFICIAL NEURAL NETWORKS AND ITS APPLICATIONS	ECE
23	19ECP13	MACHINE LEARNING TECHNIQUES	ECE
24	19EEP01	VIRTUAL INSTRUMENTATION	EEE
25	19EEP02	PLC AND INDUSTRIAL AUTOMATION	EEE
26	19EEP03	PROCESS CONTROL ENGINEERING	EEE
27	19EEP04	SOFT COMPUTING TECHNIQUES	EEE
28	19ITP01	SOCIAL NETWORKING	IT
29	19ITP02	DATA SCIENCE USING R	IT

30	19ITP03	FUZZY SYSTEMS AND APPLICATIONS	IT
31	19ITP04	ANDROID AND IOS APPLICATION DEVELOPMENT	IT
32	19MEP01	PROPERTIES AND SELECTION OF ENGINEERING MATERIALS	MECH
33	19MEP02	INNOVATION AND DESIGN THINKING	MECH
34	19MEP03	MECHATRONICS	MECH
35	19MEP04	METALLURGY OF STEEL	MECH
36	19MEP05	SURFACE COATING TECHNOLOGY	MECH
37	19MEP06	SOLAR ENERGY TECHNOLOGIES	MECH
38	19UCP01	NANO MATERIALS AND THEIR APPLICATIONS	CHE
39	19UCP02	COMPUTER APPLICATIONS IN CHEMICAL SCIENCE	CHE
40	19UMP02	INTRODUCTION TO NUMBER THEORY AND CRYPTOGRAPHY	MAT
41	19UMP06	NUMBER THEORY AND GRAPH THEORY FOR CRYPTOGRAPHY	MAT

UG Open Elective-2

S.No	Code	Name of the Course	Offered
1	19ADP07	GEO SPATIAL ANALYTICS	AID
2	19ADP08	DIGITAL ASSET MANAGEMENT SYSTEMS	AID
3	19ADP09	EVOLUTIONARY COMPUTING ALGORITHMS	AID
4	19ADP10	DISTRIBUTED COMPUTING	AID
5	19ADP11	DATA SCIENCE USING PYTHON	AID
6	19ADP12	DATA VISUALIZATION WITH TABLEAU	AID
7	19BMP03	BIOMEDICAL SENSOR TECHNOLOGY	BME
8	19BMP04	SURGICAL AND CRITICAL CARE EQUIPMENT	BME
9	19BTP03	PRINCIPLES AND APPLICATIONS OF RADIOISOTOPES IN BIOTECHNOLOGY	BT
10	19BTP04	BIOFUELS	BT
11	19BTP05	MOLECULAR PATHOGENESIS OF INFECTIOUS DISEASES	BT
12	19BTP10	CLINICAL TRIALS	BT
13	19CEP06	PROJECT MANAGEMENT	CIV
14	19CSP04	CYBER CRIME AND LAWS	CSE
15	19ECP05	TOTAL QUALITY MANAGEMENT	ECE
16	19EEP05	PRINCIPLES OF MANAGEMENT	EEE
17	19EEP06	PROFESSIONAL ETHICS AND HUMAN VALUES	EEE
18	19ITP05	HUMAN RESOURCE AND MANAGEMENT	IT
19	19ITP06	INTELLECTUAL PROPERTY RIGHTS	IT
20	19ITP07	ETHICS IN COMPUTING	IT
21	19ITP08	REINFORCEMENT LEARNING	IT
22	19MEP07	ENGINEERING ECONOMICS AND COST ANALYSIS	MECH
23	19MEP08	INDUSTRIAL MANAGEMENT AND PSYCHOLOGY	MECH
24	19MEP09	DESIGN OF EXPERIMENTS	MECH
25	19MEP10	LITHOGRAPHIC PROCESSES	MECH
26	19MEP11	THERMAL TURBOMACHINES	MECH
27	19MEP12	FUEL CELL AND HYDROGEN TECHNOLOGY	MECH
28	19UEP01	BUSINESS COMMUNICATION	ENG
29	19UEP02	WRITING FOR MASS MEDIA	ENG
30	19UMP01	OPTIMIZATION TECHNIQUES	MAT
31	19UMP03	FUZZY SET AND ITS APPLICATIONS	MAT
32	19UMP04	LATTICE THEORY	MAT
33	19UMP05	GRAPH THEORY	MAT
34	19UPP01	THIN FILMS TECHNOLOGY	PHY
35	19UPP02	CRYSTAL GROWTH AND SPECTROSCOPY	PHY
36	19UPP03	PHOTONICS	PHY

UG Allied Elective-1

S.No	Code	Name of the Course	Offered
1	19BMA01	BIOLOGICAL SCIENCE AND ENGINEERING	BME
2	19BMA02	HOSPITAL PLANNING AND EQUIPMENT MANAGEMENT	BME
3	19BTA01	BIOLOGY FOR ENGINEERS	BT
4	19BTA02	BASIC MICROBIOLOGY	BT
5	19BTA03	BASIC BIOCHEMISTRY	BT

6	19BTA04	FUNDAMENTALS OF IMMUNOLOGY	BT
7	19CEA01	BUILDING PLANNING AND DRAWING	CIV
8	19CEA02	INDUSTRIAL POLLUTION PREVENTION AND CONTROL	CIV
9	19CEA03	INTRODUCTION TO ENGINEERING SEISMOLOGY	CIV
10	19CEA04	PRINCIPLES OF GLOBAL POSITIONING SYSTEM	CIV
11	19CEA05	WATER RESOURCES PLANNING AND MANAGEMENT	CIV
12	19CSA01	INTERNET PROGRAMMING	CSE
13	19CSA02	FUNDAMENTALS OF SOFTWARE ENGINEERING	CSE
14	19CSA03	INTRODUCTION TO DATABASE	CSE
15	19CSA04	FUNDAMENTALS OF OPERATING SYSTEMS	CSE
16	19ECA01	COMMUNICATION SYSTEMS	ECE
17	19ECA02	INTRODUCTION TO IMAGE PROCESSING	ECE
18	19ECA03	ARDUINO FOR ENGINEERS	ECE
19	19ECA04	MATLAB PROGRAMMING FOR ENGINEERS	ECE
20	19EEA01	INDUSTRIAL ELECTRICAL SYSTEMS	EEE
21	19EEA02	ELECTRICAL MACHINES AND DRIVES	EEE
22	19EEA03	FUNDAMENTALS OF ELECTRIC POWER UTILIZATION	EEE
23	19EEA04	GREEN ENERGY SOURCES	EEE
24	19ITA01	WEB DESIGN AND DEVELOPMENT	IT
25	19ITA02	INTRODUCTION TO JAVA	IT
26	19ITA03	PYTHON SCRIPTING	IT
27	19MEA01	AUTOMOTIVE MAINTENANCE AND POLLUTION CONTROL	MECH
28	19MEA02	ADDITIVE MANUFACTURING	MECH
29	19MEA03	DECISION SUPPORT AND INTELLIGENT SYSTEMS	MECH
30	19MEA04	ENERGY EFFICIENT BUILDINGS	MECH
31	19MEA05	ELECTRONICS PACKAGING TECHNOLOGY	MECH
32	19MEA06	FUNDAMENTALS OF ENERGY RESOURCES	MECH
33	19MEA07	FUNDAMENTALS OF FIRE SAFETY ENGINEERING	MECH
34	19MEA08	RELIABILITY ENGINEERING	MECH
35	19MEA09	STATISTICAL QUALITY CONTROL	MECH

UG Allied Elective-2

S.No	Code	Name of the Course	Offered
1	19BMA03	BIOSENSORS AND ITS APPLICATIONS	BME
2	19BMA04	INTRODUCTION TO BIOMEDICAL DEVICES	BME
3	19BTA05	CHEMICALS IN ENVIRONMENT AND PUBLIC HEALTH	BT
4	19BTA06	BIOLOGICAL WASTE MANAGEMENT	BT
5	19BTA07	NANOBIOTECHNOLOGY	BT
6	19BTA08	INTRODUCTION TO BIOINFORMATICS	BT
7	19CEA06	ENVIRONMENTAL GEOTECHNOLOGY	CIV
8	19CEA07	FUNDAMENTALS OF SMART CITY PLANNING	CIV
9	19CEA08	HYDROPOWER ENGINEERING	CIV
10	19CEA09	RESOURCES AND ENERGY RECOVERY FROM WASTE	CIV
11	19CEA10	ROAD AND RAIL TRANSPORT	CIV
12	19CSA05	FUNDAMENTALS OF CLOUD COMPUTING	CSE
13	19CSA06	INTRODUCTION TO IOT	CSE
14	19CSA07	XML PROGRAMMING	CSE
15	19CSA08	INTRODUCTION TO UML	CSE
16	19CSA09	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	CSE
17	19ECA05	MOBILE COMMUNICATION	ECE
18	19ECA06	EMBEDDED SYSTEMS FOR INDUSTRIAL APPLICATIONS	ECE
19	19ECA07	VERY LARGE SCALE INTEGRATED CIRCUITS	ECE
20	19ECA08	ROBOTICS AND ITS APPLICATIONS	ECE
21	19EEA05	SWITCHED MODE POWER CONVERTERS	EEE
22	19EEA06	FUNDAMENTALS OF POWER QUALITY	EEE
23	19EEA07	CONTROL ENGINEERING	EEE
24	19EEA08	INDUSTRIAL MEASUREMENTS AND INSTRUMENTATION	EEE
25	19EEA09	INSTRUMENTS IN BIOENGINEERING RESEARCH	EEE
26	19ITA04	GRAPHICS PROGRAMMING	IT
27	19ITA05	BIG DATA AND APPLICATIONS	IT

28	19ITA06	DECISION MAKING METHODS	IT
29	19ITA07	PHP PROGRAMMING	IT
30	19MEA10	FUNDAMENTALS OF AIRCRAFT AND SPACE TECHNOLOGY	MECH
31	19MEA11	FUNDAMENTALS OF NANOMATERIALS	MECH
32	19MEA12	FUNDAMENTALS OF THERMAL SCIENCE	MECH
33	19MEA13	PROPELLANTS, EXPLOSIVES AND PYROTECHNICS	MECH
34	19UBA01	ESSENTIALS OF FINANCE	MBA
35	19UBA02	ESSENTIALS OF HUMAN RESOURCE MANAGEMENT	MBA
36	19UBA03	ESSENTIALS OF MARKETING	MBA
37	19UBA04	ESSENTIALS OF ENTREPRENEURSHIP	MBA

Emerging Area Electives for BTECH ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

Internet of Things

S.No	Code	Name of the Course	Offered
1	19ECH01	SENSORS AND ACTUATORS	ECE
2	19ECH02	IOT ARCHITECTURE AND FRAMEWORK	ECE
3	19ECH03	COMMUNICATION PROTOCOLS FOR IOT	ECE
4	19ECH04	CLOUD SERVICES FOR IOT	ECE
5	19ECH05	BIG DATA ANALYTICS FOR IOT	ECE
6	19ECH06	PRIVACY AND SECURITY IN IOT	ECE

Sensor Technology

S.No	Code	Name of the Course	Offered
1	19ECH01	SENSORS AND ACTUATORS	ECE
2	19EEH41	DIGITAL MEASUREMENTS AND INSTRUMENTATION	EEE
3	19ECH21	ENERGY AWARE SENSORS	ECE
4	19ECH22	MULTIDISCIPLINARY SENSORS	ECE
5	19ECH23	ADVANCED SENSOR AND DETECTION MATERIALS	ECE
6	19EEH91	INDUSTRIAL INSTRUMENTATION AND TECHNOLOGY MANAGEMENT	EEE

Cyber Security

S.No	Code	Name of the Course	Offered
1	19MAH91	NUMBER THEORY FOR INFORMATION SECURITY	MAT
2	19CSH21	CRYPTOGRAPHIC ALGORITHMS AND ARCHITECTURE USING JAVA	CSE
3	19CSH22	COMPUTER FORENSICS	CSE
4	19CSH23	NETWORK SECURITY ESSENTIALS	CSE
5	19CSH24	INTERNET SECURITY	CSE
6	19CSH25	ETHICAL HACKING	CSE

Blockchain

S.No	Code	Name of the Course	Offered
1	19ITH01	CRYPTOGRAPHY AND HASHING	IT
2	19ITH02	INTRODUCTION TO DIGITAL CURRENCIES	IT
3	19ITH03	BLOCKCHAIN TECHNOLOGIES	IT
4	19ITH04	SMART CONTRACTS AND DECENTRALIZED APPLICATIONS	IT
5	19ITH05	BLOCKCHAIN PLATFORMS	IT
6	19ITH06	BLOCKCHAIN FORENSICS	IT

Virtual Reality & Augmented Reality

S.No	Code	Name of the Course	Offered
1	19ITH21	INTRODUCTION TO COMPUTER GRAPHICS	IT
2	19ITH22	INTRODUCTION TO VIRTUAL REALITY	IT
3	19ITH23	GEOMETRIC MODELLING FOR XR	IT
4	19ITH24	INTERACTIVE 3D DESIGN	IT
5	19ITH25	XR APP DEVELOPMENT	IT
6	19ITH26	VIRTUAL REALITY AND GAME DEVELOPMENT	IT

Smart Cities

S.No	Code	Name of the Course	Offered
1	19CEH01	URBAN AND REGIONAL PLANNING REGULATIONS	CIV

2	19CEH02	URBAN CLIMATE CHANGE AND ADAPTATION	CIV
3	19CEH03	IOT PLATFORM FOR SMART CITY PLANNING	CIV
4	19CEH04	INTELLIGENT TRANSPORT SYSTEMS	CIV
5	19CEH05	INTEGRATED URBAN WATER MANAGEMENT	CIV
6	19CEH06	GIS IMPLEMENTATION IN SMART CITY DEVELOPMENT	CIV

Infrastructure Engineering

S.No	Code	Name of the Course	Offered
1	19CEH21	MATERIAL PROCUREMENT AND MANAGEMENT	CIV
2	19CEH22	STRATEGIC PLANNING FOR INFRASTRUCTURE SECTORS	CIV
3	19CEH23	GEOTECHNIQUES FOR INFRASTRUCTURE	CIV
4	19CEH24	PROJECT FORMULATION AND IMPLEMENTATION	CIV
5	19CEH25	HIGH RISE BUILDINGS	CIV
6	19CEH26	INFRASTRUCTURE FINANCE	CIV

Construction Technology

S.No	Code	Name of the Course	Offered
1	19CEH41	MODERN CONSTRUCTION MATERIALS	CIV
2	19CEH42	CONSTRUCTION EQUIPMENT MANAGEMENT	CIV
3	19CEH43	ENERGY CONSERVATION METHODS IN CONSTRUCTION	CIV
4	19CEH44	INTELLIGENT BUILDING TECHNIQUES	CIV
5	19CEH45	QUALITY CONTROL IN CONSTRUCTION	CIV
6	19CEH46	RESOURCE MANAGEMENT IN CONSTRUCTION	CIV

Smart Grid Technologies

S.No	Code	Name of the Course	Offered
1	19EEH01	CONVENTIONAL AND ALTERNATE ENERGY SOURCES	EEE
2	19EEH02	INTRODUCTION TO SMART GRID AND ELECTRIC VEHICLES	EEE
3	19EEH03	DISTRIBUTED GENERATION AND MICRO GRID	EEE
4	19EEH04	IOT FOR SMART GRIDS	EEE
5	19EEH05	POWER ELECTRONIC INTERFACES FOR SMART GRID	EEE
6	19EEH06	COMMUNICATION PROTOCOLS, SECURITY AND PROTECTION FOR SMART GRID	EEE

Electrical & Computer Engineering

S.No	Code	Name of the Course	Offered
1	19EEH21	OBJECT ORIENTED PROGRAMMING USING JAVA FOR ELECTRICAL ENGINEERS	EEE
2	19EEH22	DATA ANALYSIS USING PYTHON FOR ELECTRICAL ENGINEERS	EEE
3	19EEH23	DATA MANAGEMENT FOR SMART GRID	EEE
4	19EEH04	IOT FOR SMART GRIDS	EEE
5	19EEH24	COMMUNICATION AND DATA SECURITY IN ELECTRICAL ENGINEERING	EEE
6	19EEH25	OPTIMIZATION STUDIES IN ELECTRICAL SYSTEMS	EEE

Control Systems and Sensors Technology

S.No	Code	Name of the Course	Offered
1	19ECH01	SENSORS AND ACTUATORS	ECE
2	19EEH41	DIGITAL MEASUREMENTS AND INSTRUMENTATION	EEE
3	19EEH42	INDUSTRIAL INSTRUMENTATION	EEE
4	19EEH43	PROCESS CONTROL	EEE
5	19EEH44	MEMS SENSORS AND ACTUATORS	EEE
6	19EEH45	LOGIC AND DISTRIBUTED CONTROL SYSTEMS	EEE

Artificial Intelligence and Machine Learning

S.No	Code	Name of the Course	Offered
1	19CSH01	ARTIFICIAL INTELLIGENCE FOR ENGINEERS	CSE
2	19CSH02	MACHINE LEARNING USING PYTHON	CSE
3	19CSH03	NLP TOOLS AND APPLICATIONS	CSE
4	19CSH04	COMPUTER VISION WITH OPENCV	CSE
5	19CSH05	DEEP LEARNING USING TENSOR FLOW	CSE

6	19CSH06	KNOWLEDGE REPRESENTATION AND REASONING	CSE
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3D Printing

S.No	Code	Name of the Course	Offered
1	19MEH01	INTRODUCTION TO PRODUCT DESIGN	MECH
2	19MEH02	ADDITIVE MANUFACTURING PROCESSES	MECH
3	19MEH03	DESIGN FOR ADDITIVE MANUFACTURING	MECH
4	19MEH04	REVERSE ENGINEERING	MECH
5	19MEH05	BUSINESS VALUE ENHANCEMENT WITH ADDITIVE MANUFACTURING	MECH
6	19MEH06	STANDARDS, QUALITY CONTROL AND INSPECTION	MECH

Robotics

S.No	Code	Name of the Course	Offered
1	19MEH21	FUNDAMENTALS OF ROBOTICS	MECH
2	19EEH92	ROBOT MANIPULATOR CONTROL	EEE
3	19ECH91	ROBOT OPERATING SYSTEM AND PROGRAMMING	ECE
4	19ECH92	ARTIFICIAL INTELLIGENCE AND REINFORCEMENT LEARNING	ECE
5	19MEH22	AUTONOMOUS ROBOTS	MECH
6	19MEH23	ROBOTICS IN MANUFACTURING AUTOMATION	MECH

Electric Vehicles

S.No	Code	Name of the Course	Offered
1	19MEH41	FUNDAMENTALS OF ELECTRIC AND HYBRID VEHICLES	MECH
2	19MEH42	ENERGY STORAGE AND MANAGEMENT FOR ELECTRIC VEHICLES	MECH
3	19EEH93	INTELLIGENT AND AUTONOMOUS VEHICLES	EEE
4	19MEH43	VEHICLE DYNAMICS AND CONTROL	MECH
5	19MEH44	ELECTRIC VEHICLE DESIGN	MECH
6	19EEH94	MODELING, SIMULATION AND CONTROL OF ELECTRIC VEHICLES	EEE

Energy Engineering

S.No	Code	Name of the Course	Offered
1	19MEH61	BIO ENERGY	MECH
2	19MEH62	ALTERNATE ENERGY FUELS	MECH
3	19MEH63	COMBUSTION ENGINEERING	MECH
4	19MEH64	ANALYSIS AND DESIGN OF AIR CONDITIONING SYSTEMS	MECH
5	19MEH65	ENERGY AUDIT AND ENVIRONMENT MANAGEMENT	MECH
6	19MEH66	DESIGN OF ENERGY EFFICIENT BUILDINGS	MECH

Systems Engineering

S.No	Code	Name of the Course	Offered
1	19MEH81	SCHEDULING ALGORITHMS	MECH
2	19MEH82	LEAN AND AGILE MANUFACTURING	MECH
3	19MEH83	SYSTEMS SCIENCE AND ENGINEERING	MECH
4	19MEH84	SERVICES OPERATIONS MANAGEMENT	MECH
5	19MEH85	QUALITY ENGINEERING	MECH
6	19MEH86	PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING	MECH

Data Science

S.No	Code	Name of the Course	Offered
1	19CSH41	DATA SCIENCE FOR ENGINEERS	CSE
2	19CSH02	MACHINE LEARNING USING PYTHON	CSE
3	19CSH42	DATA MINING USING R	CSE
4	19CSH43	DATA ANALYTICS USING SPARK	CSE
5	19CSH05	DEEP LEARNING USING TENSOR FLOW	CSE
6	19CSH44	DATA DRIVEN DECISION MAKING	CSE

Genome Engineering & Technology

S.No	Code	Name of the Course	Offered
1	19BTH01	HUMAN PHYSIOLOGY	BT
2	19BTH02	ENZYME - COENZYME CHEMISTRY	BT

3	19BTH03	INTRODUCTION TO ECOLOGY AND EVOLUTION	BT
4	19BTH04	REGULATORY ISSUES IN PRODUCTION OF BIOLOGICALS	BT
5	19BTH05	GENE EDITING TECHNOLOGIES	BT
6	19BTH06	TRANSGENIC TECHNOLOGY	BT

Biosimilar Technology

S.No	Code	Name of the Course	Offered
1	19BTH01	HUMAN PHYSIOLOGY	BT
2	19BTH02	ENZYME - COENZYME CHEMISTRY	BT
3	19BTH21	MOLECULAR TOXICOLOGY	BT
4	19BTH04	REGULATORY ISSUES IN PRODUCTION OF BIOLOGICALS	BT
5	19BTH22	BIO-TRANSPORT PHENOMENA	BT
6	19BTH23	GOOD LABORATORY AND MANUFACTURING PRACTICES	BT

Computer Science and Biology

S.No	Code	Name of the Course	Offered
1	19CSH91	COMPUTER FUNDAMENTALS FOR BIOLOGICAL DATA REPRESENTATION	CSE
2	19CSH92	PYTHON AND R PROGRAMMING FOR BIOTECHNOLOGISTS	CSE
3	19BTH03	INTRODUCTION TO ECOLOGY AND EVOLUTION	BT
4	19BTH41	COMPUTER-AIDED DRUG DESIGN	BT
5	19BTH42	MATHEMATICAL MODELING IN BIOLOGY	BT
6	19BTH43	COMPUTATIONAL GENOMICS	BT

Medical Robotics and Devices

S.No	Code	Name of the Course	Offered
1	19MEH21	FUNDAMENTALS OF ROBOTICS	MECH
2	19EEH92	ROBOT MANIPULATOR CONTROL	EEE
3	19ECH91	ROBOT OPERATING SYSTEM AND PROGRAMMING	ECE
4	19CSH04	COMPUTER VISION WITH OPENCV	CSE

19HS101 TECHNICAL ENGLISH - I

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

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Developing listening skills and participate effectively in conversations
- Basic reading and writing skills to comprehend engineering and technology concepts
- Using grammatical structures
- Enhancing the vocabulary building
- Key strategies and expressions for communicating effectively and appropriately in real life situations

Course Outcome:

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

- Improve the listening skills to practice in real contexts
- Read general as well as technical articles and construct lucid sentences in English
- Apply the right grammar convention in all sorts of communication in English language
- Develop a comprehensive understanding of the extensive vocabulary usage in formal English language
- Use English in multiple contexts

Unit I**9**

Listening: Listening Skills: Importance and Types - Differentiating Hearing and Listening - Listening to small talks (mp3 files)

Speaking: Greetings, Introducing Oneself, One's family/friends, Describing Native places, Festivals

Reading: Casual Reading - Skimming and Scanning - Identifying the main ideas - Summarizing and Note-making

Writing: Free writing on any given topic (My favourite place / Hobbies / School life, etc.) - Informal letter and Informal email, Instructions

Grammar: Parts of Speech- Kinds of Sentences - Word Order - Question Framing - Question Tags

Vocabulary: Etymology - Word Formation - Affixes

Unit II**9**

Listening: Listening to video lectures/talks (TED Talk), Leaders' orations with follow-up exercises, Newspaper Articles

Speaking: Seeking and Sharing Information

Reading: Deducing meanings from contexts - Making Inferences, Predicting & Finding key information in given texts - Comprehension Exercises

Writing: Letter to the Editor (Regarding Social Issues) - Recommendations - Developing Hints

Grammar: Nouns (Singular and Plural forms) - Determiners - Prepositions

Vocabulary: Single line Definitions - Idioms

Unit III**9**

Listening: Listening to different accents - Watching documentaries and responding to questions

Speaking: Describing Pictures - Events and chit-chats

Reading: Cohesive Markers - Sieving Transition words

Writing: Interpretations of bar graphs and tables - Paragraph Writing (Compare and Contrast/Analytical) - Jumbled sentences - Dialogue Writing

Grammar: Conjunctions - Gerunds - Degrees of Comparison

Vocabulary: Discourse markers - Single word Substitutes

Unit IV**9**

Listening: Excerpts from Films Focusing on Themes and Follow up exercises

Speaking: Responding to Questions - Giving Impromptu Talks - Pair Interactions

Reading: Predicting Open-ended Stories/Documentaries/Speech

Writing: Formal Letters - Invitations (Accepting/Declining) - Seeking Permission (Industrial Visits)

Grammar: Tense - Adverbs - Phrasal Verbs

Vocabulary: Standard Abbreviations & Acronyms - Collocations

Unit V**9**

Listening: Listening to Quiz Programmes/ Spell Bee Contests

Speaking: Role-play Activities

Reading: Silent Reading (Newspapers/Books/ Pamphlets) understanding captions

Writing: Creating Posters/Notices - Creative Writing (Story Writing) - Advertisements Grammar: Modal verbs - Same word in a different parts of speech - Error Corrections (Paragraphs)

Vocabulary: Lexical items (fixed / semi fixed expressions)

Text Book:

1. Kumar, Sanjay and Pushp Lata. Communication Skills: A Workbook. New Delhi: OUP, 2018.
2. Shoba, K.N. and Lourdes Joavani Rayen . Communicative English: A Workbook. New Delhi: CUP, 2019

Reference Book:

1. Sudharshana,N.P. and C.Savitha. English for Technical Communication. NewDelhi: OUP, 2017.
2. Haines, Simon, Mark Nettle and Martin Hewings. Advanced Grammar in Use Supplementary Exercises. New Delhi: CUP, 2008.

19BS101 MATHEMATICS - I

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

L	T	P	C
3	2	0	4

Course Objective:

To impart knowledge on

- To explain the concept of functions of several variables and partial derivatives.
- To evaluate problems in multiple integrals and its applications in Engineering.
- To compare the types of infinite series and their convergence.
- To solve ordinary differential equations obtained in Engineering problems.
- To explain about the importance of statistical methods in Engineering.

Course Outcome:

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

- Apply the concept of functions of several variables and partial derivatives.
- Explain about multiple integrals and their usage.
- Examine the convergence for any infinite series.
- Solve ordinary differential equations by various techniques.
- Compute different measures of central tendency and dispersion

Unit I FUNCTIONS OF SEVERAL VARIABLES**12**

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

Unit II MULTIPLE INTEGRALS**12**

Double integrals – Change of order of integration – Change of variables – Double integrals in polar coordinates – Area enclosed by plane curves – Triple integrals– Triple integrals in cylindrical and spherical coordinates – Volume of Solids.

Unit III INFINITE SERIES**12**

Sequences – Convergence of series – General properties – Series of positive terms – Tests for convergence: Comparison test, Integral test, Comparison of ratios 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

Unit IV DIFFERENTIAL EQUATIONS**12**

Equation of first order with higher degree – Clairaut's equation – Linear differential equations – Rules for finding the complementary function – Rules for finding the particular integral – Method of variation of parameters – Homogeneous equation of Euler's and Legendre's type.

Unit V STATISTICS**12**

Measures of central tendency – Arithmetic Mean – Geometric Mean– Harmonic Mean – Median – Mode – Measures of Dispersion – Range – Quartile deviation – Mean Deviation –Standard deviation- Coefficient of Variation- Correlation – Coefficient of correlation – Lines of Regression.

Text Book:

1. Grewal B.S., "Higher Engineering Mathematics", Khanna Publishers, New Delhi, 44th Edition, 2017.

Reference Book:

1. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 4th Edition, 2014.
2. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Pvt. Ltd, Singapore, 9th Edition, 2006, (Reprint 2013).
3. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 11th Reprint, 2013.
4. Srimanta Pal and Subodh C. Bhunia, " Engineering Mathematics" Oxford university Press, New Delhi, Third impression 2016.
5. S.C. Gupta, V.K. Kapoor, " Fundamentals of Mathematical Statistics", Sultan Chand & Sons, 11th Edition, 2002 (Reprint, 2015)

19BS102 ENGINEERING CHEMISTRY

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

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- Treatment of water for potable and industrial purposes.
- Principles of electrochemistry, electrochemical cells, emf and applications of emf measurements.
- Principles of corrosion and corrosion control techniques.
- Energy storage devices and various types of Lubricants.
- Different types of fuels and combustion.

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 its applications.
- Know the principles, various types of corrosion and corrosion control techniques.
- Have a thorough knowledge on batteries and lubricants.
- Have a sound knowledge on different types of fuels.

Unit I WATER TECHNOLOGY**9**

Characteristics of water – alkalinity – types of alkalinity and determination – hardness – types of hardness and estimation by EDTA method (problems on calculation of hardness only) – Boiler feed water – requirements – disadvantages of using hard water in boilers – priming and foaming – sludges and scales – caustic embrittlement – boiler corrosion – external conditioning (demineralization process) – internal conditioning (colloidal, phosphate, carbonate and calgon conditionings) – Domestic water treatment – disinfection methods (Chlorination, Ozonation and UV treatment) – break point chlorination – salinity – desalination by reverse osmosis.

Unit II ELECTROCHEMISTRY**9**

Electrochemical cells – reversible and irreversible cells – EMF – measurement of emf – Single electrode potential – Nernst equation (problems) – reference electrodes – Standard Hydrogen electrode – Calomel electrode – Ion selective electrode – glass electrode and measurement of pH – Standard Cell – electrochemical series – significance – potentiometric redox titration – conductometric titrations (Strong acid Vs Strong base and Weak acid Vs Strong base)

Unit III CORROSION AND ITS CONTROL**9**

Chemical corrosion – Pilling-Bedworth rule – electrochemical corrosion – differential aeration corrosion – factors influencing corrosion – different types – galvanic corrosion, erosion corrosion, pitting corrosion, crevice corrosion, waterline corrosion and stress corrosion – corrosion control – sacrificial anode and impressed current cathodic methods – corrosion inhibitors – Protective coatings – pretreatment of surface – metallic coating – hotdipping, spraying, cladding, cementation and electroplating (Cr, Cu, Ni and Au) – electrolessplating (electroless nickel plating only).

Unit IV ENERGY STORAGE DEVICES AND LUBRICANTS**9**

Batteries – Primary battery – Dry cell and Lithium battery – Secondary battery – Lead acid battery, Nicad battery and Lithium ion battery – Fuel cells – H₂-O₂ fuel cells – Supercapacitors – EDLC and its applications.

Lubricants – mechanism of lubrication, liquid lubricants – properties (viscosity index, flash point, fire point, cloud point, pour point and oiliness) – solid lubricants – graphite and molybdenum disulphide – semisolid lubricants and emulsions.

Unit V FUELS AND COMBUSTION**9**

Fuels – Classification – Calorific value (Problems using Dulong's formula) – Coal – proximate and ultimate analysis – Hydrogenation of coal – Petroleum – processing and fractions – cracking – catalytic cracking and methods – synthetic petrol – Fischer-Tropsch and Bergius processes – knocking – octane number and cetane number – Biofuels – Gaseous fuels – Natural gas, CNG and LPG – Flue gas analysis – Orsat apparatus – Combustion – theoretical calculation of air (Problems on calculation of weight of air only).

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).

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).

19GEM01 ENGINEERING GRAPHICS

Offered by MECH (Core Theory offered to BAD, BBT, BCI, BCS, 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 solids.
- 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
- Section and Develop lateral surfaces of solids
- Apply isometric and perspective projections.

Unit I PLANE CURVES AND PICTORIAL VIEWS TO ORTHOGRAPHIC VIEWS**8**

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**8**

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**8**

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 SECTION OF SOLIDS AND DEVELOPMENT OF LATERAL SURFACES OF SOLIDS**8**

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.

Development of lateral surfaces of simple solids – Prisms, pyramids, cylinders and cones - Development of lateral surfaces of sectioned solids.

Unit V ISOMETRIC AND PERSPECTIVE PROJECTIONS**5**

Principles of isometric projection – Isometric scale – Isometric View – Isometric projections of simple solids and cut solids – Prisms, pyramids, cylinders, cones – Combination of two solid objects in simple vertical positions.

Perspective projection of simple solids – Prisms, pyramids and cylinders by visual ray method.

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.

Text Book:

1. Natarajan K.V., "A text book of Engineering Graphics", Dhanalakshmi Publishers, Chennai, 2018.

Reference Book:

1. Venugopal K. and Prabhu Raja V., "Engineering Graphics", New Age International (P) Limited, 2018.
2. Gopalakrishna K.R., "Engineering Drawing" (Vol. I&II combined), Subhas Stores, Bangalore, 2007.
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. Shah M.B., and Rana B.C., "Engineering Drawing", Pearson, 2nd Edition, 2009.
5. N.D. Bhatt, "Engineering Drawing" Charotar Publishing House, 53rd Edition, (2014).

19GE101 COMPUTER PROGRAMMING

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

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 modular and readable C programs
- To understand the usage of arrays and strings
- To learn to use pointers to access and manipulate memory
- To exploit the notion of derived data types and file

Course Outcome:

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

- Solve problems using sound techniques
- Develop modular C programs for a given problem
- Store and manipulate homogeneous data using arrays and strings
- Write programs that uses memory based on the run time needs
- Store and manipulate heterogeneous data using structures and manipulate data stored on permanent storage

Unit I FUNDAMENTALS OF C**9**

Basic Organization of a Computer - 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 - Pre-processor directives (#include, #define)

Unit II BASIC CONSTRUCTS IN C**9**

Managing simple Input and Output operations - Operators and Expressions - Decision Making: Branching statements, Looping statements - Function: Declaration, Definition - 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 - Pre-processor directives (#if, #else, #elif, #ifdef, #ifndef)

Unit IV POINTERS IN C**10**

Pointers - Parameter passing mechanism in functions - 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 - Command Line Arguments

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, Working with Text Files and Binary Files

Text Book:

1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013 reprint
2. Byron S Gottfried, "Programming with C, Schaum's Outlines", Third Edition, Tata McGraw-Hill Education, 2017 reprint.

Reference Book:

1. Brian.W.Kernighan and Dennis.M.Ritchie, "The C Programming language", Second Edition, Pearson Education, 2006 reprint.
2. R.G. Dromey, "How to Solve it by Computer", Pearson Education, 2008
3. Al Kelley, Ira Pohl, "A Book on C : Programming in C", Fourth Edition, Pearson Education, 2008 reprint
4. Deitel.P.J and Deitel.H.M, "C How to Program", Seventh Edition, Prentice-Hall of India, 2013 reprint.
5. Ashok N. Kamthane, "Computer programming", Second Edition, Pearson Education, 2012.
6. Yashavant P. Kanetkar, "Let Us C", Sixteenth Edition, BPB Publications, 2018.

Extensive Reading:

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

19BS181 ENGINEERING PHYSICS

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

L	T	P	C
3	0	2	4

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 introduce the fundamentals of Quantum physics.
- To impart knowledge on waves and 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 of properties of matter and its applications.
- Have adequate knowledge on the concepts of acoustics and ultrasonics.
- Acquire knowledge on the concepts of waves, lasers and their applications in fiber optics.
- Get knowledge on advanced physics concepts of quantum theory.
- Comprehend the basics of crystals, their structures and different crystal growth techniques.

Unit I PROPERTIES OF MATTER

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

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

Inadequacy of classical mechanics- Black body radiation -Planck's theory (derivation) -Wave and particle duality of radiation-de Broglie concept of matter waves-Heisenberg's uncertainty principle -Applications -Principle of superposition - wave packet-Schrodinger wave equation - Time dependent and time independent wave equation- Interpretation of wave function-Admissibility conditions of wave function- Particle confined in one and three dimensional infinite square well potential

Unit IV WAVES AND FIBER OPTICS

Wave motion-Travelling wave in one dimension-Wave equation examples-Superposition of waves and standing waves-Simple harmonic motion -Lasers - Einstein's coefficients - CO₂, Nd:YAG and semiconductor lasers - homojunction and heterojunction lasers-construction and working - applications - Optical fibers - classification (index & mode based) - principle and propagation of light in optical fibers - acceptance angle and numerical aperture - fiber optic communication system - pressure and displacement fiber optic sensors

Unit V SOLID STATE PHYSICS

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 vectors, stacking faults

Practical Course**20****Practical Experiments:**

LIST OF EXPERIMENTS FOR PHYSICS LABORATORY

(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. Air-wedge-Determination of thickness of a thin sheet of paper
4. Spectrometer-Determination of wavelength of Hg spectrum using grating
5. Determination of ultrasonic velocity of sound and compressibility of liquid-Ultrasonic interferometer.
6. Carey Foster Bridge-Determination of specific resistance of the given coil of wire.
7. Laser-(i) Particle size and wavelength determination (ii) Numerical aperture and acceptance angle measurement of an optical fibre
8. Post Office Box- Determination of band gap of a semiconductor
9. Indexing of Powder Diffraction Pattern

10. Uniform pending- Young's modulus determination
11. Spectrometer- Dispersive power of the prism
12. Viscosity of liquids-Determination of co-efficient of viscosity of a liquid by Poiseuille's method.

Text Book:

1. John W. Jewett. Jr, and Raymon A. Serway, Physics for Scientists and Engineers with Modern Physics – Seventh Edition, Cengage Learnings, Delhi, India, 2013.
2. David Halliday, Robert Resnick and Jearl Walker, Fundamentals of Physics, sixth edition, John Wiley and Sons, New Delhi, 2010.
3. Marikani A, Engineering Physics, PHI, New Delhi, 2013.
4. Arumugam, M., Engineering Physics, Anuradha Publications, 2000.

Reference Book:

1. Sankar, B.N., Pillai.S.O., Engineering Physics I, New Age International (P) Ltd., 2015.
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
4. Physics Laboratory Manual, Department of Physics, Mepco Schlenk Engineering College, Sivakasi.

19GE151 COMPUTER PROGRAMMING LABORATORY

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

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:**

Study of simple Document Processing & Presentation Preparation

Study of basic OS commands, Software Engineering Practices -2 sessions (Not for End Examination)

Programs using simple statements

Programs using decision making statements

Programs using looping statements

Programs using user defined functions and recursive functions

Programs using one dimensional and two dimensional arrays

Solving problems using string functions

Programs using pointers and dynamic memory allocation

Programs using structures and unions

Programs using pointers to structures and other data types

Programs using text files

Programs using binary files

Practical Experiments:

Word Processing

i) Create a new word document named 'Student Record' and

- Set left margin at 1.8" and right margin at 1.3".

- Your heading should be in Times New Roman, Bold and Italic with size 12.

- Include the Page number at the top of every page.

- Type your personal details.

- Table with details of 10 students with the following fields: Student name, Department, Internal, External, total, result, Examination held.

ii) Create a word document named "Scientific Notation" and type one paragraph about the Equation editor with font size 10, and in 'Calibri' format. Apply page set up with line spacing of 1 and type the following equations:

iii) Create a sheet in EXCEL as shown below:

Roll No	Name	M1	M2	M3	M4	Total	Percentage	Status
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Maximum

Minimum

- Validate the columns M1, M2, M3 and M4 so that the marks lie in the range 0- 100 and enter the roll number of the students using auto fill.

- Calculate Total = sum of M1, M2, M3 and M4 and it should appear at the center of the cell.

- Percentage = Total / 3 and format these cell values so that all the values got 2 digits after the decimal point.

Status = "pass", if M1, M2, M3 and M4 ≥ 50 = "fail", otherwise

iv) Create a power point presentation about your school using animation, design template and effective presentation.

A company XYZ pays their employers on a monthly basis. 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.

A company XYZ pays their employers on a monthly basis. 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.

Collecting money becomes increasingly difficult during periods of recession, so companies may tighten their credit limits to prevent their accounts receivable (money owed to them) from becoming too large. In response to a prolonged recession, one company has cut its customers' credit limits in half. Thus, if a particular customer had a credit limit of \$2000, it's now \$1000. If a customer had a credit limit of \$5000, it's now \$2500. Write a program that analyzes the credit status of a customer. For each customer you're given:

- The customer's account number
- The customer's credit limit before the recession
- The customer's current balance (i.e., the amount the customer owes the company).

Your program should calculate and print the new credit limit for the customer and should determine and print whether customer has current balance that exceeds their new credit limits.

A right triangle can have sides that are all integers. The set of three integer values for the sides of a right triangle is called a Pythagorean triple. These three sides must satisfy the relationship that the sum of the squares of two of the sides is equal to the square of the hypotenuse. Find all Pythagorean triples for side1, side2, and the hypotenuse all no larger than 500. Use a triple-nested for loop that simply tries all possibilities. ($\text{hypotenuse}^2 = \text{side1}^2 + \text{side2}^2$)

It is required to display a series of numbers in descending order say 10 to 1. Develop a recursive code in c language and implement it.

Read in an array of integers and print its elements in reverse order.

Write a function that will scan a character string passed as an argument and convert all lowercase characters into their uppercase equivalents.

Read in a sequence of elements from the user and implement the code in C to find the kth largest element. Dynamically allocate memory for storing the elements based on the user's input.

Develop a code to implement mark processing system using structures. (Each record has the following fields: Name, Reg_no, Mark1, Mark2, Mark3, Mark4, Total, average). Get the details of 'n' student details with marks. Find the total and average marks for each student and print the student details based on the Reg_No given as input by the user.

A stationery shop owner needs to maintain the details of items in his shop such as item id, name, no of items available, price per item and display the details about the item based on the item id. Develop a code in c to implement the operations by dynamically allocating space for the items.

Display the contents of file from the character at nth position. Assume the content of file is
abcdefghijklmnopqrstuvwxyz0123456789ABCDEFGHIJ

Write a code in C to store details of faculty (faculty id, name, dept, designation, qualification) in a binary file. Also read the binary file and display the details of faculty belonging to a particular dept.

Miniproject: making use of the concepts learnt in this course

Reference Book:

1. Pradip Dey, Manas Ghosh, "Computer Fundamentals and Programming in C", Second Edition, Oxford University Press, 2013 reprint
2. Byron S Gottfried, "Programming with C, Schaum's Outlines", Third Edition, Tata McGraw-Hill Education, 2017 reprint.
3. Brian.W.Kernighan and Dennis.M.Ritchie, "The C Programming language", Second Edition, Pearson Education, 2006 reprint.
4. Yashavant P. Kanetkar, "Let Us C", Sixteenth Edition, BPB Publications, 2018.

Extensive Reading:

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

19GE152 ENGINEERING PRACTICES LABORATORY

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

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- Various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
- Plumbing and carpentry components.
- Basic machining processes such as drilling and lathe machine in workshop.
- Measurement of electrical quantities, energy and resistance to earth.
- Soldering Practice

Course Outcome:

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

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

The Laboratory examination would 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, totaling 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:**GROUP A (CIVIL & MECHANICAL)**

List of Experiment:

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 used

Planning practice and Middle Lap Joint

Tee Halving Joint

Dove Tail Joint

MECHANICAL ENGINEERING PRACTICE

Study of Welding and its Tools used

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 equipment – Resistor, colour coding measurement of AC signal parameter (peak-peak, rms period, frequency) using CRO.

Study of logic gates AND, OR, EXOR and NOT.

Generation of Clock Signal.

Soldering practice – Components Devices and Circuits – Using general purpose PCB.

Measurement of ripple factor of HWR and FWR.

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.

19HS201 TECHNICAL ENGLISH - II

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

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- LSRW skills in English
- Interpreting graphical data and developing logical writing using cohesive devices
- Formal writings for internal and external communication
- Acquiring English required for independent and effective communication in terms of academic requirements
- 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
- Involve in professional correspondences confidently
- Use English independently and effectively for academic requirements
- Present ideas as per the need of the audience and situation

Unit I

9

Listening: Listening to a Telephone Conversations - Video Lectures (NPTEL)

Speaking: Role-play Practice pertaining to Telephone Skills and Telephonic Phrases

Reading: Advertisements (Job/Product) - Profile of the company

Writing: Cover letter - Resume Preparation - Resume templates - Product Description - Checklist

Grammar: Compound Words - Conditional Clauses

Vocabulary: Homonyms and Homophones - Misspelt words

Unit II

9

Listening: Listening to Technical Talks and Conversations

Speaking: Asking for Direction and Help - Describing Simple Process

Reading: Speed Reading - Reading passages with time limit

Writing: Essay Writing - Interpretation of Charts (Flow chart and pie chart) - Instructions

Grammar: Connectives - Purpose Expressions

Vocabulary: American and British English - Use of Sequence Words

Unit III

9

Listening: Sports Commentaries / Animated stories and Follow-up Exercises

Speaking: Preparing Commentaries for Muted Videos

Reading: Short Story - Critical Reading - Understanding Varied Styles of Writing

Writing: Writing a review / Summary of a Story /Article - Precis Writing - Letter of Enquiry, Quotation, Order, Claim and Adjustment

Grammar: Subject-Verb Agreement

Vocabulary: Vocabulary used in Formal Letters, Emails and Reports

Unit IV

9

Listening: Listening to Informal Conversations and Follow-up Exercises. (Mp4 files). Speaking: Situational conversations (Meeting a friend in a café) - Narrating Personal Experience

Reading: Developing Analytical Skills - Verbal Reasoning

Writing: Biography Writing - Writing Statement of Purpose (SoP) - Emails, Memos, Notices and Circulars - Minutes of the Meeting

Grammar: Voice - Numerical Expressions

Vocabulary: Technical Jargons and Cliche

Unit V

9

Listening: Model Debate and Reviewing the Performance of each participant

Speaking: Group Communication Skills - Discussing Social Issues and Current Affairs Reading: Fitting Sentences in Paragraphs

Writing: Itinerary - Report - Accident report, Feasibility report - Recommendations

Grammar: Cause and Effect Expressions - Reported Speech

Vocabulary: Verbal Analogies

Text Book:

1. Sumant,S and Joyce Pereira. Technical English II. Chennai: Vijay Nicole Imprints Private Limited, 2014.
2. Kumar, Sanjay and Pushp Lata. Communication Skills: A Workbook. New Delhi: OUP, 2018.

Reference Book:

1. Raman, Meenakshi & Sangeetha Sharma. Communication Skills. New Delhi: OUP, 2018
2. Rizvi M, Ashraf. Effective Technical Communication. New Delhi: Tata McGraw-Hill Publishing Company Limited,

2007.

3. Shobha.K.N. and D.Praveen Sam. Technical English: A Workbook. Chennai: CUP, 2019.

19BS201 MATHEMATICS - II

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

L	T	P	C
3	2	0	4

Course Objective:

To impart knowledge on

- To explain the matrix algebra techniques for practical applications.
- To apply the concepts of vector calculus to solve engineering problems.
- To analyse about some elementary complex functions.
- To apply complex integration in engineering problems.
- To make the student for applying the Laplace and Fourier transform in their domains.

Course Outcome:

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

- Explain about matrix algebra.
- Solve engineering problems using vector calculus.
- Use complex variable theory for applications like heat conduction, fluid dynamics etc.
- Apply complex integration in engineering problems.
- Solve linear ODE and wave functions using Laplace and Fourier transforms.

Unit I MATRICES**12**

Characteristic equation – Eigenvalues and Eigenvectors of a real matrix – Properties of eigenvalues and eigenvectors – Cayley-Hamilton theorem – Diagonalization of matrices – Nature of quadratic forms – Reduction of a quadratic form to canonical form by orthogonal transformation – Evaluation of inverse of a matrix by elementary row operations – LU decomposition.

Unit II VECTOR CALCULUS**12**

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 (excluding proofs) – Verification and application in evaluating line, surface and volume integrals

Unit III ANALYTIC FUNCTIONS**12**

Analytic functions – Necessary and Sufficient conditions for analyticity – properties – Harmonic conjugates – Construction of analytic functions – Conformal mapping – Mapping by functions $w = z+c$, cz , $1/z$ and z^2 – Bilinear transformation.

Unit IV COMPLEX INTEGRATION**12**

Line integral – Cauchy's theorem and integral formula – Taylor's and Laurent's series – Singularities – Residues – Residue theorem – Application of residue theorem for evaluation of real integrals – Use of circular contour and semi-circular contour with no pole on real axis

Unit V LAPLACE AND FOURIER TRANSFORMS**12**

Laplace transform – Transform of periodic functions – Inverse Transform by Convolution – Application to solution of linear ODE with constant coefficients – Fourier transform pair – Transforms of elementary functions – Convolution theorem – Parseval's identity – Relation between Fourier and Laplace transforms.

Text Book:

1. Grewal. B.S, "Higher Engineering Mathematics", Khanna Publications, New Delhi, 44th edition, 2017

Reference Book:

1. Jain R.K. and Iyengar S.R.K., "Advanced Engineering Mathematics", Narosa Publications, New Delhi, 4th Edition, 2014
2. Greenberg M.D., "Advanced Engineering Mathematics", Pearson Education, New Delhi, 2nd Edition, 11th Reprint, 2013
3. Peter V.O'Neil, "Advanced Engineering Mathematics", Cengage Learning India Pvt., Ltd, New Delhi, 7th Edition, 2012
4. Ramana B.V, "Higher Engineering Mathematics", Tata McGraw Hill Publishing Company, New Delhi, 11th Reprint, 2010.
5. Erwin Kreyszig, "Advanced Engineering Mathematics", John Wiley & Sons Pvt. Ltd, Singapore, 9th Edition, 2006, Reprint 2013

19BS203 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

Classical free electron theory - electrical and thermal conductivity–Wiedemann Franz law–Draw backs 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

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–Hall effect–Determination of Hall coefficient

Unit III SEMICONDUCTING DEVICES

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, UJT, photodiode and phototransistor.

Unit IV MAGNETIC PROPERTIES OF MATERIALS

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 in audio tapes, floppy and hard disk drives.

Unit V NANO ELECTRONIC DEVICES

Introduction - quantum confinement – quantum structures - Density of states in quantum well, quantum wire and quantum dot structures – resonant tunneling Diode – quantum interference effects – mesoscopic structures: conductance fluctuations and coherent transport – Coulomb blockade effects - Single electron phenomena and Single electron Transistor – spintronics - Carbon nanotubes :Preparation (CVD, Arc Discharge, laser Ablation), Properties and applications.

Text Book:

1. Pradeep Fulay, Jung-Kun Lee, Electronic, Magnetic, and Optical Materials, CRC Press, 2017
2. Todd D. Steiner, Semiconductor Nanostructure for Optoelectronic Applications, ArTech House Publishers, Boston, London, 2004
3. Marikani A, Materials Science, PHI Publishing, New Delhi, 2017
4. Kasap, S.O., Principle of Electronic Materials and devices, Tata Mc-Graw Hill, 2007

Extensive Reading:

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

19IT201 OBJECT ORIENTED PROGRAMMING USING C++

Offered by IT

(Core Theory offered to BAD, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the concepts of object-oriented programming (OOP)
- To familiarize with function overloading, operator overloading and type conversion
- To learn the OOP concepts such as inheritance, Run Time polymorphism and exceptional handling
- To explore function and class templates and Standard Template Library(STL)
- To realize file handling, Namespaces and IO Manipulators

Course Outcome:

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

- Develop simple applications using C++
- Perform operator overloading and type conversion
- Apply exception handling and templates to functions and classes
- Apply inheritance to classes and perform Run time polymorphism by using virtual function
- Implement Files, namespaces, IO Manipulators and STL to application

Unit I OBJECT ORIENTED PROGRAMMING CONCEPTS**9**

Object oriented programming – classes - objects – methods and messages – abstraction and encapsulation – inheritance – abstract classes – polymorphism – Information hiding. Introduction to C++ – reference variables – access modifiers – operators – classes and objects – anatomy – access specifiers – static members - pointers and objects – constant objects – nested classes – local classes – inline - default arguments – function overloading – friend functions – const and volatile functions– static functions.

Unit II CONSTRUCTORS AND OVERLOADING**9**

Constructors – default constructor – Parameterized constructors – Constructor with dynamic allocation – copy constructor - explicit constructor – destructors – operator overloading – restrictions – overloading through member function - overloading unary – binary - assignment, array subscript, function call operator - overloading through friend functions – User defined type conversion.

Unit III EXCEPTION HANDLING AND TEMPLATES**9**

Exception handling – try-catch-throw paradigm – multiple catch – catch all - exception specification – rethrowing terminate and Unexpected functions – Uncaught exception – Function templates - class templates.

Unit IV INHERITANCE AND RUNTIME POLYMORPHISM**9**

Inheritance – part of relationship – public, private, and protected derivations – inheritance types – Problems in multiple inheritance - virtual base class – composite objects - Runtime polymorphism – this pointer - virtual functions – use - pure virtual functions – RTTI – typeid – dynamic casting – RTTI and templates – cross casting – down casting .

Unit V FILES, NAMESPACES AND STL**9**

Streams and formatted I/O – I/O manipulators - file handling – random access – object serialization – namespaces - std namespace – String Objects – standard template library.

Text Book:

1. Bhusan Trivedi, "Programming with ANSI C++- a step by step approach", Oxford University Press, Second Edition, 2014.

Reference Book:

1. Ira Pohl, "Object Oriented Programming using C++", Pearson Education, Third Edition, Reprint 2010.
2. S. B. Lippman, Josee Lajoie, Barbara E. Moo, "C++ Primer", Pearson Education, Fourth Edition, Reprint 2011.
3. B. Stroustrup, "The C++ Programming language", Pearson Education, Fourth edition, 2013.
4. Robert Lafore, "Object-Oriented Programming in C++", SAMS Publications, Fourth Edition, 2009.

Extensive Reading:

- <http://msdn.microsoft.com/en-us/library/hh875057.aspx>
- <http://www.cplusplus.com/doc/tutorial/>
- <http://www.cprogramming.com/tutorial/>
- <http://www.learncpp.com/cpp-tutorial/>

19IT202 DIGITAL LOGIC DESIGN

Offered by IT

(Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce various boolean theorems and different methods to simplify Boolean functions
- To attain knowledge of design of combinational circuits and their HDL / Verilog HDL simulation
- To know the basics of memory and programmable logic devices
- To train the design and analysis procedure for synchronous sequential circuits and their HDL / Verilog HDL simulation
- To guide the design and analysis procedure for fundamental mode asynchronous sequential circuits

Course Outcome:

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

- Simplify the Boolean function and realize them using logic gates
- Design the combinational circuits and simulate them using HDL / Verilog HDL
- Design of combinational circuits using memory and programmable logic devices
- Design synchronous sequential circuit and simulate them using HDL / Verilog HDL.
- Design fundamental mode asynchronous sequential circuits.

Unit I BOOLEAN ALGEBRA AND SIMPLIFICATION**9**

Number Systems - Complements - Codes - Logic gates - Boolean algebra and theorems - Boolean functions - Simplifications of Boolean functions - Karnaugh map method - Tabulation method - Implementation of Boolean functions using logic gates

Unit II COMBINATIONAL LOGIC CIRCUIT DESIGN**9**

Combinational circuits - Design procedure - Adder - Subtractor - Multiplier - Code converters - Decoders and encoders - Multiplexers and Demultiplexers - Introduction to Hardware Description Language (HDL) - HDL for combinational circuits

Unit III MEMORY AND PROGRAMMABLE LOGIC**9**

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

Unit IV SYNCHRONOUS SEQUENTIAL LOGIC CIRCUIT DESIGN**9**

Sequential circuits - Flip-Flops - Design procedure - State reduction and state assignment - Analysis procedure - Shift registers - Counters - HDL for Sequential Circuits

Unit V ASYNCHRONOUS SEQUENTIAL LOGIC CIRCUIT DESIGN**9**

Fundamental mode asynchronous sequential circuit - Design procedure - Reduction of state and flow tables - Race-free state assignment - Analysis procedure - Hazards - Design of hazard free circuits

Practical Course**-6****Text Book:**

1. S.Salivahanan and S. Arivazhagan, "Digital Circuits and Design", 5th Edition, Oxford University Press, 2018.
2. M.Morris Mano and Michael D. Ciletti, "Digital Design: with an Introduction to the Verilog HDL", Pearson Education, 5th edition, 2014.

Reference Book:

1. Thomas L. Floyd, "Digital Fundamentals", Pearson Education, 11th edition, 2015.
2. Donald D.Givone, "Digital Principles and Design", Tata McGraw-Hill, 2017.
3. William J. Dally, R. Curtis Harting, Tor M. Aamodt, "Digital Design Using VHDL - A Systems Approach", Cambridge University Press, 1st Edition, 2016.

Extensive Reading:

- <http://www.doe.carleton.ca/~shams/ELEC3500/hazards.pdf>
- <https://nptel.ac.in/>

19BS281 ENVIRONMENTAL SCIENCE AND DISASTER MANAGEMENT

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

L	T	P	C
3	0	2	4

Course Objective:

To impart knowledge on

- The student is expected to understand what constitutes the environment, what are precious resources in the environment, how to conserve these resources, what is the role of a human being in maintaining a clean environment for the future generations and how to maintain ecological balance and preserve biodiversity.
- The role of government and non-government organizations in environment management.
- About Disaster and its management.

Course Outcome:

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

- Understand the basic concepts of environment 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.
- Get the knowledge about types of disaster.
- Have a fundamental idea about the management of disasters.

Unit I INTRODUCTION TO ENVIRONMENTAL STUDIES AND NATURAL RESOURCES**9**

Definition, scope and importance – Need for public awareness – Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people – Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer, pesticide problems, water logging, salinity, case studies – Energy resources: Growing energy needs, renewable and non renewable energy sources, use of alternate energy sources. Case studies – Role of an individual in conservation of natural resources – Equitable use of resources for sustainable lifestyles

Unit II ECOSYSTEMS AND BIODIVERSITY**10**

Concept of an ecosystem – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem (single channel energy flow model) – Concept of nutrient cycling (Nitrogen cycle) – Ecological succession – Food chains, food webs and ecological pyramids – Introduction to Biodiversity – Definition: genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit III ENVIRONMENTAL POLLUTION AND SOCIAL ISSUES**12**

Definition – Causes, effects and control measures of: (a) Air pollution (b) Water pollution (c) Marine pollution (d) Noise pollution and (e) Nuclear hazards – Solid waste Management: Causes, effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution.

From Unsustainable to Sustainable development – Environmental ethics : Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, case studies – Acts for Prevention of Environmental Pollution – Wildlife Protection Act – Forest Conservation Act - Water (Prevention and Control of Pollution) Act – Air (Prevention and Control of Pollution) Act – Environment Protection Act – Issues involved in enforcement of environmental legislation – Public awareness.

Unit IV DISASTER AND ITS IMPACTS**7**

Definition of Disaster, Hazard, Vulnerability, Risk – Types – Natural disasters (earthquake, landslides, flood, cyclones, tsunami and drought) – Man-made 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, waste management and disease control) – Disaster Management Plan – Role and responsibilities of government, community, local institutions and NGOs.

Practical Course**20****Practical Experiments:**

LIST OF EXPERIMENTS FOR CHEMISTRYLABORATORY

(Any TEN Experiments)

1. Estimation of hardness of water by EDTA method
2. Estimation of alkalinity of water sample

3. pH-metric titration (acid & base)
4. Conductometric titration (strong acid Vs strong base)
5. Conductometric titration (mixture of acids Vs Strong base)
6. Potentiometric titration between ferrous ion and potassium dichromate
7. Determination of corrosion rate by weight loss method
8. Determination of DO in water by Winkler's method
9. Estimation of Chloride in water sample by Argentometric method
10. Determination of COD value of industrial effluents
11. Estimation of chromium in tannery wastes
12. Estimation of available chlorine in bleaching powder
13. Estimation of iron by spectrophotometry
14. Estimation of sodium by flame photometry

Text Book:

1. Gilbert M. Masters and Wendell P. Ela, Introduction to Environmental Engineering and Science, Pearson Education Pvt., Ltd., Third Edition, 2014.
2. Miller T.G. Jr, Environmental Science, Wadsworth Publishing Co.
3. Townsend C., Harper J., and Michael Begon, Essentials of Ecology, Blackwell Science, Third Edition.
4. Trivedi R.K. and P.K. Goel, Introduction to Air Pollution, Techno-Science Publications.
5. Anubha Kaushik and Kaushik C.P., Environmental Science and Engineering, New Age International (P) Ltd, Sixth Edition, 2018.
6. J. Mendham, R.C. Denney, J. D. Barnes, M.J.K. Thomas, Vogel's Quantitative Chemical Analysis, Prentice Hall, India, 2000.
7. D.P. Shoemaker and C.W. Garland, Experiments in Physical Chemistry, McGraw Hill, London, 2001.
8. A. I. Vogel, A Text Book of Quantitative Inorganic Analysis, ELBS London, 1995.
9. N. Manivasakam, Industrial Effluents – Origin, Characteristics, Effects Analysis & Treatment, Sakthi Publications, Coimbatore, 2003.

Reference Book:

1. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad India, 2004.
2. Trivedi R.K., Handbook of Environmental Laws, Rules, Guidelines, Compliances and Standards, Vol. I and II, Enviro Media.
3. Cunningham, W.P. Cooper, T.H. Gorhani, Environmental Encyclopedia, Jaico Publ. House, Mumbai, 2001.
4. Wager K.D., Environmental Management, W.B. Saunders Co., Philadelphia, USA, 1998.
5. Benny Joseph, Environmental Science and Engineering, Tata McGraw-Hill Publishing Company Ltd, New Delhi, ISBN: 0070601690, 2006.
6. Singh B.K., 2008, Handbook of Disaster Management: techniques & Guidelines, Rajat Publication.
7. Ghosh G.K., 2006, Disaster Management, APH Publishing Corporation.

19IT251 OBJECT ORIENTED PROGRAMMING USING C++ LABORATORY

Offered by IT

(Core Practical offered to BAD, BIT)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To understand the concepts of object-oriented programming with C++
- To familiarize with static, friend functions, function overloading, operator overloading and type conversion
- To expertise in OOP concepts such as inheritance, Run Time polymorphism and exceptional handling
- To explore function and class templates
- To realize file handling

Course Outcome:

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

- Develop applications using C++ by using the key programming construct, classes and objects
- Write generic programs by applying templates to functions and classes
- Apply exception handling mechanism for handling exceptions
- Apply reuse in application development using inheritance, Run time Polymorphism
- Implement Files for handling IOs in an application

Practical Course**45****Practical Experiments:**

Develop C++ program using the following concepts:

1. Classes and array of objects.
2. Dynamic Memory allocation operators – new and delete.
3. Reference variables and Default arguments.
4. Static data members and Static functions.
5. Function overloading and Friend function.
6. Constructor - Parameterized Constructor, Copy Constructor and Destructor.
7. Constructor with dynamic memory allocation.
8. Operator overloading.
9. Type conversion.
10. Exception Handling.
11. Function Template.
12. Class Template.
13. Inheritance.
14. Runtime Polymorphism and RTTI.
15. File Handling and I/O Manipulation.

19IT253 DIGITAL LOGIC DESIGN LABORATORY

Offered by IT

(Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To verify the various Boolean theorems
- To implement basic arithmetic circuits using logic gates and MSI devices
- To exercise code converters, multiplexers, de-multiplexers and decoders
- To construct counters and shift registers
- To be familiar with any one digital circuit simulation software (VHDL / Verilog HDL)

Course Outcome:

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

- Design and implement adders, subtractors, code convertors, multiplexers, and de-multiplexers using logic gates and MSI devices
- Design and implement magnitude comparator, and parity checker circuit using logic gates and MSI devices
- Design and implement LED display and traffic light signal controller
- Design counters and shift registers using flip flops
- Simulate combinational and sequential digital circuits using VHDL / Verilog HDL

Practical Course**45****Practical Experiments:**

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

Text Book:

1. S.Salivahan and S. Arivazhagan, "Digital Circuits and Design", 5th Edition, Oxford University Press, 2018.
2. M.Morris Mano and Michael D. Ciletti, "Digital Design: with an Introduction to the Verilog HDL", Pearson Education, 5th edition, 2014.

Reference Book:

1. Thomas L. Floyd, "Digital Fundamentals", Pearson Education, 11th edition, 2015.
2. Donald D.Givone, "Digital Principles and Design", Tata McGraw-Hill, 2017.
3. William J. Dally, R. Curtis Harting, Tor M. Aamodt, "Digital Design Using VHDL - A Systems Approach", Cambridge University Press, 1st Edition, 2016.

19HS251 COMMUNICATION SKILLS LABORATORY

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

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- Different styles of communication and to improve listening, understanding and observation skills
- Key communication styles and techniques
- Critical and analytical reading skills
- Framing sentences with precision and clarity
- Applying comprehensive skills required for academic and societal situations

Course Outcome:

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

- Understand concepts clearly and avoid misinterpretation when listening to various styles of communication
- Communicate effectively using suitable techniques
- Critically analyze and assimilate the reading materials
- Construct error free simple, concise and clear sentences
- Participate casually in classroom discussions and other general activities

Practical Course**30****Practical Syllabus:**

Listening 6

Listening & Learning Skills - Listening to Audio and Practice Exercises - Making a Critical Appreciation of the Content - Answering Cloze Test based on Listening - Chinese Gossip - Demonstration of Barriers to Good Listening and Tips for Effective Listening

Speaking 6

Self-Introduction - Introducing Friends and Chief Guests - Developing Stories using Picture Prompts - Language Etiquette in Different Situations: Sharing Memorable Incidents - Expressing Agreement and Conflict Management and Seeking Information - Expressing Feelings - Affection, Anger, Regret, Team Reviewing and Appraisal on any Social Event/Issue - Data Decoding

Reading 6

Making Inference in Readings - SQ3R Method of Reading - Reading longer texts with Time Frame - Reading Data using different types of Texts, Magazines and Internet Materials - Editing/Proofreading (Any Article/ Excerpt from Research Papers)

Writing 6

Use of Idioms and Phrases - Correct usage of Proverbs - Words that are Commonly Misspelt - Advertisement Designing with Catchy Captions and Slogans - Abstract Writing - Mind Mapping and Brainstorming on any Social Event/Issue

Remedial Grammar and Vocabulary 6

Error Identification and Correction - Word Formation - Derivational & Inflectional - Word Choice: Appropriate Words & Commonly Confused Words - Verbal Analogies - Verbal Reasoning - Synonyms - Antonyms - Vocabulary from GRE (50 words) - Vocabulary Collection from Select Newspapers (50 words)

Text Book:

1. Taylor, Grant. English Conversational Practice. New Delhi: Tata McGraw-Hill, 2019 Reprint.

Reference Book:

1. English Language Communication Skills: Lab Manual cum Workbook. New Delhi: Cengage Learning, 2014.
2. Sadanand, Kamlesh and Susheela Punitha. Spoken English: A Foundation Course, Part I. New Delhi, Orient Black Swan, 2010.
3. Sadanand, Kamlesh and Susheela Punitha. Spoken English: A Foundation Course, Part II. New Delhi, Orient Black Swan, 2010.

19MA305 MATHEMATICS - III : PROBABILITY AND QUEUEING THEORY

Offered by MAT (Core Theory)

L	T	P	C
3	2	0	4

Course Objective:

To impart knowledge on

- To know the association between the variables using correlation and regression.
- To understand the theory of discrete-time Markov chains.
- To introduce the concepts of queuing Theory.
- To solve the problems of Non – Markovian queues and Networking.
- To make the student knowledgeable in the area of probabilistic models

Course Outcome:

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

- Solve various engineering problems using Probability and Distributions
- Apply the concepts of two dimensional random variables
- Define and explain basic concepts in the theory of Markov process
- Examine the characteristic feature of a queuing system in analysing Markovian models.
- Examine the characteristic feature of a queuing system in analysing Non-Markovian models

Unit I PROBABILITY RANDOM VARIABLES AND DISTRIBUTIONS**12**

Axiomatic definition of probability – Conditional Probability – Baye's Theorem - Discrete and Continuous random variables – Cumulative distribution function – properties – Moments – Moments about mean – Moment generating function – Uniform and Exponential distributions

Unit II TWO DIMENSIONAL RANDOM VARIABLES**12**

Joint density function - Marginal and conditional density function – Functions of random variable - Transformation of random variables - Correlation and regression.

Unit III MARKOV PROCESSES AND MARKOV CHAINS**12**

Classification - Stationary process - Markov process - Markov chains - Transition probabilities - Limiting distributions - Poisson process.

Unit IV QUEUEING THEORY**12**

Markovian models – Birth and Death Queuing models - Steady state results: Single and multiple server queuing models - queues with finite and infinite size - Little's Formula.

Unit V NON-MARKOVIAN QUEUES AND QUEUEING NETWORKS**12**

Non Markovian Models: M/G/1 queue- Pollaczek- Khinchine formula, series queues. Tandem Queues: Queues with blocking, without blocking – Jackson open network and closed network.

Text Book:

1. O.C. Ibe, "Fundamentals of Applied Probability and Random Processes", Elsevier, 1st Indian Reprint, 2014.
2. D. Gross and C.M. Harris, "Fundamentals of Queueing Theory", Wiley Student edition, 2013.

Reference Book:

1. H.A. Taha, "Operations Research", Pearson Education, Asia, 8th edition, 2011.
2. A.O. Allen, "Probability, Statistics and Queueing Theory with Computer Applications", Elsevier, 2nd edition, 2005.
3. K.S. Trivedi, "Probability and Statistics with Reliability, Queueing and Computer Science Applications", John Wiley and Sons, 2nd edition, 2008.

Extensive Reading:

- 1. <http://stattrek.com/probability-distributions/discrete-continuous.aspx>
- 2. <http://people.brunel.ac.uk/~mastjjb/jeb/or/queue.html>
- 3. <http://www.win.tue.nl/~iadan/queueing.pdf>

19IT301 DATA STRUCTURES

Offered by IT (Core Theory offered to BAD, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study the design and applications of linear ADTs such as List, Stack and Queue.
- To understand the various non-linear data structures like binary tree, binary search tree, AVL, Splay and B-tree.
- To study the design and applications of various Heap Structures
- To learn the various indexing techniques to avoid collision.
- To understand the graph ADT and its applications.

Course Outcome:

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

- Implement the various linear data structures using arrays and pointers.
- Implement the different non-linear data structures.
- Develop the various heap structures.
- Work with searching and hashing techniques.
- Apply traversal algorithms in graph.

Unit I LINEAR DATA STRUCTURES**9**

Abstract Data Type (ADT) – List – Array and linked List Implementation – Doubly Linked List- Circularly Linked List – Applications– Stack: Model – Array and linked List Implementation – Applications- Queue: Model – Array and linked List Implementation – Applications.

Unit II NON-LINEAR DATA STRUCTURES – TREES I**9**

Trees – Implementation- Tree traversal with application- Binary trees – Implementation- Expression tree - Threaded binary trees – Binary Search Tree – Applications of trees – AVL trees- Generic Programming.

Unit III NON-LINEAR DATA STRUCTURES – TREES II**9**

Splay trees –Red Black Trees- B-tree – Priority queue –Model – Implementation- Binary heap – Min heap – d-heap- Leftist heap –Skew heap- Applications of Priority Queues.

Unit IV HASHING AND SET**9**

Linear search – Binary search – Hashing- Model- Implementation – Hash Function– Separate chaining – Open addressing – Rehashing - Extendible Hashing - Disjoint Set ADT – Equivalence Relations- Dynamic Equivalence Problem – Smart union algorithms – Path compression – Applications of set.

Unit V GRAPHS**9**

Graph – Definitions – Topological sort – Breadth first traversal – Shortest path algorithms – Minimum spanning tree – Prim's and Kruskal's algorithms – Network Flow Problems- Applications of Depth first traversal – Undirected Graphs- Biconnectivity- Euler Circuits- Directed graphs.

Text Book:

1. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", Pearson Education Asia, Second edition, 2012.

Reference Book:

1. Jean-Paul Tremblay and Paul G. Sorenson, "An Introduction to Data Structures with Applications", Tata McGraw-Hill, New Delhi, Second Edition, 2007.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, "Introduction to Algorithms", McGraw Hill, Third Edition, 2009.
3. Reema Thareja, "Data Structures Using C", Oxford University Press, Second Edition, 2014.
4. Alfred V. Aho, John E. Hopcroft and Jeffry D. Ullman, "Data Structures and Algorithms", Pearson Education, New Delhi, 2006.
5. Seymour Lipschutz, "Data structures with C (Schaum's Outline series)", Tata McGraw Hill Education, First edition, 2010.

Extensive Reading:

- <http://172.16.16.210/index.php/npTEL-video-courses/video-cse/video-cse-data-structures-algorithms>
- <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

19IT302 DATABASE MANAGEMENT SYSTEMS

Offered by IT (Core Theory offered to BAD, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To correlate the role of database management systems in information technology applications within organization
- To sketch basic database concepts, including the structure and operation of the relational data model
- To articulate the use of contemporary logical design methods and tools for databases
- 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

- Explore the basic concepts of Database system and design database for enterprise applications using Entity Relationship Diagrams
- Analyze the consequence of calculus in designing relational model and create database using query languages with constraints and security
- Normalize databases to reduce cost due to redundancy constraints
- Assess different types of scheduling and recovery techniques for concurrent transactions
- Validate the query evaluation plan and optimize to reduce computational complexity

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 - Extended E-R Features - Introduction of Relational Model – E-R Reduction to Relational Schemas.

Unit II RELATIONAL DATABASE MODEL**9**

Structure of Relational Databases – Schema Diagrams – Relational Query Languages - Relational Algebra – Queries in SQL – Set Operations – Aggregate Operations – Joins – Views – Integrity Constraints – Authorization – Advanced SQL – Functions and Procedures – Triggers – Assertion – 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 – 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 – Join Dependencies – Fifth Normal Form – Introduction to Domain Key Normal Form – Case Studies

Unit IV DATABASE 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 – Multi Version Schemes – Recovery System – Failure Classification – Storage – Recovery and Atomicity – Recovery Algorithm.

Unit V QUERY PROCESSING AND OPTIMIZATION**9**

Query Processing - Measures of Query Cost - Selection– Sorting - Join Operation – Other Operations - Evaluation of Expressions – Query Tuning - Query Optimization - Transformation of Relational Expressions - Estimating Statistics of Expression Results - Choice of Evaluation Plans – Materialized Views.

Text Book:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", McGraw Hill, Sixth Edition, 2011.

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/>
- http://www.service-architecture.com/database/articles/acid_properties.html
- http://www.orafaq.com/wiki/Oracle_database_Performance_Tuning_FAQ

19AD301 PYTHON PROGRAMMING

Offered by AID (Core Theory)

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 python, including defining classes, invoking methods, using class libraries, etc
- Have the ability to write a program to solve specified problems

Course Outcome:

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

- Develop basic programs using fundamental structures.
- Create programs using various collection data types.
- Apply appropriate Python control flow structure.
- Implement user defined python functions.
- Design classes and use them

Unit I INTRODUCTION**9**

Python object types – Numeric Type Basics – Numeric Literals –Built in Numeric Tools – Python Expression operators – Numbers in action – Other numeric types – String Literals – Strings in action – String methods – String formatting expressions – String formatting method calls – General type categories

Unit II LISTS AND DICTIONARIES**9**

Lists in action – Basic list operations – List Iteration and comprehensions – Indexing, Slicing and Matrixes – Changing list in place – Dictionaries – Dictionaries in action – Basic dictionary operations – Changing Dictionaries In place – Dictionary methods – A language table – Dictionary usage notes – Other ways to make dictionary – Tuples – Files – Python Type Hierarchies

Unit III STATEMENT AND SYNTAX**9**

Introducing Python statements- A Tale of Two ifs – Assignment statements – Expression statements – Print operations – if statements – Python syntax rules – while loops – for loops – Loop coding techniques – Iterators – List comprehension

Unit IV FUNCTIONS**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 AND EXCEPTIONS**9**

Class coding basics – Class Statement – Methods – Inheritance – Attribute tree construction – specializing Inherited methods – Class Interface Techniques – Abstract super classes -Namespaces –simple names – Attribute names – Namespace dictionaries – Operator overloading – Designing with classes -Exception Basics-Default Exception Handler-Catching Exceptions-Raising Exceptions-User-Defined Exceptions-Termination Actions

Text Book:

1. Mark Lutz , “Learning Python” , Fifth Edition, O,Reilly, 2013

Reference Book:

1. Jason Cannon, “Python Programming for Beginners” O,Reilly, 2010
2. David Beazley, Brain K Jones “Python CookBook” 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

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

19AD302 INTRODUCTION TO AI AND DATA SCIENCE

Offered by AID (Core Theory)

L	T	P	C
3	1	0	3.5

Course Objective:

To impart knowledge on

- To Explore the need of Artificial Intelligence.
- To provide knowledge of AI systems and its variants.
- To Investigate the role of data science.
- To Work with data pre-processing methods
- To Work with data analytics methods

Course Outcome:

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

- Apply various searching algorithm in AI
- Apply various knowledge representation methods
- Explore the basics of data science
- Apply concepts of Data Collection and Data Pre-Processing
- Work with data analytics

Unit I INTRODUCTION TO AI**9**

Introduction - Foundation and history of AI - AI Problems and techniques - AI programming languages – Introduction to LISP and PROLOG – Problem spaces and searches - Blind search strategies; Breadth first - Depth first – Heuristic search techniques Hill climbing - Best first – A* algorithm AO* algorithm – game trees - Minimax algorithm – Game playing – Alpha beta pruning

Unit II KNOWLEDGE REPRESENTATION**9**

Knowledge representation issues – Predicate logic – logic programming – Semantic nets - Frames and inheritance - constraint propagation –Representing Knowledge using rules – Rules based deduction system

Unit III INTRODUCTION TO DATA SCIENCE**9**

Introduction– Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.

Unit IV DATA COLLECTION AND DATA PRE-PROCESSING**9**

Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.

Unit V EXPLORATORY DATA ANALYTICS**9**

Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA

Text Book:

1. Daugherty, Paul R., and H. James Wilson. Human+ machine: reimagining work in the age of AI. Harvard Business Press, 2018
2. Prateek, J.: Artificial Intelligence with Python, pp. 14–16. Packt Publishing, Birmingham (2017)
3. Jojo Moolayil, “Smarter Decisions : The Intersection of IoT and Data Science”, PACKT, 2016
4. Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O'Reilly, 2015

Reference Book:

1. Husain, Amir. The sentient machine: The coming age of artificial intelligence. Simon and Schuster, 2017
2. Kaplan, Jerry. Artificial intelligence: What everyone needs to know. Oxford University Press, 2016
3. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013
4. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global

Extensive Reading:

- <https://www.geeksforgeeks.org/a-search-algorithm/>
- <https://www.javatpoint.com/propositional-logic-in-artificial-intelligence>
- <https://www.statisticshowto.com/probability-and-statistics/hypothesis-testing/anova/>

19IT351 DATA STRUCTURES LABORATORY

Offered by IT

(Core Practical offered to BAD, BIT)

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 build non linear data structures such as set using arrays, various tree structures
- To work with different hashing and searching techniques
- To build and work with different types of heaps
- To work with graph and solve applications using graph

Course Outcome:

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

- Implement various linear data structures
- Design and implement non linear data structures
- Apply various hashing techniques for searching

Practical Course**45****Practical Experiments:**

- 1 Lists and its applications
- 2 Stacks and its applications
- 3 Queues and its applications
- 4 Binary Search tree
- 5 Set ADT
- 6 AVL tree
- 7 Splay tree
- 8 Red black tree
- 9 Binary Heap
- 10 Leftist heap
- 11 Graph traversal and spanning tree
- 12 Hashing

19IT352 DATABASE MANAGEMENT SYSTEMS LABORATORY

Offered by IT

(Core Practical offered to BAD, BIT)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To persuade different issues involved in the design and implementation of a database system for real time applications
- To speculate sophisticated queries to extract information from the large datasets available
- To schematize several database projects related to an information technology problem based on given requirements

Course Outcome:

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

- Populate and query a database using SQL DML/DDDL commands
- Declare and enforce integrity constraints on a database using a state-of-the-art RDBMS
- Programming PL/SQL including stored procedures, stored functions, cursors, packages
- Design and build a GUI application using any programming language as front end

Practical Course**45****Practical Experiments:**

1. Database Design using ER Diagram and Apply Normalization
2. Data Definition Language Commands
3. Data Manipulation Language Commands
4. Data Control Language, Nested Queries
5. Set operators and Join Queries
6. Views and Indexes
7. PL/SQL – Triggers
8. PL/SQL – Functions
9. PL/SQL – Procedures
10. OORDBMS
11. Front end Tools
12. Form / Menu Design / Report
13. OLTP concepts

19AD351 PYTHON PROGRAMMING LABORATORY

Offered by AID (Core Practical)

L	T	P	C
0	0	3	1.5

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 python, including defining classes, invoking methods, using class libraries, etc
- Have the ability to write a program to solve specified problems

Course Outcome:

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

- Develop basic programs using fundamental structures.
- Create programs using various collection data types.
- Apply appropriate Python control flow structure.
- Implement user defined python functions.
- Design classes and use them

Practical Syllabus:

1. Basic operator and strings
2. Lists and dictionaries
3. List comprehensions
4. Tuples
5. Files
6. Control statements and Loops
7. Functions
8. OOPS
9. Operator overloading
10. Exception handling

19HSM01 PRESENTATION AND LANGUAGE SKILLS LABORATORY

Offered by ENG (Core Practical 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
- Pronunciation skills by learning phonetics
- Proficiency in application of language skills
- Nuances to interact with technical audience
- English usage in research papers

Course Outcome:

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

- Implement the strategies of presentation skills
- Recognize phonemes and improve pronunciation
- Speak English confidently on any topic
- Interact with a technical audience
- Apply English language skills in research papers

Practical Course**30****Practical Syllabus:**

Phonetic Practice 3

English Phonemes: Vowels, Diphthongs, Consonants - Word Stress - Phoneme Recognizing Practice - Exposure to various English Accents with main focus on Received Pronunciation (RP) Accent

Listening Comprehension 3

Documentaries and Educational Video Clips - Oration of Great Leaders - Live news - Listening Business Conversations - Reviewing News from Media & Webinar

Language Functions 6

Speaking Activities using Cohesive Markers :

1. Impromptu - Just a Minute – Turncoat - Role-Play - Small Talks
2. Prepared Talks: Giving Reasons, Future Plans, Comparing & Contrasting, Making Suggestions

Presentation Strategies 3

Defining Purpose - Audience & Locale - Topics and Organizing Contents - Preparing Outline -Audio-visual Aids - Nuances of Delivery - Body Language - Voice Dynamics – Time-Dimension

Presentation and Appraisal Sessions 15

Importance of Journal Articles - Elements of Technical Articles (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 Format and Awareness on Plagiarism and its Software, Hands-on Power Point Presentation - Quiz on Presentation - Reviews and Feedback

Reference Book:

1. Balasubramanian, T. A. Textbook of English Phonetics for Indian Students. India:MacMillan, 2011.
2. Laws, Anne. Presentations. Hyderabad: Orient Blackswan, 2011.
3. Mandel, Steve. Effective Presentation Skills. New Delhi: Viva Books Pvt. Ltd., 2004.
4. Pease, Barbara and Allan Pease. The Definitive Book of Body Language. US: RHUS, 2006.

IAS30 INTEGRATED APTITUDE SKILLS - I (LOWER)

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

L	T	P	C
2	0	0	0

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. 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 missing 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>

19AD401 STATISTICS FOR DATA SCIENTISTS

Offered by AID (Core Theory)

L	T	P	C
3	2	0	4

Course Objective:

To impart knowledge on

- To learn the various sampling distributions
- To understand the various testing strategies..
- To study the regression and prediction techniques.
- To learn the supervised machine learning techniques.
- To learn the unsupervised machine learning techniques

Course Outcome:

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

- Identify the sampling distributions in the given data.
- Conduct suitable testing for statistical experiments.
- Perform regression analysis and prediction
- Develop and apply various classification models.
- Work with clustering techniques.

Unit I DATA ANALYSIS AND SAMPLING DISTRIBUTIONS**9**

Elements of Structured Data - Rectangular Data - Data Frames and Indexes - Nonrectangular Data Structures - Estimates of Location Estimates of Variability - Exploring the Data Distribution - Exploring Binary and Categorical Data - Exploring Two or More Variables - Random Sampling and Sample Bias - Selection Bias - Sampling Distribution of a Statistic - The Bootstrap - Confidence Intervals - Normal Distribution - Long-Tailed Distributions - Student's t-Distribution - Binomial Distribution - Poisson and Related Distributions

Unit II STATISTICAL EXPERIMENTS AND SIGNIFICANCE TESTING**9**

A/B Testing - Hypothesis Tests - The Null Hypothesis - Alternative Hypothesis - One-Way, Two-Way Hypothesis Test - Resampling - Permutation Test - Exhaustive and Bootstrap Permutation Test - Permutation Tests: The Bottom Line for Data Science - Statistical Significance and P-Values - P-Value - Alpha - Type 1 and Type 2 Errors - Data Science and P-Values - t-Tests - Multiple Testing - Degrees of Freedom - ANOVA - F-Statistic - Two-Way ANOVA - Chi-Square Test - Chi-Square Test: A Resampling Approach - Chi-Square Test: Statistical Theory - Fisher's Exact Test - Relevance for Data Science - Multi-Arm Bandit Algorithm - Power and Sample Size - Sample Size

Unit III REGRESSION AND PREDICTION**9**

Simple Linear Regression - The Regression Equation - Fitted Values and Residuals - Least Squares - Prediction versus Explanation (Profiling) - Multiple Linear Regression - Assessing the Model - Cross-Validation - Model Selection and Stepwise Regression - Weighted Regression - Prediction Using Regression - The Dangers of Extrapolation - Confidence and Prediction Intervals - Factor Variables in Regression -Dummy Variables Representation - Factor Variables with Many Levels - Ordered Factor Variables - Interpreting the Regression Equation - Correlated Predictors - Multicollinearity - Confounding Variables - Interactions and Main Effects - Testing the Assumptions: Regression Diagnostics - Polynomial and Spline Regression

Unit IV CLASSIFICATION AND STATISTICAL MACHINE LEARNING**9**

Naive Bayes - Discriminant Analysis - Logistic Regression - Evaluating Classification Models - Confusion Matrix - The Rare Class Problem - Precision, Recall, and Specificity - ROC Curve -AUC - Lift - Strategies for Imbalanced Data - Undersampling - Oversampling and Up/Down Weighting - Data Generation - Cost-Based Classification - Exploring the Predictions - k- Nearest Neighbors – Tree Models – Bagging and the Random Forest - Boosting

Unit V UNSUPERVISED LEARNING**9**

Principal Component Analysis – Example – Computing and Interpreting – K-Means Clustering – Interpreting the clusters – Selecting the number of clusters – Hierarchical Clustering – Dendrogram – Agglomerative Algorithm – Model Based Clustering – Multivariate Normal Distribution – Mixtures of Normals – Scaling and Categorical Variables – Scaling the Variables – Dominant Variables – Gower's Distance

Text Book:

1. Peter Bruce and Andrew Bruce "Practical Statistics for Data Scientists", O'Reilly Media Inc, First Edition, 2017.

Reference Book:

1. James D.Miller, "Statistics for Data Science", Packt Publishers, First Edition 2017.
2. MauritsKaptein, Edwin van den Heuvel, "Statistics for Data Scientists: An introduction to probability, statistics, and data analysis", Springer, 2020

Extensive Reading:

- <https://www.coursera.org/collections/math-skills-statistics-data-science>
- <https://www.udacity.com/course/intro-to-statistics--st101>
- <https://www.udacity.com/course/data-scientist-nanodegree--nd025>

19AD402 DATA ANALYTICS

Offered by AID (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To study the concepts of data warehousing architecture
- To understand data mining principles and techniques
- To learn to use association rule mining for handling large data
- To study classification and clustering for better organization and retrieval of data
- To expose business applications and recent trends of Data mining

Course Outcome:

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

- Identify the components of data warehousing architecture
- Implement data preprocessing for mining applications
- Apply the association rules for mining the data
- Deploy appropriate classification and clustering techniques
- Use recent trends of Data mining in business applications

Unit I DATA WAREHOUSING**8**

Data warehousing - Data warehousing Components – Data Warehouse Modeling – Design and implementation Mapping the Data Warehouse to Multiprocessor Architecture - OnLine Analytical Processing and Tools – Data Cube Technologies – Multidimensional Data Analysis

Unit II DATA PREPROCESSING**10**

Introduction to KDD process - Knowledge discovery from databases - Data mining functionalities - Technologies used - Applications - Issues - Knowing Data: Data objects and attributes - Statistical description of data - Data visualization - Measuring similarity and dissimilarity - Data preprocessing: Data cleaning - Data integration and transformation - Data reduction - Data discretization and Concept hierarchy generation

Unit III MINING ASSOCIATION RULES**9**

Introduction - Association rule mining - Mining frequent itemsets with and without candidate generation - Pattern evaluation methods - Mining various kinds of association rules: Pattern mining - Mining multilevel association - Mining multidimensional association - Constraint based mining.

Unit IV CLASSIFICATION AND CLUSTERING**10**

Basic concepts - Decision tree induction - Bayesian classification - Rule based classification - Classification by back propagation - Model Evaluation and Selection - Techniques to improve classification - Cluster analysis - Clustering techniques: Partitioning methods - Hierarchical methods - Evaluation of clustering Outlier detection: Outliers and Outlier analysis - Outlier detection methods

Unit V CASE STUDIES**8**

Mining Complex Data Types - Sequential pattern mining in symbolic sequences, Time Series - Mining graphs and networks - Visual and audio data mining - Data mining for intrusion detection and prevention - Data mining and Recommender systems – Other Methods for Data Mining - Data mining applications – Data mining and society

Text Book:

1. Jiawei Han and MichelineKamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, Third edition, 2011
2. Alex Berson and Stephen J. Smith, "Data Warehousing, Data Mining & OLAP", Tata McGraw Hill Edition, 21st Reprint, 2011.Nitin Gaur et al."Hands-On Blockchain with Hyperledger" June 2018,.Packt publisher

Reference Book:

1. G. K. Gupta, "Introduction to Data Mining with Case Studies", Prentice Hall of India, Easter Economy Edition, 2014
2. MehmedKantardzic, "Data mining concepts, models, methods and algorithms", Wiley IEEE Press, 2nd edition, 2011
3. Ian Witten, Eibe Frank, "Data Mining: Practical Machine Learning Tools and Techniques", Morgan Kaufmann, Third edition, 2011
4. George M Marakas, "Modern Data Warehousing, Mining and Visualization", Prentice Hall, 2003

Extensive Reading:

- www.nptel.ac.in
- <http://www.gtbit.org/downloads/dwdmsem6/dwdmsem6lman.pdf>
- <http://www.abbottanalytics.com/data-mining-resources-websites.php>
- <http://www.gephi.org>
- <http://ocw.mit.edu/courses/sloan-school-of-management/15-062-data-mining-spring-2003>

19AD403 PROGRAMMING WITH JAVA

Offered by AID (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To comprehend the art of programming and in particular the structure and meaning of basic Java programs
- To study exception handling and generic classes and methods in Java
- To enable the students to understand the concepts of Stream and Files
- To enable the students to create GUI applications and perform event handling functionalities

Course Outcome:

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

- Develop new classes that inculcates pure object oriented concepts
- Create classes that can handle any generic data type and handles exceptions
- Create application program using Streams and File concept
- Build application programs with Graphical User Interface (GUI)
- Design multithreaded programs in java.

Unit I OBJECT ORIENTED PROGRAMMING CONCEPTS**9**

Class Fundamentals - Using predefined classes - Defining own class - Object reference - Constructors - Access control –Modifiers – Methods - Dealing with Static Members and Methods - Method Overloading - Abstract Class - Interfaces - Importing Packages - Understanding Class Path - Implementing Packages - Java Doc Comments – Inheritance – Polymorphism - Object – Cosmic Super Class – Reflection - Object Cloning - Nested Class - Inner Class - Anonymous Classes

Unit II EXCEPTION/ERROR HANDLING AND GENERICS**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 - Defining Generic Class - Generic Methods - Restrictions and Limitations - Inheritance Rules for Generic Types - Wild Card Types - Reflection and Generics - Collection Framework - Collection Types - Map/List/Set Implementations - Array List / Linked List / Hash Set Collection Classes-Lambda Expressions – Method references- functional interfaces- Optional class

Unit III STREAMS AND FILES**9**

Streams – Reading and Writing Bytes – Stream Hierarchy – Combining Stream Filters - Text Input and Output – Saving Objects in Text format – Character Sets - Reading and Writing Binary Data – Zip Archives – Object Streams and Serialization – Object Serialization File format – Serialization mechanism – Serializing singletons - Typesafe Enumeration –Versioning – Working with Files – Memory Mapped files

Unit IV APPLICATION PROGRAMMING WITH GUI**9**

Event - Driven Programming - The Event Delegation Model - Event Classes - Event Sources - Event Listeners - Adapter Classes - Anonymous Inner classes - Actions - Keyboard and Mouse Event Handling - AWT Event Hierarchy - Introduction to Swings - Frame - Components - Text Input - Choice Components - Menus - Dialog Box - Layout Management - Working with 2D shapes - Shapes - Using Colors and Fonts - Displaying Images - Accessing Databases with JDBC - Deploying Applications and Applets - Applet Life - Cycle - Applet Architecture - Parameters to Applet - 48 Adding Controls - Embedding Applets in Web Page- Struts - JSP

Unit V MULTI THREADING**9**

Multi-Threaded Programming - Thread States - Thread Life - Cycle - Thread Properties - Thread Priorities - Synchronizing Threads - Mutex – Semaphores - Inter-Thread Communication - Dead Lock Handling - Executors

Text Book:

1. Cay S. Horstmann, Gary Cornell, "Core Java: Volume I – Fundamentals", Prentice Hall, Tenth Edition, 2015
2. Cay S. Horstmann, Gary Cornell, "Core Java: Volume II – Fundamentals", Prentice Hall, Tenth Edition, 2016

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, Ninth Edition, 2014.
3. E.BalaGurusamy, "Programming with java A Primer", Tata McGraw Hill Education, Fourth Edition, 2009
4. Paul Deitel ,Harvey Deitel " Java SE8 for Programmers", Pearson Education, Third Edition,2014

Extensive Reading:

- <http://www.kodejava.org/>
- <http://docs.oracle.com/javase/tutorial/>
- <http://www.devx.com/>
- <http://horstmann.com/corejava>
- <http://www.oracle.com/technetwork/java/index.html>
- <http://www.tutorialspoint.com>

- <http://www.javatpoint.com>

19IT403 ALGORITHMS ANALYSIS AND DESIGN

Offered by IT (Core Theory offered to BAD, BIT)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the mathematical aspects of analyzing an algorithm
- To learn and analyze the problem solving techniques such as Divide and conquer, Greedy method, Backtracking, Dynamic programming, Branch and Bound
- To study various data sorting and searching methods
- To study and solve the NP problems

Course Outcome:

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

- Analyze the iterative and recursive algorithms using different techniques
- Use problem solving techniques such as Divide and conquer, greedy method and dynamic programming.
- Apply problem solving techniques such as Backtracking and Branch and Bound
- Perform sorting and searching on the given collection of records using key field
- Analyze the efficiency of NP-complete problems and work with advanced algorithms.

Unit I ALGORITHM ANALYSIS**9**

Introduction to algorithms: Growth of functions –Basic mathematics - Asymptotic notations – Solving recurrence equations: linear – nonlinear - substitution method – generating functions - master theorem -Complexity of Recursive Algorithms - Finding Complexity by Tree Method - Proving Techniques - Amortized Analysis - Probabilistic Analysis - Tail Recursion

Unit II DIVIDE AND CONQUER AND GREEDY**9**

Divide and conquer: Concept - Binary Search- Convex Hull - Strassen's Matrix Multiplication - Minimum Distance between N Points. Greedy approach: Concept - 0/1 Knapsack Problem - Job Sequencing - Coin Changing - Huffman Codes - Single-Source Shortest Path - Container Loading Problem

Unit III DYNAMIC PROGRAMMING, BACKTRACKING AND BRANCH AND BOUND**9**

Dynamic programming: Concept - Longest Common Subsequence - Matrix Chain Multiplication - Travelling Salesman Problem - Floyd's Algorithm. Backtracking: Concept - Subset Sum Problem - N-Queens Problem - m -Colouring Problem - Hamiltonian Cycle - Knapsack Problem. Branch and bound – FIFO – LIFO - Travelling Salesman Problem.

Unit IV SORTING AND STRING MATCHING**9**

Insertion sort – Merge sort – Quick sort – Heap sort –Naive string matching - KMP string matching algorithm – Boyer Moore string matching algorithm.

Unit V NP PROBLEMS AND ADVANCED ALGORITHMS**9**

NP-completeness – Concept of P and NP - Important Problems and Their Classes - Cook's Theorem – Reducibility - CNF into And-Or Graph - Maximum Clique from Sat3 - Independent Set - Vertex Cover. Introduction to approximation algorithms - Load Balancing - Vertex Cover Problem.

Text Book:

1. Harsh Bhasin, "Algorithms Design and Analysis", Oxford University Press, New Delhi, 2015
2. Ellis Horowitz, Sartaj Sahni and Sanguthevar Rajasekaran, "Fundamentals of Computer Algorithms", Universities Press, Hyderabad, Second Edition, 2008.

Reference Book:

1. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", Prentice Hall of India, New Delhi, Second Edition, 2007.
2. Sara Baase and Allen Van Gelder, "Computer Algorithms – Introduction to Design & Analysis", Pearson Education, New Delhi, Third Edition, 2000.
3. Kenneth A. Berman and Jerome L. Paul, "Algorithms: Sequential, Parallel and Distributed", Cengage learning India Edition, New Delhi, 2002.

Extensive Reading:

- www.nptel.ac.in
- <http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-046j-design-and-analysis-of-algorithms-spring-2012/>
- <http://www.personal.kent.edu/~rmuhamma/Algorithms/algorithm.html>

19AD404 ARTIFICIAL INTELLIGENCE

Offered by AID (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the various characteristics of Intelligent agents
- To learn about the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To understand the different ways of designing software agents
- To know about the various applications of AI

Course Outcome:

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

- Use appropriate search algorithms for any AI problem
- Represent a problem using first order and predicate logic
- Provide the apt agent strategy to solve a given problem
- Design software agents to solve a problem
- Design applications that uses Artificial Intelligence

Unit I INTRODUCTION**8**

Introduction – Definition - Future of Artificial Intelligence - Characteristics of Intelligent Agents - Typical Intelligent Agents – Problem Solving Approach to Typical AI problems

Unit II PROBLEM SOLVING METHODS**10**

Problem solving Methods - Search Strategies - Uninformed – Informed – Heuristics - Local Search Algorithms and Optimization Problems - Searching with Partial Observations –Constraint Satisfaction Problems – Constraint Propagation - Backtracking Search - Game Playing – Optimal Decisions in Games – Alpha - Beta Pruning - Stochastic Games

Unit III KNOWLEDGE REPRESENTATION**9**

First Order Predicate Logic – Prolog Programming – Unification – Forward Chaining - Backward Chaining –Resolution – Knowledge Representation - Ontological Engineering - Categories and Objects – Events - Mental Events and Mental Objects - Reasoning Systems for Categories - Reasoning with Default Information

Unit IV SOFTWARE AGENTS**10**

Architecture for Intelligent Agents – Agent communication – Negotiation and Bargaining – Argumentation among Agents – Trust and Reputation in Multi-agent systems

Unit V APPLICATIONS**8**

AI applications – Language Models – Information Retrieval - Information Extraction – Natural Language Processing - Machine Translation – Speech Recognition – Robot – Hardware – Perception – Planning – Moving

Text Book:

1. S.Russell and P.Norvig, "Artificial Intelligence:A Modern Approach",Prentice Hall, Third Edition, 2009
2. I. Bratko, "Prolog: Programming for Artificial Intelligence", Fourth edition, Addison-Wesley Educational Publishers Inc., 2011

Reference Book:

1. M.Tim Jones, "Artificial Intelligence: A Systems Approach",Jones and Bartlett Publishers, Inc.; FirstEdition, 2008
2. Nils J. Nilsson, "The Quest for Artificial Intelligence", Cambridge University Press,2009
3. William F. Clocksin and Christopher S.Mellish," Programming in Prolog: Using the ISO Standard", Fifth Edition, Springer, 2003
4. Gerhard Weiss, "Multi Agent System", Second Edition, MIT Press, 2013
5. David L. Poole and Alan K. Mackworth, "Artificial Intelligence: Foundations of Computational Agent", Cambridge University Press, 2010

19AD481 OPERATING SYSTEM PRINCIPLES

Offered by AID (Theory Course with Lab Component)

L	T	P	C
3	0	2	4

Course Objective:

To impart knowledge on

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

Course Outcome:

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

- Implement the various System calls and Inter process Communication
- Apply various processor scheduling algorithms and handle process synchronization problems
- Apply various memory management techniques to given situation
- Apply various disk management techniques
- Apply various processor scheduling algorithms and memory management techniques for popular operating systems – Linux, Windows and Android

Unit I OPERATING SYSTEMS OVERVIEW**9**

Introduction to operating systems – Computer system organization - architecture – Operating system structure – operations – Process, memory, storage management – Protection and security – Distributed systems – Computing environments – Open source operating systems – OS services – User interface – System calls – System programs – Process concept - scheduling – Operations on processes – Cooperating processes – Inter-process communication – Threads.

Unit II PROCESS MANAGEMENT**9**

Basic concepts – Scheduling criteria – Scheduling algorithms – Multiple processor scheduling – Algorithm evaluation – The critical section problem – Synchronization hardware – Semaphores – Classic problems of synchronization – Critical regions – Monitors – Deadlocks – Deadlock characterization – Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance – Deadlock detection – Recovery from deadlock.

Unit III MEMORY MANAGEMENT**9**

Memory management – Swapping – Contiguous memory allocation – Paging – Segmentation-Segmentation with paging – Virtual memory - 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 – Disk scheduling – Disk management – Swap space management – Protection – I/O Systems – I/O Hardware – Application I/O Interface – Kernel I/O subsystem

Unit V CASE STUDY**9**

Linux system – History – Design principles – Kernel modules – Process management – Scheduling – Memory management – File systems – Input and output – Inter Process Communication – Network structure – Security– Windows 8 – History – Design principles - Android OS – History – Design principles.

Text Book:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts Essentials", John Wiley & Sons Inc., Ninth Edition, 2012
2. Reto Meier, John Wiley and sons, "Professional Android 4 Application Development", 2012

Reference Book:

1. Andrew S. Tanenbaum, "Modern Operating Systems", Pearson Education, Fourth Edition, 2015.
2. Charles Crowley, "Operating Systems: A Design-Oriented Approach", Tata McGraw Hill Education", 2017.
3. D M Dhamdhare, "Operating Systems: A Concept-based Approach", Tata McGraw-Hill Education, Third Edition, 2012.
4. William Stallings, "Operating Systems: Internals and Design Principles", Prentice Hall, Seventh Edition, 2011.

Extensive Reading:

- <http://nptel.ac.in>
- <http://nptel.ac.in/downloads/106108055/>
- <http://cseweb.ucsd.edu/classes/fa06/cse120/lectures/120-fa06-l13.pdf>
- <http://www.cs.kent.edu/~farrell/osf03/oldnotes/>

19AD451 DATA ANALYTICS LABORATORY

Offered by AID (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To study the concepts of data warehousing architecture
- To understand data mining principles and techniques
- To learn to use association rule mining for handling large data
- To study classification and clustering for better organization and retrieval of data
- To expose business applications and recent trends of Data mining using various tools

Course Outcome:

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

- Design and build a data warehouse
- Implement data preprocessing methods for mining applications
- Apply the association rules for mining the data
- Deploy appropriate classification and clustering techniques
- Practical experience in real time business applications

Practical Syllabus:

1. Explore WEKA
2. Build Data Warehouse
3. Data Preprocessing
4. Association Mining
5. Classification
6. Clustering
7. Regression
8. Outlier detection
9. Credit Risk Assessment
10. Data Mining Applications
11. Mini Project

19AD452 ARTIFICIAL INTELLIGENCE LABORATORY

Offered by AID (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To understand the various characteristics of Intelligent agents
- To learn about the different search strategies in AI
- To learn to represent knowledge in solving AI problems
- To know about the various applications of AI

Course Outcome:

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

- Apply appropriate search algorithms for any AI problem
- Represent a problem using PROLOG and Python
- Design applications that uses Artificial Intelligence

Practical Syllabus:

1. Study of basics in PROLOG
2. Study of operations in PROLOG
3. Implement operations in PROLOG
4. Solve problems using Depth First Search
5. Solve problems using Best First Search
6. Travelling Salesperson Problem using Heuristic approach
7. N-queens problem/Towers of Hanoi problem
8. Implement Hill climbing to solve 8-Puzzle problem
9. Build and maintain a family tree
10. Implement A* search
11. Mini Project – Develop an intelligent system

IAS40 INTEGRATED APTITUDE SKILLS - II (LOWER)

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

L	T	P	C
2	0	0	0

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

Unit IV**-4****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/>

19AD501 COMPUTER NETWORKING PRINCIPLES

Offered by AID (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basic fundamental concepts, functionalities of physical layer
- To understand the functionalities of data link layer and implement protocols and algorithms for the given network
- To learn the concepts in transport layer
- To familiarize the functions and protocols of the application layer
- To understand the issues evolved during transition from IPv4 to IPv6

Course Outcome:

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

- Apply the functionalities of physical and data link layer
- Apply the protocols and algorithms for the given network
- Develop simple applications using sockets
- Implement the application layer protocol for the given application
- Analyze the various issues involved in transition from IPv4 to IPv6

Unit I NETWORKING PRINCIPLES AND PHYSICAL AND LAYER**9**

Data Communication – Networks – Network Types – TCP/IP model – OSI model – Layers – Physical layer – Topology – Transmission media – Switched Communications Networks – Circuit Switching – Packet Switching – Comparison of Circuit Switching and Packet Switching – Implementing Network Software – Networking Parameters

Unit II DATA LINK AND NETWORK LAYER**11**

Error Detection and Correction – Hamming Code, CRC, Checksum – Flow control mechanism – Sliding Window Protocol – GoBack-N – Selective Repeat – Multiple access Aloha – Slotted Aloha – CSMA, CSMA/CD – Multiple Access Networks (IEEE 802.3), Token Ring (IEEE 802.5) and Wireless Networks (IEEE 802.11, 802.15) – IP addressing – Internet Protocol – ARP – RARP – IGMP – ICMP – Routing algorithms – Link State Routing – OSPF – Distance Vector Routing – RIP – DHCP

Unit III TRANSPORT LAYER**7**

TCP and UDP – Congestion Control – Effects of Congestion – Traffic Management – TCP Congestion Control – Congestion Avoidance Mechanisms – Queuing Mechanisms – QoS Parameters

Unit IV APPLICATION LAYER**9**

Domain Name System (DNS) – E-mail – SMTP – IMAP – POP3 – File Transfer Protocol – HTTP – Simple Network Management Protocol – RMON

Unit V TRENDS IN NETWORKING**9**

IPv6 – Packet format – Extension Headers – Ipv4 and Ipv6 header comparison – IPv6 addressing – IPv6 Protocol – ICMPv6 Protocol – Transition from IPV4 to IPV6 – Dual Stack – Tunnelling – Header Translation – SDN: Defining SDN – Need for SDN – SDN Working – Fundamental Characteristics – SDN Operation – SDN Devices – SDN Controller – SDN Applications

Text Book:

1. Behrouz A. Foruzan, "Data communication and Networking", Tata McGraw-Hill, Fifth Edition, 2013

Reference Book:

1. Larry L. Peterson, Bruce S. Davie, "Computer Networks: A Systems Approach", Morgan Kauffmann Publishers Inc., Third Edition, 2011
2. William Stallings, "Data and Computer Communication", Pearson Education, Sixth Edition, 2000
3. Andrew S. Tannenbaum, "Computer Networks", Pearson Education, Fourth Edition, 2003

Extensive Reading:

- <http://nptel.ac.in/courses/106105081/>
- http://nptel.ac.in/courses/Webcourse-contents/IIT%20Kharagpur/Computer%20networks/New_index1.html
- http://nptel.ac.in/courses/IIT-MADRAS/Computer_Networks/index.php
- http://compnetworking.about.com/od/basicnetworkingconcepts/a/network_types.htm
- <http://www.protocols.com/pbook/tcpip1.htm>
- <http://cnp3book.info.ucl.ac.be/network/network>

19AD502 MACHINE LEARNING ESSENTIALS

Offered by AID (Core Theory)

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

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 analyze 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; Types – Supervised –Unsupervised–Reinforcement – Data – Tools –Basics Maths and Background – Probability – Linear Algebra – Convex Optimization –Statistical Decision Support Theory – Bayesian Learning – ML, MAP, Bayes estimates –Conjugate Priors – Datasets – Training – Testing – validation – Models and Evaluation

Unit II SUPERVISED LEARNING

9

Regression–Linear – Ridge – Lasso – Maximum Entropy Models – Logistic regression–kNearest Neighbour– Decision Trees– Support Vector Machine – Kernel–Predictive Neural Network Models–Perceptron –Multilayer Network – Feedforward Network – Back propagation– Gradient Descent – Recurrent Neural Network; Bayes Optimal classifier – Naïve Bayes –Ensemble Methods–Bagging and AdaBoost – Evaluation of Classifiers – k-Fold Cross Validation – Case Studies

Unit III UNSUPERVISED LEARNING

9

Clustering–K–Means– K–Medoids– Objective function based evaluation– Agglomerative clustering– Density Based Clustering –DBSCAN– Spectral Clustering –Competitive Neural Network Models– Radial basis Network – Self organizing maps – KSOM – Case Studies

Unit IV REINFORCEMENT LEARNING

9

Markov Decision process model– Policy–value–optimal–evaluation–planning algorithms–value iteration–policy iteration, linear programming–Learning algorithms–Stochastic approximation– Q–Learning–SARSA–Case studies

Unit V ADVANCED MACHINE LEARNING TECHNIQUES

9

Adaptive Resonance Theory–Auto Encoders – Graphical Models – Bayesian Networks–Expectation Maximization– Generative Neural Network–Learning Vector Quantization – Optimization Techniques – Evolutionary Models – Particle Swarm – Ant Colony – Genetic Algorithms – Case Studies

Text Book:

1. MohriMehryar, AfshinRostamizadeh, and AmeetTalwalkar. “Foundations of machine learning”, MIT press, 2018
2. Jiawei Han, Micheline Kamber and Jian Pei, “Data Mining: Concepts and Techniques”, Morgan Kaufmann, 2011
3. Müller Andreas C. and Sarah Guido. “Introduction to Machine Learning with Python: A Guide for Data Scientists”, O’Reilly, 2016

Reference Book:

1. Sammut, Claude, and Geoffrey I. Webb. “Encyclopedia of machine learning and data mining”, Springer,2017
2. Christopher M. Bishop. “Pattern Recognition and Machine Learning”, Springer, 2013
3. Ethem A lpaydin. “Introduction to Machine Learning” Second Edition, PHI Learning,2012
4. Mitchell Tom M. “Machine Learning”, Tata McGraw–Hill,1997
5. 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-Organizingmaps:<https://www.cs.hmc.edu/~kping/nn/som.html>
- Kaggle: <https://www.kaggle.com/>

19AD581 NO SQL DATABASES

Offered by AID (Theory Course with Lab Component)

L	T	P	C
3	0	2	4

Course Objective:

To impart knowledge on

- To explore the origins of NoSQL databases and the main types of NoSQL databases
- To discuss the Relational Database and NoSql stores
- To understand the features of key/Value databases and Document-oriented databases
- To discuss the Column-Family Data Store Features
- To explore Nosql Development tools with suitable usecase

Course Outcome:

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

- Explore different types of NoSQL Databases
- Apply different NoSQL databases for an application
- Explore the detailed architecture and performance of Document-oriented NoSQL databases
- Apply Columnar Data Model for the use cases
- Apply Nosql development tools for different types of NoSQL Databases

Unit I INTRODUCTION**9**

Overview – History of NoSQL Databases – Four Types of NoSQL Database – The Value of Relational Databases – Getting at Persistent Data – Concurrency, Integration –Impedance Mismatch –Application and Integration Databases – Attack of the Clusters – The Emergence of NoSQL –Key Points

Unit II RELATIONAL DATABASE AND NOSQL STORES**9**

Comparison of relational databases to new NoSQL stores – MongoDB – Cassandra – HBASE –Neo4j use and deployment –Application –RDBMS approach – Challenges in NoSQL approach – NOSQL in cloud – Parallel Processing with Map Reduce– Big Data with Hive – Key-Value and Document Data Models – Column-Family Stores – Aggregate-Oriented Databases – Replication and sharding – MapReduce on databases – Distribution Models – Single Server – Sharding – Master-Slave Replication – Peer-to-Peer Replication – Combining Sharding and Replication

Unit III KEY VALUE DATA STORES AND DOCUMENT ORIENTED DATABASE**9**

NoSQL Key/Value databases using MongoDB – Document Databases – Features –Consistency – Transactions – Availability – Query Features – Scaling – Suitable Use Cases – Event Logging – Content Management Systems – Blogging Platforms – Web Analytics or Real-Time Analytics – E-Commerce Applications – Complex Transactions Spanning Different Operations – Queries against Varying Aggregate Structure

Unit IV COLUMNAR DATA MODEL**9**

Apache HBASE – Apache Cassandra – Architecture of HBASE – Column-Family Data Store Features – Consistency – Transactions – Availability – Query Features – Scaling – Suitable Use Cases – Event Logging – Content Management Systems – Blogging Platforms – Counters – Expiring Usage

Unit V NOSQL KEY/VALUE DATABASES AND GRAPH NOSQL DATABASES**9**

NoSQL Key/Value databases – Key-Value Store – Key-Value Store Features – Consistency – Transactions – Query Features – Structure of Data – Scaling – Suitable Use Cases – Storing Session Information – User Profiles – Preferences, Shopping Cart Data – Relationships among Data – Multi operation Transactions – Query by Data – Operations by Sets – Graph NoSQL databases using Neo4j – NoSQL database development tools and programming languages – Graph Databases – Features – Consistency – Transactions – Availability – Query Features – Scaling – Suitable Use Cases

Text Book:

1. Sadalage, P. & Fowler, “NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence”, Wiley Publications, First Edition, 2019

Reference Book:

1. Guy Harrison, “Next Generation Database: NoSQL and big data”, Apress, First Edition, 2015
2. Shashank Tiwari, “Professional NOSQL” 2011, WROX Press, First Edition, 2011
3. Eelco Plugge, Peter Membrey and Tim Hawkins, “The Definitive guide to MongoDB, The NoSQL Database for Cloud and Desktop Computing”, Apress, First Edition 2010
4. David Hows, “The definitive guide to MongoDB”, Apress Publication, second Edition, 2009
5. Shakuntala Gupta Edward, “Practical Mongo DB”, Apress Publications, Second Edition, 2016

Extensive Reading:

- <https://www.ibm.com/cloud/learn/nosql-databases>
- <https://www.coursera.org/lecture/nosql-databases/introduction-to-nosql-VdRNp>
- <https://www.geeksforgeeks.org/introduction-to-nosql>

19AD551 COMPUTER NETWORKING LABORATORY

Offered by AID (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To learn network commands and implement flow control, error correction mechanisms
- To learn socket programming
- To implement and analyse various network protocols
- To learn and use networking tools
- To use simulation tools to analyse the performance of various network protocols

Course Outcome:

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

- Implement various networking commands
- Implement error correction codes
- Implement network and application layer protocols using sockets
- Implement protocols using TCP and UDP
- Use simulation tools to analyse the performance of various network protocols

Practical Experiments:

1. Implement commands like tcpdump, netstat, ifconfig, nslookup and traceroute, ping and traceroute
2. Implement framing and error correction technique
3. Implement error detection techniques.
4. Implement error correction technique.
5. Implementation of socket programs using TCP
6. Implementation of socket programs using UDP
7. Implement connection/connectionless oriented concurrent server
8. Simulation of sliding window protocols
9. Implementation of ARP/RARP
10. Implementation of routing protocols
11. Implementation of File Transfer Protocol
12. Implementation of Domain Name System
13. Working with simulation and analysis tools

19AD552 MACHINE LEARNING TECHNIQUES LABORATORY

Offered by AID (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To Various python libraries related to machine learning
- To Implementing machine learning algorithms
- To Training and evaluation of classifier models
- To Creating Unsupervised models, Clusters
- To Neural network usage using Tensor flow

Course Outcome:

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

- Implement classification algorithms in Python
- Implement clustering algorithms using Python
- Analyze the for data reduction using Python
- Apply neural network concepts for data analysis

TOOLS AND LANGUAGES NEEDED:

1. Orange – GUI tool
2. Python – Numpy, Scikit, pandas
3. Anaconda framework
4. Jupyter, Spyder –IDE
5. Google Colab – Cloud online browser based python notebook environment
6. Tensor flow, Pytorch
7. R programming

Practical Experiments:

1. K Nearest Neighbour
2. Naïve Bayes
3. Decision Tree/Regression Tree
4. Random Forest
5. Support Vector Machine
6. Ensemble Classifier
7. Principal Component Analysis
8. K Means
9. Agglomerative Clustering
10. DBScan
11. Feed Forward Neural network

19HSM02 CAREER PLANNING AND PROFESSIONAL ESSENTIALS LABORATORY

Offered by ENG (Core Practical offered to BAD, BBT, BCI, BCS, BEE, BIT)

L	T	P	C
0	0	2	1

Course Objective:

To impart knowledge on

- Effective English language proficiency for career skills
- Interview and group communication skills
- Becoming successful employees by honing their soft skills
- Competitive examinations and higher studies
- Significance of communicative competence

Course Outcome:

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

- Attain effective professional communication skills
- Have enhanced group communication skills
- Manifest employability and soft skills
- Face interviews / pursue higher studies / become entrepreneurs
- Appear for Competitive Examinations

Practical Course**30****Practical Syllabus:**

Vocabulary Building 6

Words & Word Chunks: Synonyms - Antonyms - Affixes - Compound Words - Business Idioms & Phrases and Phrasal Verbs - Listening Comprehension and Reading Comprehension Exercises to hone Word Power (with the Focus on English Proficiency Tests) - Verbal Ability

Business Essentials 6

Official Communication: Emails - Memos - Agenda - Meeting and Minutes of the Meeting - Resume Designing - Submitting offline/online Resume - Project Proposals - Report Writing: Project Report - Report Format - Literature Survey - Preparation of a Report Based on Print and Web Sources

Group Discussion & Interview Skills 6

Group Discussion - GD Etiquette - Sample Videos on GD - Participation in Group Discussion - Persuasive Skills - Negotiating Ability - Team Skills and Leadership Quality - Writing Minutes for Group Discussion and Notes of Observation - Successful Interview Skills - Mock Interviews and Types of Interviews

Career Planning 6

Self-Image - Goal Setting and Career Planning - Career Awareness - Adaptability - Attitude Building - Corporate Etiquette - Body Language - Dress Code and Power Dressing - Time and Stress Management - Health Awareness - Moral Conduct and Social Behavior - Netiquette - Searching Job Using Online/Offline Resources - Entrepreneurial Development

Event Management & Language Proficiency Tests 6

Master of Ceremony - Welcome Address - Vote of Thanks - 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)

Reference Book:

1. Nurnberg, Maxwell and Morris Rosenblum. How to Build a Better Vocabulary. 4th ed. USA: Warner Books, 2011.
2. Mitra, Barun. Personality Development and Soft Skills. 2nd ed. New Delhi: OUP, 2016.
3. Raman, Meenakshi and Sangeetha Sharma. Communication Skills. New Delhi: Oxford University Press, 2018.
4. Bhatnagar, R.P. English for Competitive Examination. 3rd ed. New Delhi: Macmillan, 2012.
5. Konar, Nira. English Language Laboratories. 1st ed. New Delhi: PHI Learning Private Limited, 2011.

IAS50 INTEGRATED APTITUDE SKILLS - I (HIGHER)

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

L	T	P	C
2	0	0	0

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. 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 missing 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

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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/>

19AD601 DEEP LEARNING

Offered by AID (Core Theory)

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 Deep learning concepts with Convolutional Neural Network case studies
- To Multimedia analysis using CNN
- To Advanced deep learning techniques

Course Outcome:

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

- Use the basic concepts in Neural Networks for different applications
- Apply different types of ANN architectures
- Implement convolutional networks for problem solving
- Illustrate the concepts of CNN for multimedia analysis
- Interpret advanced deep learning techniques to solve real world problems

Unit I NEURAL NETWORKS**9**

Fundamentals of Neural Networks—Comparison of Biological and Artificial Neurons - Perceptron – Model of Artificial Neuron – Neural Network Architectures – Learning Methods : Error Correction Learning – Memory Based Learning – Hebbian Learning – Delta Hebbian Learning – Competitive Learning – Boltzman learning– Taxonomy of Neural Network Architectures – Applications

Unit II ARTIFICIAL NEURAL NETWORKS ARCHITECTURES**9**

Feed forward network – Error Back Propagation – Stochastic and Gradient Descent: Radial basis network – Regularization network – kohonenSelf Organising Map (kSOM) – Linear Vector Quantization: Recurrent Neural Network – Vanishing Gradient Problem – LSTM network

Unit III CONVOLUTIONAL NEURAL NETWORK**9**

CNN Architecture – Convolution Filter Functions –ReLU function –Pooling – min, max, average pooling – Striding – Padding – Rollout – Softmax functions – Case Study: CNN based MNIST datasets analysis using Tensor flow

Unit IV MULTIMEDIA ANALYTICS**9**

Audio file analytics – Tensor flow audio spectrum libraries – Video event detection using CNN – Case Study: Voice Recognition using CNN –Music Recommended Systems using CNN – Object tracking using CNN in video files

Unit V ADVANCED DEEP LEARNING TECHNIQUES**9**

Deep Belief Networks – Deep Boltzman Machine – Deep Associative Memory networks – Generative Neural Networks – Deep fake Technology –Case Study on designing deep learning solutions for identifying fake finger prints, fake images and videos

Text Book:

1. Simon Haykin, "Neural Networks, A Comprehensive Foundation", 2nd Edition, Addison Wesley Longman, 2001
2. Ian Goodfellow, YoshuaBengio, Aaron Courville, "Deep Learning", MIT Press, 2016

Reference Book:

1. CosmaRohillaShalizi, "Advanced Data Analysis from an Elementary Point of View", 2015
2. Deng & Yu, "Deep Learning: Methods and Applications", Now Publishers, 2013
3. Michael Nielsen, "Neural Networks and Deep Learning", Determination Press, 2015
4. CharuC.Aggarwal, "Neural Networks and Deep learning" Springer International Publishing, 2018
5. Satish Kumar, "Neural Networks, A Classroom Approach", Tata McGraw -Hill, 2007

Extensive Reading:

- <http://www.deeplearning.net>
- www.cs.toronto.edu/~fritz/absps/imagenet.pdf
- <http://neuralnetworksanddeeplearning.com/>
- <http://neuralnetworksanddeeplearning.com/>

19AD602 FULL STACK DEVELOPMENT

Offered by AID (Core Theory)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To gain knowledge on Interactive Web Page development
- To learn about Programming servers using Node.js
- To study client side applications with React
- To understand the Type script and use it
- To study the deployment of web applications

Course Outcome:

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

- Design Interactive Web Pages
- Develop server side coding with Node.js
- Design client side applications with React
- Use Typescript for web programming applications
- Develop the server and client for any applications and deploy using containers

Unit I HTML5,CSS AND JAVASCRIPT**9**

HTML: Tags – structuring document – web page –Make it Prettier with CSS–Loading background images –Organizing files. JavaScript – Variables–Controlling HTML and CSS–Organizing JavaScript code

Unit II SERVER SIDE – NODE.JS**9**

Server–Side Action: Node and NPM – JavaScript Runtimes and Building Servers – Node Installation – NPM – NPM Commands – Initializing a New NPM/Node Project – Adding Dependencies – Semantic Versioning – Node Web Server – Advanced Node and NPM : package.json – other commands – Node: Standard Modules

Unit III CLIENT–SIDE – REACT**9**

Client–Side Adventures: React – History – Components – Props – Memory State – Style – Advanced React – JSX – Compile JSX – Put It All Together– Default Props – Typing Props – Component Lifecycle

Unit IV TYPESCRIPT AND WEBPACK**7**

TypeScript : Jumping into the Deep End – Configuring TypeScript Compilation – Types : String – Number – Boolean – Arrays – Tuples –Enums– Function – Object –Null, Void, and Undefined – Custom Type Aliases – Union Types – TypeScript == ES6 Features –Advanced TypeScript : Interfaces – Namespaces and Modules – Decorators – Third–Party Libraries – Debugging TypeScript Apps–Webpack : Bundle, and How Do I Make One–Webpack in detail – Getting Started with Webpack– Using Modules – Wither TypeScript

Unit V APPLICATION DEPLOYMENT**11**

MailBagServer: Basic Requirements – Setting Up the Project – Starting Point: main.ts–ServerInfo.ts– Time to Send the Mail – Time to Get the Mail – Reach Out and Touch Someone – NoSQL–NeDB– Testing–MailBagClient: Basic Requirements – Setting Up the Project – Starting Point: index.html –Redux: main.tsx – Configuration – Worker for All Seasons – Cavalcade of Components.Docker– Containers and Containerization – Installing Docker– Key Docker Commands – Creating Your Own Image – Deploying to Docker Hub – Wrapping Up MailBag

Text Book:

1. Frank Zammetti, “Modern Full–Stack Development” , Apress, 2020
2. BReX van der Spuy “Foundation Game Design with HTML5 and JavaScript” Apress / friends of ED,2012

Reference Book:

1. W. P. Petersen, P. Arbenz, “Introduction to ParallelComputing”, Oxford University Press, 2004
2. PawełCzarnul, “Parallel Programming for ModernHigh PerformanceComputing”,CRC Press, 2018
3. Cyrus Dasadia, AmolNayak, “MongoDB Cookbook” , Packt Publishing , 2016
4. KrasimirTsonev, “Node.js by Example”, Packt Publishing , 2015

Extensive Reading:

- <https://nodejs.org/en/>
- <https://www.typescriptlang.org/>
- <https://www.mongodb.com/>
- <https://www.w3schools.com/react/>

19AD691 PRINCIPLES OF SOFTWARE ENGINEERING

Offered by AID (Theory Course with Project Component)

L	T	P	C
3	0	2	4

Course Objective:

To impart knowledge on

- To understand the fundamental concepts of software engineering
- To analyse and design the software based on software requirement
- To understand the concepts of different testing and management techniques
- To Understand the business value of adopting Agile approaches and practices for developing software
- To Identify the various phases involved in agile scrum

Course Outcome:

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

- Apply software engineering principles for software development
- Use software requirement specification and design software according to the specification
- Apply different testing and manage the software
- Use the Agile approaches and practices for software design
- Implement Agile Scrum for software projects

Unit I SOFTWARE PROCESS AND DEVELOPMENT METHODOLOGY**9**

Software engineering concepts – Development activities – Software lifecycle models – Classical waterfall – Iterative waterfall – Prototyping – Evolutionary – Spiral – Win Win Spiral model – Prototyping model – Increment model – RAD model – Specialized process models – The rational unified process

Unit II SOFTWARE REQUIREMENTS ANALYSIS, DESIGN CONCEPTS AND PRINCIPLES**9**

Functional and non functional – Software requirement document – Requirement engineering process – Feasibility studies – Functional and behavioural models – Structured analysis and data dictionary – Design process and concepts – Design heuristic – Architectural design – Mapping data flow into a software architecture – Data design – User interface design – Real time software design

Unit III SOFTWARE TESTING & PROJECT MANAGEMENT**9**

Taxonomy of software testing – Types of S/W testing – Black box testing – White box testing – Regression testing – Unit testing – Integration testing – Validation testing – System testing – Software cost estimation – Function point models – COCOMO Model – Delphi method – Project planning – Project scheduling – Risk management – Software configuration management

Unit IV AGILE SOFTWARE DEVELOPMENT**9**

Fundamentals of Agile Process Methods – Values – Principles – stakeholders – Challenges – Agile Manifesto and Principles – Extreme Programming – Feature Driven development – Lean Software Development – Agile project management – Design and development practices in Agile projects – Test Driven Development – Continuous Integration – Refactoring – Pair Programming – Simple Design – User Stories – Agile Testing

Unit V AGILE SCRUM FRAMEWORK**9**

Agile Manifesto – Twelve Practices of XP – Scrum Practices – Applying Scrum – Need of scrum – working of scrum – Advanced Scrum Applications – Scrum and the Organization – scrum values – Scrum case study – Tools for Agile project management

Text Book:

1. Roger S. Pressman, "Software Engineering: A practitioner's Approach", McGraw-Hill International Edition, Seventh Edition, 2014
2. Robert C. Martin, "Agile Software Development, Principles, Patterns and Practices", Pearson Education Limited, First Edition, 2013

Reference Book:

1. Ian Sommerville, "Software engineering", Pearson Education Limited, Ninth Edition, 2012
2. James F. Peters and Witold Pedrycz, "Software Engineering, An Engineering Approach", Wiley-India, Third Edition, 2007
3. Lisa Crispin, Janet Gregory, "Agile Testing: A Practical Guide for Testers and Agile Teams", Addison Wesley, First Edition, 2009
4. Alistair Cockburn, "Agile Software Development: The Cooperative Game", Pearson Education Limited, Second Edition, 2006
5. Mike Cohn, "User Stories Applied: For Agile Software", Pearson Education Limited, First Edition, 2004
6. Ken Schwaber, Mike Beedle, "Agile Software Development with Scrum", Pearson Education Limited, First Edition, 2001

Extensive Reading:

- <http://172.16.16.210/index.php/nptel-video-courses/video-cse/video-cse-software-engineering>
- <http://172.16.16.210/index.php/nptel-video-courses/video-cse/video-cse-software-engineering/2503->

software-metrics-quality

- <http://nptel.ac.in/video.php?subjectId=106101061>

19AD651 DEEP LEARNING LABORATORY

Offered by AID (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To Study the concepts of Neural Network
- To Implement Neural Network Architecture to build real time applications
- To Build convolution neural network for solving application
- To Construct and apply feature reduction techniques

Course Outcome:

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

- Apply various activation function
- Design and build a neural network model
- Implement SOM, LSTM and Associative Memory
- Deploy Convolutional Neural Network for given application

Practical Experiments:

Implement the following using Python and TensorFlow

1. Implementation of Perceptrons
2. Feed Forward neural Network using Backpropagation
3. Restricted Boltzman machine using Python with TensorFlow
4. Self Organising Map
5. Radial Basis Neural Network
6. LSTM
7. Bidirectional Associative Memory
8. Deep belief Network
9. Generative Neural Networks
10. Construct CNN model for Image Analysis
11. Construct CNN model for Audio Analysis
12. Team Project –Deep Learning Based Applications

19AD652 FULL STACK DEVELOPMENT LABORATORY

Offered by AID (Core Practical)

L	T	P	C
0	0	3	1.5

Course Objective:

To impart knowledge on

- To gain knowledge on Interactive Web Page development
- To learn about Programming servers using Node.js
- To study client side applications with React
- To understand the Type script and use it
- To study the deployment of web applications

Course Outcome:

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

- Design Interactive Web Pages
- Develop server side coding with Node.js
- Design client side applications with React and Typescript
- Develop web applications and deploy

Practical Experiments:

1. Design Webpages for any given application
2. Write Server side programming with Node.js
3. Perform Email applications using Nodemailer Module
4. Write custom applications with Node.js and Mongo DB
5. Use React components, JSX, Class, Prop, Events
6. Write custom applications Forms with React
7. Use Type script for enhancing web application
8. Apply useCallback, use State, use Effect, useRef Hook of React to applications
9. Use Web Pack for Application
10. Bind server and client side and deploy as a deliverable application
11. Deploy applications to Docker Hub

Text Book:

1. Frank Zammetti, "Modern Full—Stack Development" , Apress, 2020
2. BReX van der Spuy "Foundation Game Design with HTML5 and JavaScript" Apress / friends of ED, 2012

Reference Book:

1. 1W. P. Petersen, P. Arbenz, "Introduction to ParallelComputing", Oxford University Press, 2004
2. PawełCzarnul, "Parallel Programming for ModernHigh PerformanceComputing ",CRC Press, 2018
3. Cyrus Dasadia, AmolNayak, "MongoDB Cookbook" , Packt Publishing , 2016
4. KrasimirTsonev, "Node.js by Example", Packt Publishing , 2015

Extensive Reading:

- <https://nodejs.org/en/>
- <https://www.typescriptlang.org/>
- <https://www.mongodb.com/>
- <https://www.w3schools.com/react/>

IAS60 INTEGRATED APTITUDE SKILLS - II (HIGHER)

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

L	T	P	C
2	0	0	0

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. 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, 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/>

19ADC01 DATA ENGINEERING USING R

Offered by AID (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Explore the need of R tool
- To Apply various Data manipulation techniques in R to import and export data
- To Work on applications, implementing R Analytics to create Business Insights
- To Use concepts of object oriented programming in R
- To 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 data types
- Apply the functional programming and data manipulation statements in
- Identify packages to implement machine learning techniques in R
- Apply concepts of object oriented programming in R
- Implement graphics and create new packages with R

Unit I INTRODUCTION TO DATA SCIENCE & R**9**

Introduction to Data Science – Data Science Lifecycle - Introduction – R environmental setup – Installation – R Studio – 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: Classes - Programming with New Classes – Inheritance and Inter – class Relations – Virtual Classes – Creating and Validating Objects – Programming with S3 Classes – Class Hierarchies – 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. TorstenHothorn, 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. JohnMairdonald, 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”, PacktPublishing, 2010
6. K.G.Srinivasa, G M Siddesh, ChetanShetty, “Statistical Programming in R”, Oxford University Press, New Delhi, 2017

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>

19ADC02

Offered by AID

INFORMATION RETRIEVAL AND WEB SEARCH

(Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To Learn about the architecture of World Wide Web
- To Know the concept of text extraction and organizing from various documents
- To Understand the concepts of document classification and clustering
- To study web crawling technologies and page ranking techniques
- To study the designing of recommender systems

Course Outcome:

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

- Differentiate various of documents including from world wide web
- Evaluate documents using the term analysis
- Apply Classification and clustering of documents based on different machine learning techniques
- Apply and analyze various web crawling strategies and perform page ranking
- Design Recommender systems

Unit I INTRODUCTION**9**

Information Retrieval – Early Developments –IR Problem –Users Task – Information versus Data Retrieval –IR System –Software Architecture of the IR System –Retrieval and Ranking Processes –Web –e-Publishing Era – How the web changed Search – Practical Issues on the Web – How People Search – Search Interfaces Today – Visualization in Search Interfaces

Unit II MODELING AND RETRIEVAL EVALUATION**9**

Basic IR Models – Boolean Model – TF-IDF (Term Frequency/Inverse Document Frequency) Weighting – Vector Model – Probabilistic Model – Latent Semantic Indexing Model – Neural Network Model – Retrieval Evaluation – Retrieval Metrics – Precision and Recall – Reference Collection – User-based Evaluation – Relevance Feedback and Query Expansion – Explicit Relevance Feedback

Unit III TEXT CLASSIFICATION AND CLUSTERING**9**

A Characterization of Text Classification – Unsupervised Algorithms: Clustering – Naïve Text Classification – Supervised Algorithms – Decision Tree – k-NN Classifier – SVM Classifier – Feature Selection or Dimensionality Reduction – Evaluation metrics – Accuracy and Error – Organizing the classes – Indexing and Searching – Inverted Indexes – Sequential Searching – Multi-dimensional Indexing

Unit IV WEB RETRIEVAL AND WEB CRAWLING**9**

The Web – Search Engine Architectures – Cluster based Architecture – Distributed Architectures – Search Engine Ranking – Link based Ranking – Simple Ranking Functions – Learning to Rank – Evaluations – Search Engine Ranking – Search Engine User Interaction – Browsing – Applications of a Web Crawler – Taxonomy – Architecture and Implementation – Scheduling Algorithms – Evaluation

Unit V RECOMMENDER SYSTEMS**9**

Recommender Systems Functions – Data and Knowledge Sources – Recommendation Techniques – Basics of Content-based Recommender Systems – High Level Architecture – Advantages and Drawbacks of Content-based Filtering – Collaborative Filtering – Matrix factorization models – Neighbourhood models

Text Book:

1. RicardoBaeza-Yates and BerthierRibeiro-Neto, Modern Information Retrieval: The Concepts and Technology behind Search, Second Edition, ACM Press Books, 2011
2. Ricci, F, Rokach, L. Shapira, B.Kantor, —Recommender Systems Handbook, Springer, First Edition, 2011

Reference Book:

1. C.Manning, P. Raghavan, and H. Schütze, —"Introduction to Information Retrieval", Cambridge University Press, 2008
2. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, —"Information Retrieval: Implementing and Evaluating Search Engines", The MIT Press, 2010
3. Bing Liu, " Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)", Springer; 2nd Edition 2009
4. Charu C. Aggarwal, "Recommender Systems", Springer, 2016

Extensive Reading:

- https://www.tutorialspoint.com/natural_language_processing/natural_language_processing_information_retrieval.htm
- <https://www.upgrad.com/blog/information-retrieval-system-explained/>
- Page ranking: <https://www.geeksforgeeks.org/page-rank-algorithm-implementation/>
- Web crawler:<https://www.cloudflare.com/en-in/learning/bots/what-is-a-web-crawler/>

19ADC03 PRINCIPLES OF COMPUTER ARCHITECTURE

Offered by AID (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basic structure, operations and parallel processing unit
- To learn the arithmetic and logic unit and implementation of fixed-point and floating point arithmetic unit
- To understand the basics of processing unit, control unit and pipelining architecture
- To study the hierarchical memory system and cache memory
- To learn the interfaces for I/O devices

Course Outcome:

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

- Use the instruction set of given architecture
- Design the processing unit and find the execution sequence of an instruction
- Design a pipeline for execution of instructions with minimum hazards
- Analyse memory hierarchy and its impact on system performance
- Design I/O circuits with suitable interfaces

Unit I BASIC STRUCTURE OF COMPUTERS

9

Functional units – Basic operational concepts – Bus Structures – Memory locations and addresses – Memory operations – Instruction and instruction sequencing – Addressing modes – Assembly Language – Basic I/O Operations – Evolution to parallel computers – Parallel processing challenges – Flynn's classification – SISD, MIMD, SIMD, SPMD, and Vector Architectures – Performance – Multiprocessors and Multicomputer

Unit II ARITHMETIC UNIT

9

Operands – Instruction representation – Logical operations – decision making – MIPS Addressing – Addressing modes – Arithmetic: Design of fast adders – Multiplication of unsigned and signed numbers – Fast Multiplication – Integer division – Floating point numbers and operations

Unit III BASIC PROCESSING UNIT

9

Fundamental concepts – Instruction Execution – Hardware Components – Instruction Fetch and Execution Steps – Control Signals – Hardwired control – Micro programmed control – Pipelining – Basic concepts – Data hazards – Instruction hazards – Data dependencies – Memory and branch delays – Performance evaluation – Data path and control considerations – Superscalar operation

Unit IV MEMORY SYSTEM

9

Basic concepts – Semiconductor RAM – Read-only Memories – Speed – Size and Cost – Direct Memory Access – Memory hierarchy – Cache memories – Performance considerations – Virtual memory – Secondary storage

Unit V I/O ORGANIZATION

9

Introduction to Data transfer techniques – Bus Interface – Programmed I/O – Interrupt driven I/O, I/O Interrupt, I/O processor – Interconnection Standards – PCI Bus, SCSI, USB, Firewire, SATA, SAS, PCI

Text Book:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, and Naraig Manjikian, "Computer Organization and Embedded Systems", McGraw Hill Higher Education, Sixth Edition, 2012

Reference Book:

1. Randal E. Bryant, Davie Richard O'Hallaron, "Computer Systems - A Programmer's Perspective, Pearson, 2016
2. David A. Patterson and John L. Hennessy, "Computer Organization and Design: The Hardware / Software interface", Elsevier, Third Edition, 2005
3. William Stallings, "Computer Organization and Architecture — Designing for Performance", Pearson Education, Sixth Edition, 2008

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-systemarchitecture-fall-2005/>

19ADC04 RANDOMIZED ALGORITHMS

Offered by AID (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about the tools and techniques of Randomized algorithm
- To understand the Markov Chains And Random Walks
- To familiarize with Random Number and Variate Generation
- To study Application In Data Structures And Graphs
- To appreciate the Applications of Randomized Algorithms for real world problems

Course Outcome:

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

- Utilize the tools and techniques of Randomized algorithm
- Apply Markov Chains and Random Walks for different real world problems.
- Make use of Random Number and Variate Generation
- Apply Randomness with information
- Analyze Applications of Randomized Algorithms for real world problems

Unit I TOOLS AND TECHNIQUES**9**

Introduction: Min-cut algorithm – Las Vegas and Monte Carlo – Binary planar Partition – Probabilistic recurrence – computation model and complexity classes. Game Theoretic Techniques: Game tree evaluation – minimax principle – Randomness and Non-uniformity. Moments and Deviations: Occupancy problems – Markov and Chebyshev Inequalities – Randomized Selection – Two point sampling – Stable Marriage Problem

Unit II MARKOV CHAINS AND RANDOM WALKS**9**

Tail inequalities: Chernoff Bound – Routing in a parallel computer – Wiring Problem – Martingales. Markov Chains And Random Walks: 2-SAT – Markov Chains – Random Walks on Graphs – Electrical Networks – Cover times – Graph connectivity – Expanders and Rapidly mixing random walks – Probability amplification by random walks

Unit III RANDOM NUMBER AND VARIATE GENERATION**9**

Random Number Generators: Random Number Generators – Nonuniform Random Variables – Methods for Multivariate Random Generation – Asymptotic Methods Based on Markov Chains. Vector Randomization Methods : Rejection Methods for Uniform Vector Generation – Generalized Gamma Density – Uniform Sample Generation of Real Vectors – Uniform Sample Generation of Complex Vectors – Uniform Generation of Stable Polynomials

Unit IV RANDOMNESS AND INFORMATION**7**

Entropy, Randomness, and Information: Entropy Function – Entropy and Binomial Coefficients – Measure of Randomness – Compression – Coding: Shannon's Theorem

Unit V APPLICATIONS OF RANDOMIZED ALGORITHMS**11**

PageRank Computation and Multi-agent Systems – PageRank Problem. . – Distributed Randomized Approach – Distributed Link Matrices and Their Average – Convergence of Distributed Update Scheme – Control Design of Mini-UAVs – Modeling the MH1000 Platform – Uncertainty Description. – Randomized Control Algorithms – Performance of High-Speed Networks – Robustness for Symmetric Single Bottleneck – Randomized Algorithms for Nonsymmetric Case – Monte Carlo Simulation – Quasi-Monte Carlo Simulation – Numerical Results – Probabilistic Robustness of Flexible Structures – Stability of Quantized Sampled-Data Systems

Text Book:

1. Rajeev Motwani and Prabhakar Raghavan, "Randomized Algorithms", Cambridge University Press, Reprint 2017
2. Tempo Roberto, Calafiore Giuseppe, Dabbene Fabrizio, "Randomized Algorithms for Analysis and Control of Uncertain Systems With Applications", Springer, 2013

Reference Book:

1. Michael Mitzenmacher, Eli Upfal, "Probability and Computing: Randomized Algorithms and Probabilistic Analysis", Cambridge University Press, 2005
2. Thomas H Cormen, Charles E Leiserson, Ronald L Rivest and Clifford Stein, "Introduction to Algorithms", Prentice Hall of India, New Delhi, Second Edition, 2007
3. J. Hromkovic, "Design and Analysis of Randomized Algorithms: Introduction to Design Paradigms", Springer, 2005

Extensive Reading:

- <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-856j-randomized-algorithms-fall-2002/>
- <https://www.geeksforgeeks.org/randomized-algorithms/>
- <https://brilliant.org/wiki/randomized-algorithms-overview/>

19ADC05 PRINCIPLES OF COMPUTER GRAPHICS

Offered by AID (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about the techniques of Computer Graphics and 2D
- To understand the human visual perception
- To familiarize with 2D and 3D shapes
- To study the different Transformations In Two Dimensions
- To appreciate the Applications of Transformations In three Dimensions

Course Outcome:

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

- Utilize the graphics tools for handling 2D objects
- Apply human visual perception for scene creation
- Make use of 2D and 3D shapes
- Apply transformations to Two Dimension objects
- Use transformations in Three Dimension objects

Unit I GRAPHICS AND 2D**9**

Introduction: Computer Graphics – Current and Future Application Areas – User–Interface Considerations Resources, and Appropriate Abstractions – Numbers and Orders of Magnitude – Graphics Pipeline – Relationship of Graphics to Art, Design, and Perception – Graphics Systems– Polygon Drawing As a Black Box.

2D Graphics Pipeline – Evolution of 2D Graphics Platforms–Specifying a 2D Scene Using WPF –Structure of an XAML Application – Specifying the Scene via an Abstract Coordinate System– Spectrum of Coordinate–System – WPF Canvas – Dynamics in 2D Graphics Using WPF. Renderer: Dürer Woodcut–Visibility– Implementation– Drawing

Unit II HUMAN VISUAL PERCEPTION**9**

Introduction : Visual System –The Eye –Gross Physiology of the Eye –Receptors –Constancy and Its Influences– Approximating the Physics –Mesh and Lighting Specification–Planning the Scene– Realistic LightingFixed–Function Rendering–Curved–Surface Representation and Rendering– Interpolated Shading –Surface Texture in WPF–WPF Reflectance Model–Color Specification –Light Geometry

Unit III SHAPE IN 2D AND 3D**9**

Introduction : Meshes in 2D: Polylines –Data Structure for 1D Meshes – Meshes in 3DManifold – Nonmanifold Meshes– Memory Requirements –Mesh Operations–Edge Collapse–Edge SwapBarycentric Interpolation– View of Linear Interpolation– Scanline Interpolation – Limitations of Piecewise Linear Extension – Dependence on Mesh Structure

Unit IV TRANSFORMATIONS IN TWO DIMENSIONS**7**

Introduction : Important Facts about Transformations–Linear Transformation–Multiplication by a Matrix – Matrix Inverse and Inverse Functions –Transformations and Coordinate Systems–Matrix Properties and the Singular Value Decomposition – Translation– Points and Vectors – Windowing Transformations–Building 3D Transformations– Building a 2D Transformation– Coordinate Frames. Application: Rendering from a Scene Graph–Transforming Vectors and Covectors– Transformations versus Interpolation. Hidden Surface Elimination

Unit V TRANSFORMATIONS IN THREE DIMENSIONS**11**

Introduction : Projective Transformation Theorems–Rotations– Euler Angles– Axis–Angle Description of a Rotation – Body–Centered Euler Angles– Rotations and the 3–Sphere – Stability of Computations – Comparing Representations–Rotations versus Rotation – Interpolating Matrix Transformations– Virtual Trackball and Arcball. Transformation Library:Points and Vectors – Transformations – Efficiency – Specification of Transformations– Implementation– Projective Transformations– Three Dimensions – Associated Transformations

Text Book:

1. John F.Hughes, Andries Van Dam, Morgan McGuire, David F. Sklar, James D. Foley, Steven K. Feiner, Kurt Akeley, "Computer Graphics -Principles and Practice",Addison Wesley, Third Edition 2014
2. Steve Marschner, Peter Shirley, "Fundamentals of Computer Graphics", CRC Press, 2016

Reference Book:

1. Donald D. Hearn, M. Pauline Baker and Warren Carithers, "Computer Graphics with OpenGL", Fourth Edition, Pearson Education, 2010
2. James D. Foley, Andries Van Dam, Steven K. Feiner, John F. Hughes, "Computer Graphics Principles and Practice in C", Second Edition, Pearson Education 2007
3. F.S. Hill, "Computer Graphics using OPENGL", Second edition, Pearson Education 2003

Extensive Reading:

- <https://www.edx.org/course/computer-graphics-2>
- <https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-837-computer-graphics-fall-2012/>

- <https://www.geeksforgeeks.org/introduction-to-computer-graphics/>

19ADC06 SOFTWARE DEFINED NETWORKS

Offered by AID (Core Elective)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To gain knowledge of the various network operations
- To learn the functions of a SDN, and its architecture
- To understand the internals of a SDN and get an experience of designing such systems
- To learn about behavior of the network at different conditions

Course Outcome:

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

- Apply real time data in SDN Data Centre
- Use Openflow for Software Defined Networks
- Use SDN in data centers
- Apply suitable protocol and Network Functions Virtualization for SDN architecture
- Develop simple SDN for given application

Unit I INTRODUCTION AND WORKING**9**

Virtualization – Defining SDN – Need for SDN – Evolution of switched and control Planes – Cost – Implications for research and innovation – Data center: innovation, needs – SDN Working – Fundamental Characteristics – SDN Operation– SDN Devices – SDN Controller –SDN Applications– Alternate SDN Methods

Unit II OPENFLOW**9**

OpenFlow Specification : Specific Terminology – OpenFlow Overview– Switch, Controller, Protocol , Secure Channel – OpenFlow 1.0 and OpenFlow Basics – Additions in OpenFlow 1.1 – Multiple Flow Tables, Groups, MPLS and VLAN Tag Support , Virtual Ports– Additions in OpenFlow 1.2, 1.3, 1.4,1.5 – Improving OpenFlow Interoperability –Optical Transport Protocol Extensions –Limitations

Unit III SDN IN DATA CENTER**9**

Data center concepts and constructs – SDN in data center – Data center definition, demands – Tunneling technologies – Path technologies – Ethernet fabrics – SDN use cases in data center – Open SDN Vs. Overlays in data center – Data Center implementation – SDN in other environment

Unit IV PROTOCOL, CONTROLLER AND APPLICATION MODELS**7**

Expanded Definitions of SDN–Network Management Versus SDN– Additional SDN Protocol Models – Controller Models– ApplicationModels: Proactive –Declarative –External – New Approaches to SDN Security – P4 Programming Language. Network Functions Virtualization : Definition –Virtualize– Standards – OPNFV– Leading NFV Vendors– SDN vs NFV– In–Line Network Functions– Server Load–Balancing– Firewalls –Intrusion Detection

Unit V SDN APPLICATIONS**11**

Application Types : Reactive – Proactive – Internal –s External – Using Floodlight for Training Purposes– Simple Reactive Java Application– Controller Considerations –Open Daylight–ONOS–Network Device Considerations – Creating Network Virtualization Tunnels– Offloading Flows –Access Control for the Campus –Traffic Engineering for Service Providers –SDN Open Source – Landscape – Open Flow Open Source Environment –Profiles of SDN Open Source Users – Open Flow Source Code–Switch, Controller Implementations –Open Daylight– ONOS – SDN Applications – Orchestration and Network Virtualization – Open Source Cloud Software

Text Book:

1. Paul Goransson, Chuck Black and Timothy Culver, “Software Defined Networks: A Comprehensive Approach” , Second Edition, Morgan Kaufmann, 2014

Reference Book:

1. Patricia A. Morreale, James M. Anderson, “Software Defined Networking: Design and Deployment”, CRC Press,2014
2. Thomas D. Nadeau, Ken Gray , SDN: “Software Defined Networks”, OReilly, 2013
3. By Siamak Azodolmolky “Software Defined Networking with OpenFlow”, packt publishing, October 2013

Extensive Reading:

- <http://noise.gatech.edu/classes/cs8001-sdn/fall2013/>
- <https://sites.google.com/site/sdnreadinglist/>
- <http://www.brocade.com/solutions-technology/technology/software-defined-networking/index.page>
- <http://www.cisco.com/web/IN/solutions/trends/sdn/index.html>
- <https://www.coursera.org/course/sdn1>

19ADC07 WEB MINING

Offered by AID (Core Elective)

L	T	P	C
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Course Objective:

To impart knowledge on

- To Study about the web crawlers and term indexing techniques
- To know about web structure mining
- To Study about various content based classification and clustering
- To study about web log mining and expanded query processing

Course Outcome:

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

- Apply web crawlers and extract and index terms from documents
- Apply Web structure mining techniques to extract communities
- Use machine learning methods to classify and cluster documents
- Extract useful information from huge weblog data
- Design expandable queries

Unit I INTRODUCTION

9

Architecture of the WWW – Web Document Representation– Web Search Engine – Challenges –Basic Crawler Algorithm– Breadth-First– depth-First Crawlers – Universal Crawlers – Preferential Crawlers – Focused Crawlers – Topical Crawlers– INDEXING – Static and Dynamic Inverted Index– Index Construction and Index Compression– Latent Semantic Indexing. Searching using an Inverted Index: Sequential Search – Pattern Matching – Similarity search

Unit II WEB STRUCTURE MINING

9

Link Analysis – Social Network Analysis – Co-Citation and Bibliographic Coupling – Page Rank– Weighted Page Rank– HITS – Community Discovery –Overlapping community detection – Web Graph Measurement and Modelling – Using Link Information for Web Page Classification

Unit III WEB CONTENT MINING

9

Classification – Decision tree for Text Document – Naive Bayesian Text Classification – Ensemble of Classifiers. Clustering: K-means Clustering – Hierarchical Clustering – Markov Models – Probability–Based Clustering. Vector Space Model – Latent semantic Indexing – Automatic Topic Extraction from Web Documents

Unit IV WEB USAGE MINING

9

Web Usage Mining – Click stream Analysis – Log Files – Data Collection and Pre–Processing – Data Modelling for Web Usage Mining – The BIRCH Clustering Algorithm – Modelling web user interests using clustering – Affinity Analysis and the A Priori Algorithm – Binning –Web usage mining using Probabilistic Latent Semantic Analysis – Finding User Access Pattern via Latent Dirichlet Allocation Model

Unit V QUERY PROCESSING

9

Relevance Feedback and Query Expansion – Automatic Local and Global Analysis – Measuring Effectiveness and Efficiency – Case studies on Community detection in social networks

Text Book:

1. Bing Liu, “ Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)”, Springer; 2nd Edition 2009
2. Zdravko Markov, Daniel T. Larose, “Data Mining the Web: Uncovering Patterns in Web Content, Structure, and Usage”, John Wiley & Sons, Inc., 2007

Reference Book:

1. GuandongXu ,Yanchun Zhang, Lin Li, “Web Mining and Social Networking: Techniques and Applications”, Springer; 1st Edition.2010
2. SoumenChakrabarti, “Mining the Web: Discovering Knowledge from Hypertext Data”, Morgan Kaufmann; edition 2002

Extensive Reading:

- <https://www.geeksforgeeks.org/web-mining/>
- Page ranking: <https://www.geeksforgeeks.org/page-rank-algorithm-implementation/>
- Web crawler:<https://www.cloudflare.com/en-in/learning/bots/what-is-a-web-crawler/>

19ADC08 PARALLEL COMPUTING

Offered by AID (Core Elective)

L	T	P	C
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Course Objective:

To impart knowledge on

- To gain knowledge of the Parallel Systems
- To learn about Programming multi core and shared memory multiprocessor
- To study vector architecture and GPU architecture
- To understand the architecture, issues and working of warehouse scale computers
- To study the multicore architectures and their design issues

Course Outcome:

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

- Design parallel systems for real time systems
- Develop OpenMP based Programs for multi core and shared memory multiprocessor
- Use MPI Processes and Messaging for applications
- Use GPUs for programming applications
- Design parallel computing solutions for problems

Unit I PARALLEL SYSTEMS**9**

Parallel Computer – Types of Parallelism –Time–Consuming Computations – History –Modelling Parallel – Multiprocessor Models: Parallel Random Access Machine ,Local–Memory Machine , Memory–Module Machine – Impact of Communication – Interconnection Networks –Parallel Computational Complexity – Brent’s Theorem – Amdahl’s Law

Unit II PROGRAMMING MULTI–CORE AND SHARED MEMORY**9**

Shared Memory Programming Model– Write Multithreaded Programs with OpenMP –Parallelization of Loops – Distributing Iterations Among Threads – Parallel Tasks –case studies

Unit III MPI PROCESSES AND MESSAGING**9**

Distributed Memory Computers – Programmer’s View – Message Passing Interface –Basic MPI – Process–to–Process Communication – Collective MPI Communication – Communication and Computation Overlap

Unit IV MASSIVELY PARALLEL GRAPHIC PROCESSORS**7**

Anatomy of a GPU– Introduction to GPU Evolution – Modern –Scheduling Threads on Compute Units – Memory Hierarchy on GPU –Programmer’s — Heterogeneous System –Programming in OpenCL – Examples

Unit V ENGINEERING PARALLEL COMPUTATION**11**

Engineering Parallel Computation of the Number pi – Engineering Parallel Solution of 1–D Heat Equation – Engineering: Parallel Implementation of Seam

Text Book:

1. Roman Trobec, Boštjan Slivnik, Patricio Bulić, Borut Robič, “Introduction to Parallel Computing: From Algorithms to Programming”, Springer Nature Switzerland, 2018

Reference Book:

1. W. P. Petersen, P. Arbenz, “Introduction to Parallel Computing”, Oxford University Press, 2004
2. Paweł Czarnul, “Parallel Programming for Modern High Performance Computing”, CRC Press, 2018
3. David E. Culler, Jaswinder Pal Singh, “Parallel computing architecture: A hardware/software approach”, Morgan Kaufmann /Elsevier Publishers, 1999
4. Kai Hwang and Zhi.Wei Xu, “Scalable Parallel Computing”, Tata McGraw Hill, New Delhi, 2003

Extensive Reading:

- <http://docs.nvidia.com/cuda/cuda-c-programming-guide/>
- <http://www.cs.cmu.edu/~fp/courses/15213-s07/lectures/27-multicore.pdf>
- <http://rolfed.com/nehalem/nehalemPaper.pdf>

19ADC09 MACHINE LEARNING DESIGN PATTERNS

Offered by AID (Core Elective)

L	T	P	C
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Course Objective:

To impart knowledge on

- To Basic concepts and techniques for representation of data
- To Representation of problems and training
- To Prediction and feature store to design patterns
- To Various machine learning techniques to solve problems
- To Decision based and probability based learning techniques

Course Outcome:

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

- Design and apply Data Representation techniques to solve any problem
- Apply machine learning techniques to represent any given problem.
- Implement evaluation model and reproducibility for any given problem
- Design systems that uses the appropriate training models of machine learning
- Modify existing machine learning algorithms to improve classification efficiency

Unit I INTRODUCTION AND DATA REPRESENTATION**9**

Need for Machine Learning Design patterns: Machine Learning Terminology – Challenges in Machine Learning – Data representation: Simple Data Representation – Hashed Features – Embedding – Feature Cross – Multimodal Input

Unit II PROBLEM REPRESENTATION AND TRAINING MODELS**9**

Reframing – Multilabel – Ensembles – Cascaded – Neutral Class – Rebalancing - Training Loop : Stochastic Gradient Descent – Keras Training Loop – Training Design Patterns – Useful Overfitting – Checkpoints – Transfer Learning – Distribution Strategy Hyper parameter tuning

Unit III DESIGN PATTERNS AND REPRODUCIBILITY**9**

Stateless Serving Function – Batch Serving – Continued Model Evaluation – Two-Phase Prediction – Keyed Predictions – Transform – Repeatable Splitting – Bridged Schema – Windowed Inference – Workflow pipeline – feature store

Unit IV MACHINE LEARNING TECHNIQUES**9**

Fundamentals Of Neural Networks – Model of Artificial Neuron – Neural Network Architectures – Learning Methods – Taxonomy Of Neural Network Architectures – Applications – Supervised Learning – Unsupervised Learning – Reinforcement Learning

Unit V TREE AND PROBABILISTIC MODELS**9**

Learning with Trees – Decision Trees – Constructing Decision Trees – Classification and Regression Trees – Ensemble Learning – Boosting – Bagging – Different ways to Combine Classifiers – Probability and Learning – Data into Probabilities – Basic Statistics – Gaussian Mixture Models – Nearest Neighbor Methods – Unsupervised Learning – K means Algorithms – Vector Quantization – Self Organizing Feature Map

Text Book:

1. Valliappalakshmanan, Sara Robinson, Michael Munn, "Machine Learning Design Patterns", O'Reilly , 2020

Reference Book:

1. Stephen Marsland, "Machine Learning – An Algorithmic Perspective", Second Edition, CRC Machine Learning and Pattern Recognition Series, second edition, 2014
2. Peter Flach, "Machine Learning: The Art and Science of Algorithms that Make Sense of Data", First Edition, Cambridge University Press, 2012
3. Jason Bell, "Machine learning – Hands on for Developers and Technical Professionals", First Edition, Wiley, 2014
4. Ethem Alpaydin, "Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series)", Third Edition, MIT Press, 2014

Extensive Reading:

- <https://datawarrior.wordpress.com/2019/09/15/data-representation-in-machine-learning/>
- <https://www.geeksforgeeks.org/ml-introduction-data-machine-learning/>
- <https://brilliant.org/wiki/gaussian-mixture-model/>

19ADC10 DIGITAL IMAGE ANALYTICS

Offered by AID (Core Elective)

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Course Objective:

To impart knowledge on

- To Fundamentals of Digital Image analytics
- To Simple image enhancement techniques in Spatial and Frequency domain
- To Degradation function and restoration techniques
- To Image segmentation and representation techniques
- To Image compression and recognition methods

Course Outcome:

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

- Use the basics and fundamentals of digital image processing and color models
- Manipulate on images using the techniques of smoothing, sharpening and enhancement
- Apply the restoration and filtering techniques to restore the original image
- Apply various segmentation algorithms to extract information from the Digital Image
- Implement suitable compression and recognition methods for solving Image processing problems

Unit I DIGITAL IMAGE FUNDAMENTALS**9**

Steps in Digital Image Processing – Components – Elements of Visual Perception – Image Sensing and Acquisition – Image Sampling and Quantization – Relationships between pixels – Color image fundamentals – RGB, HSI models, Twodimensional mathematical preliminaries, 2D transforms – DFT, DCT

Unit II IMAGE ENHANCEMENT**9**

Spatial Domain: Gray level transformations – Histogram processing – Basics of Spatial Filtering–Smoothing and Sharpening Spatial Filtering, Frequency Domain: Introduction to Fourier Transform– Smoothing and Sharpening frequency domain filters – Ideal, Butterworth and Gaussian filters, Homomorphic filtering, Color image enhancement

Unit III IMAGE RESTORATION**9**

Image Restoration – degradation model, Properties, Noise models – Mean Filters – Order Statistics – Adaptive filters – Band reject Filters – Band pass Filters – Notch Filters – Optimum Notch Filtering – Inverse Filtering – Wiener filtering

Unit IV IMAGE SEGMENTATION**9**

Edge detection, Edge linking via Hough transform – Thresholding – Region based segmentation – Region growing – Region splitting and merging – Morphological processing– erosion and dilation, Segmentation by morphological watersheds – basic concepts – Dam construction – Watershed segmentation algorithm

Unit V IMAGE COMPRESSION AND RECOGNITION**9**

Need for data compression, Huffman, Run Length Encoding, Shift codes, Arithmetic coding, JPEG standard, MPEG. Boundary representation, Boundary description, Fourier Descriptor, Regional Descriptors – Topological feature, Texture – Patterns and Pattern classes – Recognition based on matching

Text Book:

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

Reference Book:

1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2011
3. Dan E. Dudgeon and Russell M. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990
4. William K. Pratt, "Digital Image Processing", John Wiley, New York, 2002

Extensive Reading:

- <http://inst.eecs.berkeley.edu/~ee225b/fa12/lectures/>
- <http://www.debugmode.com/imagecmp/>
- <https://sisu.ut.ee/imageprocessing/book>
- <https://www.tutorialspoint.com/dip/>

19ADC11 COMPILER DESIGN

Offered by AID (Core Elective)

L	T	P	C
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Course Objective:

To impart knowledge on

- To learn about lexical analyzer
- To learn to implement a parser
- To understand the various intermediate code representations
- To learn the code generations and its algorithm
- To understand the code optimization techniques and 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
- Use the appropriate intermediate code
- Apply the suitable optimization techniques
- Generate the machine code for simple language constructs

Unit I INTRODUCTION AND LEXICAL ANALYSIS**9**

Language processors – Phases of a compiler – Pass and phase – Bootstrapping – Compiler construction tools – Applications of compiler technology – Programming language basics– 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

Unit II SYNTAX ANALYSIS– PARSER**9**

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, CLR and LALR parsing table – Error Recovery in Parsers – syntax analyzer generators

Unit III INTERMEDIATE CODE GENERATION**9**

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 – case statements – back patching– procedure calls

Unit IV RUN-TIME ENVIRONMENT AND CODE OPTIMIZATION**9**

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 – DAG – optimization of basic blocks – global data flow analysis

Unit V CODE GENERATION**9**

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

Text Book:

1. K.Muneeswaran, "Compiler Design", Oxford University Press, 2013
2. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D.Ullman, "Compilers: Principles, Techniques andTools",Pearson Education, 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. V. Raghavan, "Principles of Compiler Design", Tata McGraw Hill Education Publishers, 2010
4. Allen I. Holub, "Compiler Design in C", Prentice–Hall software series, 1993

Extensive Reading:

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

19ADC12 RECOMMENDER SYSTEMS

Offered by AID (Core Elective)

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Course Objective:

To impart knowledge on

- To know about Neighborhood model and collaborative filtering
- To study about content based recommender systems
- To understand evaluation of recommender systems
- To study time aware recommender systems
- To know about structural recommender systems in networks

Course Outcome:

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

- Apply collaborative filtering to arrive at conclusions
- Design content based recommender systems
- Compare and evaluate various recommender systems
- Design time and location based recommender systems
- Apply network structural knowledge to design recommender systems

Unit I NEIGHBOURHOOD AND MODEL BASED COLLABORATIVE FILTERING 9

Introduction to Recommender Systems – NEIGHBOURHOOD BASED – Cluster based Model – Regression based Model – Graph Model – Model based collaborative filtering – Decision – Regression tree – Rule based – Latent factor models – Matrix Factorization – Singular Vector Decomposition

Unit II CONTENT BASED AND HYBRID SYSTEMS 9

CONTENT BASED – Components of Content based – Pre-processing and Feature Extraction – Learning user profiles and filtering – Nearest neighbour – Bayes – Rule based – Regression based – ENSEMBLE AND HYBRID – Weighted – Switching – Cascade – Feature augmentation – Feature combination – Metal level hybrids – CONTEXT SENSITIVE recommender systems – Contextual modelling

Unit III EVALUATING RECOMMENDER SYSTEMS 9

Measuring accuracy and rating prediction – Evaluation paradigms – Evaluation design – Accuracy – coverage – confidence – trust – novelty – serendipity – diversity

Unit IV TIME AND LOCATION SENSITIVE SYSTEMS 9

Temporal collaborative filtering – recency based – handling periodic context – Time-SVD++ model – Discrete Temporal Model – Markovian – Sequential pattern mining – Location aware – Preference and travel locality – Measuring accuracy and rating prediction – Evaluation paradigms – Evaluation design – Accuracy – coverage – confidence – trust – novelty – serendipity – diversity

Unit V STRUCTURAL RECOMMENDATIONS IN NETWORKS 9

Ranking algorithm – Page rank; Recommending Friends – link prediction – Neighbourhood – Katz measure – random walk based – Matrix factorization; Social Influence analysis – Linear Threshold – Independent cascade – Influence function evaluation – Recommendation using Deep Neural Networks – SoftMax model – Soft max Training – Case Studies

Text Book:

1. Charu C. Aggarwal, "Recommender Systems", Springer, 2016

Reference Book:

1. Ricci, F, Rokach, L. Shapira, B. Kantor, "Recommender Systems Handbook", Springer, First Edition, 2011
2. C. Manning, P. Raghavan, and H. Schütze, "Introduction to Information Retrieval", Cambridge University Press, 2008
3. Stefan Buettcher, Charles L. A. Clarke and Gordon V. Cormack, "Information Retrieval: Implementing and Evaluating Search Engines", The MIT Press, 2010
4. Bing Liu, "Web Data Mining: Exploring Hyperlinks, Contents, and Usage Data (Data-Centric Systems and Applications)", Springer, 2nd Edition 2009

Extensive Reading:

- <https://developers.google.com/machine-learning/recommendation/dnn/softmax>
- <https://www.analyticssteps.com/blogs/what-are-recommendation-systems-machine-learning>
- <https://www.kdnuggets.com/2019/09/machine-learning-recommender-systems.html>
- <https://medium.com/recombee-blog/machine-learning-for-recommender-systems-part-1-algorithms-evaluation-and-cold-start-6f696683d0ed>

19ADP01 DATA ANALYTICS IN BIOINFORMATICS

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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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**

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 – 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

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-data-analysis-methods/microarrays/analysis-of-microarray-data/>

19ADP02 TEXT ANALYTICS

Offered by AID (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 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

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 – syntax parsing 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 – image 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. Dan Jurafsky and James H Martin, "Speech and Language Processing". Pearson Education India, 2000
2. Christopher D. Manning, Prabhakar Raghavan, and Hinrich Schuetze, "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>

19ADP03 KNOWLEDGE REPRESENTATION AND REASONING

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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Course Objective:

To impart knowledge on

- To Basic concepts of knowledge and its role
- To Representation of knowledge & associated methods for automated reasoning
- To Identifying knowledge-based techniques which are appropriate for specific tasks
- To Representation of knowledge using object oriented and its structural description
- To Design and apply knowledge-based systems

Course Outcome:

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

- Use the basic concept of KRR and Evaluate how the knowledge can be used to represent
- Design the Rule based system
- Represent the knowledge using Object oriented approach
- Generate the plans using knowledge about actions and assess the trade off between representation and reasoning
- Apply KRR systems for challenging real-world problems

Unit I KNOWLEDGE REPRESENTATION**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 REPRESENTATION 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 – Auto epistemic 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

Reference Book:

1. Deepak Khemani, "A First Course in Artificial Intelligence", McGraw Hill Education (India), 2013

Extensive Reading:

- <https://www.javatpoint.com/knowledge-representation-in-ai>
- <https://www.edureka.co/blog/knowledge-representation-in-ai/>

19ADP04 ARTIFICIAL INTELLIGENCE IN FINANCE

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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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**9**

Artificial Intelligence: Algorithms, Neural Networks— Importance of Data. Super Intelligence : Forms of Intelligence – Paths to Superintelligence – Intelligence Explosion

Unit II FINANCE AND MACHINE LEARNING**9**

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 : Oando 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>

19ADP05 ETHICS AND VALUES IN INTELLIGENT COMPUTING

Offered by AID (Open Elective offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME)

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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 analyse 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 Technology Freedom 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 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

19ADP06 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 Various types of classical cryptographic algorithms
- To Symmetric and asymmetric key encryption techniques
- To Authentication measures and digital signatures
- To Program based security threats including virus and trojan
- To 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 validation techniques
- Design and detect various attacks in 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 cipher and Stream Cipher – Steganography

Unit II CRYPTOGRAPHY

9

Key management – Session and Interchange keys – Key exchange and generation – Cryptographic Key Infrastructure–Storing and Revoking Keys –Digital Signatures –Cipher Techniques – Symmetric and Asymmetric Cryptographic Techniques: DES –AES –RSA–algorithms

Unit III AUTHENTICATIONANDDIGITALSIGNATURES

9

AuthenticationandDigitalSignatures:UseofCryptographyforauthentication –Secure Hash function –Key management– Kerberos –Representing Identity – Access Control Mechanisms – Information Flow and Confinement Problem

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 – Buffer overflow – Incomplete mediation – Time-of-check to Time-of-use Errors –Viruses –Trapdoors –Salami attack –Man-in-the-middle attacks –Covert channels

Unit V SECURITY IN NETWORK

9

Threats in networks –Network Security Controls – Architecture – Encryption – Content Integrity – Strong Authentication–Access Controls –Wireless Security – Honeypots –Traffic flow security –Firewalls–Design and Types of Firewalls –Personal Firewalls –IDS –Email Security–PGP,S/MIME

Text Book:

1. Shari Lawrence Pfleeger, Charles P. Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition, Pearson Education, 2015
2. William Stallings, "Cryptography And Network Security Principles And Practice", Seventh Edition, Pearson, 2017

Reference Book:

1. Matt Bishop, "Computer Security art and science", Addison-Wesley Professional, 2003
2. Wenbo Mao, "Modern Cryptography: Theory and Practice", HP Professional books, 2003
3. William Stallings, "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>

19BMP01 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

- Explain about atomic physics and non-ionizing radiation, interaction with tissue and its effects.
- Understand the physics of the senses
- Explain the fundamentals of radioactivity and radioactive isotopes
- Summarizes the ionizing radiation interacts with the human body and to quantify its levels
- Illustrates the methods of detecting and recording the ionizing radiation and its interaction with matter

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-Techetium 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. Gopal 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>

19BMP02 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 of nanomaterials.
- To implement different strategies for synthesizing 0, 1D, 2D nanomaterials.
- To explore the role and application of nanomaterials in various fields.

Course Outcome:

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

- Classify and understand various top-down and bottom-up approaches for nanomaterial synthesis.
- Understand and discuss various chemical approaches for nanomaterial synthesis.
- Comprehend various physical approaches for nanomaterial synthesis.
- Acquire knowledge about various kinds of nanoporous materials and its characterization.
- Get clear knowledge on the application and implementation of nanomaterials to solve the societal problems.

Unit I BULK SYNTHESIS**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.

Unit II CHEMICAL APPROACHES**9**

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 III 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 IV NANOPOROUS MATERIALS**9**

Zeolites, mesoporous materials, nano membranes - Carbon nano tubes and graphene - Core shell and hybrid nano composites.

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. G.A. Ozin and A.C. Arsenault, "Nanochemistry: A chemical approach to nanomaterials", Royal Society of Chemistry, 2nd Edition, 2009

Reference Book:

1. K. Barriham, D.D. Vvedensky, "Low dimensional semiconductor structures: fundamental and device applications", Cambridge University Press, 2010.
2. G. Cao, Y. Wang. "Nanostructures & Nanomaterials: Synthesis, Properties & Applications", Imperial College Press, 2nd Edition, 2011

Extensive Reading:

- https://onlinecourses.nptel.ac.in/noc21_mm05/preview
- <https://www.manchester.ac.uk/study/undergraduate/courses/2022/12661/meng-materials-science-and-engineering-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>

19BTP01 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.
- Comprehend the transduction systems used in enzymatic Sensors.
- Explain the role of affinity interactions in biosensors.
- Analyze the application of DNA based biosensors.
- Apply nanoconstructs in design of Biosensors.

Unit I FUNDAMENTALS OF BIOSENSOR**9**

Definition, Historical development, Important aspects of sensors- 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 response time.

Unit II ENZYMATIC SENSORS**9**

Enzymes with relevance to Biosensors - Transduction Methods in Enzymatic Biosensors - Potentiometric enzyme electrodes - Amperometric enzyme electrodes - Semiconductor enzyme sensors - Optical enzyme sensors - Thermal enzyme sensors - Piezoelectric enzyme sensors.

Unit III IMMUNOLOGICAL SENSORS**9**

General Principles - Immobilization Methods in Immunosensors - Immunoassay Formats - Membrane Immunosensors - Piezoelectric Systems - Optical Immunosensors - Biosensors Using Intact Biological Receptors.

Unit IV NUCLEIC ACID BASED BIOSENSORS**9**

Nucleic Acid Structure and Properties, Nucleic Acid Analogs, Nucleic Acids as Receptors in Recognition Processes, Immobilization of Nucleic Acids, Transduction Methods in Nucleic Acids Sensors, 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

19BTP02 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

- To learn the basic concepts of radiation and its applications in medical imaging.
- To provide knowledge on Optical microscopy and advancements.
- To know the advanced microscopic techniques.
- To learn about the photomicrography.
- To impart knowledge on medical imaging techniques and its applications

Course Outcome:

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

- Learn the basic concepts of radiation and its effect on macro molecules.
- Study about the basics in optical microscopy and photomicrography.
- Know the principle and applications of advanced microscopic techniques.
- learn the basis of recording and reproduction of captured image for analysis.
- Learn the application of radiation in medical imaging.

Unit I INTRODUCTION**9**

Imaging: overview - Non-invasive methods of imaging - Electromagnetic spectrum - Radiation types – Initial physical events – radiolysis of water – effects of radiation on DNA and chromosomes – Whole body response to radiation: the acute radiation syndrome - radiation induced carcinogenesis.

Unit II OPTICAL MICROSCOPY**9**

Microscope: simple and compound microscope - Optical microscopy – Conventional light microscopy: Principle, applications - Confocal microscopy: principle, applications - Fluorescence, fluorescent molecules and dyes, Gel documentation, Fluorescent microscopy: principle, applications.

Unit III ADVANCED MICROSCOPIC TECHNIQUES**9**

Scanning electron microscopy (SEM): principle, applications - Transmission electron microscopy (TEM): principle, applications - Scanning probe microscopy - Scanning tunneling microscopy (STM): principle, applications - Atomic force microscopy (AFM): principle, applications.

Unit IV RECORDING AND REPRODUCTION OF MICROSCOPIC IMAGES**9**

Photomicrography: general principles, photomicrographic equipment, the holomicrographic exposure, contrasts in the negative, colour photomicrography - Some special techniques in photomicrography: microflash, stereophotomicrography, holography.

Unit V MEDICAL IMAGING**9**

Imaging modalities – X ray: principle, applications - Ultrasound: principle, applications - Computed tomography (CT): principle, applications – Magnetic resonance imaging (MRI): principle, applications – Positron emission tomography (PET): principle, applications.

Text Book:

1. Jerrold T., Bushberg, J. Anthony S., Edwin M. L., Jr, John M. B., “The Essential Physics of Medical Imaging”, 3rd Edition, LWW, 2011.
2. Douglas B. Murphy, “Fundamentals of Light Microscopy and Electronic Imaging”, Wiley-Blackwell, 2nd Edition, 2012.
3. Haidekker, M. A., “Medical Imaging Technology”, Springer, 2013.

Reference Book:

1. Prescott M., Harley J, PandKlein D.A., “Microbiology”, McGraw-Hill Education, 9th 2013.
2. Nadine B.S., Andrew W., “Introduction to Medical Imaging: Physics, Engineering and Clinical Applications”, Cambridge University Press, 1st Edition, 2010.
3. Wilson K., Walker J, “Principles and Techniques of Biochemistry and Molecular Biology”, Cambridge University Press, 7th Edition, 2010.

19CEP01 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 ELEMENTS OF ARCHITECTURE**9**

Elements - Mass and space visual emotional effects of geometric forms and their derivatives - sphere, cube, pyramid, cylinder and cone - aesthetic qualities of architecture: Proportion, scale, balance, symmetry, rhythm and axis - Contrast in form - Harmony.

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**

General - 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 - Case studies.

Unit V LANDSCAPE ARCHITECTURE**9**

Principles - Site planning - Design - Styles - Elements and materials - Plant characteristics and design - 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. Edward D.Mills, "Planning and Architects Handbook", Butterworth London, 1995.
6. Paul Alan Johnson, "The Theory of Architecture: Concepts, Themes & Practices", John Wiley & Sons, Inc.1994.

Extensive Reading:

- <https://theconstructor.org/building/green-building-materials/7028/>
- <https://nptel.ac.in/courses/124/107/124107011/>

19CEP02 BASICS OF CLIMATE 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

- 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

- 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. Banerjee K.K., "Global Warming Database Technology Options in Power and End-use Sectors Using Fossil Fuels", New Delhi, 2005.
2. Gupta M., "Restricting Greenhouse Gas Emissions: Economic Implications for India", New Delhi, 2006.

Reference Book:

1. Barbara J., Pitts F. and Pitts J.N., Jr, "Chemistry of the Upper and Lower Atmosphere- Theory, Experiments and Applications Academic Press", San Diego, 2000.
2. Oliver J.E. and Hidore J.J., "Climatology: An Atmospheric Science", Pearson educationl, 2009.
3. Seinfeld J.H. and Pandis S.N. , "Atmospheric Chemistry and Physics-from Air Pollution to Climate Change", John Wiley and Sons, Inc, 2016.
4. Hardy J., "Climate Change: Causes, Effects and Solutions", John Wily & Sons, 2003.
5. Nakicenovic N. (Eds), "Integrative Assessment of Mitigation, Impacts and Adaptation to Climate Change", Austria, 1994.
6. Sathaye J. and Meyers S.D., "Greenhouse Gas Mitigation Assessment: A Guidebook", Springer, 2010.
7. Thomas S., Jessica C., "Policy Instruments for Environment and Natural Resource Management", Taylor and Francis Inc, Washington DC, 2011.
8. Tiwari G.N., "Greenhouse Technology for Controlled Environment", New Delhi, 2003.
9. Mahajan.S.P., Pollution Control in Process Industries, Tata Mc-Graw Hill Company, NewDelhi, 2017.

Extensive Reading:

- <https://www.ncdc.noaa.gov/news/what-have-we-learned-paleoclimatology>
- <https://cdm.unfccc.int/>

19CEP03 FUNDAMENTALS OF URBAN PLANNING

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 city planning.
- The planning policies.
- The types of urban patterns.
- The infrastructure facilities and planning.
- The development control and management.

Course Outcome:

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

- Plan for the land use and other developments in a city.
- Design the facilities in a city using the knowledge of planning policies.
- Locate the facilities and design the components of the city.
- Plan and manage the inventories of the infrastructure facilities of a proposed city.
- Evolve the required policies for controlling the city development.

Unit I INTRODUCTION**9**

Urbanization - Urbanization trends in 20th century & Growth of cities - Land uses - Types - Change of land use - Its implications on development - Conceptual Foundations of Sustainability in city planning.

Unit II PLANNING POLICIES**9**

Planning policies - theories - Standards of planning facilities for the city - Social issues in planning - Various development plans - Land use planning - Detailed development plan - Master plan - Comprehensive planning - Role of external funding in planning of cities.

Unit III URBAN DESIGN**9**

Urban growth - Urban sprawl - Urban renewal and community development - Urban design - Types of cities - Sustainable design of cities - Case studies of Chandigarh and Pondicherry - Strategies for smart growth.

Unit IV INFRASTRUCTURE PLANNING**9**

Need and importance of infrastructure planning - Housing - Transportation planning - Toll ways vs. freeways - Economic development planning - Case studies of Chennai & Delhi.

Unit V DEVELOPMENT CONTROL AND MANAGEMENT**9**

Sustainable development - Environmental and energy planning - Conservation - Development Control Regulations - Byelaws in Planning - Natural Hazards & Disasters - Management plans Post - Disaster Redevelopment - Case studies of Chennai & Delhi.

Text Book:

1. Prakash M Apte, "Urban Planning and Development: An Indian Perspective", Zorba Publishers. 2013.
2. Faia Arthur B. Gallion, "The Urban Pattern City Planning And Design", CBS Publishers & Distributors, 2005.

Reference Book:

1. Hall, P., "Cities of tomorrow: - An intellectual history of urban planning and design in the twentieth century", Blackwell, London.2001.
2. Ingram, G., A. Carbonell, Y. Hong and A. Flint. "Urban Development Patterns and Smart Growth Policies", Cambridge, MA, 2009.
3. Wheeler, S. "Sustainable Urban Development: A Literature Review and Analysis", UC Berkeley: Institute of Urban and Regional Development, 1996.

19CEP04 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

- 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

- 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 - Interaction with matter - 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 - standard GIS software's - 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. Bannister A and Raymond S, "Surveying", Addison Wesley Longman Ltd, England, 2006.
2. Duggal R.K, "Surveying" Vol. I and II, Tata McGraw Hill Publishing Company Ltd., New Delhi, 2004.
3. Anderson, J.M. and Mikhail, E.M., "Surveying: Theory and Practice", McGraw Hill, 1998
4. Schofield, W. and Breach M., "Engineering Surveying", 6th Ed., Butterworth-Heinemann, 2007
5. Bossler, J.D., "Manual of Geospatial Science and Technology", Taylor and Francis, 2002.
6. Kang Tsung Chang., Introduction to Geographic Information Systems, Tata McGraw Hill Publishing Company Ltd, New Delhi, 2008.

19CEP05 INSTRUMENTATION FOR ENGINEERS

Offered by CIV (Open 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 principles of instrumentation and measurements.
- The theoretical and practical aspects of temperature measurement.
- The pressure measurements and calibration.
- The flow velocity by using various types of insertion measuring instruments.
- The latest testing and calibration of various measuring instruments.

Course Outcome:

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

- Realize the basic principles of instrumentation and measurements.
- Do the temperature measurement considering theoretical and practical aspects.
- Measure the pressure in various systems and able to calibrate the pressure measuring instruments.
- Compute the flow velocity by using insertion type measuring instruments.
- Get exposed to the latest testing and calibration of various measuring instruments.

Unit I INTRODUCTION**9**

Functional elements of an instrument - Static and dynamic characteristics - Response of first and second order instruments to step, ramp and sinusoidal inputs - Uncertainty in measurement - Systematic and random errors - Error propagation - Significant figures – Smart sensor applications in measurement – Data acquisition systems.

Unit II TEMPERATURE MEASUREMENT**9**

Filled in and bimetallic thermometers - RTD - Thermistor - Thermocouple and associated circuitry - Radiation and optical pyrometry - Accuracy, errors and compensation.

Unit III PRESSURE MEASUREMENT**9**

Low and high pressure measurement - Differential pressure measurement - Force balance types - Displacement, diaphragm and piezoelectric types - Pressure standards and calibration.

Unit IV FLOW MEASUREMENT**9**

Flow velocity measurement - Pitot tube - Hot wire and hot film anemometers - Drag force and turbine flow meters - Flow rates by pressure variation measurement - Venturimeter - Flow nozzle and orifice meters - Ultrasonic and cross correlation flow meters.

Unit V MISCELLANEOUS MEASUREMENTS**9**

Level, density, viscosity and pH measurement - Displacement, velocity and acceleration measurements - Force and torque measurements - Testing and calibrating of various measuring instruments.

Text Book:

1. Patranabis. D, "Principles of Industrial Instrumentation, "Tata McGraw-Hill Publishing Company, 2010.
2. Eckman D.P, "Industrial Instrumentation", CBS Publishers & Distributors, 2006.

Reference Book:

1. Ernest Doebelin, Dhanesh N Manik, "Doebelin's Measurement Systems: Application and Design", McGraw- Hill publishing Company, 2011.
2. James. W. Dally, "Instrumentation for Engineering Measurement", Wiley India Pvt. Limited, 2010.
3. ArunShukla, James W. Dally, "Instrumentation and Sensors for Engineering Measurements and Process Control", College House Enterprises, 2012.
4. Nakra. B.C., Chaudhry. K. K "Instrumentation, Measurement and Analysis", Tata McGraw Hill, 3rd edition, 2009.

Extensive Reading:

- https://www.oreilly.com/library/view/fundamentals-of-instrumentation/9781118613641/006_9781118613641_chapter1.html
- https://doc.xdevs.com/doc/_Metrology/introduction-to-instrumentation-and-measurements-2-edition-by-robert-b-northrop.pdf
- <https://www.wwdmag.com/water/7-basic-types-temperature-measuring-sensors>

19CSP01 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 system and source code management system
- To be familiar with Web servers.
- To study 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 manages the packages using different package managers in linux and able to manage source code using versioning systems
- Work with Web servers.
- Explore the open source cloud platform

Unit I PHILOSOPHY**9**

Introduction to Open sources – Need of open sources- Advantages of open sources – Application of open sources-, open source operating system – Linux: Introduction- General Overview – Kernel Mode and User Mode –Advanced concepts – Scheduling – Personalities – Cloning – Signals – Development with Linux – OSS Installation - Four degrees of freedom - FOSS Licensing Models - FOSS Licenses – GPL- AGPL- LGPL - FDL - Implications – FOSS examples.

Unit II LINUX UTILITIES**9**

Gwak - Conceptual Overview - Command-Line Syntax - Patterns and Procedures - Built-in Variables – Operators - Variable and Array Assignment - User-Defined Functions - Group Listing of awk Functions and Commands –Specific features - df - env - grep - ifconfig - locate, slocate - ln - netconfig, netcfg - netstat - ping - Snort –traceroute, Linux for portable Devices, Creation of Bootable CD and USB from command line, Case Studies – 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 WEBSERVER AND DEVELOPMENT PLATFORMS**9**

Apache HTTP Server and its flavors – Lighttpd - Tornado HTTP static File Server - WAMP server, MySQL, PHP, PYTHON - PERL as development platform.

Unit V OPEN SOURCE CLOUD**9**

Introduction to Cloud, FOSS Cloud Software Environment, Eucalyptus – History, Overview and goals of Eucalyptus, Architecture and components, Compatibility with Amazon EC2, Open Stack – History and overview, Characteristics, Features, Architecture, Components, Open Stack Cloud Operating System

Text Book:

1. RAO M N, Fundamentals of Open source software, PHI New Delhi, 2015
2. Stephen Figgins, Arnold Robbins, Ellen Siever, Robert Love, Linux in a Nutshell 6th Edition, O'Reilly, 2009.

Reference Book:

1. Rachna Kapur, Mario Briggs, Getting started with open source development, First Edition, IBM corporation, July 2010
2. B.Mahendran, Understanding FOSS, GNU Developers, 2009
3. Evi Nemeth, Garth Snyder, Trent R. Hein, Linux Administration Handbook, Second Edition, Pearson Education, 2011

Extensive Reading:

- www.bitnami.com
- Philosophy of GNU URL: <http://www.gnu.org/philosophy/>
- <https://fossbazaar.org/content/foss-policies-and-guidelines/>
- <http://open-source.gbdirect.co.uk/migration/benefit.html>
- Introduction to Linux – A Hands on Guide, URL: <http://tldp.org/guides.html>
- <http://rute.2038bug.com/index.html.gz>
- Version control system , URL: <http://git-scm.com>
- SVN version control , URL: <http://svnbook.red-bean.com/>

- Case study SAMBA: URL : <http://www.samba.org/>
- www.cups.org/
- www.rpm.org

19CSP02 VIRTUAL REALITY AND AUGMENTED REALITY

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 introduce virtual reality and input and output devices
- To acquire knowledge on computing architectures and modeling
- To explore VR programming and human factors
- To learn various applications of VR
- To get exposure on augmented reality

Course Outcome:

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

- Explore different input and output devices used in virtual reality system
- Model the VR system
- Create scene graph using different toolkits
- Apply VR in various fields.
- Apply visualization techniques for AR

Unit I INTRODUCTION TO VIRTUAL REALITY AND INPUT AND OUTPUT DEVICES**9**

Introduction: The three I's of Virtual Reality - A short history of early virtual reality - Early commercial VR technology - VR becomes an industry - The five classic components of a VR system. Input devices: Three-Dimensional position trackers - tracker performance parameters - ultrasonic trackers - optical trackers - navigation and manipulation interfaces - gesture interfaces. Output devices: graphics displays - large-volume displays - sound displays.

Unit II COMPUTING ARCHITECTURES AND MODELING OF A VR SYSTEM**9**

Computing architectures for VR: The rendering pipeline - The graphics rendering pipeline - The haptics rendering pipeline - PC graphics architecture - PC graphics accelerators - Graphics benchmarks - Distributed VR architectures - Multipipeline synchronization - Colocated rendering pipelines. Modeling: geometric modeling - kinematics modeling - physical and behavior modeling

Unit III VR PROGRAMMING AND HUMAN FACTORS**9**

Toolkits and scene graphs - WorldToolKit - Model geometry and appearance - The WTK scene graph - Sensors and action functions - WTK networking - Java 3D - Model geometry and appearance - Java 3D scene graph - Sensors and behaviors - Java 3D networking - WTK and Java 3D performance comparison - Human factors in VR: Methodology and terminology - user performance studies - VR health and safety issues - VR and society

Unit IV APPLICATIONS OF VR**9**

Medical applications of VR - Virtual anatomy - Triage and diagnostic - Surgery - VR in education - VR and the Arts - Entertainment applications of VR - military VR applications - Army use of VR - VR applications in the Navy - Air force use of VR - Applications of VR in Robotics - Robot programming - Robot teleoperation

Unit V AUGMENTED REALITY**9**

Augmented reality: An overview: Introduction - History - Augmented reality technologies - Computer vision methods in AR - AR devices - AR interfaces - AR systems. Visualization techniques for augmented reality: data integration - Depth perception - Augmenting pictorial depth cues - Occlusion handling - Image based X-ray visualization - Scene manipulation: Rearranging real world objects - Space-distorting visualization - Context driven visualization.

Text Book:

1. Grigore C. Burdea, Philippe Coiffet, "Virtual reality technology", Wiley, Second Edition, 2006
2. "Handbook of Augmented Reality", Borko Furht, Springer, 2011.

Reference Book:

1. Sherman, William R & Craig, Alan B, "Understanding Virtual reality", Elsevier India Private Limited, Noida, 2008

Extensive Reading:

- https://www.cs.uic.edu/~jbell/Courses/Eng591_F1999/HWGUIDE_NT.PDF
- <http://www.iamwire.com/2017/10/19-ways-on-how-to-get-the-most-from-virtual-reality/167724>
- https://www.atlantis-press.com/php/download_paper.php?id=5686
- <http://www.agocg.ac.uk/reports/virtual/37/37.pdf>

19CSP03 INTRODUCTION TO GENETIC ALGORITHMS

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 fundamental concepts of genetic algorithms
- To solve optimization problems using advanced GA operators
- To understand the multi objective optimization concepts
- To learn the significance of evolutionary algorithms
- To study the applications of genetic algorithms

Course Outcome:

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

- Work with the basics of genetic algorithms
- Solve real world problems using advanced operators of GA
- Work with multi objective optimization problems
- Identify the different evolutionary algorithms for solving problems
- Apply genetic algorithms to solve real-world domain problems

Unit I INTRODUCTION TO GENETIC ALGORITHMS**9**

Introduction - Comparison of Biological and GA terminology – Mutation – Selection – Elitism – Crossover – Initialization

Unit II ADVANCED OPERATORS OF GA**9**

Combinatorial optimization – Constraints - Multicriteria optimization - Hybrid algorithm - Alternative selection and crossover methods - Meta GAs – Mutation - Parallel Genetic Algorithm

Unit III MULTIOBJECTIVE OPTIMIZATION**9**

Multi objective optimization problem - Principles of Multi objective optimization problem - Difference with single objective optimization - Dominance and Pareto optimality - Optimality conditions

Unit IV EVOLUTIONARY ALGORITHMS**9**

Difficulties with classical optimization algorithms - Genetic algorithms - Evolution strategies - Evolution programming - Genetic programming – Multi-model function optimization

Unit V APPLICATIONS OF GENETIC ALGORITHMS**9**

Image registration - Recursive prediction of night light levels - Estimation of the optical parameter of liquid crystals – Intrusion Detection- Wireless Networks-Feature Selection in Machine learning using GA

Text Book:

1. David A Coley, "An Introduction to Genetic Algorithms for Scientists and Engineers", World Scientific Publishing Company, 1997. (UNIT I and II)
2. Kalyamoy Deb, "Multi objective optimization using Evolutionary Algorithms", John Wiley & Sons, First Edition, 2003. (UNIT III and IV)
3. S.N. Sivanandam, S.N. Deepa "Introduction to Genetic Algorithms", Springer, 2008. (UNIT V)

Reference Book:

1. Melaine Mitchell "An Introduction to Genetic Algorithms", First MIT Press paperback edition, 1998.
2. David E. Goldberg "Genetic Algorithms", Pearson Education, Fourth Edition, 2009.
3. Koza, John, Wolfgang Banzhaf, Kumar Chellapilla, Kalyanmoy Deb, Marco Dorigo, David Fogel, Max Garzon, David Goldberg, Hitoshi Iba, and Rick Riolo(Eds.), "Genetic Programming", Academic Press. Morgan Kaufmann, USA, 1998.
4. John R.Koza, Forrest H Bennett III, David Andre, Martin A Keane, "Genetic Programming III: Darwinian Invention and Problem Solving" Morgan Kaufmann, USA, 1999.

Extensive Reading:

- http://www.doc.ic.ac.uk/~nd/surprise_96/journal/vol1/hmw/article1.html
- <http://www.obitko.com/tutorials/genetic-algorithms/>
- <http://intelligence.worldofcomputing.net/machine-learning/genetic-algorithms.html>
- <http://epubs.siam.org/doi/abs/10.1137/0202009>
- <http://study.com/academy/lesson/genetic-algorithms-examples-lesson.html>
- <https://www.cs.wmich.edu/~elise/courses/cs6800/Genetic-Algorithms.ppt>

19ECP01 NANO 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 basics of nano electronics and scaling principles.
- To enhance the knowledge in the field of quantum electron devices.
- To analyze the superconducting devices and photonics.

Course Outcome:

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

- Explain the basics of nano electronics and the fabrication techniques.
- Realize the working of quantum electronic devices.
- Narrate the working of tunneling devices.
- Design superconducting device for memory applications.
- Analyze sensor and advanced electronic systems for various applications.

Unit I BASICS OF NANOELECTRONICS**9**

Basic information theory- Data & bits – Data processing - Capabilities of nano electronics - physical fundamentals of nano electronics: Moores law, Scaling principles, limits to scaling,– Replacement Technologies - Energy and Heat dissipation - Parameter spread as Limiting Effect - Limits due to thermal particle motion - Reliability as limiting factor - Final objectives of integrated chip and systems. Tools for micro and nano fabrication, basics of lithographic techniques for nano electronics.

Unit II QUANTUM ELECTRON DEVICES**9**

Quantum electron devices - from classical to quantum physics: upcoming electronic devices - electrons in mesoscopic structure - short channel MOS transistor - split gate transistor - electron wave transistor - electron spin transistor - quantum cellular automate - quantum dot array. Principles of Single Electron Transistor (SET) - SET circuit design - comparison between FET and SET circuit design.

Unit III TUNNELLING DEVICES**9**

Tunnelling element technology - RTD: circuit design based RTD, Nano structured LEDs, photo detectors. Superconducting devices: Macroscopic characteristics, macroscopic model, super conducting switching devices, memory cells, flux quantum devices - application of Superconducting devices. Molecular electronics - Nano tubes and fullerene based switches, elementary circuits

Unit IV SUPER CONDUCTING DEVICES AND PHOTONICS**9**

Cooper pairs – Super conducting switching Devices – Cryotron– Josephson Tunnelling Devices – Associative or Content Addressable Memory – SQUID – Flux Quantum device –LC Gate – Magnetic Flux Quantum – Quantum computer with Single Flux devices – SFQD – RSFQD – Application of superconducting devices.

Unit V MEMORY DEVICES AND SENSORS**9**

Nano ferroelectrics - Ferroelectric random access memory - Fe-RAM circuit design - ferroelectric thin film properties and integration - calorimetric sensors - electrochemical cells - surface and bulk acoustic devices - gas sensitive FETs - resistive semiconductor gas sensors -electronic noses - identification of hazardous solvents and gases - semiconductor sensor array.

Text Book:

1. K. Goser, P. Glosekotter and J. Dienstuhl, “Nanoelectronics and Nanosystems: From Transistors to Molecular Quantum Devices”, Springer, 2004.

Reference Book:

1. Rainer Waser, —Nanoelectronics and Information Technology: Advanced Electronic Materials and Novel and Devices||, Wiley VchVerlag, Weiheim, 2012.
2. Keith Barnham, DimitriVvedensky, “Low-dimensional semiconductor structures: Fundamentals and device applications”, Cambridge University Press, 2001.
3. HerveRigneault, Jean-Michel Lourtioz, Claude Delalande, Ariel Levenson, “Nanophotonics”, Wiley-ISTE, 2006.
4. W.R.Fahrner, “Nanotechnology and Nanoelectronics: Materials, Devices and Measurement Techniques” Springer, 2005.
5. Tai-Ran Hsu, “MEMS & Microsystems Design and Manufacture”, Tata McGraw-Hill, 2007.

Extensive Reading:

- <http://www.understandingnano.com/nanotechnology-electronics.html>
- https://www.mitre.org/sites/default/files/pdf/nano_overview.pdf
- http://www.cein.ucla.edu/new/file_uploads/chapter08.pdf
- http://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-701-introduction-to-nanoelectronics-spring-2010/readings/MIT6_701S10_notes.pdf

19ECP02 IMAGING MODALITIES

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 working principle and artifacts of various Imaging modalities.
- To apply imaging techniques to various applications.

Course Outcome:

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

- Apply the domain knowledge of X ray imaging modalities to solve various problems.
- Apply the domain knowledge of Magnetic resonance imaging modalities to solve various problems.
- Explore the Ultrasound Imaging and Thermal Imaging applications.
- Analyze the impact of Microwave Imaging and SAR Imaging techniques in various applications.
- Analyze the impact of emerging Optical and Microscopy imaging techniques in various applications.

Unit I X-RAY IMAGING AND COMPUTED TOMOGRAPHY**9**

Physics of X-Ray – Attenuation based X-Ray Imaging –X-Ray Detection - Image Quality – X-rays in Diagnostic imaging –X ray Mammography – Computed tomography systems –Principles –Attenuation Tomography- Biomedical CT Scanners – Complications of X-Ray Imaging – Diagnostic Applications of X-Ray Imaging

Unit II MAGNETIC RESONANCE IMAGING AND NUCLEAR MEDICINE IMAGING**9**

MRI Principles – MR Instrumentation –MRI Pulse sequences – fMRI – Contrast, Spatial Resolution and SNR – Radioactivity – SPECT – Detectors and Data Acquisition System , Contrast , spatial Resolution and SNR in SPECT imaging - PET – Detectors and Data Acquisition System , Contrast , spatial Resolution and SNR in PET imaging- Dual modalities SPECT – CT and PET-CT scanners.

Unit III ULTRASOUND IMAGING AND THERMAL IMAGING**9**

Generation and Detection of Ultrasound Waves – Physical and Physiological Principles of Ultrasound – Resolution– Ultrasound Imaging Modalities – Modes of Representation – Ultrasound Image Artifacts – Three–Dimensional Ultrasound Image Reconstruction – Applications of Ultrasound Imaging.

Fundamentals of Infrared Thermal Imaging - Basic Properties of IR Imaging Systems - Advanced Methods in IR Imaging -IR Imaging of Buildings and Infrastructure - Applications – Industry , Medical, Security and surveillance.

Unit IV MICROWAVE IMAGING AND SAR IMAGING**9**

Microwave Imaging Apparatus and Systems – Scanning Systems for Microwave Tomography Antennas for Microwave Imaging – Modulated Scattering Technique, Microwave Camera – Applications of Microwave Imaging – Civil and Industrial Applications – Medical Applications of Microwave Imaging.

Synthetic Aperture Radar Imaging - Principle- Imaging in Range Direction-SAR Data Model-Properties of SAR Images-SAR System-Processing of Radar Data - Applications of imaging radar to land use and land cover mapping.

Unit V OPTICAL IMAGING AND MICROSCOPY IMAGING**9**

Optical Imaging – Optical Microscopy –Optical Endoscopy –Optical Coherence Tomography, Medical Application.

Scanning Probe Microscopy- Atomic forcemicroscopy (AFM)-Principle, operating modes- Application- – Electron Microscopy Imaging - Scanning electron microscopy (SEM) –Configuration - Imaging vs. Diffraction -igh Resolution Imaging and Diffraction Modes - operating parameters-Application- Transmission electron microscopy(TEM)-Working Principle- Construction and resolution -TEM imaging -Electron Diffraction- Scanning TEM- Application.

Text Book:

1. KavyanNajarian and Robert Splerstor, “Biomedical signals and Image processing”, 2nd Edition, CRC – Taylor and Francis, New York, 2012.
2. Atam.P.Dhawan, “Medical Image Analysis”, 2nd Edition, John Wiley and Sons, 2011.

Reference Book:

1. MatteoPastorino, “ Microwave Imaging”, John Wiley & Sons, Inc, 2010.
2. Michael Vollmer, Klaus–Peter Möllmann, “Infrared Thermal Imaging: Fundamentals, Research and Applications”, 2nd Edition, John Wiley & Sons, 2011.
3. Herbert Kaplan, “ Practical Applications of Infrared Thermal Sensing and Imaging Equipment”, 3rd Edition, SPIE, 2007.
4. Transmission Electron Microscopy, by David B. Williams and C. Barry Carter (Plenum Press, New York, 1996) ISBN: 0-306-45247-2
5. Milan Sonka, J. Michael Fitzpatrick, “Handbook of Medical Imaging: Medical Image Processing and Analysis volume”, 2nd Edition, SPIE press, 2009.
6. F. M. Henderson, A. J. Lewis, et all, Principles & Applications of Imaging Radar – Manual of Remote Sensing (3rd edition, volume 2), John Wiley & Sons, New York, 1998.
7. J. Goldstein, D.E. Newbury, D.C. Joy, C. E. Lyman, P. Echlin, E. Lifshin, L. C. Sawyer, J.R. Michael, “ Scanning Electron Microscopy and X-Ray Microanalysis”, Third Edition, Plenum Press. 2003.

Extensive Reading:

- <http://www.sbirc.ed.ac.uk/research/imageanalysis.html>
- <http://www.siemens.com/press>

19ECP03

Offered by ECE

CONSUMER ELECTRONICS

(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 familiarize 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 of Microphones, types, Electrical, Mechanical and Acoustical Analog - Loudspeakers, types, Loudspeaker 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**9**

Monochrome TV Standards and Systems, Elements of a Television System, the Scanning Process, Scanning Methods and Aspect Ratio, Monochrome TV Camera, Camera Tubes, Vestigial Sideband Transmission-Colour TV Standards and Systems, 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, UPS – Inverter, PC, Laptops, iPad, Digital Camera

Unit V HOME APPLIANCES AND TROUBLESHOOTING PRINCIPLES**9**

Microwave Ovens, Washing Machines, Air Conditioners and Refrigerators - 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://nptel.ac.in/courses/117/105/117105084/>

19ECP04 ARTIFICIAL NEURAL NETWORKS 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 explore the architecture and learning principles of Neural Networks.
- To develop various hybrid algorithms involved in Neural Networks.
- To provide adequate knowledge of application of Neural Networks in real time systems.

Course Outcome:

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

- Apply the concept of neural networks in practical applications
- Design, implement and analyze the performance of Back Propagation Neural Network.
- Apply Counter Propagation Network and Self Organizing Map for solving various problems.
- Solve real world problems using Associative and Adaptive Neural Network Techniques
- Implement Neocognitron architecture for practical applications

Unit I NEURAL NETWORKS ARCHITECTURES**9**

Neurophysiology – General Processing Element – Perceptron representation – Learning – Linear separability – Problems with the perceptron training algorithms – Multilayer perceptron Learning rules – Supervised learning – ADALINE Architecture – LMS learning rule – Applications

Unit II BACK PROPAGATION NETWORK AND SIMULATED ANNEALING**9**

Back Propagation Network – operation, generalized delta rule, Training algorithm – updating of output and hidden layer weights – Practical difficulties and considerations – Application of BPN – Annealing – Boltzmann machine – Learning – Application

Unit III COUNTER PROPAGATION NETWORK AND SELF ORGANIZING MAP**9**

Counter Propagation network concept – Architecture – Training – Practical consideration – Applications – Self organizing map – learning algorithm, feature map classifier, Applications

Unit IV ASSOCIATIVE MEMORY AND ADAPTIVE RESONANCE THEORY**10**

Associative Memory concept – Bi-directional Associative Memory – Hopfield memory – traveling salesman problem – Architecture of Adaptive Resonance Theory – Pattern matching in ART network.

Unit V NEOCOGNITRON**8**

Architecture of Neocognitron – Data processing and performance of architecture of spatio temporal networks for speech recognition.

Text Book:

1. J.A. Freeman and B.M. Skapura, "Neural Networks, Algorithms Applications and Programming Techniques", Addison-Wesely, 2003.
2. Laurene V. Fausett "Fundamentals of Neural Networks: Architectures, Algorithms and Applications", Prentice Hall, 2013.

Reference Book:

1. Jang J.S.R., Sun C.T and Mizutani E, "Neuro Fuzzy and Soft computing", Pearson education (Singapore), Reprint 2010.
2. S.Rajasekaran and G.A.VijayalakshmiPai "Neural networks, Fuzzy logics, and Genetic algorithms", Prentice Hall of India, 2013.

Extensive Reading:

- <https://www-cs-faculty.stanford.edu/.../neural-networks/Applications/index.html>
- http://www.softcomputing.net/ann_chapter.pdf
- http://home.thep.lu.se/pub/Preprints/91/lu_tp_91_23.pdf

19ECP13 MACHINE LEARNING 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 discuss different learning techniques.
- To understand various machine learning procedures.
- To learn various algorithms.

Course Outcome:

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

- Explain the fundamental concepts of machine learning.
- Implement supervised methods of machine learning.
- Apply tree based models for classification and regression
- Apply ensemble learning for the real world applications.
- Employ clustering algorithms

Unit I FOUNDATIONS OF MACHINE LEARNING**9**

Types of machine learning: Supervised learning- Unsupervised learning-Reinforcement Learning- Machine Learning Process-Terminologies: Weight Space, Curse of Dimensionality, Overfitting, Training, Testing, Validation Sets- Performance Measures: Confusion Matrix, Accuracy Metrics, Receiver Operator Characteristic (ROC) Curve, Measurement Precision- Model selection-No free lunch theorem- Bias-Variance Tradeoff

Unit II SUPERVISED LEARNING**9**

Linear Classification- Probability and Bayes learning - Naive Bayes - Bayesian Network - Perceptron - Perceptron Learning - Neural Networks – Back propagation- Support Vector Machines.

Unit III REGRESSION AND TREE BASED MODELS**9**

Linear Regression - Multivariate Regression- Logistic Regression- Principal Component Regression- Decision Trees, Regression Trees

Unit IV ENSEMBLE LEARNING**9**

Ensemble Methods - Bagging, Committee Machines and Stacking, Boosting - Gradient Boosting, Adaptive Boosting, Random Forests-Multi-class Classification

Unit V UNSUPERVISED LEARNING**9**

Introduction to Clustering- Partitional Clustering - Hierarchical Clustering - Birch Algorithm-CURE Algorithm - Density based Clustering- Expectation Maximization

Text Book:

1. Stephen Marsland, "Machine Learning - An Algorithmic Perspective" 2nd Edition, CRC Press, 2015
2. Ethem Alpaydin, "Introduction to Machine Learning", 3rd Edition, MIT Press, 2014.

Reference Book:

1. P. Flach, "Machine Learning: The art and science of algorithms that make sense of data", Cambridge University Press, 2012
2. K. P. Murphy, "Machine Learning: A probabilistic perspective", MIT Press, 2012.
3. C. M. Bishop, "Pattern Recognition and Machine Learning", Springer, 2007
4. Tom M. Mitchell, "Machine Learning", McGraw Hill Indian Edition, 2013.
5. Yagang Zhang, "Machine Learning", InTech, 2010

Extensive Reading:

- <https://nptel.ac.in/courses/106/106/106106139/>
- <https://nptel.ac.in/courses/106/105/106105152/>

19EEP01 VIRTUAL INSTRUMENTATION

Offered by EEE (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

- Programming of Virtual Instruments using various programming structures.
- Designing real time application using LabVIEW software and data acquisition

Course Outcome:

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

- Recognize the importance and parts of Virtual Instrumentation.
- Relate different data types and do basic arithmetic and logic programming
- Use advanced LabVIEW programming structures to develop virtual instruments
- Implement modular programming and data storage in files.
- Acquire real time signal / data using DAQ Hardware in LabVIEW and develop simple applications

Unit I INTRODUCTION TO VIRTUAL INSTRUMENTATION AND ITS PARTS 9

Introduction to Virtual Instrumentation – Need and Advantages of VI – data flow programming, comparison with conventional programming, creating VI - Front Panel, Block diagram, Parts of VI- Tools palette – function palette – Control palette.

Unit II BASIC VI PROGRAMMING 9

Data types – Numeric, Boolean, String, Enum, and TypeDefs. – Basic arithmetic and Math operations, Implementing VI - Loops – FOR & WHILE loops, Tunneling options, Shift Registers, Feedback node

Unit III ADVANCED VI PROGRAMMING STRUCTURES 9

Control Timing in a VI, Timed loop - Sequence Structure, Local and global variable, Arrays & Clusters – Basic operations on Array and Cluster, String handling, Case structure, Formula nodes,

Unit IV MODULAR PROGRAMMING AND FILE HANDLING 9

Creating a subVI – editing and saving a subVI, icon and connector pane; Charts & Graphs – Update mode; File read / write operations – File formats

Unit V DATA ACQUISITION AND APPLICATIONS 9

Basics of Data Acquisition– Digital and analog signal interfacing, sampling, resolution, connecting signal to the board, Data Acquisition with LabVIEW, DAQmx and DAQ VIs -Resolution of DAQ devices–DAQ interface requirements, Simulation of a simple second order system, sensor interfacing - temperature data acquisition system.

Text Book:

1. Jovitha Jerome, “Virtual Instrumentation Using LabVIEW”, PHI Learning Pvt. Ltd, 2010.
2. Robert H. Bishop, “Learning with LabVIEW TBM”, by Pearson Education, Inc., Upper Saddle River, New Jersey 07458, 2015.
3. 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. WEB Reference: www.ni.com

19EEP02 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

- Simple logic circuits used in industrial applications
- Various programming methods of PLC
- Timers and Counters
- Functions, Function Blocks and Data Blocks
- Applications in automation industries.

Course Outcome:

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

- Explicate the Architecture of Industrial Automation and working of Programmable Logic Controllers
- Choose the components of PLC and addressing the memory
- Do simple programs for simple applications using bit logic instructions and timers & counters
- Use Functions and Function Blocks for Industrial Applications programming.
- Diagnose the Hardware faults, Programming Error, and developing simple application.

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 Cycle.

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 – Dependency Structure and Resources, Error Handling OBs.

Unit IV INDUSTRIAL AUTOMATION**9**

History of Automation – Architecture of Industrial Automation, Fixed Automation – Programmable Automation – Flexible Automation, Components of Industrial Automation – Sensors.

Unit V PLCs IN PROCESS AUTOMATION**9**

Development of control logic for: Planner machine-Skip hoist control-Automatic control of water pump-Air compressor-Conveyor system-Battery operated truck-bottle filling system.

Text Book:

1. SIMATIC S7-300 & S7-400 PLC Programming Manual.
2. SIMATIC Programming with STEP 7 Manual.

Reference Book:

1. Frank Petruzella, "Programmable Logic Controllers" McGraw-Hill Education – Fourth Edition, 2010.
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.

19EEP03 PROCESS CONTROL ENGINEERING

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 impart knowledge on
- Dynamics of various processes.
- Effect of various control actions.
- Evaluation criteria and tuning techniques of controllers.
- Concept of multi loop control techniques.

Course Outcome:

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

- Build the mathematical model of Simple systems
- Select the suitable control methods for a particular process
- Choose the Final control elements for process control
- Develop a simple tuning algorithm for PID controller
- Relate the 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 – PI, PD and PID Control modes –Electronic PID controller – Auto transfer - Reset windup.

Unit III FINAL CONTROL ELEMENTS**9**

I/P converter – Pneumatic, hydraulic and electric actuators – Valve Positioner – Control Valves – Characteristic of Control Valves: - Inherent and Installed characteristics.

Unit IV CONTROLLER TUNING**9**

PID Tuning – 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 Hall of 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 and Sons, second Edition, 2003.

19EEP04 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, rule based expert system, 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 – inferencing 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 2012.
2. K. Sundareswaran, "A Learner's Guide to Fuzzy Logic Systems", Jaico Publishing House, 2006.
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., "Artificial Intelligence and Intelligent System, Oxford University Press, 2005.
6. Allain Bonnet, "Artificial Intelligence – Promise and Performance, Prentice Hall International Publisher

19ITP01 SOCIAL NETWORKING

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 about Twitter and Github

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 Twitter analysis and Trend Mining in Github

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 TWITTER ANALYSIS AND TRENDS MINING IN GITHUB 9

Getting the data from Twitter - 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 Krystianczuk "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

19ITP02 DATA SCIENCE USING R

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**

Introduction to 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 Hierarchies - 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

19ITP03 FUZZY SYSTEMS AND APPLICATIONS

Offered by IT

(Open Elective offered to BAD, BBE, BBT, BCI, 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:

- 1. www.math.ucdenver.edu/~wlodwick/m4-5779/lecture3fuzzylogic
- 2. https://link.springer.com/chapter/10.1007/978-3-642-58930-0_11

19ITP04 ANDROID AND IOS APPLICATION DEVELOPMENT

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 system requirements for mobile applications
- Generate suitable design using specific mobile development frameworks
- Generate mobile application design
- Implement the design using specific mobile development frameworks
- Deploy the mobile applications in marketplace for distribution

Course Outcome:

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

- Describe the requirements for mobile applications
- Design user interface for mobile applications
- Store mobile data of android applications
- Evaluate native capabilities of android applications
- Design iOS applications with tools

Unit I INTRODUCTION TO MOBILE APPLICATIONS**9**

Web Vs mobile App – Cost of Development – Myths - Mobile Applications – Marketing - Mobile User Interface Design - Effective Use of Screen – Mobile Users - Mobile Information Design - Mobile Platforms - Tools of Mobile Interface Design

Unit II ANDROID USER INTERFACE DESIGN**9**

Android Architecture – Android SDK Tools - Application Components - Intents - Content providers - Broadcast receivers – Services - User Interface Design - Views - View Groups – Layouts - Event Handling – Listeners – Adapters – Menus - Action Bars – Notifications - Android Localization

Unit III ANDROID DATA STORAGE**9**

Content Providers – Uri - CRUD access –Browser – CallLog – Contacts – Media Store - Data Access and Storage - Shared Preferences - Storage External - Network Connection - SQLite Databases

Unit IV ANDROID NATIVE CAPABILITIES**9**

Camera – Audio - Sensors and Bluetooth - Playing audio/video - Media recording - Sensors - Listening to sensor readings – Bluetooth - Android Communications – GPS - Working with Location Manager, Working with Google Maps extensions - Maps via intent - Map Activity - Location based Services - Location Updates - Location Providers - Selecting a Location Provider - Finding Location

Unit V IOS DESIGN**9**

iPhone Craze – iOS Features – iOS Tools - iOS Project – Objective C Basics – Building iOS App – Actions and Outlets – Delegates - User Interface Elements – Accelerometer – Location Handling - SQLite Database

Text Book:

1. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development", Wrox, 2012
2. Reto Meier, "Professional Android 4 Development", John Wiley and Sons, 2012
3. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, "Beginning iOS 6 Development: Exploring the iOS SDK", Apress, 2013.

Extensive Reading:

- <https://developer.android.com>
- <http://www.androidcentral.com/apps>
- <https://www.opensesame.com/c/android-app-development-beginners-training-course>

19MEP01 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
3	0	0	3

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 optimum use of materials in the 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-Materials 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, 2007
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

19MEP02 INNOVATION AND DESIGN THINKING

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

- 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
- Able to generate concepts and select the promising one.
- Follow modularity concept in deciding Product architecture.
- Able to design a product with Design for Manufacturing 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-Centered Design. Sustainable innovation – Technological 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”, 5th edition Mcgraw Higher Ed.2016.
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 Limited 6th edition, 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/>

19MEP03 MECHATRONICS

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

- 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, 2016.

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. Histan and David G. Alciatore, "Introduction to Mechatronics and Measurement Systems", McGraw-Hill International Editions, 2018.
4. Bradley D. A., Dawson D., Buru N.C. and. Loader A.J, "Mechatronics", Chapman and Hall, 1993.
5. Dan Neculescu, "Mechatronics", Pearson Education Asia, (Indian Reprint) 2002.
6. Lawrence J. Kamm, "Understanding Electro – Mechanical Engineering", an Introduction to Mechatronics, Prentice – Hall of India Pvt., Ltd., 2000.
7. Nitaigour Premchand Mahadik, "Mechatronics", Tata McGraw-Hill publishing Company Ltd., 2003.

Extensive Reading:

- <http://nptel.iitm.ac.in/courses.php>
- <http://ebookbrowse.net/np/nptel-lecture-notes>

19MEP04 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, efficient and effective uses and applications 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 to steel – crystal structure and phase formation in steel - Iron Carbide Diagram - importance and uniqueness of steel - Type of 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 - formation of grains in steels and their structure - 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 for quality steel, salient process features for quality 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 of properties of steels - 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

19MEP05 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 the different 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 INTRODUCTION 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: Binders 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.

19MEP06 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

- Application of solar energy technologies in various fields like power generation, air conditioning and desalination.
- 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
- To have knowledge on solar photovoltaic and photochemical engineering.
- Be able to 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, glazing-evacuated tube collector-concentrating collector-parabolic trough 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 space cooling and refrigeration-vapour compression cycle, absorption air-conditioning (NH₃-H₂O & LiBr- H₂O). 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, solar still: simple solar still, solar desalination techniques, 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", 3rd edition, CRC press, 2015.

Reference Book:

1. HP Garg and J Prakash, "Solar Energy: Fundamentals and Applications", Tata McGraw Hill, 2010.
2. Suhatme and Nayak, "Solar Energy: Principles of Thermal Collection and Storage", Tata McGraw Hill, 2008.
3. H P Garg, M Dayal, G Furlan, "Physics and Technology of Solar Energy- Volume I: Solar Thermal Applications", Springer, 2007.
4. Edward E. Anderson, "Fundamentals for solar energy conversion", Addison Wesley Publ. Co, 1983.
5. Anne Grete Hestnes, Robert Hastings, Bjarne Saxhof, "Solar Energy Houses: Strategies, Technologies Examples", Earthscan Publications, 1st edition, 2003.

19UCP01 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.

19UCP02 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/>

19UMP02 INTRODUCTION TO NUMBER THEORY AND 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, 2nd 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.

19UMP06 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, 2nd 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.

19ADP07 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 – Satio – 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/>

19ADP08 DIGITAL ASSET MANAGEMENT SYSTEMS

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>

19ADP09 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 behavioural 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 behavioural 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

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**

Behaviour in Cognitive Science – Behaviour in Artificial Intelligence – Behaviour-Based Robotics – Biological Inspiration for Robots – Robots as Biological Models – Robot Learning – Evolution of Behavioural Systems – Evolution and Learning in Behavioural Systems – Evolution and Neural Development in Behavioural 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 – Co-evolutionary 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/Sl.ppt>

19ADP10 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 Niranjana 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>

19ADP11 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 work using Numpy and pandas libraries
- To study about applying matplotlib and seaborn libraries
- To study about applying sklearn for classification and clustering
- To study about applying tensor flow libraries for convolutional networks

Course Outcome:

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

- Apply Numpy and pandas libraries on data sets for pre-processing
- Apply matplotlib and seaborn libraries for data visualization
- Implement machine learning algorithms in Scikit learn to generate models
- Apply Scikit learn to perform clustering
- Implement deep learning analysis using tensor flow

Unit I DATA PROCESSING USING NUMPY AND PANDAS**9**

Python Jupyter – Ipython shell commands; Arrays – universal functions – aggregations – broadcasting – comparison – masks – Boolean logic – fancy indexing – sorting – structured arrays; Pandas Objects – Data indexing and selection – Operating on Data in pandas – Handling missing data – Combining Data sets – Aggregation and grouping – Vectorized string operations – Time series data

Unit II VISUALIZATION WITH MATPLOTLIB AND SEABORN**9**

Simple line plots – Simple scatter plots – Visualizing errors – Density and contour plots – Multiple sub plots – Text and annotation – Three dimensional plotting – Geographic data with base map – visualization with seaborn

Unit III SUPERVISED LEARNING USING SCIKIT LEARN**9**

Hyperparameters and model validation – Feature engineering – Naïve Bayes – Support Vector Machine – Linear Regression – Decision Trees and Random Forest – Principal Component Analysis – In depth manifold learning – Model Evaluation – Cross validation – Grid search – Metrics and scoring

Unit IV CLUSTERING AND TEXT ANALYTICS USING SCIKIT LEARN**9**

k-Means clustering – Agglomerative Clustering – DBSCAN – Gaussian mixture models – Kernel Density Estimation – Model Case Study: Face Detection – HOG – Text data analytics – Bag of words – stop words – TF-IDF – n grams – Stemming – Topic modelling – Document clustering

Unit V DEEP LEARNING USING TENSOR FLOW**9**

Neural network – Convolutional neural network – Max pooling – ReLU activations – Strides-zero padding – Tensor flow – Convolutional neural network – Case study using MNIST dataset

Text Book:

1. Jake Vander Plas, "Python Data Science Handbook", O'Reilly, 2016
2. Andreas C. Muller, "Introduction to Machine learning with Python", O'Reilly, 2016

Reference Book:

1. John Paul Mueueller, Luca Massaron, "Python for Data Science for Dummies", Wiley, 2019
2. Samir Madhavan, "Mastering Python for Data Science", 2015

Extensive Reading:

- <https://realpython.com/tutorials/data-science/>
- https://www.tutorialspoint.com/python_data_science/index.htm
- <https://www.analyticsvidhya.com/learning-paths-data-science-business-analytics-business-intelligence-big-data/learning-path-data-science-python/>
- <https://www.datacamp.com/tracks/data-scientist-with-python>

19ADP12 DATA VISUALIZATION WITH TABLEAU

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
- To gain knowledge about the different Chart types in tableau
- To get used with chart types and frameworks
- To explore different security aspects involved in data visualization

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
- Outline the security issues present in data visualization

Unit I INTRODUCTION**9**

Introduction to Tableau – Tableau products – Connecting to Data in Tableau – Shaping Data for Use with Tableau – Tableau Terminology – Views of data and records – Measure – Dimension – Discrete – Continuous

Unit II CREATION OF CHARTS IN TABLEAU**9**

Creation of bar charts in Tableau – Aggregation – Line Graphs – Independent Axes – Date Hierarchies – Marks Cards – Encoding – Level of Detail – Filters – Calculated fields – Table Calculations – Parameters – Level of detail expressions – Dashboards and distribution

Unit III CHART TYPES**9**

Spreadsheet – Highlight table – Heat Map – Dual-Axis Combination Chart – Scatter Plot – Tree Map – Spark lines – Small Multiples – Bullet graphs – Stacked area – Histogram – Box-and-Whisker Plot – Symbol Map – Mapbox – Filled Map – Dual axis Map – Sequential Map – Polygon Maps – Gantt Chart – Waterfall Chart – Dual-Axis Slope Graphs – Donut Chart – Funnel Chart – Pace chart – Pareto Chart – Control Chart – Dynamic Dual-Axis Bump Chart – dumbbell Chart

Unit IV DATA VISUALIZATION TIPS AND FRAMEWORK**9**

Icon-Based Navigation – Filters – Analysis using Parameters – Adding alerts to dashboards – Methodology Using Custom Shape Palettes – Tableau Data Visualization Tips – Alternative Approaches to Pie Charts – One-Dimensional Unit Charts – Insight Framework for Data Visualization – Steps in Insight Framework – Introduction to Data Storytelling and its elements

Unit V SECURITY DATA VISUALIZATION**9**

Port scan visualization – Vulnerability assessment and exploitation – Firewall log visualization – Intrusion detection log visualization – Attacking and defending visualization systems – Creating security visualization system

Text Book:

1. Ryan Sleeper, "Practical Tableau" O'Reilly Media, Inc, First Edition, 2018

Reference Book:

1. Greg Conti, "Security Data Visualization: Graphical Techniques for Network Analysis", Starch Press Inc., First Edition, 2007

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>

19BMP03 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

- Introduce the students to different types of electrodes used in bio potential recording
- To expose the students to perceive the need for bio amplifiers and their characteristics needed to be design for various bandwidth and frequency response.
- To proclaim the conception in detection of chemical and biomolecules

Course Outcome:

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

- Realize the need for reusable electrodes and understands the method of implementation.
- Capable of understanding the design principles of bio-amplifiers and drawback related with noises.
- Gain knowledge for implementing different types of physiological parameter measurement using appropriate sensors.
- Understand and apply the concepts to design various biochemical sensors.
- Acquire knowledge on advanced sensor design process.

Unit I BIOPOTENTIAL ELECTRODES**9**

Origin of bio potential and its propagation. Electrode-electrolyte interface, electrode-skin interface, half-cell potential, impedance, polarization effects of electrode – nonpolarizable electrodes. Types of electrodes - surface, needle and micro electrodes and their equivalent circuits. Recording problems - measurement with two electrodes.

Unit II BIOMEDICAL SENSORS**9**

Sensors Terminology in human body, Introduction, Cell, Body Fluids Musculoskeletal system, Bioelectric Amplifiers, Bioelectric Amplifiers for Multiple input Circuits, Differential Amplifiers, Physiological Pressure and other cardiovascular measurements and devices.

Unit III PHYSICAL SENSORS IN BIOMEDICINE**9**

Temperature measurement: core temperature, -surface temperature- invasive. Blood flow measurement: skin blood- hot film anemometer- Doppler sonography- electromagnetic sensor - blood pressure measurement: noninvasive- hemodynamic invasive. Spirometry- sensors for pressure pulses and movement- ocular pressure sensor- acoustic sensors in hearing aid, in blood flow measurement, sensors for bio-magnetism, tactile sensors for artificial limbs, sensors in ophthalmoscopy, artificial retina.

Unit IV CHEMICAL BIOSENSORS**9**

Blood gas and Acid-Base Physiology, Electrochemical sensors, reference electrode, electrodes, Ion-Selective Field-Effect Transistor (ISFET), Noninvasive Blood-Gas Monitoring, BloodGlucose Sensors. Transcutaneous arterial oxygen tension & carbon dioxide tension monitoring enzyme electrode.

Unit V ADVANCED SENSOR DESIGN**9**

Fluoroscopic machines design, Nuclear medical systems, EMI to biomedical sensors, types and sources of EMI, Fields, EMI effects. Computer systems used in X-ray and Nuclear Medical equipments. Calibration, Typical faults, Trouble shooting, Maintenance procedure for medical equipments and Design of 2& 4 wire transmitters with 4 – 20 mA output.

Text Book:

1. J. G. Webster, J. G. Webster, "Medical Instrumentation; Application and Design", John Wiley & Sons, 4th Edition, 2015.
2. Khandpur R.S, "Handbook of Biomedical Instrumentation", Tata McGraw-Hill, 3rd edition, 2014.
3. Sabrie Soloman, "Sensors Hand Book", McGraw Hill, 2010.

Reference Book:

1. Graham Ramsay, "Commercial Biosensors", John Wiley & Sons, 1st edition, 1998.
2. Tran Minh Canh, "Sensor Physics & Technology – Biosensors", 1st Edition, Champan& Hall, 1993.
3. Carr and Brown, "Introduction to Medical Equipment Technology", Addison Wesley, 2nd Edition, 1999.

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/>

19BMP04 SURGICAL AND CRITICAL CARE EQUIPMENT

Offered by BME (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 principle of biotelemetry and diathermy and its uses
- Explore the different types of critical care and medical lasers and their applications extracorporeal devices
- Understand the importance of patient safety against electrical hazard.

Course Outcome:

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

- Perform continuous monitoring and transmission of vital parameters
- Explain the types of diathermy and its applications.
- Express the basics of critical care equipment's and special diagnostic devices its application in medicine
- Describe surgical applications of lasers.
- Outline the importance of patient safety against electrical hazard

Unit I PATIENT MONITORING AND BIOTELEMETRY**9**

Patient monitoring systems - ICU/CCU Equipment, Infusion pumps, bed side monitors, Central monitoring console. Architecture of Biotelemetry system – single and multi-channel Biotelemetry - Inductively coupled Biotelemetry - Optical Biotelemetry - readout formats. Concept of m-Health 2.0, Point of care devices – disposable haematology sensors.

Unit II DIATHERMY**9**

IR and UV lamp and its application. Short wave diathermy, ultrasonic diathermy, Microwave diathermy, Surgical Diathermy- Principle of surgical diathermy, Surgical diathermy machine, Safety Aspects in Electro-Surgical units, Surgical diathermy analyzers.

Unit III CRITICAL CARE EQUIPMENT**9**

Cardiac Pacemaker- Internal and External Pacemaker– Batteries, AC and DC Defibrillator- Internal and External, Defibrillator Protection Circuit, Cardiac ablation catheter. Types of Ventilators – Pressure, Volume, and Time controlled. Humidifiers, Nebulizers. Need for heart lung machine, functioning of bubble, disc type and membrane type oxygenators. Hemo Dialyser unit,

Unit IV SURGICAL THERAPEUTIC APPLICATIONS OF LASERS**9**

Lasers in ophthalmology, Dermatology, Dentistry, Urology, Otolaryngology, Tissue welding and Soldering. Lithotripsy, Principles of Cryogenic technique and application, Endoscopy, Laparoscopy, Oscopes.

Unit V PATIENT SAFETY**9**

Physiological effects of electricity – important susceptibility parameters – Macro shock – Micro shock hazards – Patient's electrical environment – Isolated Power system – Conductive surfaces – Electrical safety codes and standards – IEC 60601-1 2005 standard, Basic Approaches to Protection against shock, Protection equipment design, Electrical safety analyzer – Testing the Electric system.

Text Book:

1. John G. Webster, "Medical Instrumentation Application and Design", Wiley India Pvt. Ltd, New Delhi, 4th edition, 2015.
2. Khandpur.R.S, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, New Delhi, 3rd edition, 2014.

Reference Book:

1. Leslie Cromwell, "Biomedical Instrumentation and measurement", Prentice Hall of India, New Delhi, 2nd edition, 2015.
2. Richard Aston, "Principles of Biomedical Instrumentation and Measurement", Merrill Publishing Company, 1990.
3. L.A Geddes and L.E.Baker, "Principles of Applied Biomedical Instrumentation", 3rd edition, 2008.
4. Myer Kutz, "Standard Handbook of Biomedical Engineering and Design", McGraw Hill, 2003.
5. Joseph J. Carr and John M. Brown, "Introduction to Biomedical Equipment Technology", Pearson education, 2012

Extensive Reading:

- <https://www.eintegrity.org/e-learning-healthcare-course/intensive-care-medicine.html>

19BTP03 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

- To impart knowledge on basic concepts related to radioisotopes.
- To impart knowledge on applications of radioisotopes in fields of Biotechnology.
- To impart knowledge on 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 radioisotope methods
- Apply of radioisotopes in Biotechnology, agriculture and food processing.
- Apply of 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 OF RADIOISOTOPES**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.

19BTP04 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

- To understand the sources of energy and their types
- To provide a thorough understanding of various renewable feedstock of importance their availability and attributes for biofuels production.
- To provide a thorough understanding of the broad concept of second and third generation biofuel production from biomass and other low-cost agri residues and bio-wastes.

Course Outcome:

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

- Able to know about the resources of biofuels.
- Able to learn the source of second generation different biofuels.
- Able to know the importance of biological conversion process for biofuels.
- Able to learn about the role of chemical conversion process in biofuel formation.
- Able to know about the biofuel economy in 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 Biorenewable Sources - Non-combustible Renewable Energy Sources -Biorenewable 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**

Vegetable Oils and Biodiesel-Biogas-Aerobic Conversion Processes-Anaerobic Conversion Processes -Biogas Processing -Reactor Technology for Anaerobic Digestion-Landfill Gas-Crude Gases from Biorenewable 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 Gasification.

Unit V BIOFUEL ECONOMY**9**

Introduction to Biofuel Economy -Biofuel Economy- Estimation of Biofuel Prices- Biodiesel Economy -Bioethanol Economy-Biorenewable 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.

Reference Book:

1. Robert C. Brown, "Biorenewable Resources: Engineering New Products from Agriculture", Wiley-Blackwell Publishing, 2003
2. Lee, James., "Biochemical Engineering", PHI, 1992.

19BTP05 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
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Course Objective:

To impart knowledge on

- To acquire basic knowledge about the characteristics of pathogens.
- To know about the mechanism involved in the host defense and pathogenic strategies.
- To know about the molecular mechanism of the virulence strains.
- To learn the host pathogen interactions.
- To learn the modern pathogen control strategies.

Course Outcome:

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

- Able to know about the concepts involved in the pathogenic cycle, disease and vaccines.
- Able to learn the mechanisms involved in the host defense.
- Able to learn the molecular pathogenesis mechanisms of various pathogens.
- Able to analyze the host pathogen interactions.
- Able to know about the modern approaches in controlling the pathogens.

Unit I OVERVIEW**9**

Historical perspective - microbial toxins, vaccines, antibiotics and 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, parasitiparous 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 amantidine.

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, hybridisation 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 success story of small pox 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, 4th revised Edition, 2003.
4. Janeway C.A. Jr, Travers P. and Walport M., "Immunobiology: The Immune System in Health and Disease", Garland Science, 5th Edition, 2001.

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.

Extensive Reading:

- Issar Smith, "Mycobacterium tuberculosis Pathogenesis and Molecular Determinants of Virulence", Clin. Microbiol Rev. 2003 Jul; 16(3): 463–496
- T. Jacob John and Vipin M. Vashishtha, "Eradicating poliomyelitis: India's journey from hyperendemic to polio-free status", Indian J Med Res. 2013 May; 137(5): 881–894.
- Munita J M, Arias C A. "Mechanisms of Antibiotic Resistance", Microbiol Spectr. 2016 Apr;4(2).
- <http://www.historyofvaccines.org/>
- <http://www.bt.cdc.gov/agent/smallpox/training/overview/pdf/eradicationhistory.pdf>
- <http://www.polioeradication.org/Polioandprevention/Historyofpolio.aspx>

19BTP10 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
- The ethical considerations of clinical trials
- The stages in clinical trials based on the available principles
- Documents required for conducting clinical trials
- Management strategies for efficient trials

Course Outcome:

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

- List the steps involved in the drug development process
- Explain the ethical principles to be followed while conducting clinical trials
- Describe the guidelines of clinical trials
- Comprehend the essential documents required for conducting trials
- Apply project management strategies to conduct clinical trials

Unit I HISTORY AND STAGES IN DRUG DEVELOPMENT PROCESS 9

Origin and history of clinical research, Introduction to drug discovery and drug development, Preclinical trials- animal studies, toxicology, Clinical Trials in India –The National Perspective, Clinical Trial Phase I, Clinical Trial Phase II, Clinical Trial Phase III, Clinical Trial Phase IV – methods

Unit II ETHICS IN CLINICAL TRIALS 9

Historical guidelines in clinical research- Nuremberg code, Declaration of Helsinki, Belmont report, Research ethics and Bioethics – Principles of research ethics; Ethical issues in clinical trials; Use of humans in Scientific Experiments; the informed consent; Introduction to animal ethics; Animal rights and use of animals

Unit III GUIDELINES FOR CLINICAL RESEARCH 9

International Conference on Harmonization (ICH) - Brief history of ICH, Structure of ICH, ICH Harmonization Process, Responsibilities of Stakeholders: Sponsors, Investigators, CROs, Monitors, Institutional ethics committee.

Unit IV ESSENTIAL DOCUMENTS 9

Essential Documents in Clinical Trials: SOP, Clinical Trial Protocol and Amendments, Investigator Brochure, Master Files, Informed Consent Forms, Consort statement, Case Record Form.

Unit V CLINICAL TRIAL MANAGEMENT 9

Project management in clinical trials - principles of project management; Application in clinical trial management; Risk assessment, Pharmacovigilance, Project Auditing and Inspection.

Text Book:

1. Mira T. SundaraRajan. "Moral Rights: Principles, Practice and New Technology", Oxford University Press, 1st Edition, 2011.
2. Rao M. B, Manjula Guru. "Patent Law in India", Kluwer Law International, 1st Edition, 2010.
3. McFadden Elizabeth, M McFadden. "Management of Data in Clinical Trials", John Wiley & Sons Inc, 2nd Edition, 2008

Reference Book:

1. Lee, Chi-Jen; et.al. "Clinical Trials for Drugs and Biopharmaceuticals", CRC / Taylor & Francis, 2011.
2. Friedman, L.M., Furberg, C.D., DeMets, D., Reboussin, D.M., Granger, C.B. "Fundamentals of Clinical Trials", Springer International Publishing, 5th Edition, 2015.

19CEP06 PROJECT MANAGEMENT

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 project management fundamentals.
- The project costing and budgeting.
- The project planning and scheduling.
- The project control and resource management
- Computer application in project management.

Course Outcome:

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

- Employ management fundamentals in complex projects.
- Carry out costing and budgeting during project estimation.
- Plan and schedule large scale projects.
- Ensure proper project control and resource management.
- Incorporate latest technologies in project management.

Unit I PROJECT MANAGEMENT FUNDAMENTALS**9**

Introduction - Characteristics of projects - Project management Process - Role of Project Manager - Project life cycle - Project Teams - Work Breakdown Structure - Organizational Breakdown Structure and Linear Responsibility Charts.

Unit II PROJECT COSTING AND BUDGETING**9**

Capital Cost Estimating - Estimating work process - Preparing early estimates - Methods and Techniques - Cost Capacity Curves - Risk Analysis - Contingency.
Project Budgeting - Types of Project Budgets - Development of Project Estimates for Budgeting - Owner's Estimate for Budgeting - Economic Feasibility Study - Single Payments - Uniform Payment Series - Time Value of Money - Contractor's bid.

Unit III PROJECT PLANNING AND SCHEDULING**9**

Estimating project time - Developing project plan - Planning for Multiple Projects - Assigning Realistic Durations - Bar charts - Activity on Arrow (AOA) and Activity on Node (AON) Scheduling - Network analysis - Start and finish time - Floats - Critical path - Time-cost trade off - Network crashing - Program Evaluation and Review Technique (PERT).

Unit IV PROJECT CONTROL AND RESOURCE MANAGEMENT**9**

Project Measurement and Control - Earned-Value System - Monitoring Project Performance - Interpretation of Performance Indices - Cost and Schedule Variances -Resource Management - Resource constrained Scheduling - Material Management -Inventory control - Types of Inventory - Selective Inventory Control - Economic Order Quantity - Material Requirements Planning.

Unit V COMPUTER APPLICATION IN PROJECT MANAGEMENT**9**

Introduction - Managing special projects - International Projects - Issues in managing international projects - Total Quality Management - Background - Training - Teamwork - Statistical Methods - Cost of quality - Lean Management - Case studies.

Text Book:

1. Garold D. Oberlender, "Project Management for Engineering and Construction", McGraw-Hill Education, 3rd edition, 2014.
2. Chitkara K K, "Construction Project Management – Planning, Scheduling and Controlling" McGraw Hill Education; 3rd edition, 2019.

Reference Book:

1. S. Choudhury, "Project Scheduling and Monitoring in Practice", McGraw-Hill Professional, 2016.
2. P. K. Joy, "Total Project Management: The Indian Context", Macmillan India Ltd. 2016.
3. Shtub, Bard and Globerson, "Project Management: Engineering, Technology, and Implementation", Prentice Hall India. 2015.

Extensive Reading:

- <https://nptel.ac.in/courses/105/104/105104161/>
- https://www.cmu.edu/cee/projects/PMbook/12_Cost_Control,_Monitoring,_and_Accounting.html

19CSP04 CYBER CRIME AND LAWS

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 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

- Analyze various network security issues
- Identify different types of cyber crimes
- Use cyber laws against various cyber crimes
- Perform evidence collection on digital devices
- Apply various tools to analyze collected evidence

Unit I NETWORK CONCEPTS AND NETWORK SECURITY**7**

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**10**

Introduction – Role of Electronic Communication Devices in Cybercrime – Mens rea and Actus reus 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 – Ransomware – 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. Deje, Murugan, "Cyber Forensics", Oxford, 2018

Reference Book:

1. John R. Vacca, "Computer Forensics, Computer Crime Investigation", Firewall Media, New Delhi, 2nd Edition, 2005
2. Nelson, Phillips Enfinger, Stuart, "Computer Forensics and Investigations", Cengage Learning, 4th Edition, 2009
3. Keith J. Jones, Richard Bejtlich, Curtis W. Rose, "Real Digital Forensics", Addison – Wesley Pearson Education, 2005
4. Christopher L.T. Brown, "Computer Evidence Collection & Presentation", Firewall Media, 2th Edition, 2009
5. Jesus Mena, "Homeland Security, Techniques & Technologies", Firewall Media, 2007
6. Robert M. Slade, "Software Forensics Collecting Evidence from the scene of a Digital Crime", TMH 2005
7. Chad Steel, "Windows Forensics", Wiley India Edition, 2006

Extensive Reading:

- <http://www.sans.org/course/computer-forensic-investigations-windows-in-depth>
- <http://www.porcupine.org/forensics/forensic-discovery/>

- <http://www.cftt.nist.gov/>

19ECP05 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 - 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**

Quality statements - 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 - 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, Washinton Accord, Blooms Taxonomy.

Unit V QUALITY SYSTEMS**9**

Need for ISO 9000- ISO 9000-2008 Quality System – Elements, Documentation, Quality auditing- QS 9000 – ISO 14000 – Concepts, Requirements and Benefits – Case studies of TQM implementation in manufacturing and service sectors including IT, NBA, NAAC.

Text Book:

1. Dale H.Besterfield, et al., "Total Quality Management", Pearson Education Asia, 3rd Edition, Indian Reprint (2006).

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/

19EEP05 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.

19EEP06 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

- 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.

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 Boatright, "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.
- 9.
- 10.
- 11.
- 12.
- 13.
14. WEB Reference:
- 15.
16. www.onlineethics.org
17. www.nspe.org
18. www.globoethics.org
19. www.ethics.org

19ITP05 HUMAN RESOURCE AND MANAGEMENT

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BIT, BME)

L	T	P	C
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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. Eugene 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&recordId=873189&fileId=1134952>
- http://www.ljmu.ac.uk/secretariat/docs/Getting_to_Grips_HR_Management.pdf

19ITP06 INTELLECTUAL PROPERTY RIGHTS

Offered by IT (Open Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BIT, BME)

L	T	P	C
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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 - Case Studies – Patents - Basmati rice – Turmeric - Neem

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

19ITP07 ETHICS IN COMPUTING

Offered by IT

(Open Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BIT, BME)

L	T	P	C
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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**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 Technology - Freedom 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 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

19ITP08 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

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

Practical Course**-5****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.

19MEP07 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 years 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.

19MEP08 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

- principles and functions of management and psychological concepts.

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:

- Herald Koontz and Heinz Weihrich, "Essentials of Management", Tata McGraw Hill Education Private Limited, 10th Edition, 2015.
- Robert S. Feldman, "Understanding Psychology", McGraw Hill Education Private Limited, 10th Edition, 2011.

Reference Book:

- Stephen P. Robbins and Mary Coulter, "Management", Prentice Hall (India) Pvt. Ltd., 10th Edition, 2009.
- Miner J.B, "Industrial/Organizational Psychology", McGraw Hill NY, 1992.
- Aamodt M.G, "Industrial Organizational Psychology: An Applied Approach", Wadsworth/Thompson: Belmont, C.A, 5th Edition, 2007.

19MEP09 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, dependant/ 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.

19MEP10 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**

Introduction to micromachining and lithography - Overview of Lithography - introduction to semiconductor processing - necessity of a clean room - different 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 – Process-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 - Chemical Reactions in 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.

19MEP11 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

- To instruct the importance of the principles of various turbo machines.
- To understand the principles, operations and applications of different types of turbo machinery components.
- To design 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 on basic concepts and operating principles of turbo machines.
- Be able to understand the design procedure of centrifugal fans and blowers.
- Recognize the importance and to understand the concept of Centrifugal compressor
- Familiar 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-classification of fluid machinery- 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-Impeller flow losses- slip factor- diffuser Analysis - losses and performance curves.

Unit IV AXIAL FLOW COMPRESSOR**9**

Stage velocity diagrams- enthalpy entropy diagrams- design procedure of axial flow compressor- 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-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.

19MEP12 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 - Over-potentials 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, 2013.
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.

19UEP01 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

- The importance of business communication
- Techniques and styles of business communication
- The language usage in marketing techniques and advertising
- Strategies to be a successful employee or employer in the workplace
- Using vocabulary in formal and informal business contexts

Course Outcome:

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

- Communicate appropriately in various business environment
- Know the techniques and styles of business communication
- Use apt language for marketing
- Analyze and adapt to working environment
- Write business correspondences with related terms and phrases

Unit I RUDIMENTS OF BUSINESS COMMUNICATION**9**

Importance of Communication - Characteristics of Communication - Channels of Communication - Intrapersonal Communication - Managerial Communication - Group Communication and Strategies - Role of Listening and Speaking in Business Context - 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 - Order 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 and Websites especially Blogs, Online Reviews, Ratings

Unit III BUSINESS COMMUNICATION – II**9**

Questionnaire Preparation for Market Survey - Writing Business Plan and Proposal - Guidelines for Report Preparation - Product-based Project Report Content development - Project Appraisal Techniques - Steps for Product Analysis & Financial Analysis

Unit IV BUSINESS SKILLS**9**

Case Studies - Finance Specific Scenarios - Team Building - Crisis Management - Customer Service - Leadership Skills - Types of Leadership - Management Skills - Business Idioms and Phrases - Business Jargons

Unit V MARKETING AND ADVERTISING**9**

Definition of Marketing and Advertising - Integrated Marketing Communication - Human Resource Communication - Functions of Advertising - Persuasion Process - 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. Pal, Rajendra and J. S. Korlahalli. Essentials of Business Communication. 13th ed. India: Sultan Chand & Sons, 2011.
2. Sharma, Sangeetha. Entrepreneurship Development. 1st ed. New Delhi: PHI Learning Private Limited, 2017.

19UEP02 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

- Understanding general functions, laws and ethics of media writing
- Objective and accurate news stories development in print media style
- Modes of media writing styles among radio, television news, print journalism and advertising
- Script for TV programmes and film editing process
- Trending and invincible digital media style of writing

Course Outcome:

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

- Understand 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
- Know the various steps involved in TV programme and film making process
- Generate personal/official blogs, effective e-contents and e-posters

Unit I INTRODUCTION TO MEDIA WRITING**9**

Definition of Mass Media - Their characteristics and Functions - Challenges in Mass Media Writing – Ways to Overcome Obstacles - What Makes News - Copyright Issues and Libel/Defamation - News Values and Ethics - The Writer and the Law - Obligations, Considerations and Qualities of a Media Writer - Media Writing Glossary

Unit II PRINT MEDIA**9**

Writing for the Print Medium - The Characteristics of the Print Media - News - Types (Hard and Soft News) - Story Structure - Basics of Reporting - Newspaper, Magazine, Newsletter - Types of Reporting - Writing Techniques & Information Presentation Styles in Print - Op-ed - Letter to the Editor - Film Review - Book Review - Sports Review - Photojournalism & the Place of Pictures in Print Writing – Headlines - Feature Writing

Unit III BROADCAST MEDIA & WRITING FOR RADIO**9**

Similarities and Differences between Print and Broadcast Journalism - Writing for the Broadcast Media - Techniques and Approaches to Broadcast Style - Broadcast Writing Tips - Key Elements of Radio Jockeying - Preparation of Radio News - 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) - 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 - Interviews and Talk Shows - Film - Dialogue, Language & Themes - Film Based Programmes - Documentaries - Serials - Roles of Editors

Unit V DIGITAL MEDIA**9**

Web Writing – Importance of Web Writing - Differences between Web Writing and other Journalism - Online Journalism - Features - Interactivity - Headlines and Blurbs - Language Techniques for Search Engine Optimization (SEO) - Writing Effectively for the Social Media - Editing for Effective User-Friendly Content - Blogs - E-Advertisements - Elements of Advertising - Posters

Text Book:

1. Ceramella, Nick, and Elizabeth Lee. Cambridge English for the Media. UK: CUP, 2016.
2. Nair, Latha. English for the Media. India: CUP, 2014.

Reference Book:

1. Kershner, J.W. The Elements of News Writing. 2nd ed. Boston: Pearson/Allyn & Bacon, 2009.
2. Lieb, T. All the News: Writing and Reporting for Convergent Media. Boston: Pearson/Allyn & Bacon 2009.

19UMP01 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.

19UMP03 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.

19UMP04 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 special 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 Grätzer, "Lattice Theory: Foundations", 1st Edition, Birkhäuser Basel, 2011.
2. George Grätzer, "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.

19UMP05 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 – Kruskals'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.

19UPP01 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 using different techniques

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, electroless deposition, anodic oxidation, spray pyrolysis, spin and dip coating, chemical vapor deposition (CVD), homogeneous 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 Thin film 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.

19UPP02 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 TECHNIQUES

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

19UPP03 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.

19BMA01 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

- Describe the basic concepts of cell biology
- Understand the biochemical aspects of human biology.
- Explain the fundamental concepts of metabolism and enzymes
- Discuss the inheritance concepts of genes.
- Describe the applications of microbiology in industries.

Unit I BASIC CELL BIOLOGY**9**

What is a 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. Sohini Singh and Dr. Tanu Allen, "Biology for Engineers", Vayu Education of India, New Delhi, 2014.
3. Dr. Suraish Kumar, "Biology for Engineers", Oxford University Press

Reference Book:

1. Arthur T. Johnson, "Biology for Engineers" CRC Press, 2011
2. N. A. Campbell, J. B. Reece, L. Urry, M. L. Cain and S. A. Wasserman, "Biology: A global approach", Pearson Education Ltd, 2014.
3. 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/>

19BMA02 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

- Explain the details of basics of hospital Management.
- Summarize the health sectors in India.
- Understand the various challenges in hospital Management.
- Describe the duties of clinical engineers in hospitals.
- Develop 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, 3rd edition.

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.
6. Hans Pfeiff and VeraDammann (Ed.), "Hospital Engineering in Developing Countries", Z Report, Eschbom, 1986.

Extensive Reading:

- <https://www.coursera.org/browse/health/healthcare-management>

19BTA01 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. Prescott L.M., Harley J.P., Klein D.A., "Microbiology", Wm.C.Brown Publishers, 7th Edition 2008.

19BTA02 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

- Upon completion of the course students will
- 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,

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

19BTA03 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, Macmillan, 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.

19BTA04 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. myasthenia 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. Kubly 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.

19CEA01 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 the building blueprints.
- Adopt climate and weather suitability in buildings.
- 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 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

19CEA02 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

- The types of environmental pollution.
- The air pollution control methods.
- The principles of water treatment.
- The concept of sustainability.
- The environmental regulations

Course Outcome:

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

- Familiarize the pollution and its regulating standards.
- Apply the different air pollution control methods gases and particulates.
- Apply the principles of water 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 eco system and human health - Need for effluent treatment and toxicity control - Standards for portable water - Agricultural and left-off streams - Industrial areas and Resorts - Noise pollution measurements and its control.

Unit II AIR 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 - Predicting concentrations of air pollutants.

Unit III PRINCIPLES OF WASTE WATER TREATMENT**9**

Preliminary treatment, Primary Treatment - Sedimentation tanks, Imhoff tanks, coagulation, secondary treatment - Intermittent sand filters, Trickling filters, Activated Sludge Process, Oxidation ponds & tertiary treatments - Chlorination & disinfection systems - Advanced waste water 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) - Air standards for cities - Regulations for clean environment and implications for industries.

Text Book:

1. Freeman.H.M, "Industrial Pollution Prevention Hand Book", McGraw Hill, 1995.
2. Garg, S.K., "Environmental Engineering I & II", Khanna Publishers, New Delhi, 2013 (39th 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>

19CEA03 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

- 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

- Categorize the various components of engineering seismology.
- Identify the 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, 2009.

Reference Book:

1. Bozorgnia Y and Bertero V.V "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, 2010.

Extensive Reading:

- Recent Advances in Earthquake Geotechnical Engineering and microzonation edited by Ansai Kluwar Academic Publishers, Netherlands, 2004.
- Assessing and managing Earthquake risks edited by Oliveira C.S and Roca and Goula.X, Springer, Netherlands, 2006.

19CEA04 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

- 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 DATUM TRANSFORMATION AND DIFFERENTIAL GPS**9**

Reduction of observation - Transformation to various map projection systems - Real time kinematic GPS - Multiple reference stations - Virtual reference stations.

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.

19CEA05 WATER RESOURCES PLANNING AND 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

- Water resources of the country.
- Various components of hydrological cycle.
- The importance of utilizing water judiciously.
- Various flood control techniques.
- Various cost benefit analysis.

Course Outcome:

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

- Collect all kinds of hydrological data and perform the analysis.
- Design the optimum rain gauge network.
- Prepare the water budget and development plan.
- Estimate the sediment load in reservoirs.
- Perform economic analysis of water resource projects.

Unit I INTRODUCTION**9**

Water resources survey - Water resources of India and Tamilnadu - Description of water resources planning - Economics of water resources planning, physical and socio economic data - National Water Policy - Collection of meteorological and hydrological data for water resources development.

Unit II HYDROLOGIC CYCLE**9**

Components of Hydrological cycle - system representation - Historical development of hydrology - Weather system - Cloud and cloud seeding - General atmospheric circulation - Types and forms of precipitation - Measurement of rainfall - Optimum rain gauge network design.

Unit III WATER RESOURCE NEEDS**9**

Consumptive and non-consumptive water use - Estimation of water requirements for irrigation, for drinking and navigation - Water characteristics and quality - Scope and aims of master plan - Concept of basin as a unit for development - Water budget and development plan.

Unit IV RESERVOIR PLANNING AND MANAGEMENT**9**

Reservoir - Single and multipurpose - Multi objective - Fixation of Storage capacity - Strategies for reservoir operation - Sedimentation of reservoirs - Design flood - levees and flood walls - Channel improvement - Flood warning - Mitigation measures.

Unit V ECONOMIC ANALYSIS**9**

Estimation of cost and Evaluation of Benefits - Discount rate - Discounting factors - Discounting techniques - Computer Applications.

Text Book:

1. Linsley R.K. and Franzini J.B, "Water Resources Engineering", McGraw-Hill Inc, 2000.
2. Douglas J.L. and Lee R.R., "Economics of Water Resources Planning", Tata McGraw-Hill Inc. 2000.

Reference Book:

1. Chaturvedi M.C., "Water Resources Systems Planning and Management", Tata McGraw-Hill Inc., New Delhi, 1997.
2. Goodman Alvin S., "Principles of Water Resources Planning", Prentice-Hall, 1984.
3. Maass et al, "Design of Water Resources Systems", Macmillan, 1968.

Extensive Reading:

- <https://ascelibrary.org/journal/jwrmd5>
- <https://www.worldbank.org/en/topic/water>
- <https://www.un.org/waterforlifedecade/>

19CSA01 INTERNET PROGRAMMING

Offered by CSE (Allied Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To identify the basics of Internet and its protocol
- To learn HTML5 controls for the creation of static web pages
- To present HTML documents using Cascading Style Sheets (CSS).
- To learn to create user interactive web pages using JavaScript and DOM
- To build web application using Ruby on Rails

Course Outcome:

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

- Exploit the basics of Internet and realize the significance of HTTP protocol in the WWW.
- Develop website using HTML5
- Design interesting and appealing HTML pages using CSS
- Validate the users' data using JavaScript and process various elements of web pages using DOM
- Develop Web Application using Ruby on Rails

Unit I BASICS OF NETWORK AND WEB CONCEPTS**9**

Types of network – Reason for networks – Communication between computers – Serial and parallel communication – Asynchronous and synchronous communication – Simplex, half-duplex, full-duplex communications – Data rate, bandwidth and throughput – Switched connections – Topologies used in networking. Basic Internet protocols – The World Wide Web – HTTP request message – HTTP response message – Web clients – Web servers.

Unit II HTML5**9**

Introduction to HTML5 – Editing HTML5 – W3C HTML validation service – Headings – Linking - Internal linking - Images – Special characters and horizontal rules – Lists – Tables – Forms – Meta elements – New HTML5 Form input types – Input and datalist elements and auto complete attribute – Page structure elements.

Unit III CSS3, JAVASCRIPT**9**

Types of CSS – Conflicting style sheets – Positioning elements – Element dimension – Box model and Text Flow – Drop-Down menus – Text shadows – Rounded corners – Color – Box Shadows. JavaScript: Introduction – Syntax - Variables and data types – control statements – operators – literals - functions –objects – arrays – Built-in objects.

Unit IV DOCUMENT OBJECT MODEL**9**

Introduction to the Document Object Model – Intrinsic event handling – Modifying element style – The Document tree – DOM collections – Using Timer and dynamic styles to create animated effects – JavaScript event handling – Reviewing the load, mousemove, mouseover, mouseout events – Form processing with focus, blur, submit, reset – Event bubbling.

Unit V RUBY ON RAILS**9**

Introduction to Ruby : Data types - Simple input and output - Control statements - Fundamentals of arrays – Hashes – Methods – Classes - Code blocks and Iterators - Pattern matching. Introduction to Ruby on Rails: Overview of Rails – Document requests – Rails applications with databases.

Text Book:

1. P.J. Deitel, H.M. Deitel, "Internet and World Wide Web – How to program", Fifth Edition, Pearson Education Publishers, 2009.
2. Robert. W. Sebesta, "Programming the World Wide Web", Eighth Edition, Pearson Education, 2015
3. John Cowley, "Communications and Networking An Introduction", Second Edition, Springer, 2013

Reference Book:

1. Jeffrey C. Jackson, "Web Technologies - A Computer Science Perspective", Pearson Education, 2011
2. Chris Bates, "Web Programming: Building Internet Applications", Wiley, 2006

Extensive Reading:

- https://www.w3schools.com/html/html5_intro.asp
- <https://www.geeksforgeeks.org/javascript-tutorial/>
- <https://www.w3schools.com/css/>
- <https://www.tutorialspoint.com/ruby-on-rails/index.htm>

19CSA02 FUNDAMENTALS OF SOFTWARE ENGINEERING

Offered by CSE (Allied Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To explore the fundamental concepts of software engineering process
- To learn the requirements engineering process
- To understand the software design principles
- To know the different testing strategies
- To learn the project management techniques

Course Outcome:

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

- Apply software engineering process for software development.
- Formulate software requirement specification
- Design software according to the specification
- Test the software under development
- Manage and maintain the software projects

Unit I SOFTWARE ENGINEERING PROCESS 9

The Nature of Software - Software Engineering Practice - Software Myths – Generic Process Models: Prescriptive Process Models, Specialized Process Models, The Unified Process, Personal and Team Process Models – Overview of Agile Process – Extreme Programming – Agile Process Models

Unit II REQUIREMENT ENGINEERING AND MODELING 9

Requirements Engineering: Establishing the Groundwork - Eliciting Requirements – Building the Requirements Model - Negotiating and Validating Requirements - Requirements Analysis using scenario based modeling – UML Models – Modelling: Data Modeling Concepts - Class-Based Modeling - Flow-Oriented Modeling - Creating a Behavioral Model

Unit III DESIGN 9

Design 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 Evaluation

Unit IV SOFTWARE TESTING 9

Testing: Strategic approach to Software Testing - 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

Unit V PROJECT MANAGEMENT 9

Project Management Concepts – Process and Project Metrics - Estimation for Software Projects - Project Scheduling

Text Book:

1. Roger S. Pressman, "Software Engineering – A practitioner's approach", McGraw Hill Publications, Ninth Edition, 2019

Reference Book:

1. PankajJalote, "An Integrated Approach to Software Engineering", Springer, Third Edition, 2005
2. Ian Sommerville, "Software engineering", Pearson Education Asia, Ninth Edition, 2011.
3. Watts S.Humphrey, "A Discipline for Software Engineering", Pearson Education, 2008.
4. James F.Peters and WitoldPedrycz, "Software Engineering, Engineering Approach", Wiley-India, 2007.
5. Stephen R.Schach, "Software Engineering", Tata McGraw-Hill, 2007.
6. S.A.Kelkar, "Software Engineering", Prentice Hall of India Pvt, 2007

Extensive Reading:

- www.mhhe.com/pressman
- www.rspa.com/spi/
- https://www.tutorialspoint.com/software_engineering/index.htm

19CSA03 INTRODUCTION TO DATABASE

Offered by CSE (Allied Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To correlate the role of database management systems in information technology applications
- To reduce the anomalies using Normalization
- To structure data using relational model
- To explore the features of structured query language
- To manage transaction and concurrency control techniques

Course Outcome:

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

- Draw ER Diagrams for enterprise applications
- Apply normalization techniques on the databases
- Design databases using relational model
- Query the database using SQL
- 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 – Removing Redundant Attributes in Entity Sets – ER Diagrams – Design Issues – Extended ER Features – ER Reduction to Relational Schemas

Unit II NORMALIZATION**9**

Functional Dependencies – Decomposition using Functional dependencies – Dependency Preservation – Closure of attributes – Atomic domains and First Normal Form – Second Normal Form – Third Normal Form – Boyce Codd Normal Form

Unit III RELATIONAL DATABASE MODEL**8**

Introduction of Relational Model – Structure of Relational Databases – Database Schema – Schema Diagrams – Set Theory – Equivalence Operations – Relational Query Languages – Relational Algebra – Tuple Relational Calculus – Domain Relational Calculus

Unit IV STRUCTURED QUERY LANGUAGE**10**

Overview of SQL query language – SQL Data definition – Integrity Constraints – Basic Structure of SQL Queries – Additional Basic Operations – Set Operations – Null values – Aggregate Operations – Nested Sub queries – Joins – Views – Authorization – Introduction to Advanced SQL – Functions and Procedures – Triggers

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

Text Book:

1. Henry F Korth, Abraham Silberschatz, S. Sudharshan, "Database System Concepts", McGraw Hill, Sixth Edition, 2013.
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, 2010.
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:

- <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://www.service-architecture.com/database/articles/acid_properties.html

19CSA04 FUNDAMENTALS OF OPERATING SYSTEMS

Offered by CSE (Allied Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To acquire basic knowledge of operating system structures and its functioning
- To study the concept of process management
- To learn the basics of memory management
- To understand the structure of file systems
- To familiarize with different 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
- Analyze the various process management algorithms
- Evaluate the performance of various memory management techniques
- Design a simple file system and analyze the performance
- Work with some popular operating systems like Linux, Windows

Unit I OPERATING SYSTEMS OVERVIEW**9**

Introduction to operating systems – Computer system organization - Architecture – Operating system structure - operations – Process, memory, storage management – Open source operating systems – OS services – User interface – System calls – System programs – Process concept - scheduling – Operations on processes –Inter-process communication.

Unit II PROCESS MANAGEMENT**10**

Basic concepts – Scheduling algorithms – Algorithm evaluation – The critical section problem – Classic problems of synchronization – Deadlocks – Deadlock characterization – Methods for handling deadlocks – Deadlock prevention – Deadlock avoidance – Deadlock detection – Recovery from deadlock.

Unit III MEMORY MANAGEMENT**9**

Memory management – Swapping – Contiguous memory allocation – Paging – Segmentation - Virtual memory: Background – Demand paging – Copy on write – Page replacement – Thrashing

Unit IV FILE MANAGEMENT**8**

File concept – Access methods – Directory structure – Protection – Directory implementation – Allocation methods – Free space management

Unit V MASS STORAGE AND I/O SYSTEM**9**

Disk scheduling – Disk management – Swap-Space management – RAID structure – Application I/O subsystem – Kernel I/O subsystem

Text Book:

1. Abraham Silberschatz, Peter B. Galvin, Greg Gagne, "Operating System Concepts Essentials", John Wiley & Sons Inc., 9th Edition, 2013.

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.

Extensive Reading:

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

19ECA01 COMMUNICATION SYSTEMS

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 analog and digital communication techniques.
- To impart knowledge on data and pulse communication techniques.
- To introduce source and Error control coding.
- To develop knowledge on multi-user radio communication

Course Outcome:

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

- Identify and apply different analog communication techniques and compare its performance
- Analyze the performance of digital modulation and demodulation techniques in various transmission environments
- Apply data and pulse communication techniques.
- Apply baseband encoding & decoding techniques in the storage / transmission of signals.
- Utilize multi-user radio communication.

Unit I FUNDAMENTALS OF ANALOG COMMUNICATION**9**

Principles of amplitude modulation – AM envelope, frequency spectrum and bandwidth – modulation index and percent – modulation, AM Voltage distribution, AM power distribution – Angle modulation – FM and PM waveforms – phase deviation and modulation index – frequency deviation and percent modulation – Frequency analysis of angle modulated waves – Bandwidth requirements for Angle modulated waves.

Unit II DIGITAL MODULATION TECHNIQUES**9**

Amplitude shift keying – frequency shift keying – FSK bit rate and baudrate – FSK transmitter – FSK receiver – phase shift keying – binary phase shift keying – BW consideration of BPSK- QPSK – Quadrature Amplitude modulation – bandwidth efficiency – DPSK.

Unit III DATA AND PULSE COMMUNICATION**9**

Open Systems Interconnection– Data Communication Circuit arrangements - Data Communication Codes – ASCII and Bar Codes- Error Detection and Correction Techniques – Data communication Hardware – serial and parallel interfaces.

Pulse Communication: Pulse Amplitude Modulation (PAM) – Pulse Time Modulation (PTM) – Pulse code Modulation (PCM) – Comparison of various Pulse Communication System (PAM – PTM – PCM).

Unit IV SOURCE AND ERROR CONTROL CODING**9**

Entropy – Source encoding theorem – Shannon Fano coding – Huffman coding – mutual information – channel capacity – channel coding theorem – Error Control Coding – linear block codes.

Unit V MULTI-USER RADIO COMMUNICATION**9**

Advanced Mobile Phone System (AMPS) – Global System for Mobile Communications (GSM) – Code Division Multiple Access (CDMA) – Cellular Concept and Frequency Reuse – Channel Assignment and Hand off – Bluetooth.

Text Book:

1. Wayne Tomasi, "Advanced Electronic Communication Systems", 6th Edition, Pearson Education, 2009.

Reference Book:

1. Simon Haykin, "Communication Systems", 5th Edition, John Wiley & Sons, 2009.
2. Rappaport T.S, "Wireless Communications: Principles and Practice", 2nd Edition, Pearson Education, 2007.
3. Martin S.Roden, "Analog and Digital Communication System", 5th Edition, Prentice Hall of India
4. B.Sklar, "Digital Communication Fundamentals and Applications" 2nd Edition Pearson Education, 2007.

Extensive Reading:

- <http://www.wirelesscommunication.nl/reference/chaptr01/telephon/amps.html>
- http://ecee.colorado.edu/~liue/teaching/comm_standards/gsm/index.html
- http://edu.eap.gr/pli/pli23/documents/Parallila_Keimena/GSM.pdf
- https://www.eff.org/files/filenode/global_system_for_mobile_communication_technology.pdf
- http://users.ece.utexas.edu/~jandrews/publications/cdma_talk.pdf
- <http://nptel.ac.in/courses/106105080/pdf/M5L8.pdf>
- www.intel.com/education/.../lectures/lecture_06_80211bandBT.ppt

19ECA02 INTRODUCTION TO IMAGE PROCESSING

Offered by ECE (Allied Elective offered to BAD, BBE, BBT, BCI, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand image fundamentals and different image enhancement techniques.
- To analyze image restoration process and segmentation techniques
- To analyze the various image compression algorithms

Course Outcome:

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

- Simulate basic image processing algorithms.
- Develop algorithms for image enhancement.
- Analyze the algorithms for image restoration.
- Develop algorithms for image segmentation, representation and description.
- Analyze the techniques for image compression.

Unit I DIGITAL IMAGE FUNDAMENTALS**9**

Elements of digital image processing systems, Elements of visual perception, brightness, contrast, hue, saturation, machband effect, Color image fundamentals - RGB, HSI models.

Unit II IMAGE ENHANCEMENT**9**

Intensity Transformation - Spatial filtering - Histogram equalization and specification techniques, Noise distributions, Image Smoothing, Image sharpening – Homomorphic filtering.

Unit III IMAGE RESTORATION**9**

Image Restoration - degradation model, Restoration in the presence of Noise only situations, Mean Filter, Order Statistics Filter- Inverse filtering –LMS filter- Geometric transformations - spatial transformations

Unit IV IMAGE SEGMENTATION, REPRESENTATION AND DESCRIPTION**9**

Edge detection-Edge linking via Hough transform –Thresholding -Region based segmentation Region growing – Region splitting and merging – Simple image Representation and Description Schemes.

Unit V IMAGE COMPRESSION**9**

Need for data compression - Huffman, Run Length Encoding, Arithmetic coding, Vector Quantization, Transform coding, JPEG standard, MPEG.

Text Book:

1. Rafael C. Gonzalez, Richard E. Woods, "Digital Image Processing", Prentice Hall, 3rd Edition, 2014.
2. Anil K. Jain, "Fundamentals of Digital Image Processing", Pearson Education, 2003.

Reference Book:

1. Kenneth R. Castleman, "Digital Image Processing", Pearson, 2006
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, "Digital Image Processing using MATLAB", Pearson Education, Inc., 2004
3. D.E. Dudgeon and R.M. Mersereau, "Multidimensional Digital Signal Processing", Prentice Hall Professional Technical Reference, 1990
4. William K. Pratt, "Digital Image Processing", John Wiley, New York, 4th Edition, 2007
5. Milan Sonka et al, "Image Processing, Analysis And Machine Vision", Brookes/Cole, Vikas Publishing House, 3rd edition, 2007

Extensive Reading:

- www.digitalimageprocessingplace.com

19ECA03 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 – Watchdog Timer – Interrupts – Overview of ATmega168/328 – ATmega1280/ATmega2560 – ATmega32U4

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 – Digital Interface Layout – Using Digital Outputs – Working with Digital Inputs – Working with Analog Interfaces – Analog Interface Layout – Interfacing with Analog Sensors – Working with Motors – Working with the Ethernet Shield

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, 2015.

Reference Book:

1. Shibu K V, "Introduction to Embedded Systems", 1st Edition, McGraw Hill Education Private Limited, India, 2009.
2. Michael Margolis, "Arduino Cookbook", 2nd Edition, O'Reilly Media, Inc, USA, 2012.
3. Jeremy Blum, "Exploring Arduino: Tools and Techniques for Engineering Wizardry", 1st Edition, John Wiley & Sons, Inc. Publishing, USA, 2013
4. Simon Monk, "Programming Arduino Getting Started with Sketches", 1st Edition, McGraw-Hill Education, USA, 2012

Extensive Reading:

- <https://www.arduino.cc/en/Tutorial/HomePage>
- <https://circuits4you.com/arduino-projects-vol-1/>
- <https://www.electronicshub.org/arduino-tutorial/>

19ECA04 MATLAB PROGRAMMING 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 apply knowledge of the MATLAB functions to manipulate complex values, arrays and matrices.
- To develop skills in M File Programming and Elementary Solution Methods
- To develop skills in MATLAB Simulink.

Course Outcome:

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

- Analyze the MATLAB Concepts and various input output methods.
- Manipulate operators and functions.
- Create M-files using IF, FOR, WHILE statements.
- Evaluate the results of Elementary Solution Methods.
- Simulink signals and systems.

Unit I MATLAB CONCEPTS

9

Directory and Defined Path - Menus and the toolbar - Saving & Loading Files - Using the command line to call functions - Computing with MATLAB - Reading and Writing from a file: Reading and Writing data from/to a .mat file, Reading and Writing from an Excel spreadsheet, Reading and Writing from and to other text files, MATLAB Help System.

Unit II DATA STORAGE AND MANIPULATION

9

Rational Operators on Single Values - Boolean Operators on Single Values - Relational Operators - Strings - Inline functions - complex number declaration - MATLAB functions to manipulate complex values – Arrays and Matrices - Declaring a vector - Dot product - Cross Product.

Unit III M FILE PROGRAMMING AND GRAPHICS

9

M-files - syntax - Nested functions - Placing comments - Control Flow: IF statement, FOR statement, WHILE statement - Program Flow: Arithmetic errors - Indexing errors, Assignment errors, Struct array errors, Syntax errors. 2D Graphics: XY- plotting functions, Subplots and Overlay plots - Special Plot types, Regression - 3D Graphics – Mesh – Contour.

Unit IV MATHEMATICAL MANIPULATIONS

9

Operations - Linear Algebraic Equations : Elementary Solution Methods, Statistics and probability, Special Matrices- Row reduced echelon form – Inverse, Cofactor, minor, Differential equation solver- advanced I/O.

Unit V MATLAB SIMULINK

9

Resources in Simulink, Create and run simple model in Simulink, modifying a model, Design of Models: Multiplying two Sinusoids- Adding derivative of sine and cosine Waves-Passing a sinusoid through a Gaussian channel- Generating an AM signal.

Practical Experiments:

Programming Exercises

- Let $x = [3 \ 2 \ 6 \ 8]'$ and $y = [4 \ 1 \ 3 \ 5]'$
 - Add the sum of the elements in x to y
 - Raise each element of x to the power specified by the corresponding element in y .
 - Multiply each element in x by the corresponding element in y , calling the result " z ".
 - Add up the elements in z and assign the result to a variable called " w ".
 - Compute $x' * y - w$ and interpret the result
- Create an M-by-N array of random numbers. Move through the array, element by element, and set any value that is less than 0.2 to 0 and any value that is greater than (or equal to) 0.2 to 1.
- The Fibonacci numbers are computed according to the relation $F_n = F_{n-1} + F_{n-2}$ with $F_0 = F_1 = 1$. Compute the first 10 Fibonacci numbers.
- Plot the graph of $f(x) = \exp(-2x^2 - 3y^2)$. Choose appropriate intervals for x and y .
- Show that if a matrix M can be written as $M = P - 1DP$, where D is diagonal and P is invertible, then $\exp(M) = P - 1 \exp(D)P$. [Define the matrices $P = [1 \ 2 : 3 \ 7]$, $P - 1 = [7 \ -2 : -3 \ 1]$, $D = [1 \ 0 : 0 \ 4]$
- Write a program to calculate $N!$ ("N factorial"), where N is a non-negative integer.
- Simulink Multiplying integration of sine and cosine waves
- Simulate a second order closed loop system

Text Book:

- Linda Coulson, 'MATLAB Programming', First Edition, 2009, Global Media, Delhi, ISBN 978 93 80168 38 8.
- K KSarma, 'MATLAB Demystified – Basic concepts and applications', First Edition, 2010, Vikas Publishing house Pvt Ltd., Noida.

Reference Book:

1. William J. Palm III, Introduction to Matlab 7 for Engineers, McGraw Hill 2005.
2. G. H. Golub and C. F. Van Loan, Matrix Computations, 3rd Ed., Johns Hopkins University Press, 1996.
3. Stephen J. Chapman, 'MATLAB Programming for Engineers', Fourth Edition, Thomson Learning, 2007

Extensive Reading:

- www.mathworks.com/academia/student_center/tutorials/launchpad.html

19EEA01 INDUSTRIAL ELECTRICAL SYSTEMS

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

- Power supplies and filters.
- Multivibrators and timers
- Concepts of Electrical heating and welding
- Concepts of Industrial automation
- Functions and programming of Programmable Logic Controller.

Course Outcome:

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

- Familiar with the power supplies and filters used in industry.
- Exercise multivibrator for control applications and timers for time delay applications.
- Explain the concepts of Electricity in heating and welding applications.
- Explicate the Architecture of Industrial Automation and working of Programmable Logic Controllers
- Choose the components of PLC and addressing the memory Identify and select the switching devices

Unit I POWER SUPPLIES**9**

Introduction to Power Supply – Rectifier – Half-wave, Full-wave – Performance parameters – Rectification efficiency, Utilization factor, Peak Inverse Voltage, voltage regulation, source regulation, load regulation and Ripple factor – Filters – Series inductor filter, Shunt capacitor filter, LC filter and Pi filter – Regulated power supply – Zener diode based regulator, Transistorised regulator and op-amp based regulator – introduction to switched mode power supply.

Unit II MULTIVIBRATORS AND TIMERS**9**

Introduction to Multivibrator – Astable, Monostable and Bistable multivibrator – Timers – Principle of Timers – LM555 IC Timer – Astable working mode and Monostable working mode – Applications of LM555 IC Timer– voltage controlled oscillator, Ramp generator and Schmitt trigger – Sequential Timer –Electronic Time Delay circuits – AC and DC timer – Introduction to Programmable Timer.

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 AUTOMATION**9**

History of Automation – Architecture of Industrial Automation, Fixed Automation – Programmable Automation – Flexible Automation, Components of Industrial Automation – Sensors.

Unit V PROGRAMMABLE LOGIC CONTROLLERS**9**

Evolution of PLC – Sequential and Programmable controllers – Architecture of PLC-PLC Hardware components: I/O modules, CPU, Memory-Programming devices-Memory allocation and Addressing.

Text Book:

1. BISWANATH PAUL, "Industrial Electronics and Control Including Programmable Logic Controller" Prentice-Hall of India Private Limited – Third Edition, 2014.
2. Frank Petruzella, "Programmable Logic Controllers" McGraw-Hill Education – Fourth Edition, 2010.

Reference Book:

1. Rashid M H, " Power Electronics: Circuits, Devices and Applications ", Pearson Education, 3rd Edition, 2014.
2. P.S.Bimbhra P.S., "Power Electronics" Khanna Publishers, 5th Edition 2003.
3. Philip T Krein, "Elements of Power Electronics", Oxford University Press, 2014.
4. W. Bolton, "Programmable Logic Controllers" Newnes, Sixth edition 2015.
5. Jon Stenerson, "Programmable Logic Controllers with Control Logics, DELMAR Cengage Learning.
6. Simatic S7 – 1200 Programming Manual
7. Simatic St – 300 Programming Manual
8. John W. Webb, Ronald A. Reis, "Programmable Logic Controllers: Principles and Applications" Prentice Hall of India, 2003.

19EEA02 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.

19EEA03 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

- Elucidate the working of various electric lamps and the various types of electric heating, electric welding and design a heating element
- Explain the working principle of refrigerators and Air Conditioning System
- Explain about electrolytic processes and storage of electricity
- Explain about electric traction.
- Explicate the importance of electrical energy conservation and apply various measures for economic aspects of utilising electrical energy

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.

19EEA04 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

Unit II SOLAR COLLECTORS

9

Angle of sunrays on solar collector - Flat plate and concentrating collectors- Photovoltaic cell-characteristics- Equivalent circuit-Photovoltaic modules and arrays- Applications.

Solar Room Heating – Solar Room cooling – Solar Pond – Solar Desalination

Maximum Power Point Tracking (MPPT) Algorithms – P&O , I&C

Unit III WIND ENERGY

9

Wind resource assessment -site selection - wind energy conversion devices – classification - Types of wind energy systems – Performance of wind turbine generator - applications - 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 HYBRID RENEWABLE ENERGY SYSTEMS & OCEAN ENERGY TECHNOLOGIES

9

Wave Energy - Tidal energy - 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. Twidell, J.W. and Weir, A., "Renewable Energy Sources", EFN Spon Ltd., 2005.
2. B.H.Khan, "Non Conventional energy resources", Tata McGraw-Hill Education, 2nd Edition, 2009.
3. Sukhatme S P, Nayak J K, "Solar Energy: Principles of Solar Thermal Collection and Storage", Tata McGraw Hill, 2008.
4. Chetan Singh Solanki, "Solar Photovoltaics: Fundamentals, Technologies and Applications", PHI Learning Private Limited, 2012
5. Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press , Third edition, 2012

Reference Book:

1. Kothari D. P & Singal K. C & Ranjan, Rakesh, "Renewable Energy Sources and Emerging Technologies", PHI Learning Private Limited, New Delhi, 2013.
2. Tasneem Abbasi & Abbasi Sa, "Renewable Energy Sources", PHI Learning Private Limited, New Delhi, 2013.
3. Gilbert M. Masters, "Renewable and Efficient Electric Power Systems", Second Edition, John Wiley & Sons, 2013.
4. Rashid .M. H "power electronics Hand book", Academic press, 2001.

Extensive Reading:

- Godfrey Boyle, "Renewable Energy, Power for a Sustainable Future", Oxford University Press, U.K, 1996.
- Veziroglu, T.N., "Alternative Energy Sources", Vol 5 and 6, McGraw-Hill, 1990.

19ITA01 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://tutoriahtml.com/en/>
- <http://www.alternetwebdesign.com/htmltutorial/lesson1.htm>
- <http://www.htmlhelp.com/reference/css/>

19ITA02 INTRODUCTION TO JAVA

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, 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 , Polyines, 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>

19ITA03 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 Administrators”, 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

19MEA01 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 Air Pollution due to Automobile Exhaust and its control methods
- Understand about Exhaust Emission Control

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.

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- Smog-Other emissions – Sources and effects of pollution

Unit V EMISSION CONTROL**9**

Basic methods of emission control, catalytic converter-particulate traps-Ammonia injection system- 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.
2. B.P. Pundir, "Engine Emissions: Pollutant Formation and Advances in Control Technology, Narosa publishing
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.

19MEA02 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

- 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

- 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**11**

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**7**

Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications& Case studies in automotive, aerospace and electronics industries

Text Book:

1. Rapid prototyping: Principles and applications, 3rd edition, Chua C.K., Leong K.F., and Lim C.S., World Scientific Publishers, 2008.
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, 2014.
2. LiouW.Liou, Frank W.Liou, Rapid Prototyping and Engineering applications: A tool box for prototype development, CRC Press, 2007.
3. Ali K. Kamrani, EmadAbouel 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.

19MEA03 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 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**10**

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**10**

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**7**

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, 9th Edition, 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, 1st Edition, 2013.
4. Elain Rich, Kevin Knight and Shivashankar B. Nair, "Artificial intelligence", Tata McGraw-Hill Publishing Company Limited, 3rd Edition, 2009.

19MEA04 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. Colin Porteous, "The New Eco-Architecture", Spon Press, 2002.
2. Lever More G J, "Building Energy Management Systems", E and F.N Spon, London, 2000.
3. Means R.S., "Green building: project planning and cost estimating", Kingston, 3rd Edition, 2010.
4. Kibert C.J. "Sustainable Construction: Green Building Design", Wiley, 4th Edition, 2016.
5. Eicker U., "Low Energy Cooling for Sustainable Buildings", Wiley, 2009.
6. Attmann O., "Green Architecture", McGraw-Hill, 2010.

Extensive Reading:

- <http://www.bee-india.nic.in>
- <http://www.iea.org>
- <http://www.unep.org>

19MEA05 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 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.

19MEA06 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

- Understanding the basics of Conventional and non-conventional energy resources.
- Learning the basic principles and methods of utilizing Biomass.
- 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 – Global energy scene – Indian energy scene - 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, hydel and nuclear power plants, 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. Thermochemical conversion – Biological conversion, Chemical conversion – Hydrolysis & hydrogenation, Biodiesel, biodiesel power generation, gasifier, biogas - Classification of biogas plant

Unit V ENERGY CONSERVATION**9**

Energy conservation - Act; Energy management importance, duties and responsibilities; 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, 2006.
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.

19MEA07 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 an 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 building 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 about basic concepts of fire science.
- Understand the operation of various types of firefighting equipment.
- Know the different causes and effects of fire.
- Equip the students to effectively employ fire protection techniques in building.
- Understand the technics of 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. "Fire fighters hazardous materials Reference Book Fire Prevention in Factories", Nostrand Rein Hold, New York, 1991.
5. "Fire Prevention Hand Book", NFPA, 20th edition, 2008.
6. "Fire Prevention and fire fighting", International Maritime Organisation, London, 2000.

19MEA08 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

- The aim of the course is to provide students with knowledge in concepts, methodology, and tools of reliability engineering.
- On completion of the course, the students should be able to construct models for the estimation and improvement 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**8**

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**8**

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**12**

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**8**

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", overseas Press (2011).
2. L.S.Srinath, "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, 1998.
3. Roy Billington and Ronald N. Allan, "Reliability Evaluation of Engineering Systems", Springer, 2013

19MEA09 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

- Grasp the importance of quality and the means to control it using SQC.
- Understand and interpret the mean, variance, and standard deviation of distributions for modelling process quality.
- 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**7**

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).

DMAIC PROCESS - Examples of DMAIC

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**10**

Chance and assignable causes, Statistical Basis of the Control Charts - Control Charts for X-Bar and R- Charts, Control Charts for \bar{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**10**

Lot-By-Lot Acceptance Sampling problem, single sampling plan for attributes, Double, Multiple, and Sequential sampling, OC curves, Military Standard 105E, the Dodge-Romney 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.

19BMA03 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 gain knowledge of fundamentals and significance of biosensors.
- To learn the applications of biosensor technology in medical field.
- To be trained to utilize the principles of nanotechnology in biosensing technology

Course Outcome:

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

- Understand the insights of the basics of bio sensing technology.
- Explain the different surface modification process in the immobilization techniques.
- Classify biosensors based on transducer and design accordingly.
- Explain the various applications of biosensors.
- Explain the uses of different types of nanomaterials used in biosensors.

Unit I INTRODUCTION TO BIOSENSORS**9**

Definitions, biological inspiration, types of sensors, target analytes, various recognition, Recognition event: Catalytic, Single and multiple enzyme, Bio Affinity: Labeled and Label free, whole cell sensing – bacteria, yeast, mammalian cell, Generation of Biosensor; Biomolecule Immobilization Techniques, Enzyme Kinetics.

Unit II MODIFICATION OF SENSOR SURFACES AND IMMOBILIZATION TECHNIQUES**9**

Covalent modification and activation of surfaces using surface chemistry covalent coupling, Covalent attachment of biomolecules on electronic transducer surfaces using homo and hetero bi-functional crosslinkers, carbodiimide mediated chemical coupling, polymerization using soluble (acrylic/glycol) pre-polymers, Self Assembled Monolayers (SAM) and adsorption phenomenon, Other ways to immobilize biological macromolecules includes, entrapment, encapsulation, and cross-linking on various solid surfaces

Unit III BASIC DESIGN AND TRANSDUCER**9**

Various types of transducers; principles and applications - Calorimetric, Optical, Potentiometric / Amperometric, Conductometric / Resistometric, Piezoelectric, Semiconductor, Impedimetric, Chemiluminiscence - based Biosensors.

Unit IV APPLICATION AND USES OF BIOSENSORS**9**

Biosensors in clinical chemistry, medicine and health care, biosensors for veterinary, agriculture and food Low cost - biosensor for industrial processes for online monitoring; biosensors for environmental monitoring. Application of enzymes in analysis; design of enzyme electrodes and their application as biosensors in industry, healthcare, food and environment.

Unit V APPLICATIONS OF NANOMATERIALS IN BIOSENSORS**9**

Nano Materials in biosensors; Carbon based Nano Material, Metal oxide and nano particle, Quantum dots, 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. Mohammed Zourob, "Recognition Receptors in Biosensors", Springer, 1st Edition, 2010.

Reference Book:

1. Graham Ramsay, "Commercial Biosensors", John Wiley, 1st edition 1998.
2. Tran Minh Canh, "Sensor Physics & Technology – Biosensors", Champan & Hall, 1st Edition, 1993.

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/>

19BMA04 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 understand the function of different sensors and bio-potential electrodes.
- To describe the different Cardiac function measuring devices.
- To describe the respiratory, electrosurgical and clinical lab devices

Course Outcome:

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

- Understand the functions of different biomedical sensors
- Explain the functions of different bio-potential electrodes.
- Explain the cardiac function measurement devices and its functions
- Describe the frequency domain specifications of the different systems.
- Explain the concept and model of physiological control systems.

Unit I INTRODUCTION

9

Introduction to biomedical sensors, physical sensors- linear and Angular displacement sensors, Measurement of Fluid Dynamic Variables, Force Measurement, Velocity Measurement, Accelerometers, temperature measurement, 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 FUNCTIONS 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.
2. R S Khandpur, "Handbook of Biomedical Instrumentation", Tata McGraw Hill, 1994.

Reference Book:

1. L A Geddes, L A Baker, "Principles of Applied Biomedical Instrumentation", Wiley India edition, 3rd edition.
2. Joseph J. Carr and John M Brown, "Introduction to Biomedical Equipment Technology", Pearson; 4th edition, 2000.

Extensive Reading:

- <https://www.coursera.org/learn/bioengineering>

19BTA05 CHEMICALS IN ENVIRONMENT AND PUBLIC HEALTH

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

- Define the major sources and types of environmental agents and discuss the transport and fate of these agents in the environment.
- Identify the carriers or vectors that promote the transfer of these agents from the environment to the human.
- To understand the procedures and requirement for hazardous waste management and gain the knowledge on the policies, legislations.

Course Outcome:

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

- Learn the relationship between environment and human health
- Discuss the impact of hazardous waste on environment and human health
- Explain the impact of biomedical waste, radioactive waste and nuclear waste
- Learn about different risk assessment methods and their use in environmental health studies
- Acquire the knowledge about the Environmental Management Policies and Practices

Unit I ENVIRONMENT AND HEALTH**9**

Human impact on the environment, Environment-human interaction, Environmental impact on humans, Indoor and outdoor air, water & soil pollution, Exposure, dose, response, Food- and water-borne disease.

Unit II IMPACT OF INDUSTRIAL PRODUCTS AND HAZARDOUS WASTE**9**

Non Hazardous wastes, Hazardous wastes: Metals, chemical, drugs, lather, pulp, electroplating, dye, rubber; Hazardous wastes on environment and human health: case studies (chemical accumulation in plants: Cadmium in rice, Hexachlorobenzene in seed grains; Carbamate pesticide in watermelons, Lead in paint), food adulterants and their impact on human health.

Unit III IMPACT OF BIOMEDICAL WASTES**9**

Characteristics & sources, BMW – Segregation, collection, transportation, disposal, Liquid BMW, Radioactive waste, Metals / Chemicals / Drug waste, Modern technology for handling BMW Monitoring & controlling of cross infection, Health and Environmental effect: case studies.

Unit IV IMPACT OF NUCLEAR WASTES**9**

Sources, Types of Nuclear waste, nuclear power plants and fuel production; waste generation from nuclear power plants; disposal options, Defining risk and environmental risk; methods of risk assessment; measures and health effects: case studies.

Unit V ENVIRONMENTAL MANAGEMENT POLICIES AND PRACTICES**9**

Environment and pollution - definition as per Environmental law, General powers of Central and state Government under EPA, Important Notification in EPA 1986, Constitution of Pollution Control Boards - Powers, functions, Accounts, Audit etc. Equitable remedies for pollution control. Solid waste management–Hazardous Wastes (Handling and Management) Rules 1998, Biomedical Wastes (Handling and Management) Rules 1998.

Text Book:

1. Joseph V. Rodricks, "Calculated Risks- The Toxicity and Human Health Risks of Chemicals in Our Environment", Cambridge University press, 2nd Edition, 2007.
2. Lippmann, M. (Ed.), "Environmental toxicants: Human exposures and their health effects", John Wiley & Sons, 2008.

Reference Book:

1. Philp, R. B. (1995). "Environmental hazards and human health", Boca Raton: Lewis Publishers, 1995.
2. Eckenfelder, W.W. Jr., "Industrial Water Pollution Control", McGraw-Hill Book Company, New Delhi, 3rd edition, 2000.
3. Michel, McKinney, Robert and Logan, "Environmental Science – Systems & Solutions", Jones & Barlett Publishers, Canada, 4th revised edition, 2007.

19BTA06 BIOLOGICAL WASTE MANAGEMENT

Offered by BT (Allied Elective offered to BAD, BBE, BCS, BEC, BEE, BIT, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To impart knowledge on
- Hazardous wastes and its effects.
- Classification and Risks associated with bio hazardous 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

- Upon completion of the course students will be able
- To explain about hazardous wastes, its origin and effects on public health.
- To impart knowledge about sources of biohazardous wastes and risks associated with it.
- To know the Legislative, Regulatory and Policy Aspects Of Health-Care Waste
- To apply the methods for treatment and safe disposal of wastes.
- To study the concepts of waste minimization, reducing and recycling.

Unit I INTRODUCTION TO HAZARDOUS WASTE**9**

Hazardous waste - Classifications of hazardous waste and its sources - Effects on public health and environment.

Unit II BIO HAZARDOUS WASTE**9**

Biological, biomedical and healthcare wastes – Sources - Bio hazardous wastes classification - Risks associated with bio hazardous waste - Need for control.

Unit III LEGISLATIVE, REGULATORY AND POLICY ASPECTS OF HEALTH-CARE WASTE**9**

National policies and its five guiding principles - Available guidance – World health organization (WHO), The International Solid Waste Association (ISWA) and its policy document.

Unit IV BIOLOGICAL WASTE TREATMENT AND DISPOSAL**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.

Unit V MANAGEMENT OF BIO HAZARDOUS WASTES**9**

Healthcare waste-management planning - Infectious waste management plans - Healthcare waste minimization, reuse and recycling.

Text Book:

1. Blackman W. C., "Basic Hazardous Waste Management", CRC Press, 3rd Edition, 2001.
2. Henry J. G., Heinke G. W., "Environmental Science and Engineering", Prentice Hall India Learning Private Limited, 2nd Edition, 2004.
3. Cheremisinoff, N. P., Cheremisinoff P. N., "Hazardous Materials and Waste Management: A Guide for the Professional Hazards Manager", Noyes Publications, 1995.

Reference Book:

1. Panda H., "The Complete Book on Biological Waste Treatment and their Utilization", NIIR Project Consultancy Services, 2013.

Extensive Reading:

- Safe Management of Wastes from Health-Care Activities, 2nd Ed., WHO, 2014.
- Biomedical waste (Management and Handling) Rules, Ministry of Environment & Forests, 1998.

19BTA07 NANOBIO TECHNOLOGY

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

- To provide the knowledge in basics of nanobiotechnology.
- To learn the application of nanomaterials in biotechnology and acquire the knowledge about the DNA, proteins, amino acids, drug delivery, biomedicine etc.,
- To make the students understand about the functional principles of bionanotechnology

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.
- Learn the DNA based nanostructures.
- Learn the protein based nanostructures.
- Know the application of nanomaterials to biological problems including nanomedicine.

Unit I NANOSCALE AND NANOBIO TECHNOLOGY**9**

Introduction to Nanoscience and Nanotechnology; Milestones in Nanotechnology; Overview of Nanobiotechnology and Nanoscale processes; Lessons from Nature on making nanodevices.

Unit II PROPERTIES AND MEASUREMENT OF NANOMATERIALS**9**

Optical Properties: Absorption, Fluorescence, and Resonance; 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 PROTEIN BASED NANOSTRUCTURES**9**

Protein based nanostructures building blocks and templates – Proteins as transducers and amplifiers of biomolecular recognition events –Nanobioelectronic devices and polymer nanocontainers –Microbial production of inorganic nanoparticles –Magnetosomes.

Unit V APPLICATIONS**9**

Nanoparticles as carrier for genetic material – Nanomedicine, Drug delivery, DNA computing, Molecular design using biological selection, Harnessing molecular motors, Artificial life, Hybrid materials, Biosensors, Future of Bionanotechnology.

Reference Book:

1. Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor) "Nanobiotechnology: Concepts, Applications and Perspectives", Wiley VCH; 1 Edition, 2004.
2. Oded Shoseyov and Ilan Levy "NanoBioTechnology: BioInspired Devices and Materials of the Future", Humana Press; 1 Edition 2007.
3. Sandra J Rosenthal and David W. Wright, "NanoBiotechnology Protocols (Methods in Molecular Biology)", Humana Press; 1 Edition, 2005.
4. Clarke. A.R. and Eberhardt C. N. (Editors), "Microscopy Techniques for Material Science", CRC Press. 1st Edition, 2002.
5. David S.G., "Bionanotechnology: lessons from nature", John Wiley & Sons, 1st edition, 2004

19BTA08 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, Linux commands, File transfer protocols ftp and telnet, 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 PHYLOGENETIC ANALYSIS ALGORITHMS

Introduction to phylogenetics, Distance based trees UPGMA trees, Molecular clock theory, Ultrametric trees, Parsimonious trees, Neighbour joining trees, trees based on morphological traits, Bootstrapping.

Text Book:

1. Neil J. Jones (Author), Pavel A. Pevzner Introduction to Bioinformatics Algorithms, ANE Books; 1st Edition, 2009
2. David W. M., "Bioinformatics Sequence and Genome Analysis", Cold Spring Harbor Laboratory Press, 2nd Edition, 2008.
3. 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>

19CEA06 ENVIRONMENTAL GEOTECHNOLOGY

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

- Physics and chemistry of soil.
- Inorganic and organic geochemistry.
- Contaminant fate and transport in soil.
- Soil remediation technologies.
- Principles behind site selection and methods of disposal.

Course Outcome:

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

- Classify the soil based on Index properties and exchange capacity.
- Analyse the inorganic and organic geochemistry and Distribution of metals in soils.
- Identify the contaminant fate and transport in soil.
- Apply the soil remediation technologies available in the affected soil.
- Procure idea in site selection and disposal methods.

Unit I PHYSICS AND CHEMISTRY OF SOIL**9**

Soil formation - Composition - Mass volume relationship - Index properties and soil classification - Hydraulic and consolidation characteristics - Chemical properties - Soil pH - Surface charge and point of zero charge - Anion and Cation exchange capacity of clays - Specific surface area - Bonding in clays - Soil pollution - Factors governing soil - Pollutant interaction.

Unit II INORGANIC AND ORGANIC GEOCHEMISTRY**9**

Inorganic Chemistry - Metal contamination - Distribution of metals in soils - Geochemical processes controlling the distribution of the metals in soils - Chemical analysis of metal in soil - Organic geochemistry - Organic contamination - Distribution of NAPLs in soils - Process controlling the distribution of NAPLs in soil - Chemical analysis of NAPLs in soils.

Unit III CONTAMINANT FATE AND TRANSPORT IN SOIL**9**

Transport processes - Advection - Diffusion - Dispersion - Chemical mass transfer processes - Sorption and desorption - Precipitation and dissolution - Oxidation and reduction - Acid base reaction - Complexation - Ion exchange - Volatilization - Hydrolysis - Biological process - Microbial transformation of heavy metals.

Unit IV SOIL REMEDIATION TECHNOLOGIES**9**

Contaminated site characterization - Containment - Soil vapour extraction - Soil washing - Solidification and stabilization - Electro-kinetic remediation - Thermal desorption - Vittrification - In-situ and Ex-situ Bioremediation - Phytoremediation - Soil fracturing - Bio stimulation - Bio augmentation - Chemical oxidation and reduction.

Unit V SITE SELECTION AND METHODS OF DISPOSAL**9**

Criteria for sites for waste disposal facilities - Current practices for waste disposal - Sub surface techniques - Passive contaminant system - Leachate contamination - Application of geo-membranes - Rigid and flexible membrane liners.

Text Book:

1. Hilary I. Inyang Lakshmi Reddi, "Geoenvironmental Engineering: Principles and Applications", CRC Press 2018.
2. Hari D. Sharama and Krishna R.Reddy, "Geo-Environmental Engineering: Site Remediation, Water Contamination and Emerging Water Management Technologies", John Wiley & Sons Limited, 2004.

Reference Book:

1. Paul Nathanail C. and Paul Bardos R., "Reclamation of contaminated Land", John Wiley & Sons Limited, 2004.
2. Marcel Vander Perk, "Soil and Water contamination from Molecular to catchment Scale", Taylor & Franncis, 2006.

Extensive Reading:

- William J. Deutsch, "Groundwater Geochemistry: Fundamentals and Applications to Contamination", Lewis Publishers, 1997.

19CEA07 FUNDAMENTALS OF SMART CITY PLANNING

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 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.
- Design the 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>.

19CEA08 HYDROPOWER ENGINEERING

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

- 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 of hydropower plants.

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 hydro power plants - Run-of-river plants - General lay out 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**

Fore bay - 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. Madanmohan das, Mimi Das sakia, "Irrigation And Water Power Engineering", PHI Learning Pvt. Ltd., 2009.

Reference Book:

1. R S Varshney, "Hydropower structures ", Volume III, Jain book depot, New Delhi, 2014.
2. Dr. Darde P N, "Treatise on Hydropower Engineering edition" JBC Press 2012.

Extensive Reading:

- <http://www.gomezandsullivan.com/service/engineering>
- <https://www.pietrangeli.com/hydropower/engineering>
- <https://www.stantec.com/uk/services/dams-hydropower-engineering-services>

19CEA09 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

- The toxic materials which pollute the environment and underground water.
- The different biological conventional methods to process the waste.
- Different treatments for converting waste to energy.
- Recycling of the usable materials recovered from solid waste with its socio-economic and legal considerations.
- Application of recovery process of the recyclable materials and energy recovery by various transformation processes from the solid waste.

Course Outcome:

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

- Deal with recovery of resources and energy from the waste for sustainable development.
- Develop biological process for transformation of solid waste to useful by-products.
- Develop Bio-chemical process for transformation of solid waste to useful by-products.
- Develop Thermo-chemical process for transformation of solid waste to useful by-products.
- Analyze 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 - Material and energy flow management and analysis - 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 and processes - factors affecting - Design of Windrow Composting Systems - In Vessel Composting - Compost Quality Control - Vermiculture: definition, scope and importance - Common species for culture - Culture methods - Applications of vermiculture.

Unit III BIO-CHEMICAL CONVERSION OF WASTE TO ENERGY**9**

Principles and Design of Anaerobic Digesters - Process characterization and control - The biochemistry and microbiology of anaerobic treatment - 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, heat recovery - Emission Controls - Flue gas cleaning, dedusting, flue gas scrubbers, DeNOx processes, dioxins and furans - Alternative thermal processes: co-incineration, pyrolysis and gasification - Process characterization and control - Waste heat recovery- Planning and construction of incineration plants.

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. Saeid Mokhatab "Handbook of Liquefied Natural Gas", Gulf Professional Publishing 2016.
2. Chiumenti, Chiumenti, Diaz, Savage, Eggerth, and Goldstein , Modern Composting Technologies , JG Press October 2005.
3. Gary C. Young, "Municipal Solid Waste to Energy Conversion Processes: Economic, Technical, and Renewable Comparisons", John Wiley & Sons, 2010.
4. Manser A G R, Keeling A A, "Practical handbook of processing and recycling on municipal waste", Pub CRC Lewis London, 1996.

19CEA10 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/>

19CSA05 FUNDAMENTALS OF CLOUD COMPUTING

Offered by CSE (Allied Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the basics and challenges of Cloud Computing
- To introduce the virtualization concepts and cloud file system
- To get an exposure on third-party cloud solutions
- To understand the cloud security and efficiency issues
- To explore the possibilities of applying cloud solutions in various applications

Course Outcome:

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

- Identify the challenges in Cloud Computing adoption
- Implement virtualization and work with cloud file system
- Identify the various cloud-based solutions available with different providers
- Secure and optimize the cloud for delivering better performance
- Identify and provide cloud-based solution for the problem under consideration

Unit I INTRODUCTION TO CLOUD COMPUTING**9**

Overview of Distributed computing - Introduction to Cloud Computing: Definitions - Central idea - Properties and Characteristics - Benefits - Cloud service and deployment model - Organizational scenario - Architecture - Vocabulary - Challenges

Unit II VIRTUALIZATION AND FILE SYSTEM**9**

Virtualization Techniques: Virtualization Technology - Overview of x86 virtualization - Types of virtualization - Virtualization products - VLAN - SAN - VM Migration - VM Consolidation and Management - Cloud interoperability standards

Cloud File System: Distributed file system - GFS - HDFS

Unit III CLOUD SOLUTIONS**9**

Different Cloud Providers and service comparison: Infrastructure service providers - Identification of business requirement - Cloud infrastructure setup procedure - Platform service provide - Identification of business requirement - Cloud platform setup procedure - Cloud application development - Software service providers - Cloud Database - Cloud programming model - Private cloud computing platforms-Eucalyptus-Open Nebula

Unit IV CLOUD SECURITY - MIDDLEWARE AND TESTING**9**

Cloud Security: Fundamentals - Cloud Risk - Division - Security Architecture - VM Security Challenges - Vulnerability assessment tool for cloud - Open source security solution products

Cloud Middleware: Need for Cloud Middleware - QoS issues in cloud - Data migration and Streaming - Performance monitoring tools in cloud - Cloud Testing: Types - Testing strategy

Unit V CLOUD APPLICATIONS AND CASE STUDIES**9**

Advanced Cloud Applications - Sharing and Collaborative services in cloud - Outside the cloud services - Cloud Analytics - Software plus services - Cloud Content Delivery Network services (CDN) - Mobile cloud computing - Sky computing - Cloud governance

Case Study: Cloud infrastructure adoption case study - Cloud platform adoption case study - Future of cloud computing

Advanced Cloud Applications - Sharing and Collaborative services in cloud - Outside the cloud services - Cloud Analytics - Software plus services - Cloud Content Delivery Network services (CDN) - Mobile cloud computing - Sky computing - Cloud governance

Case Study: Cloud infrastructure adoption case study - Cloud platform adoption case study - Future of cloud computing

Text Book:

1. Rishabh Sharma, "Cloud Computing Fundamentals, Industry Approach and Trends", Wiley India, 2015.
2. Kai Hwang, Geoffrey C Fox, Jack G Dongarra, "Distributed and Cloud Computing From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012

Reference Book:

1. Ronald L. Krutz, Russell Dean Vineqs, "Cloud Security – A comprehensive Guide to Secure Cloud Computing", Wiley – India, 2010.
2. John W.Rittinghouse and James F.Ransome, "Cloud Computing: Implementation, Management, and Security", CRC Press, 2010.
3. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud" O'Reilly

Extensive Reading:

- http://whatiscloud.com/basic_concepts_and_terminology/cloud
- <http://www.vmware.com/in/virtualization/overview>
- <http://www.csoonline.com/article/2125258/cloud-security/cloud-security--the-basics.html>
- <http://thecloudtutorial.com/cloudvendors.html>
- <http://thecloudtutorial.com/freecloudcomputingapplications.html>

19CSA06 INTRODUCTION TO IOT

Offered by CSE (Allied Elective offered to BAD, BBE, BBT, BCI, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the physical, logical design and components of IoT
- To outline the global context of M2M and IoT
- To provide an overview of IoT architecture
- To learn to program Arduino microcontroller for IoT
- To cover real-world implementation examples of IoT.

Course Outcome:

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

- Identify the components of IoT devices and communication technologies
- Discriminate between M2M and IoT technologies
- Realize the significance of various IoT architectures
- Develop portable IoT applications using appropriate microcontroller
- Develop IoT applications for real-world situations

Unit I INTRODUCTION TO IOT**9**

Definition and characteristics of IoT - Physical and logical design of IoT - IoT enabling technologies - IoT levels & deployment templates - IoT design methodology - Components of Internet of Thing devices: Control units – Sensors – Communication modules – Power sources. Communication technologies: RFID – Bluetooth – ZigBee – Wi-Fi – RFlinks – Mobile Internet – Wired Communication. Safety – privacy – trust - security model.

Unit II M2M AND IOT**9**

Machine-to-Machine (M2M) communication – IoT – M2M towards IoT – Main characteristics of M2M and IoT – Global value chains – Ecosystem – M2M and IoT value chains – Main design principles and needed capabilities - An IoT architecture outline - Standardizations around M2M and IoT.

Unit III IOT ARCHITECTURE**9**

European Telecommunications Standards Institute (ETSI) model – International Telecommunication Union-Telecommunication (ITU-T) IoT model – Internet Engineering Task Force (IETF) IoT model – Open Geospatial Consortium (OGC) architecture – IoT domain model – IoT information model – IoT functional model – IoT communication model.

Unit IV IOT PROGRAMMING**9**

Basics of sensors and actuators – Examples and working principles of sensors and actuators – Arduino/Equivalent Microcontroller platform – Programming for IoT – Reading from sensors. Communication: Connecting microcontroller with Bluetooth and USB – Connection with the Internet using Ethernet.

Unit V IOT APPLICATIONS**9**

Asset Management: Introduction - Expected benefits - e-Maintenance in the M2M era - Hazardous goods management in the M2M era. Industrial automation: Service-oriented architecture-based device integration - SOCRADES: realizing the enterprise integrated Web of Things - IMC-AESOP: from the Web of Things to the Cloud of Things. Smart Grid: Smart metering - Smart house - Smart energy city. Smart cities: Need – definition – examples - Roles, actors, engagement - Transport and logistics-an IoT perspective.

Text Book:

1. Arshdeep Bahga and Vijay Madiseti, "Internet of Things: A Hands-On Approach", VPT Publisher, 2014. (for Unit I)
2. Charalampos Doukas, "Building Internet of Things with the Arduino", Create space, April 2002. (for Unit I and IV)
3. 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. (for Unit I, II, III and V)

Reference Book:

1. Jean-Philippe Vasseur and Adam Dunkels "Interconnecting Smart Objects with IP: The Next Internet", Morgan Kaufmann Publishers, 2010.

Extensive Reading:

- <http://www.internet-of-things-book.com/>
- <http://www.theinternetofthings.eu/what-is-the-internet-of-things>
- <http://postscapes.com/internet-of-things-examples/>
- <https://pdfs.semanticscholar.org/92ea/dd2ccea08b62ce4bccbd87ba46899accda2d.pdf>

19CSA07 XML PROGRAMMING

Offered by CSE (Allied Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To structure the XML document using DTD
- To understand XML schema creation
- To work with DOM-based and SAX-based parsers
- To work with different technologies related to XML
- To extract data using XQuery and define vector-based graphics using SVG

Course Outcome:

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

- Design XML document based on DTD
- Design and Validate XML document using XML Schema
- Process XML document using DOM and SAX parsers
- Locate the XML content and perform translation using XPath and XSLT
- Process data from XML document using XQuery and define graphics in XML format using SVG

Unit I XML MARKUP CREATION AND DTD**9**

XML Markup introduction – characters – markup – XML namespaces – Parsers, Well-formed and valid XML documents - Parsing XML document with MSXML –Document Type Declaration - Element type declarations - Attribute declarations – Attribute types - Simple DTD creation.

Unit II XML SCHEMA**9**

Schema versus DTDs – XML Schema basics – Defining simple types: date and time – number – defining element's content – Deriving custom simple types – Deriving named custom types – Specifying range and set of acceptable values – Limiting length and Specifying pattern for an element – limiting number of digits. Defining Complex types: deriving anonymous, named complex types – Deriving from existing complex types – Defining elements with child elements - Defining elements in sequence, any order - Creating a set of choices - Defining elements with only text, empty elements, mixed content – Defining attributes – Defining named model groups, attribute groups.

Unit III DOM AND SAX PARSERS**9**

DOM with JavaScript – DOM components – Traversing the DOM – DOM versus SAX - SAX-based parsers – Events – Simple SAX program

Unit IV XPATH AND XSLT**9**

XPath: Nodes – Location paths – Node-set operators and Functions – XSLT: Templates – Creating elements and attributes – Iteration and sorting – Conditional processing – Copying nodes - Combining stylesheets – Variables

Unit V XQUERY AND SCALABLE VECTOR GRAPHICS (SVG)**9**

XQuery: Building blocks of XQuery: FLWOR expression – examples. SVG and bitmaps - SVG graphics model - SVG and CSS - SVG tools - SVG basic built-in shapes – SVG transforms and groups.

Text Book:

1. H.M. Deitel, P.J. Deitel, T.R. Nieto, T.M. Lin, and P. Sadhu, "XML How to program", Pearson Education India, 2009 (Reprint).
2. Joe Fawcett, Danny Ayers, Liam R. E. Quin, "Beginning XML", Fifth Edition, John Wiley & Sons Publisher, 2012.
3. Kevin Howard Goldberg, "XML", Second Edition, Peachpit Press, 2010

Reference Book:

1. Heather Williamson, "XML: The Complete Reference", First Edition, Tata McGraw-Hill Education, 2001.
2. Erik T. Ray, "Learning XML", Second Edition, O'Reilly Media, Inc., 2003.
3. Elliotte Rusty Harold, W. Scott Means, "XML in a Nutshell", Third Edition, O'Reilly Media Inc., 2009.

Extensive Reading:

- <http://www.xmlmaster.org/en/article/d01/>
- <http://www.javatpoint.com/xml-tutorial>
- https://www.w3schools.com/xml/schema_intro.asp
- https://www.w3schools.com/graphics/svg_intro.asp

19CSA08 INTRODUCTION TO UML

Offered by CSE (Allied Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To gain basic knowledge in object oriented system.
- To study the use case and domain model.
- To assess the requirement using interaction and activity diagrams.
- To gain knowledge on class and package diagrams to solve real world problems.
- To learn the appropriate usage of state, component and deployment diagrams.

Course Outcome:

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

- Create use case documents that capture requirements for a software system.
- Create use case and domain model and design model for a software system.
- Create interaction and activity diagram for a software system.
- Apply UML tools to address the real world problems through sequence and package diagrams.
- Create state, component and deployment diagrams to address the real world problems with software solutions.

Unit I INTRODUCTION**9**

Introduction to Object Oriented Analysis and Design – Iterative, Evolutionary and Agile – Unified Process Phases – UP Disciplines – Inception and Use Cases – Artifacts of Inception – Evolutionary Vs. Waterfall Requirements – Types and Categories of Requirements – UP Artifacts - Case Study: NextGenPOS System and Monopoly Game.

Unit II USE CASES AND DOMAIN MODEL**9**

Introduction to UML Diagrams: Use Case Diagrams – Guidelines – Requirements – Actors - Notational Components – Different Formats - Relating Use Cases: Includes, Extends, Generalize - Domain Model – Conceptual Classes – Domain Class Diagram – Associations – Attributes – Generalization - Case Study: NextGenPOS System and Monopoly Game.

Unit III INTERACTION AND ACTIVITY DIAGRAMS**9**

System Sequence Diagrams – Notational Components of Sequence Diagrams – Iterative and Evolutionary System Sequence Diagrams - Relationship between System Sequence Diagrams and Use Cases – Communication diagrams - Activity Diagrams – Notations - States – Transitions – Case Study: NextGenPOS System and Monopoly Game.

Unit IV CLASS AND PACKAGE DIAGRAMS**9**

UML class diagrams – Attributes – Associations - Relationship – Operations – Methods - Aggregation – Composition – Constraints – Discriminators – Singleton Classes - Inheritance – Abstract classes – Polymorphism - Operation contracts – UML Package Diagram – Logical Architecture – Design with Layers – Model View Separation Principle - Case Study: NextGenPOS System and Monopoly Game.

Unit V STATE, COMPONENT AND DEPLOYMENT DIAGRAMS**9**

State Machine Diagrams – Notational Components – Composite States – UI Navigation Modeling - Component Diagrams – Components – Dependencies – Deployment Diagrams – Nodes - Communication Associations - Case Study: NextGenPOS System and Monopoly Game.

Text Book:

1. 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. Jason T. Roff, "UML A Beginner's Guide", Twelfth Reprint, Tata McGraw-Hill, 2012.
2. Mike O'Docherty, "Object-Oriented Analysis & Design: Understanding System Development with UML2.0", John Wiley & Sons, 2005.
3. Martin Fowler, "UML Distilled – A Brief Guide to the Standard Object Modeling Language", Third Edition, 2011.
4. Micheal Blaha, James Rumbaugh, "Object-Oriented Modeling and Design with UML", Second Edition, Prentice Hall of India Private Limited, 2007.

Extensive Reading:

- <http://www.uml.org/>
- <http://www.agilemodeling.com/>
- <http://www.uml.org/>
- <http://www.uml-diagrams.org/package-diagrams-examples.html>
- http://www.tutorialspoint.com/uml/uml_interaction_diagram.htm

19CSA09 INTRODUCTION TO ARTIFICIAL INTELLIGENCE

Offered by CSE (Allied Elective offered to BAD, BBE, BBT, BCI, BEC, BEE, BME)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the principles and approaches of artificial intelligence (AI)
- To explore the processes, systems and principles that make intelligent behavior possible
- To expose the real world applications of AI

Course Outcome:

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

- Explore the fundamental concepts in Artificial Intelligence
- Work with reasoning and uncertainty
- Apply Searching Techniques for the real world applications
- Design a knowledge based system
- Apply Artificial Intelligence to the current trends

Unit I KNOWLEDGE ACQUISITION AND REPRESENTATION**9**

Overview of Artificial Intelligence- Turing's Test- Chinese Room- Objectives of AI- Applications of AI- Symbolic Logic- Machine Intelligence- Procedures for Knowledge Acquisition- Knowledge Representation- Representation Schemes

Unit II REASONING AND UNCERTAINTY**9**

Reasoning- Knowledge Representation and Reasoning System- Domain Modeling- Semantic Nets- Frames Based System- Bayes Theorem- Bayesian Networks- Fuzzy Logic

Unit III SEARCH TECHNIQUES AND AI TECHNOLOGIES**9**

Problem Representation and Schemes- Problem Solving in AI- Blind Search Techniques- Heuristic Search Techniques- Game Searches- Computer Vision- Natural Language Processing- Speech Recognition

Unit IV EXPERT SYSTEMS AND NEURAL NETWORKS**9**

Characteristics of an Expert System- Knowledge Engineering- Inferencing- Tools for Expert Systems- Neural Networks- Learning Algorithms- Network Architectures

Unit V APPLICATIONS OF ARTIFICIAL INTELLIGENCE**9**

Case-Based Reasoning- Applications of CBR Systems- Constraint Programming- AI Applications: E-Commerce, E-Tourism, Industry, Medicine

Text Book:

1. Rajendra Akerkar, "Introduction to Artificial Intelligence" 2nd Edition, Prentice-Hall India Pvt. Ltd., 2014

Reference Book:

1. Mariusz Flasiński, "Introduction to Artificial Intelligence", Springer, 2016
2. Wolfgang Ertel, "Introduction to Artificial Intelligence", Springer, 2017.
3. Eugene Charniak, "Introduction to Artificial Intelligence", Pearson Education, 2016

Extensive Reading:

- <https://nptel.ac.in/courses/106105077/>
- <https://in.udacity.com/course/intro-to-artificial-intelligence--cs271>
- <https://hackernoon.com/understanding-understanding-an-intro-to-artificial-intelligence-be76c5ec4d2e>

19ECA05 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 impart the fundamental concepts of mobile communication systems.
- To understand advanced multiple access techniques.
- To give the student an understanding of digital cellular systems.

Course Outcome:

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

- Analyze the cellular radio concepts such as frequency reuse, handoff and how interference between mobiles and base stations affects the capacity of cellular systems.
- Explain the frequency management and handoff process in cellular mobile systems.
- Analyze the performance of various digital modulation and error coding techniques
- Apply the concepts on basic diversity, equalization and spread spectrum techniques in mobile communication.
- Analyze the current and future cellular mobile communication systems (GSM, IS95, WCDMA, etc.).

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 reduction factor – desired C/I from a normal case in an omni directional antenna system – co-channel interference and Non-co-channel interference – design of antenna system – antenna parameter and their effects – diversity receiver – Traffic theory – Erlang B 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 in cellular wireless systems – OFDM – Block Coding – convolution coding and Turbo coding.

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) – CDMA capacity – probability of bit error considerations – CDMA vs TDMA.

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. KavehPahlavan 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.
- http://staff.neu.edu.tr/~fahri/wireless_chp6.pdf.

19ECA06 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 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 RTOS based embedded system
- Realize the importance of distributed embedded system
- 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 – Embedded System Design Process.

Unit II EMBEDDED SYSTEM DESIGN**9**

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 OPERATING SYSTEMS**9**

Operating system basics – Real Time Operating systems – Tasks, Processes and Threads – Multiprocessing and Multitasking – Task scheduling – Task communication and synchronization.

Unit IV DISTRIBUTED EMBEDDED SYSTEMS IN AUTOMOBILES**9**

Network abstractions, CAN bus, I2C bus – Distributed computing in cars and airplanes – Design Example: Engine control unit, Embedded Airbag System & Navigation System, Automated Parking System.

Unit V EMBEDDED CONTROL APPLICATIONS**9**

Reconfigurable Embedded Control Systems, Design Example: Optical Tachometer, Electronic sliding puzzle game, Laser Light Show and Fuzzy logic based security system.

Text Book:

1. Shibu K.V, "Introduction to Embedded Systems ", Tata McGraw Hill, 2009.
2. Marylin wolf, "Computer as Components" Elsevier, 2013,
3. Raj Kamal, "Embedded Systems", 2 nd Edition, TMH, 2008

Reference Book:

1. Frank Vahid, Tony Givargis, "Embedded System Design", John Wiley, 2001
2. Lyla B. Das, "Embedded System", Pearson, 2013.
3. C.M. Krishna, Kang G. Shin, "Real Time Systems", McGraw Hill International Editions, 1997
4. David E. Simon, "An Embedded Software Primer", Pearson Education, 2007.
5. Rajib Mall, "Real-time systems: theory and practice", Pearson Education, 2007
6. Philip.A.Laplante, "Real Time System Design and Analysis", 3rd Edition, Prentice Hall of India, 2004.
7. Jean J Labrosse, "Embedded Systems Building Blocks", CMP Books, 2005.
8. Barrett, Embedded Systems: Design and Applications, 2008.

Extensive Reading:

- <http://nptel.ac.in/courses/108102045/>
- <https://users.ece.cmu.edu/~koopman/lectures/index.html>

19ECA07 VERY LARGE SCALE INTEGRATED 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 FET
- Understand the Fabrication process of IC
- Analyse the characteristics of MOS device Characteristics
- Design combinational and sequential circuits.
- Synthesize the combinational and sequential circuits using Verilog HDL.

Unit I FIELD EFFECT TRANSISTOR**9**

JFETs –Drain and Transfer characteristics–Pinch off voltage and its significance –MOSFET Characteristics –DMOSFET –E MOSFET.s

Unit II 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 III MOS DEVICE CHARACTERISTICS**9**

Ideal I–V and C–V characteristics –non ideal I–V effects –DC transfer characteristics –Scaling of Devices

Unit IV DIGITAL LOGIC DESIGN**9**

Programmable Logic Devices, Design of Combinational and sequential circuits.

Unit V HARDWARE DESCRIPTION LANGUAGE**9**

Verilog HDL fundamentals –Types of Modelling –HDL for Logic Gates –Half Adder –Full Adder –Half / Full Subtractor –Comparators. - Programming with FPGA boards.

Text Book:

1. Donald A Neaman, “Semiconductor Physics and Devices”, 4th Edition, Tata McGrawHill Inc. 2017
2. D.Roy Choudhary, Sheil B.Jani, “Linear Integrated Circuits”, 4th Edition, New Age international, 2015.
3. N.H.E.Weste et al, “CMOS VLSI Design”, 4th Edition, Pearson, 2015
4. Samir Palnitkar, “Verilog HDL - A Guide to Digital Design and Synthesis”, Pearson, 2003.

Reference Book:

1. Wayne Wolf, “FPGA – based System Design”, Pearson, 2004
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.

Extensive Reading:

- [http://www.eolss.net/sample chapters/c05/e6195-04.pdf](http://www.eolss.net/sample%20chapters/c05/e6195-04.pdf)
- <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

19ECA08 ROBOTICS AND ITS 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 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 application in Artificial Intelligence and programming of Robots

Course Outcome:

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

- Integrate sensors and Robotic vision in Robot system
- Control Robot Actuators and motors
- Analyze using Translational Transformation
- Realize the importance of Artificial Intelligence algorithms
- Implement robotics application using Robot Programming Languages

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**10**

Introduction to Artificial Intelligence - 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**8**

AI and Robotics – Robot Programming – Robot Languages – Programming solution for Pick and Place Robot using VAL – Design example: Egg Packing System, Mars Rover and Farm Drone.

Text Book:

1. R.D.Klafter, Chemieleskio, T.A.and Negin .M, "Robotics Engineering an Integrated approach", Prentice Hall, 1989.
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.
4. K.S.FU, R.C. Gonzalez, and C.S.G.Lee., "Robotics control, Sensing, Vision, and Intelligence", McGraw-Hill, 1987.
5. G.Bekey, "Autonomous Robots", MIT Press, 2005.
6. J.J.Craig, "Introduction to Robotics Mechanics and Control", 4th Edition, Pearson, 2018.

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>

19EEA05 SWITCHED MODE POWER CONVERTERS

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 cycloconverter

Text Book:

1. Muhammad H.Rashid, "Power Electronics Circuits, Devices and Applications", Pearson Publication, 4th Edition, 2004.

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.

19EEA06 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.
- Explicate benchmark process and calculate the various benchmarking indices
- Explain about Power quality monitoring techniques

Unit I INTRODUCTION TO POWER QUALITY**9**

Terms and definitions: Transient, voltage unbalance, over voltage, under voltage, sustained interruption; sags and swells; waveform distortion, frequency variation-Computer Business Equipment Manufacturers Association (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 measurement equipment: harmonic / spectrum analyzer, flicker meters, disturbance analyzer- applications of expert system for power quality monitoring.

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.

19EEA07 CONTROL ENGINEERING

Offered by EEE (Allied Elective offered to BAD, BBE, BBT, BCI, BCS, 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 INDUSTRIAL APPLICATION OF CONTROL SYSTEM (QUALITATIVE ONLY)**9**

Typical control schemes for level control, position control, pressure control and temperature control of industrial processes.

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. Dhanesh N. 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.

19EEA08 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

19EEA09 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. Christie, “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.

19ITA04 GRAPHICS PROGRAMMING

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, 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 with openGL by applying Modelling Techniques, 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-Bresenham's 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-Newtonian 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 Rendering-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 Kaufmann, 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

19ITA05 BIG DATA AND APPLICATIONS

Offered by IT (Allied Elective offered to BAD, BBE, BBT, BCI, 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/nosql dbs.pdf>
- <https://www.mongodb.com/>

19ITA06 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>

19ITA07 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 – handling 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/>

19MEA10 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, and space shuttles in the field of inter-discipline.
- This Course would equip the students to effectively enhance the concepts of aircrafts and space crafts.

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, Airbus.

Atmospheric Science: Earth's atmosphere, structure, classification, constituents – Temperature in atmosphere – International standard atmosphere (ISA) - Space Debris – Airport METARs.

Unit II AEROSPACE ENGINEERING**9**

Aerodynamic forces – lift generation – aerofoils – drag – anatomy of an aircraft – major parts of an aircraft (Radome, Fuselage, Wings, 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.

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-Heinemann, 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/>

19MEA11 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

- The evolution, uniqueness and properties of nanomaterials.
- The various theories behind the interaction of nanoparticles.
- The various synthesis methods available for producing nano materials.
- The various characterization techniques available for nano materials.
- The special nano materials available and the applications of nano materials.

Course Outcome:

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

- Gain knowledge on the basic science behind nanotechnology.
- Able to interpret the nano scale phenomena of nano particles
- Capable to prepare nanomaterials.
- Ability to characterize the nano materials.
- Acquire knowledge on the available special nanomaterials and their applications

Unit I INTRODUCTION TO NANOMATERIALS**9**

Background to nano technology - scientific revolutions - basic principles of nano scale materials - Comparison with bulk materials, Classification of Nanomaterials: zero, one, two, and three dimensional nanostructures and its nature – Surface area and aspect ratio, Length scales involved and effect on properties: Mechanical, Electronic, Optical, Magnetic and Thermal.

Unit II THEORIES OF NANO SIZED MATERIALS**9**

Surface energy – chemical potential as a function of surface curvature - electrostatic stabilization -surface charge density - electric potential at the proximity of solid surface - Zeta potential - Interaction between two particles: DLVO theory – Steric Stabilization.

Unit III SYNTHESIS OF NANOMATERIALS**9**

Bottom-up Synthesis - Physical vapour Deposition – Chemical vapour Deposition - Atomic Layer Deposition - Molecular Beam Epitaxy - liquid phase methods - colloidal and sol gel methods – methods for templating the growth of nanomaterials – ordering of nano systems - self-assembly - Top-down Approach: Mechanical Milling, Dry etching, Lithography.

Unit IV CHARACTERISATION OF NANOMATERIALS**9**

Characterisation Techniques: X-ray diffraction Technique – Fourier Transform Infrared Spectroscopy -Energy Dispersive X-ray Analysis - Spectroscopy techniques: Raman spectroscopy– Infrared surface Spectroscopy - Brillouin Spectroscopy – Ultraviolet-visible Spectroscopy – Photon Correlation Spectroscopy - surface analysis and depth profiling – Luminescence: Photoluminescence - Thermoluminescence.

Unit V SPECIAL NANOMATERIALS & APPLICATIONS**9**

Allotropes of Carbon (Basics only): Fullerenes, Carbon Nanotubes, Graphene-Self-assembled Monolayers - Micro and Mesoporous Materials – Core Shell Structures – Organic-Inorganic Hybrids – Intercalation Compounds – Nanocomposites– Bioceramics – Applications of Nanomaterials: Nanomaterials in energy storage–health-communication sector – environment – textile – safety.

Text Book:

1. Guozhong Cao, "Nanostructures and nanomaterials: Synthesis, properties and applications", Imperial College Press, 2011.
2. Charles P. Poole, Jr., Frank J. Owens, "Introduction to Nanotechnology", John Wiley and Sons Publishers, 2008.

Reference Book:

1. Alan S. Edelstein, Robert C. Cammarata, "Nanomaterials: Synthesis, Properties and Applications", Taylor & Francis, 1998.
2. Koch C, "Nanostructured materials: processing, properties and applications", William Andrew Publication, 2008.
3. Joel I. Gersten, "The Physics and Chemistry of Materials", Wiley, 2003.
4. S. Edelstein & R. C. Cammarata, "Nanomaterials: Synthesis, properties and applications", Institute of Physics Pub., 1998.

19MEA12 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, Steam, Hydel, Diesel, Tidal, Geothermal, Wind, Solar power plants-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

Text Book:

- R.S.Khrurmi, "A Textbook of Thermal Engineering", S Chand publisher; 15th edition (2018)
- Yunus A. Cengel, "Fundamentals of Thermal-Fluid Sciences", McGraw-Hill College; 5th edition (2016)

Reference Book:

- Nag.P.K, "Engineering Thermodynamics", Tata McGraw-Hill, 6th Edition, New Delhi, 2017.
- Nag P.K, "Power Plant Engineering", Tata McGraw- Hill, 4th Edition, 2017.
- Rajput. R. K., "Thermal Engineering" S.Chand Publishers, 2015.
- Cengel, "Thermodynamics – An Engineering Approach" TataMcGraw Hill, New Delhi, 5th Edition, 2006
- El-Wakil M.M, "Power Plant Technology", Tata McGraw-Hill 2001.
- Sarkar, B.K, "Thermal Engineering", Tata McGraw-Hill Publishers, 2007.
- Kothandaraman.C.P, Domkundwar.S, Domkundwar. A.V., "A course in thermal engineering", Dhanpat Rai & sons, 5th Edition, 2012.

19MEA13 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 and ingredients of Propellants.
- Know the different ingredients of Propellants
- Know about the basic process 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, Color 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.

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. <https://doi.org/10.1021/ed018p500.1>

19UBA01 ESSENTIALS OF 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.

19UBA02 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. Eugene 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.

19UBA03 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.

19UBA04 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:

- S.S.Khanka, "Entrepreneurial Development", S.Chand and Company Limited, New Delhi, 2012.
- Hisrich, "Entrepreneurship", (9th ed.), Tata McGraw Hill, New Delhi, 2012.

Reference Book:

- Cynthia L.Greene, "Entrepreneurship ideas in action", (5th ed.), Thompson – Southwestern, 2012.
- Donald.F.Kurato, "Entrepreneurship", (8th ed.), Thompson – Southwestern, 2009.
- HBR on "Entrepreneurship".
- Peter.F. Drucker, "Innovation and entrepreneurship", Harper business, 1993.
- K.Dennis Chambers, "The Entrepreneur's guide to writing Business plans and proposals", Macmillan, 2008.
- 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).

19ECH01 SENSORS AND ACTUATORS

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To recognize different types of sensors and actuators for different environments.
- To learn about the different measurements using sensors
- To identify suitable sensors and actuators for developing 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
- Explain the concept of Optical sensors and actuators
- Narrate 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 Impedance 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**

Units of Temperature - 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**

Units - The Electric Field: Capacitive Sensors and Actuators - Magnetic Fields: Inductive sensors and Hall effect sensors - Magnetohydrodynamic (MHD) Sensors and Actuators - Magnetometers - Magnetic Actuators - Voltage and Current Sensors -

Unit V MECHANICAL SENSORS AND ACTUATORS, RADIATION SENSORS, MEMS AND SMART SENSORS**9**

Force Sensors – Accelerometers - Pressure Sensors – Gyroscopes - Radiation Sensors - Microwave Radiation - Antennas as Sensors and Actuators - MEMS Sensors and Actuators - Smart Sensors and Actuators - Sensor Networks

Text Book:

1. Nathan Ida, "Sensors, Actuators and their Interfaces", Scitech publishing, 2013.
2. Patranabis D, "Sensor and Actuators", Prentice Hall of India (Pvt) Ltd. 2005

Reference Book:

1. Clarence W. de Silva, "Sensors and Actuators: Engineering System Instrumentation", 2nd Edition, CRC Press, 2015
2. Ernest O. Doebelin, "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", Thomson Press India Ltd., 2004
4. Renganathan.S, "Transducer Engineering", Allied Publishers (P) Ltd., 2003.
5. Bolton W., "Mechatronics", 4th edition, Pearson, 2011.

Extensive Reading:

- www.endnote.com/downloads/style/sensors-and-actuators
- www.iav.com/en/engineering/.../sensor-and-actuator-systems
- www.biophysics.org/2015naiwat

19ECH02 IOT ARCHITECTURE AND FRAMEWORK

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 Madiseti, "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/e0/ESP8266_Specifications_English.pdf
- https://swayam.gov.in/nd1_noc20_cs24
- https://swayam.gov.in/nd2_arp19_ap52

19ECH03 COMMUNICATION PROTOCOLS FOR IOT

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To discuss the fundamental concepts of internet protocols and standards
- To examine the protocol standards in data link and networking layers
- To simulate the different protocols through IoT 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 IoT Standards
- Demonstrate and visualize the data link protocols for IoT.
- Elucidate the network protocols and standards for IoT
- Analyse the importance of IoT Edge devices.
- Apply security mechanisms for protocol security.

Unit I EVOLVING IOT STANDARDS**9**

Overview and Approaches – IoT Ecosystem – Protocols for IoT- Structural Aspects- Key Technologies-Sensor Technology-RFID technology – Satellite 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.
3. 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.

Reference Book:

1. 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
2. Vijay Madiseti, Arshdeep Bahga, "Internet of Things (A Hands-on Approach)", 1st Edition, VPT, 2014
3. Perry Lea , "Internet of Things for Architects_ Architecting IoT solutions by implementing sensors, communication infrastructure, edge computing, analytics, and security",Packt Publishing ,2018
4. Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, 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_ar19_ap52

19ECH04 CLOUD SERVICES FOR IOT

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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
- To understand the various cloud services for IoT
- To familiarize the applications security issues

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 sensors and the technologies
- Develop IoT applications using cloud platforms
- Integrate the IoT applications into the cloud services
- Access the security issues in 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)-Platform as a service(PaaS)-Software as a service(SaaS)-Architectural design of compute and storage clouds: Layered cloud architectural development-Architectural design challenges-Public cloud platforms: GAE,AWS and Azure

Unit II PROGRAMMING IOT DEVICES FOR CLOUD INTERFACE 9

Basics of Sensors and actuators – examples and working principles of sensors and actuators – Cloud computing and IOT – Arduino/Equivalent Microcontroller platform. IoT Communication Technologies – RFID – Bluetooth – Zigbee – Wifi –Wired Communication

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 CLOUD SERVICES FOR IOT 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

Application Safety and Service Vulnerability in Cloud Network- IoT Security and Privacy Preservation-Security and Challenges in Mobile Cloud Computing-The vital role of Fog computing in Internet of Things

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.
3. Charalampos Doukas, "Building Internet of Things with the Arduino", Create Space, April 2002.
4. Agus Kurniawan "Learning AWS IoT"Packt Publishing (January 29, 2018)

Reference Book:

1. Dac-Nhuong Le , Chintan Bhatt , Mani Madhukar "Security Designs for the Cloud, IoT, and Social Networking" John Wiley & Sons (11 October 2019)
2. Honbo Zhou, "The Internet of Things in the Cloud: A Middleware Perspective", CRC Press, 2013.
3. Marco Schwatz, "Internet of Things with Arduino Cookbook", Packt Publications, 2016.
4. Rajkumar Buyya, Christian Vecchiola. S.ThamaraiSelvi, "Mastering Cloud Computing", McGraw Hill Education, 2013.
5. 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

19ECH05 BIG DATA ANALYTICS FOR IOT

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn Big data analytics for IoT
- To get exposure on IoT semantics and big data streaming analytics
- To be familiar with Processing IoT data for data analytics
- To identify applications that makes use of multimedia Big Data and IoT
- To implement smart systems using IoT

Course Outcome:

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

- Integrate big data and IoT for IoT analytics
- Process IoT real-time and linked stream data.
- Process and handle IoT Big data using Apache Hadoop
- Work with multimedia Big Data and IoT
- Design and implement smart IoT systems with big data

Unit I BIG DATA INTEGRATION FOR IOT ANALYTICS**9**

Introduction to IoT data and Big data – Challenges of IoT analytics applications – IoT analytics life cycle and techniques –Searching the Internet of Things: Introduction - 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**

Introduction – 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**

Apache Hadoop, Employing Hadoop Map Reduce - Creating the components of Hadoop Map Reduce jobs - Distributing data processing across server farms –Executing Hadoop Map Reduce jobs - Monitoring the progress of job flows

Unit IV MULTIMEDIA BIGDATA COMPUTING FOR IOT**9**

Introduction - Definition and Characteristics – Relationship between IoT and Multimedia Big Data(MMBD) – Multimedia Big Data LifeCycle - MMBD for IoT Applications - Data Collection – Technologies used - Analysis of Various Techniques - Opportunities, Issues, and Challenges

Unit V CASE STUDIES OF IOT DATA ANALYTICS**9**

Precision Agriculture and its Cyber-Physical Management, IoT implementation for smart cities and future Challenges, IoT based Intelligent Transportation System for Global Perspective, IoT based implementations for smart buildings

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 Minter, "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

19ECH06 PRIVACY AND SECURITY IN IOT

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the security requirements in IoT.
- To learn the cryptographic fundamentals in IoT.
- To understand the working of authentication credentials and access control.
- To familiarize with privacy protection and trust models.
- To familiarize with the various IoT Attacks.

Course Outcome:

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

- Identify the security requirements in IoT Architecture.
- Apply different cryptographic techniques in IoT Security.
- Apply different solutions in Identity and Access Management.
- Familiarize the privacy preservation and trust models in IoT.
- Develop solutions for different types of IoT attacks.

Unit I INTRODUCTION: SECURING THE IOT**9**

Security Requirements in IoT Architecture - Security in Enabling Technologies -Security Concerns in IoT Applications. Security Architecture in the Internet of Things -Security Requirements in IoT - Insufficient Authentication/Authorization – Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity -Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault trees

Unit II CRYPTOGRAPHIC FUNDAMENTALS FOR IOT**9**

Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes –Digital Signatures – Random Number Generation – Cipher Suites – Key Management Fundamentals – Cryptographic Controls Built into IoT Messaging and Communication Protocols – IoT Node Authentication

Unit III IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IOT**9**

Identity Lifecycle – Authentication Credentials – IoT IAM infrastructure – Authorization with Publish / Subscribe Schemes – Access Control

Unit IV PRIVACY PRESERVATION AND TRUST MODELS FOR IOT**9**

Concerns in Data Dissemination – Lightweight and Robust Schemes for Privacy Protection – Trust and Trust Models for IoT – Self-organizing Things - Preventing Unauthorized Access

Unit V IOT ATTACKS - CASE STUDIES**9**

MIRAI Botnet Attack -Iran's Nuclear Facility Stuxnet Attack –Tesla Cryptojacking Attack -The TRENDnet Webcam Attack -The JeepSUV Attack -The Owlet Wi-Fi Baby Heart Monitor Vulnerabilities -St.Jude_Hackable Cardiac Devices

Text Book:

1. Brian Russell, Drew Van Duren, "Practical Internet of Things Security", Packt Publishing Limited, 2nd Edition, 2018.
2. Shancang Li and Li Da Xu, "Securing the Internet of Things", Elsevier, 2017.

Reference Book:

1. Fei Hu, "Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations", CRC Press, 1st Edition, 2009

Extensive Reading:

- https://subscription.packtpub.com/book/hardware_and_creative/9781785889639/9
- <https://www.businessinsider.com/iot-security-privacy?IR=T>
- <https://www.peerbits.com/blog/biggest-iot-security-challenges.html>
- <https://www.coursera.org/learn/iot-cyber-security>
- https://tools.cisco.com/security/center/resources/secure_iiot_proposed_framework

19EEH41 DIGITAL MEASUREMENTS AND INSTRUMENTATION

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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

19ECH21 ENERGY AWARE SENSORS

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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
- Analyse 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.
- Analyse 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 issues- wired 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 CASE STUDIES**-3**

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. S.Sitharama Iyengar , Richard Brooks, "Distributed Sensor Network – Image and sensor signal processing", CRC Press, 2013.
3. 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>

19ECH22 MULTIDISCIPLINARY SENSORS

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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>

19ECH23 ADVANCED SENSOR AND DETECTION MATERIALS

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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**

Influence 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>

19EEH91 INDUSTRIAL INSTRUMENTATION AND TECHNOLOGY MANAGEMENT

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- 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 techniques practiced in industries and able to select appropriate sensor.
- the management concepts and strategies used in process industries.

Course Outcome:

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

- Explain the working principle of instruments used for measurement of acceleration, vibration and force
- Explicate the working principle of instruments used for measurement of pressure and Calibrate the measuring instruments
- Narrate the working principle of instruments used for measurement of temperature, and design a signal conditioning circuits for RTD transducers
- Report the working principle of instruments used for measurement of level and flow and select the instruments according to the application.
- Delineate the management concepts and strategies for the development of instrumentation industries.

Unit I MEASUREMENT OF ACCELERATION, VIBRATION AND FORCE**9**

Functional elements of generalized instrumentation systems- Accelerometers: LVDT, Piezoelectric and Strain gauge type accelerometers - Seismic instruments as accelerometer - Vibration sensor. Force Measurement: Hydraulic, Pneumatic, Strain gauge and Piezoelectric load cells.

Unit II 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 III LOW AND HIGH TEMPERATURE MEASUREMENT**9**

RTD - characteristics and signal conditioning- 3 lead and 4 lead RTDs – Thermistors. Thermocouples and their types- compensation techniques -Radiation methods of temperature measurement - Total radiation pyrometers - Optical pyrometers.

Unit IV 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.

Unit V MANAGEMENT CONCEPTS AND STRATEGIES**9**

Management and Administration - Human factors in Managing –Steps involved in Planning- Decision-making– Motivational Theories and Techniques –Leadership Behaviours and Styles- Need for protection of Intellectual Property- Patents and their types-Copy rights- Trademark- Trade Secret.

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.
6. Kooniz, "Essentials of Management", 8th Edition Tata McGraw Hill, 2009.

19MAH91 NUMBER THEORY FOR INFORMATION SECURITY

Offered by MAT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- To introduce the concept of factorization of numbers in terms of primes numbers.
- To describe the problems in system of congruence equation.
- To define and interpret primitive roots and quadratic residues.
- To apply the concept of correction, decoding and finite fields.
- To introduce 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 congruence's 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 finite 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 phi function – Chinese remainder theorem – Euler's and Fermat's theorem – Psuedoprimes and Carmichael numbers – public key cryptography

Unit III PRIMITIVE ROOTS AND QUADRATIC RECIPROCITY**9**

Polynomials and primitive roots – primitive roots to composite moduli – power residue – Quadratic residue – Quadratic reciprocity law – Quadratic residues to composite moduli

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 (SIE), 2005.
2. San Ling and Chaoping Xing, "Coding Theory A First Course", 1st Edition, Cambridge University Press, 2004.
3. Van Lint J.H., "Introduction to Coding Theory", Springer, 2012

Reference Book:

1. David M. Burton, "Elementary Number Theory", 7th Edition, MC Graw Hill Education, 2012.
2. Merkow Mark S and Jim Breithaupt, "Information security Principles and practices", 2nd Edition, Pearson Education, 2014.

19CSH21 CRYPTOGRAPHIC ALGORITHMS AND ARCHITECTURE USING JAVA

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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, Implementing Message Digest Algorithms in Java, Message Authentication – Message Authentication Code algorithm, Implementation of Message Authentication Code 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, 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, WileyDreamtech 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>

19CSH22 COMPUTER FORENSICS

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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 and malware forensics.
- Identify the issues in mobile device forensics, Network and E-mail Forensics
- Determine the needs of software tools and forensic hardware workstations

Unit I INTRODUCTION, DATA ACQUISITION**9**

An Overview of Digital Forensics - Preparing a Digital Forensics Investigation - Procedures for Private-Sector High-Tech 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 - Collection 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- Examining 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**

Evaluating Digital Forensic Tool Needs, Digital Software Forensics Software Tools Digital Forensics Hardware Tools, 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. Dejeu, 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.securestate.com/Services/Incident%20Response/Pages/Forensic-Analysis.aspx>
- <http://www.cftt.nist.gov/>
- <http://www.brandeisdl.discom.com/Forensics/02Modules/07/01Overview/>
- <http://www.mobilephoneinvestigations.net/>
- <https://www.emailforensictool.com>

19CSH23 NETWORK SECURITY ESSENTIALS

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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Course Objective:

To impart knowledge on

- To understand types of attacks and symmetric encryption
- To learn about public key encryption, key distribution and authentication
- To study about cloud security and transport level security
- To understand the issues in wireless network security and email security
- To learn about IP security, intrusion detection and firewalls.

Course Outcome:

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

- Analyse the types of attacks and explore how symmetric encryption can mitigate the attacks.
- Explore the application of public key cryptography and effective key distribution protocols.
- Compare effectiveness of various network access control and transport level security methods.
- Distinguish issues related to wireless networks and email security.
- Explore mechanisms for IP security .
- Compare the effectiveness of intrusion detection systems and firewalls

Unit I INTRODUCTION AND SYMMETRIC ENCRYPTION**9**

Introduction: Computer Security Concepts- The OSI Security Architecture- Security Attacks- Security Services- Security Mechanisms- Fundamental Security Design Principles- Attack Surfaces and Attack Trees- A Model for Network Security- Standards

Symmetric Encryption and Message Confidentiality: Symmetric Encryption Principles- Symmetric Block Encryption Algorithms- Random and Pseudorandom Numbers- Stream Ciphers and RC4- Cipher Block Modes of Operation.

Unit II PUBLIC-KEY CRYPTOGRAPHY AND KEY DISTRIBUTION**9**

Public-Key Cryptography and Message Authentication: Approaches to Message Authentication- Secure Hash Functions- Message Authentication Codes- Public-Key Cryptography Principles- Public-Key Cryptography Algorithms- Digital Signatures

Key Distribution and User Authentication: Remote User Authentication Principles- Symmetric Key Distribution Using Symmetric Encryption- Kerberos- Key Distribution Using Asymmetric Encryption- X.509 Certificates- Public-Key Infrastructure- Federated Identity Management.

Unit III 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 IV 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 V 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.

Text Book:

1. William Stallings "Network Security Essentials: Applications and Standards", Sixth Edition, Pearson Education, 2016

Reference Book:

1. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013.
2. Charlie Kaufman, Radia Perlman and Mike Speciner, —Network Security||, PrenticeHall of India,2002
3. Dr. Wenliang Du, "Computer & Internet Security: A Hands-on Approach", 2nd Edition, 2019
4. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", 2nd edition, Pearson, 2007
5. Bruce Schneier and Neils Ferguson, —Practical Cryptography||, First Edition, Wiley Dreamtech India Pvt Ltd, 2003
6. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education, Second Edition, 2007.
7. by Behrouz A. Forouzan and Debdeep Mukhopadhyay, "Cryptography and Network Security", McGraw Hill

Education, 2010

Extensive Reading:

- <https://docs.microsoft.com/en-us/windows/win32/seccrypto/cryptography-reference>
- https://www.cisco.com/c/en_in/products/security/firewalls/what-is-a-firewall.html
- <https://digitalguardian.com/blog/what-email-security-data-protection-101>

19CSH24 INTERNET SECURITY

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- To study the fundamental concepts of classical encryption techniques and Crypt Analysis.
- To understand the principles of secret keys management.
- To acquire the concepts of IP Security and its applications
- To study the concepts of Transport layer security and its applications
- To learn the working principle of Email and public key distribution

Course Outcome:

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

- Interpret basic building blocks of encryption for cryptanalysis
- Identify suitable key generation technique for secret key management
- Apply IP security in VPN and Remote Access
- Apply SSL in World wide web transactions
- Explore various public key and certificate distribution strategies and its use in PGP

Unit I INTRODUCTION AND BASIC ENCRYPTION**9**

Introduction – Essentials of Cryptography, Essentials of Networking and Internet, Security Objectives, Communication Security, Legal restrictions, Basics of Encryption – Building Blocks of Encryption, Cryptanalysis and Modern Codes, Brute Force cracking of Secret Keys, Choosing Cryptography Algorithms

Unit II LINK ENCRYPTION AND SECURE KEY MANAGEMENT**9**

Link Encryption – In-line Encryptor, Point to Point Encryption, IP Routed Configuration, Managing Secret Keys – Issues in Secret Key Management, Technology - Random Key Generation, Random Seeding, Pseudorandom Number Generators, Manual Key Distribution, Automatic Rekeying, Key Distribution Centres, Maintaining Keys and System Security

Unit III IP LAYER SECURITY AND APPLICATIONS**9**

Basic Issues in IP Security (IPSEC), Cryptographic Checksums, IP Security Protocol, IPSEC key management, TCP/IP Network Security Protocols, Virtual Private Network (VPN) – Issues in VPN, IPSEC proxy cryptography, IPSEC encrypting Router, Site to Site Encryption, Remote Access with IPSEC – problems in IPSEC clients, IPSEC Client, Client to Server site access

Unit IV TRANSPORT LAYER SECURITY AND APPLICATIONS**9**

Public Key Cryptography, RSA Encryption, Key Exchange with RSA, Secure Socket Layer (SSL), World Wide Web Transaction Security – Issues in Internet Transaction Security, Transactions on World Wide Web, Security Alternatives for Web Forms, Web Browser with SSL, Web Server with SSL

Unit V SECURE E-MAIL AND PUBLIC KEY CERTIFICATES**9**

Secure Email - Email Security Issues, Basics of Internet E-Mail, Offline Message Keying, Digital Signature, Secure Email Client, Public Key Certificates – Distributing Public Keys, Public Key Certificates, Certificate Distribution, Centralized Certification Authority, Hierarchical Certification Authority, Pretty Good Privacy (PGP)

Text Book:

1. Richard E.Smith, Internet Cryptography, 6th Edition, Pearson, 2011

Reference Book:

1. Tim Speed, Juanita Ellis, "Internet Security", Elsevier, 2006
2. Uyless Black, "Internet Security Protocols – Protecting IP Traffic", Pearson Education, 2001
3. Wade Trappe, Lawrence C Washington, "Introduction to Cryptography with coding theory", 2nd edition, Pearson, 2007
4. William Stallings, Cryptography and Network Security, 6th Edition, Pearson Education, March 2013.
5. Bruce Schneier and Neils Ferguson, —Practical Cryptography||, First Edition, WileyDreamtech India Pvt Ltd, 2003
6. W. Mao, "Modern Cryptography – Theory and Practice", Pearson Education, Second Edition, 2007.
7. Douglas R Simson —Cryptography –Theory and practice||, First Edition, CRC Press,1995.

19CSH25 ETHICAL HACKING

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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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

- Use the various security tools to assess and to 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 – Traceroute: ICMP, TCP and UDP Traceroute – Enumerating and Fingerprinting the Webservers – 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://index-of.es/Hacking-Webserver/Certified_Ethical_Hacker_3.0_Official_Course.pdf
- <http://ptgmedia.pearsoncmg.com/images/9780789751270/samplepages/9780789751270.pdf>
- <https://cert.eccouncil.org/images/doc/CEH-Handbook-v2.0.pdf>

19ITH01 CRYPTOGRAPHY AND HASHING

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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- Steganography- 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 Algorithms", 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>

19ITH02 INTRODUCTION TO DIGITAL CURRENCIES

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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>

19ITH03 BLOCKCHAIN TECHNOLOGIES

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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>

19ITH04 SMART CONTRACTS AND DECENTRALIZED APPLICATIONS

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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 Intrinsicity - 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>

19ITH05 BLOCKCHAIN PLATFORMS

Offered by IT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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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>

19ITH06 BLOCKCHAIN FORENSICS

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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Course Objective:

To impart knowledge on

- To learn about security and privacy in Bitcoin and Blockchain
- To propose Blockchain based security mechanism for different applications
- To understand the importance of bitcoin forensics
- To build Blockchain-based apps and PKI solutions
- To understand challenges and the future of cybersecurity and Blockchain

Course Outcome:

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

- Understand the security issues in Blockchain
- Develop Blockchain-based security mechanism
- Comprehend the need for bitcoin forensics
- Summarize the security and privacy issues in bitcoin
- Realize the challenges and the potential of blockchain in the field of cyber security

Unit I BLOCKCHAIN ON THE CIA SECURITY TRIAD**9**

CIA security triad - Blockchain on confidentiality - Blockchain on integrity - Blockchain on availability - Deploying PKI-Based Identity with Blockchain - Two-Factor Authentication with Blockchain.

Unit II BLOCKCHAIN BASED SECURITY MECHANISMS**9**

Domain Name System - Understanding DNS components - DNS structure and hierarchy - DNS topology for large enterprise - Blockchain-based DNS solution - Blockchain-Based DDoS Protection.

Unit III BITCOIN FORENSICS**9**

Cryptocurrency artifacts and investigation – Bitcoin crimes – Cryptocurrency investigation challenges - Case studies - Tracking bitcoin transactions - Numisight bitcoin explorer.

Unit IV SECURITY AND PRIVACY IN BITCOIN**9**

Security of confirmed transactions – Security of Zero-confirmation Transactions – Bitcoin Forks - User privacy - Network layer attacks - Enhancing privacy in bitcoin.

Unit V BLOCKCHAIN AND CYBER SECURITY - CHALLENGES AND FUTURE**9**

Decision path for Blockchain – Checklist – Challenges - Future of cyber security with Blockchain.

Text Book:

1. Rajneesh Gupta, "Hands-On Cybersecurity with Blockchain", Packt Publishing, 2018

Reference Book:

1. Ghassan Karame, Elli Androulaki, "Bitcoin and Blockchain Security ", Artech, 2017.
2. Tiana Laurence, " Blockchain For Dummies", Dummies, 2017.
3. Niranjana Reddy, "Practical Cyber Forensics: An Incident-Based Approach to Forensic Investigations", Apress, 2019.
4. Harish Garg, "Hands-On Bitcoin Programming with Python", Packt Publishing, 2018.
5. Makoto Yano, Chris Dai, Kenichi Masuda, Yoshio Kishimoto, " Blockchain And Crypt Currency: Building A High Quality Marketplace For Crypt Data", Springer 2020.

Extensive Reading:

- www.nptel.ac.in
- www.ciphertrace.com
- www.hackernoon.com

19ITH21 INTRODUCTION TO COMPUTER GRAPHICS

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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-Bresenham's Line Algorithm-Circle Generating Algorithm- Bresenham's 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-Reflection 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 Hierarchical 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/>

19ITH22 INTRODUCTION TO VIRTUAL REALITY

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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/

19ITH23 GEOMETRIC MODELLING FOR XR

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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 the features 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 Virtual Reality 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>

19ITH24 INTERACTIVE 3D DESIGN

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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/>

19ITH25 XR APP DEVELOPMENT

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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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: Merging 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.

19ITH26 VIRTUAL REALITY AND GAME DEVELOPMENT

Offered by IT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- To understand 10-stage workflows
- To Understand static meshes and modular environments
- To learn terrain system offered by Unity and Blender
- To Understand hard-coded dependencies and even driven programming
- To understand XML, data serialization and Baking

Course Outcome:

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

- Implement 10 stage workflows
- Build Unity scenes from modular prefabs
- Use the Blender sculpting tools
- Create an event and notification system
- Load ,save game functionality and light probes in Unity

Unit I INTRODUCTION TO 10 STAGE WORKFLOWS**9**

Brainstorming-Initial Design-Prototyping-Refining Design-Project Management-Asset Creation-Importing Assets-Level Design-Scripting-Testing-Building-Configuring the Blender GUI-The Close-Without-Saving Bug- Exporting Blender Models to Unity-Exploring FBX File

Unit II MODULAR ENVIRONMENTS AND STATIC MESHES**9**

Modular Environments in Blender-Extending from the Base Tile-Modular Environment Blender Workflow-UV Mapping and Texture Creation-Importing and Configuring Environments in Unity--Using Prefabs-Static Batching

Unit III TERRAIN**9**

Creating Terrain in Unity-Evaluating Unity Terrains-Blender Terrain Modeling-Terrain Resolution-Texture-Painting Terrain-Working with Roads and Paths-Animation Units-Preparing for Animation in Blender -Keyframe Animations from Blender to Unity-Follow-Path Animations and Animation Baking-Blend Shapes and Shape Keys-Blend Shapes and Shape Keys.

Unit IV OBJECTS, DEPENDENCIES, EVENT-DRIVEN PROGRAMMING AND RETOPOLOGIZING**9**

Hard-Coded Dependencies-Solving DI: Component-Based Design and Messages-Sending Messages to Selected Objects-Sending Messages to Parents-Notification System-Notifications Manager In-Depth-Singletons-Messages and Active Objects-Traversing Game Object Hierarchies-High-Poly Meshes and Subdivision Surfaces-High-Poly Meshes and Real-Time Games-Retopologizing in Practice

Unit V SAVED GAMES AND PERSISTENT DATA AND BAKING**9**

Persistent Data-Player Preferences-Player Preferences-Customizing Persistent Data-XML Files-JSON – Binary-Class Serialization-Getting Started with XML Serialization-Saving Data to an XML File-Read Data from an XML File-Working with the SaveState Class- Baking- Preparing for Lightmapping in Unity- Lightmapping: Lightmap Resolution-Lightmapping Mode- Indirect Illumination and Ambient Occlusion- Baking Lightmaps- Baking Maps in Blender-Compositing Render Passes in GIMP-- Baking Real-Time Lighting with Unity Light Probes- Baking Navigation

Text Book:

1. Alan Thorn, "Practical Game Development with Unity and Blender", Cengage Learning, 2015

Reference Book:

1. Vahé Karamian, "Introduction to Game Programming: Using C# and Unity 3D", Noorcon Inc. 2016
2. Michelle Menard, Bryan Wagstaff, "Game development with Unity", Cengage Learning, 2015
3. Oliver Villar, "Learning Blender: A Hands-On Guide to Creating 3D Animated Characters", Addison -Wesley, 2017

Extensive Reading:

- 1. <https://learn.unity.com/>
- 2. <https://unity3d.com/learning-c-sharp-in-unity-for-beginners>
- 3. <https://www.blender.org/support/tutorials/>
- 4. <https://www.blenderguru.com/tutorials>

19CEH01 URBAN AND REGIONAL PLANNING REGULATIONS

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- Urban planning concepts and theories.
- 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 - Concept of urban 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.

Unit II EVOLUTION OF URBAN AREAS**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. Peter Hall, Mark Tewdwr-Jones., "Urban and Regional planning", Routledge; 5th edition, 2010.

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" 5th edition, 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/>.

19CEH02 URBAN CLIMATE CHANGE AND ADAPTATION

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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

- Analyze various dimensions of climate change in India.
- Analyze the several of impacts of climate change in different sectors.
- Plan and control the growth of urban area based on the climate change.
- Prepare the management plan for climate change adaptation and mitigation measures.
- Plan 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- Climate variability - Exposure - Mitigation, resilience, adaptation - Inventory of GHGs -Changes in patterns of temperature, precipitation and sea level rise - Case studies of Changes in Climate and Environment 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 - Determinants of energy demand - Phenomenon of climate change -Factors influencing climate change.

Unit IV CLIMATE CHANGE ADAPTATION AND MITIGATION MEASURES**9**

Adaptation Strategies in various sectors - Key Mitigation Technologies and Practices -Clean Development Mechanism –Carbon Trading –Biodiesel - 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 – Renewable energy cities - Carbon neutral cities -Distributed 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>.

19CEH03 IOT PLATFORM FOR SMART CITY PLANNING

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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.

19CEH04 INTELLIGENT TRANSPORT SYSTEMS

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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 suggesting 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 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

19CEH05 INTEGRATED URBAN WATER MANAGEMENT

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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

- Relate the basic concepts of integrated urban water management.
- Apply the concepts of urban water management in integrated water planning.
- 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 - Flood routing through channels and reservoir - Sectorization of distribution networks - DMA Demarcation – Software applications– 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/toolkit_for_integrated_urban_water_management_volume_1_tools_irap_2010.pdf –Toolkit
- https://www.indiawaterportal.org/sites/indiawaterportal.org/files/toolkit_for_integrated_urban_water_management_volume_2_technical_report_irap_2010.pdf -

19CEH06

Offered by CIV

GIS IMPLEMENTATION IN SMART CITY DEVELOPMENT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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Course Objective:

To impart knowledge on

- Fundamentals of remote sensing.
- Types of infrastructures in smart city development.
- Concepts of Land use mapping.
- GIS enabled smart transportation techniques.
- Significance of GIS role in smart city.

Course Outcome:

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

- Apply the principles of GIS of in smart city planning.
- Design the smart city based on the various types of infrastructure requirements.
- Map the existing terrain with the help of satellite images.
- Apply the smart navigation techniques in their smart city design.
- Implement the GIS ideologies across different sectors.

Unit I INTRODUCTION TO GIS**9**

Geographical Information System – Remote Sensing Concepts - Electro Magnetic Spectrum – Spectral Signature – Spectroradiometer – Types of Remote Sensing – Optical, Thermal , Hyper spectral , Microwave Remote Sensing.

Unit II FUNDAMENTALS OF URBAN DEVELOPMENT**9**

Smart city development – Fundamentals – Sustainability – Infrastructure – Physical Infrastructure - Housing, , Sewerage, Transport etc. – Social Infrastructure – Health, Education – Institutional Infrastructure – Planning and management – Economic Infrastructure – GDP and Employment.

Unit III LAND USE/ LAND COVER MAPPING**9**

Acquisition of digital image – Settlement – Land use/Land cover Mapping – Vector data – Digitization – Object delineation – Digital Elevation Model (DEM) - Urban Sprawl – High resolution remote sensing data.

Unit IV GIS NAVIGATION TECHNIQUES**9**

Urban and regional transportation corridors - Optimum route and plans / shortest path – Alignment planning – Traffic and flow management – Smart Street lights – Efficient Parking

Unit V GIS IMPLEMENTATION**9**

Smart governance – Information and Communication Technology (ICT) – Use of sensors - Water management – Waste management – Energy management– Air Pollution management - GIS Role - Revenue and Tax collection – Planning Facilities and Amenities – Accident Analysis – Crime Mapping.

Text Book:

1. Lillesand T.M., and Kiefer,R.W. "Remote Sensing and Image interpretation", VI edition of John Wiley & Sons-2000.
2. Juliana Maantay, John Ziegler, John Pickles, GIS for the Urban Environment, Esri Press 2006.

Reference Book:

1. Sabins, F.F.Jr, "Remote Sensing Principles and Image interpretation" , W.H.Freeman & Co,1978.
2. George Joseph, "Fundamentals of Remote Sensing", Universities Press (India) Pvt Ltd, Hyderabad, 2003.
3. Said Easa, Yupo Chan, "Urban Planning and Development Applications of GIS", Amer Society of Civil Engineers, 1999.
4. Paul Curran P.J., "Principles of Remote Sensing", ELBS 1995.
5. Juliana Maantay, John Ziegler, John Pickles, "GIS for the Urban Environment", Esri Press 2006.
6. Allan Brimicombe, "GIS Environmental Modeling and Engineering", CRC Press, 2009.

Extensive Reading:

- GIS for Smart Cities.<https://www.esri.in/~media/esri-india/files/pdfs/news/arcindianews/Vol9/gis-for-smart-cities.pdf>
- <https://www.gislounge.com/how-gis-supports-the-planning-and-development-of-smart-cities/>
- https://niti.gov.in/writereaddata/files/document_publication/CSTEP%20Report%20Smart%20Cities%20Framework.pdf.

19CEH21 MATERIAL PROCUREMENT AND MANAGEMENT

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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 functions - 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/>

19CEH22 STRATEGIC PLANNING FOR INFRASTRUCTURE SECTORS

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 the different strategies and risk management plan for any infrastructure projects
- Analyze the strategy for the 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 privatization- Challenges 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.

19CEH23 GEOTECHNIQUES FOR INFRASTRUCTURE

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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.

19CEH24 PROJECT FORMULATION AND IMPLEMENTATION

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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, 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/>

19CEH25 HIGH RISE BUILDINGS

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 Distributors, 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

19CEH26 INFRASTRUCTURE FINANCE

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Basics of financial management.
- Preparation of fund and cash flow statements.
- Capital budgeting concepts.
- Approach of capital cost and analysis.
- Details of working capital requirements.

Course Outcome:

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

- Apply the concept of Profit and Wealth maximization function
- Analyze the Changes in Financial Statements.
- Analyze Cash Flow with Capital Budgeting Problem.
- Examine the theories of capital structure
- Relate the factors of Working Capital, Policy and Financing Policy.

Unit I INTRODUCTION TO FINANCIAL MANAGEMENT 9

Scope & Functions of Finance - Goals of Financial Management - Role of Finance Manager- Profit Maximization Vs. Wealth Maximization - Organization of the Finance Function – Accounting Principles –Double Entry system.

Unit II STATEMENT OF CHANGES IN FINANCIAL POSITION 9

Preparation of Fund Flow Statement - Preparation of Cash Flow Statement - Analysis of Financial Statement– Profitability Turnover Ratios - Liquidity Ratios - Leverage Ratios, and Financial Ratios.

Unit III CAPITAL BUDGETING 9

Concept and importance - Factors influencing working capital requirements - Time Value of Money- Future value of a single cash flow - Annuity, Present value of a single cashflow- Annuity, Present value of an Uneven Cash Flow- Multi - Period Compounding – Capital Budgeting Decision.

Unit IV CAPITAL STRUCTURE 9

Cost of Capital - Cost of Debt - Cost of Preference Capital, Cost of Equity Capital - Weighted Average Cost of Capital - Theories of Capital Structure- EBIT Approach - EBT Approach - EBIT – EPS Analysis.

Unit V WORKING CAPITAL MANAGEMENT 9

Factors Influencing Working Capital Requirements - Operating Cycle and Cash Cycle - Determinants of Working Capital - Nature of Risk - Financial Leverage - Operating Leverage - Combined Leverage.

Text Book:

1. Narayanaswamy, "Financial Accounting – A Managerial Perspective", PHI, 2014.
2. Khan M.Y., Jain P.K, "Financial Management", Tata McGraw Hill Publication, 2019.

Reference Book:

1. Maheshwari S.N., Maheshwari S.K., "Advance Accountancy Vol-I", Vikas Publication, 2017.
2. Michael Jones, "Accounting for Non-Specialists", Person Education, 2012.
3. Jim McMenamin, "Financial Management – An Introduction", Taylor and Francis, 2002.
4. Amitabh Mukherjee and M Hanif, "Modern Accountancy - Vol II", TMH Publication, 2018.

Extensive Reading:

- Infrastructure Finance: An Introduction - <https://www.managementstudyguide.com/infrastructure-finance.html>.
- <https://www.cenfa.org/blog/infrastructure-finance-in-india-and-the-public-private-partnerships/>

19CEH41 MODERN CONSTRUCTION MATERIALS

Offered by CIV

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 behaviours - 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 light weight 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 water proofing 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/>

19CEH42 CONSTRUCTION EQUIPMENT MANAGEMENT

Offered by CIV

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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.
- Procurement of equipments.
- 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 analysing 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 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 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 practice - Method of Promoting - 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/>

19CEH43 ENERGY CONSERVATION METHODS IN CONSTRUCTION

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 Conservation 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/>

19CEH44 INTELLIGENT BUILDING TECHNIQUES

Offered by CIV

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- The concepts of intelligent materials and buildings.
- The functions of building comfort systems and its components.
- The modern safety systems fitted in the building.
- The electronics and communication systems involved in the modern buildings.
- The factors which have influence on the performance of buildings.

Course Outcome:

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

- Analyse and fix the materials and technology involved in the intelligent buildings.
- Choose the appropriate comfort systems and fabricate the HVAC system efficiently and effectively.
- Execute ample safety measures that are required for the building in order to avert building accidents.
- Select correct electronic components and construct a state of art built in electronic systems.
- 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, "Intelligent 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/>

19CEH45 QUALITY CONTROL IN CONSTRUCTION

Offered by CIV (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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

19CEH46 RESOURCE MANAGEMENT IN CONSTRUCTION

Offered by CIV

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The various functional areas of manpower.
- The classification, procurement, store management of materials.
- The management of machinery used in field.
- The various time management techniques.
- The types of cost and its management.

Course Outcome:

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

- Manage the diverse natured manpower in the construction field.
- Execute the management of construction materials effectively.
- Handle the equipment safely and maintaining the service records in a streamlined manner.
- Control the time phases of project and complete it within the stipulated time.
- Gain well versed knowledge on various costs involved in the project and carryout the time-cost trade off.

Unit I MANPOWER MANAGEMENT**9**

Introduction - Organization - Fulcrum of the modern enterprise - Informal groups - Management - Employees - Human resource management

Unit II MATERIAL MANAGEMENT**9**

Importance - Classification and Codification of materials - Inventory control - Managing the inventory and flow of raw materials, Work - in - Process, Finished Goods, and Supplies to ensure / enhance the organization's competitiveness and profitability - Stores Management - Quality control, Use of Material Management Systems (MMS).

Unit III MACHINERY MANAGEMENT**9**

Identification - Planning - Equipment Management in Projects - Maintenance Managements - Replacement - Cost Control of equipment - Depreciation Analysis - Safety Management.

Unit IV TIME MANAGEMENT**9**

Evolution of time management concepts - Need for time management - Challenges of project management (delays in pre-execution, construction phase) - Methods and processes for time management as per IS 15883-II, PMBOK - Work Breakdown Structure.

Unit V COST MANAGEMENT**9**

Time Cost Analysis - Cost components of a construction project - Direct and indirect costs - Critical Chain Project Management - Delay Management - Earned Value Management (EVM) - Cost-Time Relationships - Utility Curves - S-Curves - Time-Cost trade-off

Text Book:

1. Michael R. Canter, "Resource Management for Construction: An Integrated Approach", Macmillan, 3rd edition, 2005.
2. Glenn .A, Sears and Reichard, Clough .H, "Construction Project Management - A practical guide to field construction management", John Wiley and Sons, Inc, 2009

Reference Book:

1. A.K. Datta, "Materials Management: Procedures, Text and Cases", PHI Learning Pvt. Ltd., 2009.
2. Richard J. Tersine, "Principles Of Inventory And Materials, Management", Prentice Hall, 2004
3. P. Gopalakrishnan, Abid Haleem, "Handbook of Materials Management", PHI Learning Pvt. Ltd. 2015

Extensive Reading:

- <https://www.thebalancesmb.com/a-guide-to-effective-construction-resource-management-845350>
- <https://nptel.ac.in/courses/105/103/105103093/>

19EEH01 CONVENTIONAL AND ALTERNATE ENERGY SOURCES

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Operational practices of thermal power plants
- Operational practices of gas turbine and Diesel electric power plants
- the importance and process involved in harnessing power from solar and wind energy
- the importance and process involved in harnessing power from ocean and geo-thermal energy resources
- the importance and process involved in harnessing power from Bio-mass

Course Outcome:

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

- Explain the process of power generation from Thermal power plants
- Explicate the process of power generation from Gas turbine and Diesel power plants
- Appreciate the importance of alternate energy resources and explain the power harnessing methods from solar and wind resources
- Demonstrate the concept behind ocean and geo-thermal energy resources
- Enumerate 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 Wheeler Publishing Co Ltd., India, 2006.
4. Ramesh.R, Uday Kumar.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.

19EEH02 INTRODUCTION TO SMART GRID AND ELECTRIC VEHICLES

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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- Factors affecting the performance of conventional grid- Smart grid – key characteristics of smart grid – Potential benefits of smart grid - Difference between conventional grid & smart grid - Smart grid drivers – Global drivers of smart grid - Benefits of smart grid: Utility benefits, consumer benefits & Environmental benefits—Architecture of Smart Grid

Unit II SMART GRID TECHNOLOGIES - I**9**

Overview of Smart Energy Resources - Microgrid-Islanding in Microgrid Environment- Standards for smart grid system. Smart Transmission systems: Wide Area Monitoring System (WAMS)-Phasor Measurement Systems- Applications of WAMS-Role of FACTS and HVDC- Components of Smart Substation- Intelligent Electronic Devices (IEDs): Digital Fault Recorder, Digital Protective Relays, Circuit Breaker Monitors

Unit III SMART GRID TECHNOLOGIES - II**9**

Demand Side Management and strategies-Demand response Programs- Smart Distribution systems: Distribution Automation, Distribution Management System, Volt/VAR control, Outage Management System. Smart Meters: Introduction to Smart Meters, - Advanced Metering infrastructure (AMI) drivers and benefits, Advanced Metering infrastructure (AMI) Components.

Unit IV INTRODUCTION TO ELECTRIC VEHICLE (EV)**9**

Benefits of Electric vehicle to the environment and electric utility-Myths about electric vehicle – Drawbacks – Overview about Types of Electric vehicles and its challenges- overview of electric vehicle technologies: Motor Drive Technologies, Energy Source Technologies, battery charging technologies- Vehicle to Grid and Grid to Vehicle Technologies

Unit V ELECTRIC VEHICLE:ARCHITECTURE, STORAGE & IMPACT ON SYSTEM DEMAND**9**

Components of Electric Vehicle-EV systems and configurations-HEV systems and configurations- Energy Storage Solutions for Electric Vehicles- Impact of EV charging on system demand: Identification of EV demand – EV's impact on system demand

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. Seth Leitman and Bob Brant, "Build your own Electric Vehicle", McGraw Publications, second Edition, 2009.
4. K.T.Chau, "Electric vehicle Machines and drives: Design, analysis and application", John Wiley & Sons Singapore, First edition, 2015.
5. Rodrigo Garcia-Valle and Joao A. Pecos Lopes(Editors), "Electric Vehicle Integration into Modern Power Networks", Chapter 1 and 3, Springer Science + Business media, New York, 2013.

Reference Book:

1. Lars T. Berger and Krzysztof Iniewski, "Smart Grid Applications, Communications, and Security", John Wiley & Sons, March 2012.

Extensive Reading:

- The Smart Grid Vision for India's Power Sector: A White Paper, Prepared by PA consulting Group, USA, March 2010

19EEH03 DISTRIBUTED GENERATION AND MICRO GRID

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- The concept of distributed generation
- The impact of grid integration and its technical aspects
- The concept of Micro grid and its configuration
- The operating modes and control concepts of micro grid

Course Outcome:

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

- Find the size and optimal placement DGs
- Analyze the requirements for grid integration and standards
- Explain the stability and power quality issues on the system due to DGs
- Explicate the configuration and structure of AC and DC micro grids
- Describe the operational and control concepts of micro grid

Unit I NEED FOR DISTRIBUTED GENERATION**9**

Renewable sources in distributed generation – Current scenario in distributed generation – Planning of DGs – Siting and sizing of DGs – Optimal placement of DG sources in distribution systems.

Unit II GRID INTEGRATION OF DGS**9**

Concept of distributed generations, topologies, selection of sources, regulatory standards/ framework, Standards for interconnecting Distributed resources to electric power systems: IEEE 1547. DG installation classes, security issues in DG implementations. Basics of Energy storage elements: Batteries, ultra-capacitors, flywheels. Captive power plants

Unit III TECHNICAL IMPACTS OF DGS**9**

Requirements for grid interconnection, limits on operational parameters: voltage, frequency, THD, response to grid abnormal operating conditions, islanding issues. Impact of grid integration with NCE sources on existing power system: reliability, stability and power quality issues

Unit IV BASICS OF MICROGRID**1**

Concept and definition of microgrid, microgrid drivers and benefits, review of sources of microgrids, typical structure and configuration of a microgrid, AC and DC microgrids, Power Electronics interfaces in DC and AC microgrids

Unit V CONTROL AND OPERATION OF MICROGRID**9**

Modes of operation and control of microgrid: grid connected and islanded mode, Active and reactive power control, protection issues, anti-islanding schemes: passive, active and communication based techniques, microgrid communication infrastructure, Power quality issues in micro grids.

Text Book:

1. H. Lee Willis, Walter G. Scott, 'Distributed Power Generation – Planning and Evaluation', Marcel Decker Press, 2000.
2. M. Godoy Simoes, Felix A. Farret, 'Renewable Energy Systems – Design and Analysis with Induction Generators', CRC press.
3. Robert Lasseter, Paolo Piagi, 'Micro-grid: A Conceptual Solution', PESC 2004, June 2004.
4. Bollen M.H. and Hassan F. (2011); Integration of Distributed Generation in the Power System, Wiley-IEEE Press
5. Nikos Hatziargyriou, "Microgrids: Architectures and Control", ISBN: 978-1-118- 72068-4, December 2013, Wiley-IEEE Press.
6. S. Chowdhury, S.P. Chowdhury and P. Crossley, "Microgrids and Active Distribution Networks", The Institution of Engineering and Technology, London, U.K, 2009
7. Amirnaser Yazdani, and Reza Iravani, "Voltage Source Converters in Power Systems: Modeling, Control and Applications", IEEE John Wiley Publications, 2009.
8. Dorin Neacsu, "Power Switching Converters: Medium and High Power", CRC Press, Taylor & Francis, 2006.

Reference Book:

1. F. Katiraei, M.R. Iravani, 'Transients of a Micro-Grid System with Multiple Distributed Energy Resources', International Conference on Power Systems Transients (IPST'05) in Montreal, Canada on June 19-23, 2005.
2. Z. Ye, R. Walling, N. Miller, P. Du, K. Nelson, 'Facility Microgrids', General Electric Global Research Center, Niskayuna, New York, Subcontract report, May 2005.
3. Jenkins N. Strbac G. and Ekanayake J. (2009); Distributed Generation, The Institution of Engineering and Technology
4. Keyhani A. (2011); Design of Smart Power Grid Renewable Energy Systems, Wiley-IEEE Press
5. Tester J. W. (et al.) (2012); Sustainable Energy: Choosing among Options, Second Edition, The MIT Press
6. Bhattacharyya S., Rural electrification through decentralised Off-grid systems in Developing Countries, Springer, 2013
7. Zerriffi H., Rural Electrification: Strategies for Distributed Generation, Springer, 2011.

19EEH04 IOT FOR SMART GRIDS

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- the emerging area of Internet of Things and Smart Grid.
- Internet of Things and Smart Grid Applications.

Course Outcome:

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

- Describe the concepts of Internet of Things and Smart Grid
- Explain the IoT technologies and communication technologies
- Explicate the applications of HAN, NAN and WAN
- Spell out the suitable architectures for IoT aided Smart grid systems
- Enumerate the suitable architecture, possible applications and existing prototypes of IoT aided smart grid systems

Unit I IOT AND SMART GRID**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 EXISTING APPLICATIONS OF IOTAIDED 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,

Extensive Reading:

- YasirSaleem, Noel Crespi, Mubashir Husain Rehmani and Rebecca Copeland, "Internet of Things-aided Smart Grid: Technologies,Architectures, Applications, Prototypes, and Future Research Directions",IEEE, Volume: 7, 2019.
- DOI: 10.1109/ACCESS.2019.2913984
- <http://www.smartgridnews.com/story/smart-grid-101-internet-things-and-smart-grid-part-1/2013-11-12>

19EEH05 POWER ELECTRONIC INTERFACES FOR SMART GRID

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 and Distribution
- 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 control objectives and functionality of advanced FACTS devices

Unit I POWER ELECTRONIC INTERFACE FOR GENERATION AND DISTRIBUTION**9**

Power Electronic Interface for Generation: Block Diagram explanation of Power converter for Solar PV and Wind Energy Conversion System- Functions and technical trends of power system interconnection: LVRT, Islanding detection and Operation-Overview of Different Power Quality Issues- Power Quality Issues in smart grid Environment- Overview of Power Electronics in Distribution System

Unit II POWER FLOW CONTROL & FACTS CONTROLLERS**9**

Basics of power transmission networks-Control of power flow in AC transmission line - Introduction to Voltage source converter based Controller – 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

Unit III SVC & STATCOM**9**

SVC: Voltage control by SVC – Advantages of slope in the SVC dynamic characteristics – Influence of SVC on system voltage without Coupling Transformer – Applications of SVC: Transient stability enhancement, Augmentation of Power System damping - STATCOM: Principle of operation, V-I curve – Applications of STATCOM:SSR mitigation

Unit IV TCSC, SSSC AND DVR**9**

TCSC: 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 – Applications of SSSC: Power flow control and SSR Mitigation- DVR: Concept and Control strategy

Unit V UPFC, UPQC AND IPFC**9**

UPFC: Principle of operation - modes of operation – Applications of UPFC: Power flow control and oscillation damping – UPQC: Introduction – control objectives -Working principle – Integration of UPQC - IPFC: Basic Operational concept- Fault Current Limiting

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. K.R.Padiyar, "FACTS Controllers in Power Transmission and Distribution", New Age International(P) Ltd., Publishers, New Delhi, Reprint 2008
4. JanakaEkanayake, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama, Nick Jenkins, "Smart Grid Technology and Applications", John Wiley & Sons Ltd, 2012.

Reference Book:

1. V.K.Sood, "HVDC and FACTS controllers- Applications of Static Converters in Power System", Kluwer Academic Publisher, 2004.

Extensive Reading:

- ShinsukeNii, Masaki Kato, "Power Electronics Technology that Supports Smart Grid", Vol.57, No.4, Fuji Electric Review
- Laszio. Gyugyi, Kalyan.K.Sen, Colin.D.Schauder, "The Intrerline Power Flow Controller Concept:A New Approach to Power Flow Management in Transmission Systems", IEEE Transactions on Power Delivery, Vol.14, No.3, pp. 1115-1123, July 1999
- Math H.J. Bollen, , Jin Zhong, FranciscZavoda, Jan Meyer, Alex McEachern, Felipe CórcolesLópez, "Power Quality aspects of Smart Grids", International Conference on Renewable Energies and Power Quality(ICREPO'10),Granada (Spain), 23th to 25th March, 2010

- MdShafiuzzaman. K, KhademMr, MalabikaBasu, Michael F. Conlon, "UPQC for Power Quality Improvement in DGIntegrated Smart Grid Network – A Review", International Journal of Emerging Electric Power Systems, Vol.13, Issue 1, Article 3, 2012
- ShivendraPrakashVerma, Prashant Kumar, Noor-ul-Islam, "Smart Grid, Its Power Quality andElectromagnetic Compatibility", MIT International Journal of Electrical and Instrumentation Engineering, Vol. 2, No. 1, pp. 55-64, Jan. 2012.
- Tao Xia, Jian He, Yu Ye, Weiping Li, Jianmin Huang, Jie Yang, Dexiang Liu, "Application of Advanced Power Electronic Technology inSmart Grid", ACMME 2018, IOP Conf. Series: Materials Science and Engineering,Article394, 2018.
- F. Iov, M. Ciobotaru, D. Sera, R. Teodorescu and F. Blaabjerg, "Power Electronics and Control of Renewable Energy Systems," 2007 7th International Conference on Power Electronics and Drive Systems, 2007, pp. P-6-P-28, doi: 10.1109/PEDS.2007.4487668.

19EEH06 COMMUNICATION PROTOCOLS, SECURITY AND PROTECTION FOR SMART GRID

Offered by EEE

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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Course Objective:

To impart knowledge on

- Smart Grid Technologies
- Importance of protection in Smart Grid
- Data Communication for smart grid
- Communication Technologies for smart grid
- Security issues on smart grid

Course Outcome:

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

- Describe Smart Grid Technologies
- Explicate the importance of protection in smart grid
- Explain the communication requirements of a Smart Grid
- Describe the communication protocols for Smart Grid and the standards available for smart metering and Communication
- Explain the security challenges in smart grid

Unit I AN OVERVIEW OF SMART GRID IN PROTECTION PERSPECTIVE-I 9

Introduction- Major functions of a smart grid system- Features of the smart grid-Smart grid technologies-Sensing and measurement-Smart meter-Phasor measurement unit-Distribution energy resources

Unit II AN OVERVIEW OF SMART GRID IN PROTECTION PERSPECTIVE-II 9

Peak load management -Smart grid automation-Grid code-Protection system in the smart grid -Importance of protection in the smart grid-Challenges of protective devices in the smart grid

Unit III DATA COMMUNICATION FOR SMART GRID 9

Introduction - Dedicated and shared communication channels - Switching techniques - Communication channels - Layered architecture and protocols

Unit IV COMMUNICATION TECHNOLOGIES, STANDARDS AND PROTOCOLS 9

Introduction - Communication technologies: IEEE 802 series, Mobile communication, Multi protocol label switching, Power line communication - Standards for information exchange: Standards for Smart metering, Communication standards and Protocols

Unit V SECURITY AND PRIVACY 9

Cyber Security Challenges in Smart Grid- Load Altering Attacks - False Data Injection Attacks-Defense Mechanisms - Privacy Challenges – Information security for Smart grid

Text Book:

1. Ramesh Bansal, "Power System Protection in Smart Grid Environment", CRC Press, 2018.
2. Clark W Gelling, "The Smart Grid, Enabling Energy Efficiency and Demand Side Response", CRC Press, 2009.
3. JanakaEkanayake, Nick Jenkins, KithsinLiyanage, Jianzhongwu, Akihiko Yokoyama, Smart Grid Technology and applications, Wiley, 2012.

Reference Book:

1. James Momoh, "Smart Grid- Fundamentals of Design and Analysis", Wiley Publisher, 2010
2. Stuart Borlase, Smart Grid: Infrastructure, Technology and solutions, CRC Press 2012
3. Mini S.Thomas, John D McDonald, Power SCADA and Smart Grids, CRC Press, 2015.
4. Kenneth C. Budka, JayantG.Deshpande, Marina Thottan, Communication Networks for Smart Grids, Springer, 2014.

19EEH21 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, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- the concept of Object Oriented Programming.
- the basic characteristics of Java Programming.
- the principles of Inheritance, Exceptions, and interfaces.
- exceptions and use I/O streams.
- developing java program for Electrical Applications.

Course Outcome:

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

- Explain the concepts of Object Oriented Programming.
- Write simple java programmes using classes and objects.
- Describe Inheritance and Exception handling concepts in java programming.
- Narrate the concepts of multithreading and Applets in java programming.
- 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/>

19EEH22 DATA ANALYSIS USING PYTHON FOR ELECTRICAL ENGINEERS

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 PYTHON FUNDAMENTALS**9**

Introduction to Object Oriented Programming concepts: Objects-Classes-Encapsulation-Inheritance-Data Abstraction, Message Passing & Dynamic binding.

Started with Python: Keywords and identifiers- Syntax and Semantics- Statements & Comments-Variables- Operators, Data types, Strings and String Methods, Conditional Looping and Control statements.

Unit II LISTS,TUPLES & DICTIONARIES**9**

Lists: list operations, Indexing, Slicing, and Matrixes, Tuples: Tuple operations – Dictionaries – Dictionaries in action – Basic dictionary operations –Dictionary methods. Functions– Nested functions– Recursive functions – Anonymous functions.

Unit III PYTHON FUNCTIONS**9**

Coding functions –Scopes and Nested functions – Non local statement – Argument passing basics –Function design concepts - Recursive functions –Anonymous functions – Mapping functions.

Unit IV CLASSES,OBJECTS & APPLICATIONS**9**

Classes in Python– Creating Classes – Instance Methods– Class Variables–Objects– Constructor, destructors and Inheritance.

Applications: Simulation & Analysis of – Linear Circuits using R, L & C – non-linear circuits using Diodes–Half wave and Full wave rectifiers.

Unit V I/O & ERROR HANDLING IN PYTHON**9**

Introduction–Data streams –File Operations– Reading Data From a File – Writing Data to a File – Access Modes – Exceptions– Exception Hierarchy – Handling IO Exceptions.

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, Brian K Jones, "Python CookBook", Third edition, 2013.
3. Chun, Wesley J, "Core Python Programming", Pearson Education, 2012.
4. Gutttag, 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. GuidovanRossum 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=cpPG0bKHYYKc&noredirect=1>
- http://www.python-course.eu/python3_course.php

19EEH23 DATA MANAGEMENT FOR SMART GRID

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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>

19EEH24 COMMUNICATION AND DATA SECURITY IN ELECTRICAL ENGINEERING

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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, 2010.
5. Matt Bishop, "Introduction to Computer Security", Addison-Wesley, 2004.
6. Michael Whitman, Herbert J. Mattord, "Management of Information Security", Course Technology, Third Edition, 2010
7. Matt Bishop, "Computer Security: Art and Science", Addison-Wesley, First Edition, 2002
8. Michael Whitman, Herbert J. Mattord, "Principles of Information Security", Cengage Learning, Fourth Edition, 2011.
9. Behrouz A. Forouzan, "Data Communication and Networking", McGraw Hill, 2013.
10. Behrouz A. Forouzan and DebdeepMukhopadhyay, "Cryptography and Network Security", McGraw Hill

Education, 2010

Extensive Reading:

- Charlie Kaufman, Radia Perlman and Mike Speciner, —Network Security||, PrenticeHall of India,2002
- Dr. Wenliang Du, “Computer & Internet Security: A Hands-on Approach”, 2nd Edition, 2019
- Wade Trappe, Lawrence C Washington, “Introduction to Cryptography with coding theory”, 2nd edition, Pearson, 2007
- Bruce Schneier and Neils Ferguson, —Practical Cryptography||, First Edition, Wiley Dreamtech India Pvt Ltd, 2003
- W. Mao, “Modern Cryptography – Theory and Practice”, Pearson Education, Second Edition, 2007
- https://www.owasp.org/index.php/Top_10_2010
- <http://cwe.mitre.org/top25/index.html>
- <http://www.insecure.org>
- <http://www.27000.org>
- www.intechopen.com/books/cryptography-and-security-in-computing
- <https://docs.microsoft.com/en-us/windows/win32/seccrypto/cryptography-reference>
- https://www.cisco.com/c/en_in/products/security/firewalls/what-is-a-firewall.html
- <https://digitalguardian.com/blog/what-email-security-data-protection-101>

19EEH25 OPTIMIZATION STUDIES IN ELECTRICAL SYSTEMS

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- various optimization methods
- non-traditional optimization techniques

Course Outcome:

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

- elucidate the concept of approaching optimization problem
- explicate the procedure to apply the constraints while solving optimization problem
- solve convex optimization problems.
- apply multiple objectives while solving the optimization problem
- explain various non traditional methods of solving optimization problem

Unit I OPTIMIZATION OVERVIEW**9**

Optimization - Optimization Methods For Engineers – Mathematical Models – Characteristics of Optimization Models – Limitations of Optimization Models – Procedural steps of Optimization – Application areas
Formulation of Optimization problems – Decision variable and Decision vector – Design constraints –Boundary conditions - Formulation

Unit II CONSTRAINED OPTIMIZATION ALGORITHM**9**

Set Constrained Optimization Problem- Local and Global Optimal Points- Optimality Conditions- Least Square Optimization- General Optimization Algorithms- Steepest Descent Method

Unit III CONVEX PROGRAMMING**9**

Convex set - Convex Function- Standard Optimization Problem – Convex problem - Power Dispatching in Interconnected Microgrids . DUALITY Lagrangian Function- Dual Problem- Karush–Kuhn–Tucker Conditions- Lagrangian Algorithm

Unit IV MULTIOBJECTIVE OPTIMIZATION**9**

Multi-objective Optimization – Surrogate Worth Trade-off approach – Multi-objective Thermal Power Dispatch sample system – Multi-objective Active and Reactive power Dispatch sample system-
Multi-objective Stochastic Optimal Thermal Power Dispatch : ϵ -constraint method and Surrogate Worth Trade off Method

Unit V NON TRADITIONAL OPTIMIZATION METHODS**9**

Principle, Algorithm, Flowchart –Genetic Algorithm – Particle Swarm Optimization - Tabu search algorithm - Ant colony optimization - Bacteria Foraging optimization - Artificial Bee colony – Cuckoo Search Algorithm.

Text Book:

1. Optimization methods for Engineers By N.V.S. Raju PHI Learning Pvt. Limited, 2014
2. Optimization in Electrical Engineering By Mohammad Fathi,HassanBevrani, Springer , 2019
3. Power System Optimization by D.P.Kothari, J.S.Dhillon, PHI, 2006

Reference Book:

1. Kalyanmoy Deb, “Multi objective optimization using Evolutionary Algorithms”, John Wiley and Sons, 2008.
2. Electric Power Systems Applications of optimization, James A. Momoh,Second Edition, CRC Press, 2009.

19EEH42 INDUSTRIAL INSTRUMENTATION

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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 types- 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.andManik 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, PuneetSawhney, "Course in Mechanical Measurements and Instrumentation and Control", DhanpatRai& 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.

19EEH43 PROCESS CONTROL

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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 Hall of 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 and Sons, second Edition, 2003.

19EEH44 MEMS SENSORS AND ACTUATORS

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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.

Reference Book:

1. Chang Liu, "Foundations of MEMS", Pearson International Edition, 2012.
2. Tai-Ran Hsu, "MEMS and Microsystems Design and Manufacture", McGraw Hill, 2002.
3. Stephen Senturia, "Microsystems Design", Springer, 2006.
4. Marc Madou, "Fundamentals of micro fabrication", CRC Press, 1997.
5. Boston, "Micro machined Transducers Sourcebook", WCB McGraw Hill, 1998.
6. M.H.Bao, "Micromechanical Transducers: Pressure sensors, accelerometers and gyroscopes", Elsevier, New York, 2000
7. Mohamed Gad-el-Hak, editor, "The MEMS Handbook", CRC press Boca Raton, 2001.
8. NadimMaluf," An Introduction to Micro Electro Mechanical System Design", Artech House, 2000

19EEH45 LOGIC AND DISTRIBUTED CONTROL SYSTEMS

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- Data networks protocol.
- Concepts of PLC programming.
- Architecture of Distributed Control Systems.
- Highway Addressable Remote Transducer communication protocols

Course Outcome:

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

- Select a suitable Data link control protocol
- Explicate the Architecture of Programmable Logic Controllers and Supervisory Control and Data Acquisition
- Do simple programs for simple applications using bit logic instructions and timers & counters
- Use Distributed Control System for controlling the various processes in Industries
- Use Highway Addressable Remote Transducer Communication Protocols for process control applications

Unit I DATA NETWORK FUNDAMENTALS**9**

Network hierarchy and switching – ISO/OSI Reference model – Data link control protocol:- HDLC - media access protocol :- Command / response, Token passing and CSMA/CD – TC TCP/IP – Bridges – Routers – Gateways – Standard ETHERNET and ARCNET Configuration.

Unit II PLC AND SCADA**9**

Evolutions of Programmable Logic Controllers (PLCs) – Sequential and Programmable Controllers – Architecture – Comparative study of Industrial PLC – Supervisory Control and Data Acquisition (SCADA):- Hardware and software, Remote terminal units, Master station, Communication architectures and open SCADA protocols.

Unit III PLC PROGRAMMING**9**

PLC Programming: - Ladder logic, Functional block programming, sequential function chart, Instruction list.

Unit IV DISTRIBUTED CONTROL SYSTEM**9**

Distributed Control System (DCS) – Various Architectures – Comparison – Local control unit – Process interfacing issues – Displace study of any one DCS available in market - case studies in DCS.

Unit V HART AND FIELD BUS**9**

Introduction – Evolution of Signal standard – Highway Addressable Remote Transducer (HART) Communication Protocol – Communication Modes – HART Commands – HART Applications Field Bus-Introduction, General field bus Architecture, Basic requirements of Field bus standard, Field Bus topology, Interoperability and Interchangeability – Introduction to OLE for process control(OPC).

Practical Course**0****Text Book:**

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2010
2. Michael P. Lukas, Distributed Control Systems: Their Evaluation and Design, Van Nostrand Reinhold Co., 2016.
3. Clarke, G., Reynders, D. and Wright, E., "Practical Modern SCADA Protocols: DNP3,60870.5 and Related Systems", Newnes, 1st Edition, 2004.

Reference Book:

1. T.A. Hughes, Programmable Controllers, Fourth edition, ISA press, 2005
2. Krishna Kant, Computer Based Industrial Control, Second edition, Prentice Hall of India, New Delhi, 2010
3. John W. Webb and Ronald A. Reis, 'Programmable Logic Controllers, Fifth edition, Prentice Hall of India, New Delhi, 2010
4. John R. Hackworth and Frederick D. Hackworth Jr, Programmable Logic Controllers, Pearson, New Delhi, 2004.
5. Bowten, R "HART Application Guide", HART Communication foundation, 1999.
6. Berge, J., "Field Busses for process control: Engineering, operation, maintenance", ISA press, 2004

19CSH01 ARTIFICIAL INTELLIGENCE FOR ENGINEERS

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about 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 system using AI technologies and expert systems
- Design machine learning model 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 evidences-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-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, 2012.

Reference Book:

1. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson education, Third edition, 2014.
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:

- <http://www.formal.stanford.edu/jmc/whatisai/>
- http://www.sciencedaily.com/news/computers_math/artificial_intelligence/

19CSH02 MACHINE LEARNING USING PYTHON

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
2	2	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, 2012.
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/>
- www.imdb.com
- <https://www.kaggle.com/>

19CSH03

Offered by CSE

NLP TOOLS AND APPLICATIONS

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
2	2	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 familiar with text classification and topic modeling methods
- To work with sentiment analysis and machine translation using python

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
- Classify the text using text classification algorithm and find the recent topic using LSA and LDA
- Find the different emotions and sentiment using sentiment analysis and translate from one natural language to other using machine translation

Unit I INTRODUCTION TO NLP**9**

Natural language processing – History of NLP – Early NLP systems – 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**9**

Introduction and installation of NLTK – Data Pre-processing: Tokenization – Part of Speech (PoS) Tagging - Word Frequency Counting – Stop Words Removal – Text Normalization – Spelling Correction - Stemming – Lemmatization – Named Entity Recognition.

Unit III SYNTACTIC AND SEMANTIC ANALYSIS USING NLTK**9**

Feature Extraction: Building Bag of Words (BoW) Model – Building TF-IDF Model – Word Embeddings using word2vec - Sentence Boundary Detection – Parsing - Lexical Resources: WordNet – FrameNet - Word Synonyms and Antonyms using NLTK – Word Negation Tracking - Word Sense Disambiguation

Unit IV TEXT CLASSIFICATION AND TOPIC MODELING**9**

Introduction to Text Classification – Machine Learning Overview – Classification Metrics – Confusion Matrix – Developing a Text Classifier – Saving and Loading Models - Introduction to Topic Modelling – Topic Discovery – Topic Modelling Algorithms: Latent Semantic Analysis – Latent Dirichlet Algorithms.

Unit V SENTIMENT ANALYSIS AND MACHINE TRANSLATION**9**

Introduction to Sentiment Analysis – Need and Growth of Sentiment Analysis – TextBlob – Understanding Data for Sentiment Analysis – Training Sentiment Models – Introduction to Machine Translation - Problems in Machine Translation - Machine Translation Approaches - Translation involving Indian Languages using Python

Text Book:

1. Ela Kumar, "Natural Language Processing", I.K International, New Delhi 2011.
2. Sohom Ghosh, Dwight Gunning, "Natural Language Processing Fundamentals", Packt Publishing Limited, 2019.
3. Steven Bird, Ewan Klein and Edward Loper, "Natural Language Processing with Python", O'Reilly Media, 1st Edition, 2009.

Reference Book:

1. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
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.
3. 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/>
- <http://ocw.mit.edu/courses/electrical-engineering-and-computer-science>
- <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>

19CSH04 COMPUTER VISION WITH OPENCV

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
2	2	0	3

Course Objective:

To impart knowledge on

- To understand the OpenCV methods to apply the basic operations on images
- To learn about histogram and binary vision
- To study about geometric transformations and edge detection
- To understand various features and recognition techniques
- To study about video tracking and panoramas

Course Outcome:

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

- Apply OpenCV image processing basic operations
- Find the histogram and apply thresholding
- Do edge detection and apply geometric transformations in images
- Extract various features from images
- Create image panorama and track videos

Unit I OPENCV AND BASIC OPERATIONS ON IMAGES**9**

History of OpenCV - Built-in Modules - Setting up OpenCV on Your Computer - Stereo Matching - Homography Estimation in Video - Circle and Line Detection - Image Segmentation - Bounding Box and Circle - Image Inpainting - Displaying Images from Disk in a Window - The cv::Mat Structure - Converting Between Color-spaces - GUI Track-Bars and Callback Functions - ROIs: Cropping a Rectangular Portion out of an Image - Accessing Individual Pixels of an Image - Videos

Unit II IMAGES, HISTOGRAMS, BINARY VISION**9**

Simple pinhole camera model – Sampling – Quantisation – Colour images – Noise – Smoothing – 1D and 3D histograms - Histogram/Image Equalisation - Histogram Comparison - Back-projection - k-means Clustering – Thresholding - Threshold Detection Methods - Variations on Thresholding - Mathematical Morphology - Connectivity

Unit III EDGES AND GEOMETRIC TRANSFORMATIONS**9**

Problem Specification and Algorithm - Affine Transformations - Perspective Transformations - Specification of More Complex Transformations – Interpolation - Modelling and Removing Distortion from Cameras - Edge Detection - Contour Segmentation - Hough Transform

Unit IV FEATURES AND RECOGNITION**9**

Moravec Corner Detection - Harris Corner Detection - FAST Corner Detection – SIFT - Other Detectors - Template Matching - Chamfer Matching - Statistical Pattern Recognition - Cascade of Haar Classifiers - Other Recognition Techniques – Performance

Unit V VIDEO AND PANORAMAS**9**

Moving Object Detection – Tracking - Video Datasets and Formats - Metrics for Assessing Video Tracking Performance – Affine Transformations - Perspective Transformations - Image panorama

Text Book:

1. Kenneth Dawson-Howe, "A Practical Introduction to Computer Vision with OpenCV", Wiley, 2014
2. Samarth Brahmabhatt, "Practical OpenCV", Apress, 2013

Reference Book:

1. Adrian Kaehler, Gary Bradski, "Learning OpenCV 3: Computer Vision in C++ with the OpenCV Library", First Edition, O'Reilly Media, 2017
2. Prateek Joshi, David Millán Escrivá, Vinicius Godoy, "OpenCV by Example", Packt Publishing, 2016.
3. Adrian Rosebrock, "Practical Python and OpenCV", Second Edition, Py Image Search, 2016.

Extensive Reading:

- https://docs.opencv.org/master/d9/df8/tutorial_root.html
- <https://www.geeksforgeeks.org/opencv-c-program-face-detection/>
- https://docs.opencv.org/2.4/doc/tutorials/introduction/display_image/display_image.html

19CSH05 DEEP LEARNING USING TENSOR FLOW

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
2	2	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 WORD EMBEDDING AND RECURRENT NEURAL NETWORKS**9**

Word Embedding fundamentals – Distributed Representations – Static Embeddings: Word2Vec, GloVe – Gensim for creating and exploring embedding space – Neural Embeddings: Item2Vec, node2Vec – 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.

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.
3. Special Issue on deep learning for speech and language processing, IEEE Transaction on Audio, Speech and Language Processing, vol. 18, iss. 5, 2010

Extensive Reading:

- <http://www.deeplearning.net>
- <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/>

19CSH06 KNOWLEDGE REPRESENTATION AND REASONING

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about knowledge representation and FOL
- To study resolution and horn clauses
- To understand the different representation formats
- To dealt with problem of reasoning under uncertainty
- To learn to construct plans of actions

Course Outcome:

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

- Represent knowledge in suitable language format
- Solve a problem using resolution method
- Apply various representation formats to store the knowledge
- Build probabilistic reasoning models to solve uncertainty problems
- Represent planning problems and find the sequence of actions to achieve goals

Unit I INTRODUCTION AND LANGUAGE OF FOL**9**

Key concepts - Knowledge Representation and Reasoning - Role of logic – FOL – Syntax – Semantics – Pragmatics - Explicit and Implicit belief - Expressing Knowledge

Unit II RESOLUTION AND HORN CLAUSES**9**

Propositional case-Handling variables and quantifiers - Dealing with Computational Intractability - Horn clauses - SLD resolution - Computing SLD derivations

Unit III REPRESENTATION**9**

Object oriented representation - Object and Frames - Frame Formalism - Using frames to plan a trip - Structured descriptions - Meaning and entailment - Computing entailment - Taxonomies and classification - Ontological Engineering - Categories and objects - Reasoning systems for categories - Protege tool

Unit IV REASONING**9**

Default Reasoning – Closed - World reasoning – Circumscription - Default logic - Autoepistemic logic -Noncategorical reasoning - Objective probability - Subjective probability - Vagueness

Unit V ACTIONS AND PLANNING**9**

Situation calculus - Simple solution to the frame problem - Complex actions - Planning in the Situation calculus - STRIPS representation - Planning as a reasoning task - Hierarchical planning - Conditional planning

Text Book:

1. Ronald J Brachman, Hector J Levesque, "Knowledge representation and reasoning", Morgan Kaufmann Publishers, 2004.
2. Stuart Russell, Peter Norvig, "Artificial Intelligence: A Modern Approach", Pearson education, Third edition, 2015.

Reference Book:

1. Michael Gelfond, Yulia Kahl, "Knowledge Representation, Reasoning, and the Design of Intelligent Agents: The Answer-set Programming approach", Cambridge University Press, 2014.
2. "Handbook of Knowledge Representation", Editors: Frank van Harmelen Vladimir Lifschitz Bruce Porter, Volume 1, First Edition, Elsevier, 2007.
3. R.J.Brachman, H.J.Levesque, "Readings in Knowledge Representation", Morgan Kaufmann, San Mateo, CA, 1985

Extensive Reading:

- <http://cs227.stanford.edu>
- <http://syllabus.cs.manchester.ac.uk/ugt/2019/COMP34512/>
- https://protege.stanford.edu/publications/ontology_development/ontology101.pdf
- https://cgi.csc.liv.ac.uk/~frank/teaching/comp08/protege_tutorial.pdf
- <https://protegewiki.stanford.edu/wiki/Protege4Pizzas10Minutes>

19MEH01 INTRODUCTION TO PRODUCT DESIGN

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 centred 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" 4th edition, McGraw-Hill, 2009.

Reference Book:

1. Nigel Cross, "Engineering Design Methods – Strategies for Product Design", Wiley, 2005.
2. Philip Kosky, George Wise & Robert Balmer, "Exploring Engineering An Introduction to Engineering and Design", Academic Press, 2009.
3. Ernst Eder, Stanislav Hosnedl, "Introduction to Design Engineering: Systematic creativity and management", CRC Press, 2010.
4. Prasant Kumar, "Product Design-Creativity, Concepts and Usability", PHI Learning Pvt. Ltd., New Delhi, 2012.

Extensive Reading:

- <http://meche.mit.edu/research/design>
- <http://www.everyspec.com>
- <http://www.engineeringtoolbox.com>

19MEH02 ADDITIVE MANUFACTURING PROCESSES

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 – Bio-extrusion – 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 field.

Text Book:

1. Ian Gibson, David Rosen and Brent Stucker, "Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing", Second Edition, Springer, 2015.

Reference Book:

1. Chee Kai Chua, "3D Printing and Additive Manufacturing: Principles and Applications", World Scientific, 2017.
2. Jyothish Kumar, "3D Printing and Additive Manufacturing Technologies", Springer, 2019.
3. Manu Srivastava, "Additive Manufacturing: Fundamentals and Advancements", CRC Press, 2019.

19MEH03 DESIGN FOR ADDITIVE MANUFACTURING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the basics of design for additive manufacturing.
- To demonstrate comprehensive knowledge of part consolidation and tooling design
- To know the design requirements for Metal AM and Polymer AM technique.
- To illustrate the implication of part design on build time and material strength
- To realize 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 ADDITIVE 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**10**

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**8**

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.

19MEH04 REVERSE ENGINEERING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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.

19MEH05 BUSINESS VALUE ENHANCEMENT WITH ADDITIVE MANUFACTURING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn about the sustainable development with additive manufacturing
- To know about the business value enhancement in different industries with additive manufacturing
- To know about the operational values of additive manufacturing and their impact in various processes
- To know about the various factors that are acting as driving force for additive manufacturing techniques
- To know about 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.

19MEH06 STANDARDS, QUALITY CONTROL AND INSPECTION

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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Course Objective:

To impart knowledge on

- To learn about additive manufacturing standards
- To study the material characterization for additive manufacturing
- To know the process control and quality management in additive manufacturing

Course Outcome:

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

- Understand the various additive manufacturing standards.
- Select a suitable additive manufacturing standards for a given application.
- Understand the material characterization and its types for additive manufacturing systems.
- Select a suitable process control for additive manufacturing systems.
- Understand the quality management frame work in additive manufacturing.

Unit I ADDITIVE MANUFACTURING STANDARDS**8**

Introduction to standards for Additive Manufacturing, Importance of standards, Importance of Quality Management, Standards, Quality Control, And measurement Sciences. History of formation of committee for standards. Work plan and roadmap of Joint Committee between ASTM, ISO. Priority areas on Additive Manufacturing Standards, List of different types of Standards for Additive manufacturing (ASTM AM Standards).

Unit II MEASUREMENT SCIENCE AND DATA FORMAT FOR ADDITIVE MANUFACTURING**9**

Introduction to measurement science, challenges, Additive Manufacturing Materials, processes, parts and Uncertainties, Additive Manufacturing Modelling and Simulation, Potentials of Measurement science, typical applications, Data format in Additive Manufacturing – New Developments- Scanning Technology-Contact scanners and Non-contact scanners.

Unit III MATERIAL CHARACTERIZATION FOR ADDITIVE MANUFACTURING**10**

Introduction to Material Characterization –Types. Liquid Materials Characterization Techniques-rheology and wetting behaviour –curing characteristics-liquid density. Solid materials characterization techniques- Filament Diameter Consistency, density, porosity, Moisture content, thermal properties. Micro structure of filament-Mechanical properties. Powder material characterization Techniques-powder size measurements-chemical composition, Flow characteristics.

Unit IV PROCESS CONTROL AND MODELING**9**

Introduction to qualification-Definition and Terms, equipment qualification and general test, Four stages for qualification. Motivation for process control, Monitoring sensors, visual imaging, Thermal sensing, Displacement sensing. Measurand of In-Process Control Research-SLM, EBM, DED, Wire Fed DED. Commercial solutions on process modelling, simufact additive, ESI-Additive Manufacturing, Netfabb Simulation.

Unit V QUALITY MANAGEMENT FRAME WORK IN ADDITIVE MANUFACTURING**9**

Need for Quality management frame work, Leader ship and commitment, planning, Additive Manufacturing support, Additive manufacturing operation, performance Evaluation, PDCA Frame work cycle, Roles of regulatory and certification bodies, Proposed Framework For Additive Manufacturing Implementation-User inputs, product knowledge, Equipment qualification, process knowledge, continuous process verification.

Text Book:

1. Chee Kai Chua , Chee How Wong and Wai Yee Yeong,” Standards, Quality Control, and Measurement Sciences in 3D Printing and Additive Manufacturing”, Singapore Centre for 3D Printing, Academic press, Singapore, 1st Edition, 2017

Reference Book:

1. Ben Redwood, Filemon Schöffner, Brian Garret, “The 3D Printing Handbook: Technologies, Design and Applications”, 3D Hubs, 2017
2. Chee Kai Chua, “3D Printing and Additive Manufacturing: Principles and Applications”, World Scientific, 5th edition, 2017.

19MEH21 FUNDAMENTALS OF ROBOTICS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- To develop a knowledge in basics of robotics.
- To understand the basic homogeneous transformation matrices
- To study the forward and inverse kinematics.
- To know the various sensors and actuators
- To 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.
- Explain about rigid body transformations.
- Describe the forward and inverse kinematics.
- Explain about various robotic sensors and actuators.
- Illustrate end effector motion with an example.

Unit I ROBOT FUNDAMENTALS**7**

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**10**

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**10**

Forward Kinematics - Kinematic Chains - Denavit Hartenberg Representation - Existence and uniqueness issues - 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 - Other Systems.

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) – end effector systems – case study with egg picker.

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

19EEH92 ROBOT MANIPULATOR CONTROL

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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 INTRODUCTION TO ROBOT MANIPULATOR AND MATHEMATICAL MODELLING 9

Introduction – structure of robot manipulator - transfer function approach - State variable representation – Linear state variable system – double integrator system, Non-linear state variable representation of robot manipulator, Equilibrium points and Lyapunov stability theorem.

Unit II ROBOT MANIPULATOR DYNAMICS AND STABILITY 9

Lagrange-Euler Dynamics – Force, Inertia, and Energy - Lagrange's Equations of Motion, Manipulator Dynamics - Dynamics of two-link planar and planar elbow arm – manipulator arm kinematic energy – manipulator arm potential energy – Structure and properties of robot equation.

Unit III COMPUTED-TORQUE CONTROL OF ROBOT MANIPULATOR 9

Path Generation – Converting Cartesian trajectories to Joint space trajectories – polynomial path interpolation – Linear function with parabolic blends – minimum time trajectories, Independent Joint Control – feedback control – decentralised feedback compensation, Computed Torque Control – PD Outer Loop Design - PID Outer Loop Design - PD-Plus-Gravity Controller.

Unit IV ROBUST CONTROL OF ROBOT MANIPULATOR 9

Introduction, Feedback-Linearization Controllers – Lyapunov design – Input-Output design, Dynamic Controllers – Non-linear Controllers - Direct passive controllers – variable structure controllers – saturation type controllers.

Unit V ADAPTIVE CONTROL AND ADAPTIVE ROBUST CONTROL OF ROBOT MANIPULATOR 9

Introduction to Adaptive Control, Computed Torque approach – Approximate computed torque controller - Adaptive computed torque controller, Adaptive Control by an Inertia-Related Approach - Adaptive Inertia-Related Controller, Robot Controllers with Reduced on-line Computation - Desired Compensation Adaptation Law - Repetitive Control Law– Adaptive Robust Control – Compensation for Actuator Dynamics.

Text Book:

1. Frank L Lewis, Darren M. Dawson, Chaouki T.Abdallah, "Robot Manipulator Control – Theory and Practice", Marcel Dekker Inc., 2004

Reference Book:

1. Lorenzo Sciacivco and Bruno Siciliano, "Modelling and Control of Robot Manipulators" Springer, Second edition, 6 December 2012.
2. Reza N. Jazar, "Theory of Applied Robotics- Kinematics, Dynamics, and Control ", Springer International, 2007
3. Moshe Shoham "A Text book of Robotics – Structure Control and Operation" EshedRobotec, 1984

19ECH91 ROBOT OPERATING SYSTEM AND PROGRAMMING

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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>

19ECH92 ARTIFICIAL INTELLIGENCE AND REINFORCEMENT LEARNING

Offered by ECE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 using AI.
- 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. Nagenevsky, "Artificial Intelligence – a guide to intelligent systems" Addison 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>

19MEH22 AUTONOMOUS ROBOTS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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

19MEH23 ROBOTICS IN MANUFACTURING AUTOMATION

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Understanding the applications of robots in Industries.
- Knowing the effect of robots on employment.
- Selection of robot for a given task.
- Understanding the issues in selecting robotic systems for a task.
- Explaining the need for safety in a robotic environment.

Course Outcome:

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

- Understand the fundamentals of Industrial Automation.
- Explain about the various Automation system components.
- Illustrate the present day applications of robots in industries.
- Describe the process of selecting a robot for a specific task.
- Explain about the various issues in implementation of robotics in manufacturing.

Unit I INDUSTRIAL AUTOMATION**9**

Scope and Introduction to Industrial Automation - Evolution of Robots - Development of Robot Applications - Robot Structures - Robot Performance - Robot Selection - Benefits of Robots - Robots Versus Humans and Employment

Unit II AUTOMATION SYSTEM COMPONENTS**9**

Handling Equipment - Vision Systems - Process - Grippers and Tool Changers - Tooling and Assembly Automation Components - System Controls - Safety and Guarding

Unit III APPLICATIONS IN MANUFACTURING**9**

Applications and case studies in the following domains - Arc, spot and laser welding - Painting, Adhesive and sealant dispensing - Mechanical, Waterjet and laser cutting - grinding and deburring - polishing - Casting - Plastic Moulding - Stamping and Forging - Machine Tool Tending - Measurement, Inspection, and Testing - Palletising - Picking and Packing.

Unit IV SOLUTION DEVELOPMENT**9**

Determining Application Parameters - Initial Concept Design - Controls and Safety Design - Testing and Simulation - Refining the Concept.
Functional Elements of a Specification - Scope of Supply - Buy-Off Criteria - Covering Letter for off - specification parts.

Unit V FINANCIAL ISSUES IN IMPLEMENTATION**9**

Financial Analysis - Identifying Cost Savings - Developing the Justification - Need for Appropriate Budgets - Project Planning - Vendor Selection - System Build and Buy-Off - Installation and Commissioning - Operation and Maintenance - Staff and Vendor Involvement - Avoiding Problems

Text Book:

1. Mike Wilson, "Implementation of Robot Systems: An introduction to robotics, automation, and successful systems integration in manufacturing", Butterworth-Heinemann, 1st edition, 2014.
2. Mehta, B. R., Reddy, Y. Jaganmohan, "Industrial process automation systems: design and implementation", Wiley, Elsevier, 2015.

Reference Book:

1. A.K. Gupta, "Industrial Automation and Robotics: An Introduction", Mercury Learning & Information, 2016.
2. Zongwei Luo, "Robotics, Automation, and Control in Industrial and Service Settings", IGI Global, 2015

19MEH41 FUNDAMENTALS OF ELECTRIC AND HYBRID VEHICLES

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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
- Explain hybrid electric vehicle
- Analyse the different types of electric propulsion systems
- Distinguish different concept of energy storage and regenerative braking.
- Explain the 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**1**

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. Mehrdad Ehsani, Yimin Gao, Stefano Longo Kambiz M. Ebrahimi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles", CRS Press, 2018.

Reference Book:

1. Iqbal Husain "Electric and Hybrid Vehicles: Design Fundamentals" CRC Press, 2011.
2. Seref Soylu "Electric Vehicles - The Benefits and Barriers" InTech Publishers, Croatia, 2011.
3. Aulice Scibioh 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 Lory "Electric Vehicle Technology-Explained" John Wiley & Sons Ltd., 2012.

19MEH42 ENERGY STORAGE AND MANAGEMENT FOR ELECTRIC VEHICLES

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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, Jurgen Garche, 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, 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, 2011
4. Seref Soylu "Electric Vehicles - The Benefits and Barriers" InTech Publishers, Croatia, 2011

19EEH93 INTELLIGENT AND AUTONOMOUS VEHICLES

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Advanced vision system in vehicles, Autonomous 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 and Intra Vehicle Communication-VANETS-Devices-Optical Technologies and Millimeter Wave technologies

Unit III ADAPTIVE 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 System Model – System Identification Basics, Recursive Parameter Estimation, Estimator Initialization- Design Of Self-Tuning Controllers –Generalized Minimum Variance (GMV) Control, Pole Placement Control And Model Predictive Control.

Unit IV DECISIONAL ARCHITECTURES FOR AUTONOMOUS VEHICLES**9**

Control Architectures And Motion Autonomy –Deliberative Architectures, Reactive Architectures, Hybrid Architectures-Overview Of Sharp Architecture, Models Of Vehicles-Concepts Of Sensor Based Maneuver, Reactive Trajectory-Following, Parallel Parking, Platooning-Main Approaches To Trajectory Planning, Non-Holonomic Path Planning.

Unit V AUTONOMOUS VEHICLE AND CASE STUDIES**9**

DARPA Challenge Case Study- ARGO Prototype Vehicle- The Gold System-The 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:

- Ljubo Vlacic, Michel Parent and Fumio Harashima, "Intelligent Vehicle Technologies", Butterworth-Heinemann publications, Oxford, 2001-ISBN 0 7506 5093 1
- Ronald K Jurgen, "Automotive Electronics Handbook ", Automotive Electronics Series, SAE, USA, 1998.

Reference Book:

- 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

19MEH43 VEHICLE DYNAMICS AND CONTROL

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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 fundamentals 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 analysis 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.

19MEH44 ELECTRIC VEHICLE DESIGN

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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.

19EEH94 MODELING, SIMULATION AND CONTROL OF ELECTRIC VEHICLES

Offered by EEE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Modelling of Electric motors, Power Converters, Battery and Ultra capacitor.
- control of Electric Drives
- Energy Management Strategies in Hybrid and Electric Vehicles

Course Outcome:

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

- Develop mathematical models of electrical and mechanical systems
- Explain the Modelling of Electric Motors used in Hybrid and Electric vehicle.
- Explicate the Modelling of Power Converters and Battery used in Hybrid and Electric vehicle
- Narrate on controlling of Electric Drives
- Develop Energy Management rules to control Hybrid and Electric vehicle

Unit I SYSTEM MODELLING AND REPRESENTATION**9**

System concepts- Transfer function Modeling of Electrical systems, Mechanical systems (Translational & Rotational systems)- Electrical Analogy of Mechanical Systems – Park and Clark transformation.

Unit II MODELLING OF ELECTRIC MOTORS**9**

Modelling of DC motor- Modelling of Induction motor- Modelling of PMSM- Modelling of BLDC motor

Unit III MODELLING OF POWER CONVERTERS AND BATTERY**9**

Modelling of Buck converter- Modelling of Boost converter- Modelling of Inverter-Modelling of Bidirectional DC- DC converter- Battery Parameters-Modelling of Lithium ion battery

Unit IV CONTROL OF ELECTRIC DRIVES**9**

Scalar control-Field oriented control technique- Direct Torque based control technique-Speed Control of BLDC Motor

Unit V CONTROL SYSTEM FOR HYBRID AND ELECTRIC VEHICLE**9**

Function of the Control System in HEVs and EVs-Energy Management Strategies-Rule and Optimization based Energy management Strategies-EMS based on deterministic Rules

Text Book:

1. SerefSoylu, "Electric Vehicles: Modelling and Simulations", InTech Publications, 2011
2. Wei Liu, "Hybrid Electric Vehicle System Modelling and Control", Second Edition, Wiley Publications, 2017
3. Gopal M, "Control Systems – Principles and Design, Tata McGraw-Hill, New Delhi, 2013

Reference Book:

1. Krishnan R., "Electric Motor & Drives: Modelling, Analysis and Control", Pearson Education, 2015

Extensive Reading:

- <https://nptel.ac.in/courses/108103009/>

19MEH61 BIO ENERGY

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 – Henry Law – Sources and Classification – Mass Balance – Enthalpy – Energy Balance – Properties of Biomass – Thermodynamics and Kinetics of basic chemical reaction, Reaction thermodynamics and Reaction Kinetics Size.

Unit II BIO ENERGY FEEDS**9**

Growing Condition, Yield for the Production of Biofuel Production – Plantation Harvesting and Storage of Feedstock Like Corn – Sweet Potato – Cassava – Soybean – 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 – Butanol fermentation, Substrate and factors affecting – anaerobic digestion, organic conversion and Methane production – Biogas cleaning, upgrading, utilization and digestate – Microbial fuel cell , Electron transfer process, Electrical power and energy generation, Design and Operation.

Unit IV THERMAL CONVERSION TECHNOLOGIES**9**

Biomass Furnaces, Power Generation, 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**

Bio-hydrogen production – Techno-Economic Analysis, Steps, Tools, Software and Data sources – Life Cycle Assessment, Procedure, Tools – Bio Energy Market – Government Policy

Text Book:

1. Yebo Li and Samir Kumar “Bioenergy: Principles and Applications” Wiley-Blackwell, 1st Edition, 2016.

Reference Book:

1. Venkata Ramana 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.

19MEH62 ALTERNATE ENERGY FUELS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To know about different types of alternate fuels.
- To understand 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 environmental condition of earth (N₂, CO₂, CO, NO_x, SO₂, O₂)-Pollution created by Exhaust gas emission 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**9**

Sources 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 percentage blending of Alcohol.

Unit III BIO DIESEL AND SYNTHETIC FUELS**9**

Base materials used for production of Bio Diesel (Karanja 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, Di-Methyl Ether (DME), P-Series, and Eco Friendly Plastic fuels (EPF).

Unit IV HYDROGEN**9**

Hydrogen as a substitute fuel. Properties, sources and methods of production of Hydrogen, Storage and Transportation of hydrogen. 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 systems-combustion characteristics-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.

19MEH63 COMBUSTION ENGINEERING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To develop knowledge in different types of fuels.
- To understand the basics of combustion process

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

Unit V FLAMES AND COMBUSTION APPLIANCES**9**

Limits of inflammability - Velocity of flame propagation – Flame structure - Flame stability – 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.

19MEH64 ANALYSIS AND DESIGN OF AIR CONDITIONING SYSTEMS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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:

- Faye.C.McQuiston, Jerald.D.Parker, Jeffrey.D.Spittler, "Heating, Ventilating, and Air Conditioning – Analysis and Design", Wiley India (P) Ltd, 7th edition, 2011.

Reference Book:

- N.C.Gupta, "Comprehensive HVAC system design", Viva books private limited, 2016.
- Edward.G.Pita, "Air conditioning principles and systems", Pearson India education services pvt. Ltd, 4th edition, 2018.
- P.N.Ananthanarayanan, "Basic refrigeration and air conditioning", McGraw Hill education (India) pvt. Ltd, 4th edition, 2013.

19MEH65 ENERGY AUDIT AND ENVIRONMENT MANAGEMENT

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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

- To know the basics of energy audit and management in electric motors, lightings and electric load management.
- To gain knowledge on boilers and industrial furnaces.
- To know the energy saving strategies on fans, blowers and cooling towers.
- To know the conservative usage of pumps and pumping systems, Refrigeration and Air conditioning
- To 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.

19MEH66 DESIGN OF ENERGY EFFICIENT BUILDINGS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To learn the green buildings concept applicable to modern buildings
- Familiarise students with the basic principles and theories behind the passive technology, construction techniques and to create energy efficient buildings

Course Outcome:

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

- Design energy efficient buildings and suggest the conservation measures.
- Perceive the methods of landscape design and materials
- Learn the techniques of passive cooling in buildings
- Conceive the heat energy involved in building structures
- Integrate the renewable energy systems in the buildings and passive cooling in buildings.

Unit I INTRODUCTION

9

Conventional versus Energy Efficient buildings – Historical perspective - Water – Energy – Indoor Air Quality requirement analysis – Future building design aspects - Thermal comfort conditions - Energy consumption in a building– Criticality of resources and needs of modern living

Unit II LANDSCAPE AND BUILDING ENVELOPES

9

Energy efficient Landscape design - Micro-climates – various methods –water bodies-Building envelope: Building materials, Envelope heat loss and heat gain and its evaluation, Fenestration and shading, Insulation, Design methods and tools

Unit III PASSIVE COOLING OF BUILDINGS

9

Natural Ventilation, Passive cooling and heating- Trombe wall – water wall- Application of wind, water and earth for cooling, evaporative cooling, radiant cooling, shading, paints and cavity walls for cooling; Hybrid Methods – Energy Conservation measures, Thermal analysis of building integrated solar components- passive solar by glazing – Transparent thermal insulation (TTI) – Heat storage by interior building elements.

Unit IV HEAT TRANSMISSION IN BUILDINGS

9

Surface co-efficient: air cavity, internal and external surfaces, overall thermal transmittance, wall and windows; Heat transfer due to ventilation/infiltration, internal heat transfer; Sol-air temperature; Decrement factor; Phase lag. Design of day lighting; Estimation of building loads: Steady state method, network method, numerical method, correlations

Unit V RENEWABLE SOURCES INTEGRATION

9

Introduction of renewable sources in buildings, Roof radiation traps; Earth air tunnel, Solar water heating, small wind turbines, stand-alone PV systems and Hybrid system – Economics, GRIHA - Green Rating for Integrated Habitat Assessment-

Text Book:

1. Mili Majumdar, Energy Efficient Buildings in India, The Energy and Resources Institute (TERI), 2nd edition, 2009.
2. Eicker, Ursula, Energy Efficient Buildings with Solar and Geothermal Resources, John Wiley & Sons, 1st Edition, 2014.

Reference Book:

1. Sustainable Building - Design Manual: sustainable building design practices, The Energy and Resources Institute (TERI), 2004.
2. Krieder, J and Rabi, A., Heating and Cooling of buildings : Design for Efficiency, Mc Graw Hill, 1994.
3. Ursula Eicker, "Solar Technologies for buildings", Wiley publications, 2003.
4. Kumar, Pradeep & Tyagi, Amit Kumar Ed., Managing Energy Efficiently in Hotels and Commercial Buildings, New Delhi Tata Energy Research Institute, 2000.
5. Bansal Nk & Mathur Jyotirmay, Energy Efficient Windows, Anamaya Publishers, 2006.
6. Moncef Krarti, Optimal Design and Retrofit of Energy Efficient Buildings, Communities, and Urban Centers, Elsevier-1st Edition, 2018.

Extensive Reading:

- <https://www.grihaindia.org/>
- <http://www.bee-india.nic.in>

19MEH81 SCHEDULING ALGORITHMS

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 – Neighborhood search – Dynamic programming technique – Branch and Bound algorithm – Non simultaneous arrivals – Minimizing T and F for dependent jobs – Sequence dependent set up times.

Unit III PARALLEL MACHINE SCHEDULING**9**

Preemptive jobs: McNaughton's algorithm – Non preemptive jobs – Heuristic procedures – Minimizing (F_w) : 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 - Despatch 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.

19MEH82 LEAN AND AGILE MANUFACTURING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 and make them understand the various phases involved in the implementations.
- 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 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
- Analyze how lean techniques can be applied to manufacturing & service industry.
- Analyze 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, 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 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. Michael L. George, Lean Six Sigma, McGraw Hill Professional, 2002.
2. Ronald G.Askin and Jeffrey B.Goldberg, Design and Analysis of Lean Production Systems, Wiley; 1 edition, 2007.
3. Rother M. and hook J., Learning to See: Value Stream Mapping to Add Value and Eliminate Muda (Lean Enterprise Institute), Productivity Press, 1 edition, 1999.
4. Gunasekaran A, "Agile Manufacturing, 21st Strategy Competitiveness Strategy", Elsevier Publications, 2001.

19MEH83 SYSTEMS SCIENCE AND ENGINEERING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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).

19MEH84 SERVICES OPERATIONS MANAGEMENT

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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

19MEH85 QUALITY ENGINEERING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 reliability 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- \bar{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 \bar{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- \bar{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

19MEH86 PRODUCTIVITY MANAGEMENT AND RE-ENGINEERING

Offered by MECH (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To introduce the basic principles of Productivity models and the applications of ReEngineering concepts required for various organizations.
- To impart knowledge on various system approach to productivity and organisational transformation.

Course Outcome:

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

- Understand the basic concepts of Productivity and measurement.
- Acquire basic knowledge on various methodology in manufacturing sector.
- Understand the various elements of Organisation transformation and re-engineering fundamentals.
- Acquire knowledge on Various models of Re-engineering.
- Implement BPR tools and techniques for improving the productivity.

Unit I PRODUCTIVITY**9**

Productivity Concepts – Macro and Micro factors of productivity – Dynamics of Productivity - Productivity Cycle
Productivity Measurement at International, National and Organisation level - Productivity measurement models -
Factors influencing productivity-Techniques in improving productivity.

Unit II SYSTEMS APPROACH TO PRODUCTIVITY MEASUREMENT**9**

Conceptual frame work, Management by Objectives (MBO), Performance Objectivated Productivity (POP) –
Methodology and application to manufacturing and service sector.

Unit III ORGANISATIONAL TRANSFORMATION**9**

Elements of Organisational Transformation and Reengineering-Principles of organizational transformation and re-engineering, fundamentals of process re-engineering, preparing the workforce for transformation and re-engineering, methodology, guidelines – DSMC Q & PMP model.

Unit IV RE-ENGINEERING PROCESS IMPROVEMENT MODELS**9**

PMI models, PASIM Model, Moen and Nolan Strategy for process improvement, LMICIP Model, NPRDC Model.

Unit V RE-ENGINEERING TOOLS AND IMPLEMENTATION**9**

Analytical and process tools and techniques – Information and Communication Technology – Implementation of Reengineering Projects – Success Factors and common implementation Problem – Cases.

Text Book:

1. Edosomwan, J.A., "Organisational Transformation and Process Re-engineering", Library Cataloging in Pub. Data, 1996.
2. Premvrat, Sardana, G.D. and Sahay, B.S., "Productivity Management – A Systems Approach", Narosa Publishing House. New Delhi, 1998.

Reference Book:

1. Rastogi, P.N., "Re-engineering and Re-inventing the Enterprise", A.H.Wheeler Pub. New Delhi, 1995.
2. Sumanth, D.J., 'Productivity Engineering and Management', TMH, New Delhi, 1990.
3. Michael Hammer and James Champy, "Re-engineering the corporation – A Manifesto for Business Revolution", Nicholar Barkey Publishing, London, UK, Revised Edition 2006.

19CSH41 DATA SCIENCE FOR ENGINEERS

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
2	2	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>

19CSH42 DATA MINING USING R

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
2	2	0	3

Course Objective:

To impart knowledge on

- Apply various Data manipulation techniques in R to import and export data
- Apply classification and regression techniques in R
- Implement programs of clustering & outlier detection in R
- Build association rules & perform time series forecasting in R
- Explore R for various applications

Course Outcome:

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

- Apply the basics of R programming to perform import & export
- Apply the supervised learning techniques in R
- Use R to perform clustering and to detect outliers
- Explore data analysis for time series and build association rules
- Apply R for text mining and other applications

Unit I BASICS OF R & DATA IMPORT EXPORT**9**

Introduction to Data Mining – Basics of R – Working with Datasets in R – Data Import and Export – Save and Load Data in Different Formats - Data Types – Vectors & operations – Matrices – Arrays – Factors & operations – Data Frames – Subsetting of Data Frames – List – Data Exploration and Visualization

Unit II CLASSIFICATION & REGRESSION**9**

Supervised Learning – Classification – Decision Tree – Working with party and rpart module – Random Forest – Regression – Linear Regression – Logistic Regression – Non Linear Regression

Unit III CLUSTERING & OUTLIER DETECTION**9**

Unsupervised Learning – K-Means Clustering – K-Medoids Clustering – Hierarchical Clustering – Density-based Clustering – Outlier Detection – Univariate Outlier Detection – Detect by Clustering – Time Series – With LOF

Unit IV TIME SERIES & ASSOCIATION RULES**9**

Time Series Data in R – Decomposition – Time Series Forecasting – Time Series Clustering – Time Series Classification – Association Rule Mining – Removing Redundancy – Interpreting Rules – Visualizing Association Rules

Unit V TEXT MINING & SOCIAL NETWORK ANALYSIS**9**

Text Mining – Applications in R – Social Network Analysis – Network of Terms – Network of Tweets – Two-Mode Network – Analysis and Forecasting of House Price Indices - Customer Response Prediction and Profit Optimization

Text Book:

1. Yanchang Zhao, "R and Data Mining: Examples and Case Studies", Academic Press, First Edition, 2013

Reference Book:

1. K.G.Srinivasa, G M Siddesh, Chetan Shetty, "Statistical Programming in R", Oxford University Press, New Delhi, 2017
2. John Chambers, "Software for Data Analysis: Programming with R", Springer; 1st ed. 2008. , 2nd printing 2009 edition
3. Thomas Lumley, "Complex Surveys: A Guide to Analysis Using R", Wiley Series in survey methodology, 2010
4. Nicholas J. Horton, Ken Kleinman, "Using R and RStudio for Data Management, Statistical Analysis, and Graphics", CRC Press, Second edition, 2015
5. John Maindonald, W. John Braun, "Data Analysis and Graphics Using R: An Example-Based Approach", University Press, Cambridge, Third edition, 2010

19CSH43 DATA ANALYTICS USING SPARK

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
2	2	0	3

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 SPARK FOUNDATIONS AND DEPLOYING SPARK**8**

History of Big Data and Hadoop – Apache Spark – Functional Programming using Python – Spark Deployment Modes – Installing Spark: Linux, Mac OS X, Windows – Exploring Spark installation – Deploying Multi-node Spark standalone cluster – Overview of Cloud - Deploying Spark in the Cloud

Unit II SPARK ARCHITECTURE AND PROGRAMMING BASICS**10**

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 - Machine Learning with Spark – Machine Learning Primer – Machine Learning using Spark MLlib: classification, collaborative filtering, implementing recommender – Machine Learning using ML: classification, collaborative filtering, clustering – ML pipelines

Text Book:

1. Jeffrey Aven, "Data and Analytics with Spark Using Python", Pearson Education Inc., 2018.

Reference Book:

1. Wenqiang Feng, "Learning Apache Spark with Python", 2020.
2. Mike Frampton, "Mastering Apache Spark", Fourth Edition, O'Reilly Publications, 2015
3. 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

19CSH44 DATA DRIVEN DECISION MAKING

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- To understand the basics of business analytics
- To learn the algorithm and framework used in various analytics
- To study the fundamentals of descriptive analytics
- To learn the basics of predictive analytics
- To expose the applications of big data analytics

Course Outcome:

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

- Apply various tools for business analytics problems
- Apply machine learning algorithms for decision making problems
- Use descriptive analytics for data visualization
- Solve LP, ILP and MCDM problems for various case studies
- Use the big data analytics for various business applications

Unit I BUSINESS ANALYTICS**9**

Introduction to Business analytics – Importance in modern business decisions – Types of Business Analytics – Descriptive Analytics – Graphical and numerical methods – Predictive analytics – Models – Prescriptive analysis – Analytics Tools - Application and Implementation

Unit II ALGORITHMS AND FRAMEWORK**9**

Big Data Analytics - Web and Social Media Analytics - Machine Learning Algorithms - Framework for Data-Driven Decision Making - Analytics Capability Building – Road map - Challenges in Data-Driven Decision Making and Future

Unit III DESCRIPTIVE ANALYTICS**9**

Introduction to Descriptive Analytics - Data Types and Scales - Types of Data Measurement Scales - Population and Sample - Percentile, Decile and Quartile - Measures of Variation - Measures of Shape – Skewness and Kurtosis - Data Visualization

Unit IV PRESCRIPTIVE ANALYTICS**9**

Introduction to Prescriptive Analytics - Linear Programming - Linear Programming (LP) Model Building - Linear Programming Problem (LPP) Terminologies - Assumptions of Linear Programming - Sensitivity Analysis in LPP - Solving a Linear Programming Problem using Graphical Method - Linear Integer Programming (ILP) - Multi-Criteria Decision-Making (MCDM) Problems

Unit V BIG DATA ANALYTICS FOR BUSINESS INTELLIGENCE**9**

Big Data and Big Data Analytics - Data Science and the Data Scientist – Examples – Big Data Technologies – Cloud Computing - Big Data Analytics Software and Services – Applications – Online Advertising – Recommendation Systems

Text Book:

1. Amar Sahey, "Business Analytics - A Data Driven Decision Making approach for business", Volume I, Business Expert Press, LLC, 2018 (Unit I)
2. U Dinesh Kumar, " Business Analytics : The Science of Data Driven Decision Making", Wiley Publication, 2017 (UNIT II – UNIT IV)

Reference Book:

1. Jay Liebowitz, " Business Analytics", Auerbach Publications, 2013 (UNIT V)

Extensive Reading:

- <https://www.coursera.org/learn/decision-making>
- <https://www.smartsheet.com/data-driven-decision-making-management>
- <https://www.datapine.com/blog/data-driven-decision-making-in-businesses>

19BTH01 HUMAN PHYSIOLOGY

Offered by BT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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. Barrett, K.E., Barman, S.M., Boitans, S., Brook, H., Ganong's Review of Medical physiology, Tata McGrawHill, 23rd Edition (Lange basic science), 2009.

19BTH02 ENZYME - COENZYME CHEMISTRY

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 as 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 V_{max}, K_m, turnover number (K_{cat}), inhibition constant (K_i), dissociation constant (K_D), 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 anhydrase 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, protein 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-ENZYMOLGY 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., Aizawa, 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.

19BTH03 INTRODUCTION TO ECOLOGY AND EVOLUTION

Offered by BT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- To impart knowledge on the major evolutionary radiations.
- Introduce phylogenetics and taxonomy.
- Make students understand the diversification process over the course of evolution in various ecosystems.
- Demonstrate population dynamics, abundance, distribution and regulation with in the ecosystem.
- Explain 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 with in the ecosystem.
- Explain various interaction between communities and ecosystems.

Unit I THE EVOLUTIONARY RADIATIONS**9**

Origin of life: early Earth conditions; self-replicators; RNA world. Bacterial radiation: early Archaean metabolic diversification. Eukaryote radiation. Archaea-Bacteria symbiosis; sex; multicellularity. Metazoan radiation: Ediacaran and Burgess faunas; Hox and body plans. 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. Basal eukaryotes-euglenids-stramenophiles. Green plants-chlorophytes-rhodophytes. Fungi-amoebas. Animals.

Unit III DIVERSIFICATION**9**

The branching process: quasispecies, webs and trees. Phylogenetics: cladistics; estimation of phylogenetic trees. Selection and adaptation: rate of directional change. 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. Population dynamics: exponential and density-regulated populations. 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. Krebs, C.J., Ecology, Benjamin Cummings, 6th edition, 2008.
2. Hall, B.K., Evolution: Principles and Processes, Jones and Bartlett Publishers 1st edition, 2010
3. Levin, A.S., The Princeton Guide to Ecology, Princeton University Press, 1st edition, 2009.
4. 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

19BTH04 REGULATORY ISSUES IN PRODUCTION OF BIOLOGICALS

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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 dichroism, 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>

19BTH05 GENE EDITING TECHNOLOGIES

Offered by BT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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**

Design principle for Genetic Manipulation: Selection of Expression System, Target Sequence and Design of gRNA based on predicted on-target and off-target activity, 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 nanoparticles

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.

19BTH06 TRANSGENIC TECHNOLOGY

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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Course Objective:

To impart knowledge on

- Impart knowledge on the biological methods for creating transgenics.
- Impart knowledge on the physical and chemical methods for creating transgenics.
- Demonstrate the use of transgenics in biological research.
- Demonstrate the applications of transgenic animals.
- Demonstrate the applications for transgenic plants.

Course Outcome:

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

- Demonstrate the biological methods for creating transgenics.
- Describe the physical and chemical methods for creating transgenics.
- Apply transgenics in biological research.
- Explain the applications of transgenic animals.
- Explain the applications for transgenic plants.

Unit I METHODS OF CREATING TRANSGENICS - BIOLOGICAL**9**

Methods of creating transgenic animals - retroviral vectors, engineered embryonic stem cells, Cre-loxP recombination system, RNA Interference, transgenesis with high-capacity vectors. Methods of creating transgenic plants - Agrobacterium-mediated gene transfer, Gateway technology, native gene transfer method, chloroplast transformation.

Unit II METHODS OF CREATING TRANSGENICS – NON-BIOLOGICAL**9**

Physical methods of transformation – Biolistic, electroporation, microinjection, vacuum infiltration, nanotechnological approach, PEG-mediated, liposome-mediated and Silicon-carbide mediated transformation (SCMT).

Unit III TRANSGENICS IN RESEARCH**9**

Transgenic mice: applications, transgenic disease models: Alzheimer disease, amyotrophic Lateral sclerosis, Huntington disease, arthritis, muscular dystrophy, tumorigenesis, hypertension, and coronary disease. Using transgenic mice as test systems, conditional regulation of transgene expression, conditional control of cell death. Ethical, Legal and biosafety issues in working with transgenics.

Unit IV APPLICATIONS OF TRANSGENIC ANIMALS**9**

Cloning livestock by nuclear transfer, transgenic livestock - production of pharmaceuticals, therapeutic protein production in milk, production of donor organs, disease-resistant livestock, improving milk quality, improving animal production traits, transgenic poultry, transgenic fish.

Unit V APPLICATION OF TRANSGENIC PLANTS**9**

Transgenic plants resistant to biotic and abiotic stress, Plant derived vaccines – ETEC, Cholera, Measles, Rabies, HIV, Anthrax. Plantibodies - Plant-derived anti-Lewis Y mAb, anti-anthrax mAb, DoxoRx - cancer therapy, RhinoRx – rhinoviruses, CaroRx. Clinical trials on plant-derived vaccines and antibodies

Text Book:

1. B.R.Glick, J.J.Pasternack & C.L.Pattern 2010 Molecular Biotechnology – Principles and Applications of Recombinant DNA, ASM Press Washington.
2. M.Z.Abdin, U.Kiran, Kamaluddin, A.Ali 2017 Plant Biotechnology: Principles and Applications, Springer Nature Singapore.
3. J.D.Watson, Michael Gilman, J.Witkowski, M.Zoller 1992 Recombinant DNA WH Freeman and Company, NY
4. M.R.Davey, J.R.Soneji, M. Nageswara Rao (auth.), C.Kole, C.H. Michler, A.G. Abbott, T.C. Hall (eds.) 2010 Transgenic Crop Plants: Principles and Development, Springer-Verlag ISBN 10:3642048080 ISBN 13:9783642048081

Reference Book:

1. Eric F. Wagner (Author), F. Theuring (Editor) 1995 Transgenic Animals As Model Systems for Human Diseases, Springer Verlag
2. George C. Khachatourians, Y. H. Hui, Ralph Scorza, Wai-Kit Nip 2002 Transgenic Plants and Crops, CRC Press, 1 edition

19BTH21 MOLECULAR TOXICOLOGY

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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 signalling and receptor mediated toxicity- Ion channels: Receptors linked to protein kinases and phosphatases, intracellular receptors; Second messengers: Signalling to the nucleus, general overview of mechanisms of cell death; Calcium- mediated toxicity: Excitatory amino acid toxicity; Cytokines toxicity; Steroid hormone induced toxicity

Unit II OMICS TECHNIQUES FOR THE STUDY OF TOXICITY**9**

Toxicogenomics, 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.

19BTH22 BIO-TRANSPORT PHENOMENA

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
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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 – oxygen transport in blood oxygenators, bio-artificial organs, and tissue engineered constructs – kLa in bioreactors.

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.

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

Entry routes for drugs- Pharmacokinetic modelling approaches- Factors that affect drug distribution- Drug clearance- drug absorption and elimination models.

Text Book:

1. Fournier, R.L., Basic Transport Phenomena in Biomedical Engineering, CRC press, Taylor & Francis 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.

19BTH23 GOOD LABORATORY AND MANUFACTURING PRACTICES

Offered by BT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Good Laboratory Practices (GLP) facilities
- GLP for Non-Clinical Laboratory Study
- Current Good Manufacturing Practices (cGMP) for Biologicals
- cGMP for Blood and Blood product
- cGMP for Combination product

Course Outcome:

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

- Explain the facilities required to establish and carry out GLP in Pharmaceuticals.
- Describe the GLP for Non-Clinical Laboratory Study
- Explain the cGMP for the production of Biologics
- Describe the cGMP for the production of Blood and Blood product
- Explain the cGMP for the production of Combination product

Unit I GLP – FACILITIES**9**

History of GLP; organization and personnel: testing facility management, study director, quality assurance unit. facilities: animal care facilities, animal supply facilities, standard operating procedures, animal care, facilities for handling test and control articles, laboratory operation areas, specimen and data storage facilities; disqualification of testing facilities : purpose, grounds for disqualification, notice of and opportunity for hearing on proposed disqualification, final order on disqualification, actions upon disqualification, public disclosure of information regarding disqualification, alternative or additional actions to disqualification, suspension or termination of a testing facility by a sponsor.

Unit II GLP – NON CLINICAL LABORATORY STUDY**9**

Test and control articles: test and control article characterization, test and control article handling, mixtures of articles with carriers; protocol for and conduct of a nonclinical laboratory study: protocol, conduct of a nonclinical laboratory study; records and reports: reporting of nonclinical laboratory study results, storage and retrieval of records and data, retention of records.

Unit III CGMP FOR BIOLOGICAL PRODUCT**9**

Scope, personnel, starting and raw materials, seed lot and cell bank, premises and equipment, clean rooms, production, campaign production, labeling, validation, quality control, documentation (lot processing records), use of animal, Pharmaceutical Quality System (PQS) and quality risk management. GMP Guidelines – India, US FDA, EU, WHO.

Unit IV CGMP FOR BLOOD AND BLOOD PRODUCT

Organization and personnel, plant and facilities, equipment, production and process controls- standard operating procedures, plateletpheresis, leukapheresis, and plasmapheresis, additional labeling standards for blood and blood components - labeling, general requirements, container label, circular of information, laboratory controls - laboratory controls, control of bacterial contamination of platelets, compatibility testing, records and reports - records, distribution and receipt; procedures and records, adverse reaction file, reporting of product deviations by licensed manufacturers, unlicensed registered blood establishments, and transfusion services

Unit V CGMP FOR COMBINATION PRODUCT

Definition of combination product, General considerations for cGMP compliance, Application of cGMP requirements to specific types of combination products- Prefilled syringe, Drug-coated mesh, Drug Eluting Stent (DES).

Reference Book:

1. Current Good Manufacturing Practice Requirements for Combination Products; Draft Guidance OCP/CBER/CDER/CDRH/ORA, 2017.
2. WHO good manufacturing practices for biological products, WHO Technical Report Series, No. 999, Annex 2.
3. 21 CFR 58.1 - 58.219 Good Laboratory Practice Regulations effective June 1979, and amended effective October 1987
4. Good Laboratory Practice Regulations, Management Briefings, PostConference Report, 1979.
5. Current good manufacturing practice for finished pharmaceuticals. Code of Federal Regulations Title 21, Vol. 4, revised 1 April 2014. Silver Spring, MD: United States Food and Drug Administration, 2014.
6. Current Good Manufacturing Practice for Blood and Blood Components, Code of Federal Regulations Title 21, Part 606, MD: United States Food and Drug Administration, 2011.
7. EU Guidelines for good manufacturing practice for medicinal products for human and veterinary use. Vol.4, Annex 2, 2013.
8. Joseph D. Nally, (2007), Good Manufacturing Practices for Pharmaceuticals, 6th ed., New York, USA, Informa Healthcare.

9. Andrew A. Signore, and Terry Jacobs, (2005), Good Design Practices for GMP pharmaceutical Facilities, Boca Raton, FL, USA, Taylor & Francis.
10. Shayne C. Gad, (2008), Pharmaceutical Manufacturing Handbook: Regulations and Quality, Hoboken, NJ, USA, Willy Interscience.

Extensive Reading:

- <https://www.fda.gov/drugs/pharmaceutical-quality-resources/current-good-manufacturing-practice-cgmp-regulations>
- <https://www.fda.gov/vaccines-blood-biologics/general-biologics-guidances/cmc-and-gmp-guidances>
- https://ec.europa.eu/health/documents/eudralex/vol-4_en

19CSH91 COMPUTER FUNDAMENTALS FOR BIOLOGICAL DATA REPRESENTATION

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

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

19CSH92 PYTHON AND R PROGRAMMING FOR BIOTECHNOLOGISTS

Offered by CSE (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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, Hierarchical clustering, 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: B00O0RK02
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/>

19BTH41 COMPUTER-AIDED DRUG DESIGN

Offered by BT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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

- Understand 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 in-silico 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 H-bonds 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

19BTH42 MATHEMATICAL MODELING IN BIOLOGY

Offered by BT

(Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

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.

Tutorial: fundamentals of data input and performing mathematical operations, plotting

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.

Tutorial: modeling predator-prey interaction

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, Fitch-Margoliash algorithm, optimality criteria - Maximum Parsimony, bootstrapping; Case Study: "Out-of-Africa" hypothesis of human origins, Florida Dentist AIDS cases.

Tutorial: phylogenetic tree drawing case study

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; modeling cases with multiple population and differentiated infectivity.

Tutorial: Case study for infectious disease model

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

19BTH43 COMPUTATIONAL GENOMICS

Offered by BT (Emerging Area Course offered to BAD, BBE, BBT, BCI, BCS, BEC, BEE, BIT, BME, BRA)

L	T	P	C
3	0	0	3

Course Objective:

To impart knowledge on

- Basic elements of genomic data and databases
- Sequencing genomes and identification of genes
- Features of genome and relationship between genomes
- Relationship between related genomes based on a feature
- Apply the genomic information to solve social medical problems

Course Outcome:

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

- Identify the information content in a genome
- Identify methods of finding sequence features
- Use sequence features and compare genomes
- Draw relationship between sequences
- Design an exploratory set up to solve real-world problems arising from genomic variations

Unit I GENOME, GENOMICS AND DATA**9**

Genome and its anatomy – prokaryotic, eukaryotic, viral and organelle genome; sequence properties – genome size, genome complexity, average base composition, DNA repeats, genes, operon, intron, exon, coding and non-coding mRNA, rRNA and tRNA genes, genomic information: storing and finding data (GenBank, EMBL and DDBJ), specialized genome databases, organism specific databases.

Unit II GENOME SEQUENCING & PREDICTION**9**

Sequencing: Classical Sequencing - Sanger sequencing, top-down and bottom-up approaches of genome sequencing; introduction to next-generation sequencing methods and sequencing pipeline; Probabilistic models of genome sequences – alphabets, sequences, sequence space; models, markov chain, algorithm and the case study of odorant receptor prediction.

Unit III ANNOTATION & COMPARATIVE GENOMICS**9**

Genome Annotation and Statistical Analysis: composition, GC content, change point analysis, k-mer frequency and motif bias, unusual words/motifs and their biological basis, pattern discovery, genome annotation data flow, automation and accuracy; Mitochondria as a model for variation analysis, whole genome comparisons orthologs, paralogs (gene families) and synteny, Genome trees and genomic clock, tree drawing, quantification of natural selection.

Unit IV GENOMIC VARIABILITY & EVOLUTIONARY GENOMICS**9**

Sequence, similarity, homology – paralogs, orthologs, gene-order, gene loss and gene expansion, horizontal gene transfer, minimal gene set concept, phyletic patterns; analysis of genomic context, “rosetta stone”, gene clusters and genomic neighborhood; ancestral life form and evolutionary reconstruction, LUCA, prokaryote-eukaryote origin and novelty in eukaryotes.

Unit V APPLICATIONS OF COMPUTATIONAL GENOMICS**9**

Case study: phylogenetic analysis of the SARS epidemic; Case study: natural selection and the HIV genome; Case study: cancer-risk SNPs, higher order organization of proteins, structural genomics, dynamics of multidomain proteins, target identification of broad-spectrum and pathogen specific drugs.

Text Book:

1. Koonin, E. V. and Galperin, M.Y., (2004) SEQUENCE - EVOLUTION - FUNCTION: Computational approaches in Comparative Genomics, Kluwer Academic Publishers. ISBN 978-1-4419-5321-6
2. Cristianini, N. and Hahn, M. W. (2006) Introduction to Computational Genomics: A Case Studies Approach, Cambridge University Press. ISBN: 978-0-52185-603-4
3. Choudhuri, S. (2014), Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools, Academic Press; 1st edition ISBN: 978-0124104716

Reference Book:

1. Ussery, D. W., Wassenaar, T. M. and Borini, S. (Eds.) (2009), Computing for Comparative Microbial Genomics Springer-Verlag London Limited. ISBN 978-1-84800-254-8
2. Computational Genomics with R (<https://compgenomr.github.io/book/>)