B.Tech. (Computer Science and Business Systems)

2022 Regulations, Curriculum & Syllabi

BANNARI AMMAN INSTITUTE OF TECHNOLOGY
An Autonomous Institution Affiliated to Anna University - Chennai • Approved by AICTE • Accredited by NAAC with "A+" Grade
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Stay Ahead

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VISION OF THE DEPARTMENT

To be a leading center of excellence in computer science education and business technology, empowering students to become highly skilled professionals, innovative problem solvers, and ethical leaders in the rapidly evolving digital world.

MISSION OF THE DEPARTMENT

- To excel in technology and business, fostering innovation, interdisciplinary collaboration and ethical leadership in preparation for a digital future.
- To provide a stimulating environment that encourages creativity, critical thinking, and problem-solving, empowering students to develop solutions and drive industry advancements.
- To cultivate a culture of innovation, risk-taking, and business acumen, enabling our students to launch successful start-ups or contribute to entrepreneurial endeavors.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOS)

I. To perform well in their professional career by acquiring enough knowledge, technical competency in the domain of Computer Science and Business Systems to concord the industry engrossment.

II. To improve communication skills, business management skills, follow professional ethics and involve in team work in their profession.

III. To update themselves in business level innovation with societal consideration.

PROGRAMME OUTCOMES (POS)

Engineering Graduates will be able to:

a. **Engineering knowledge**: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

b. **Problem analysis**: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

c. **Design/Development of Solutions:** Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

d. **Conduct investigations of complex problems**: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

e. **Engineering Tool Usage:** Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

f. **The Engineer and The World:** Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

g. **Ethics:** Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

h. **Individual and Collaborative Team work:** Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

i. **Communication:** Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

j. **Project management and finance**: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

k. **Life-long learning**: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

1. To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

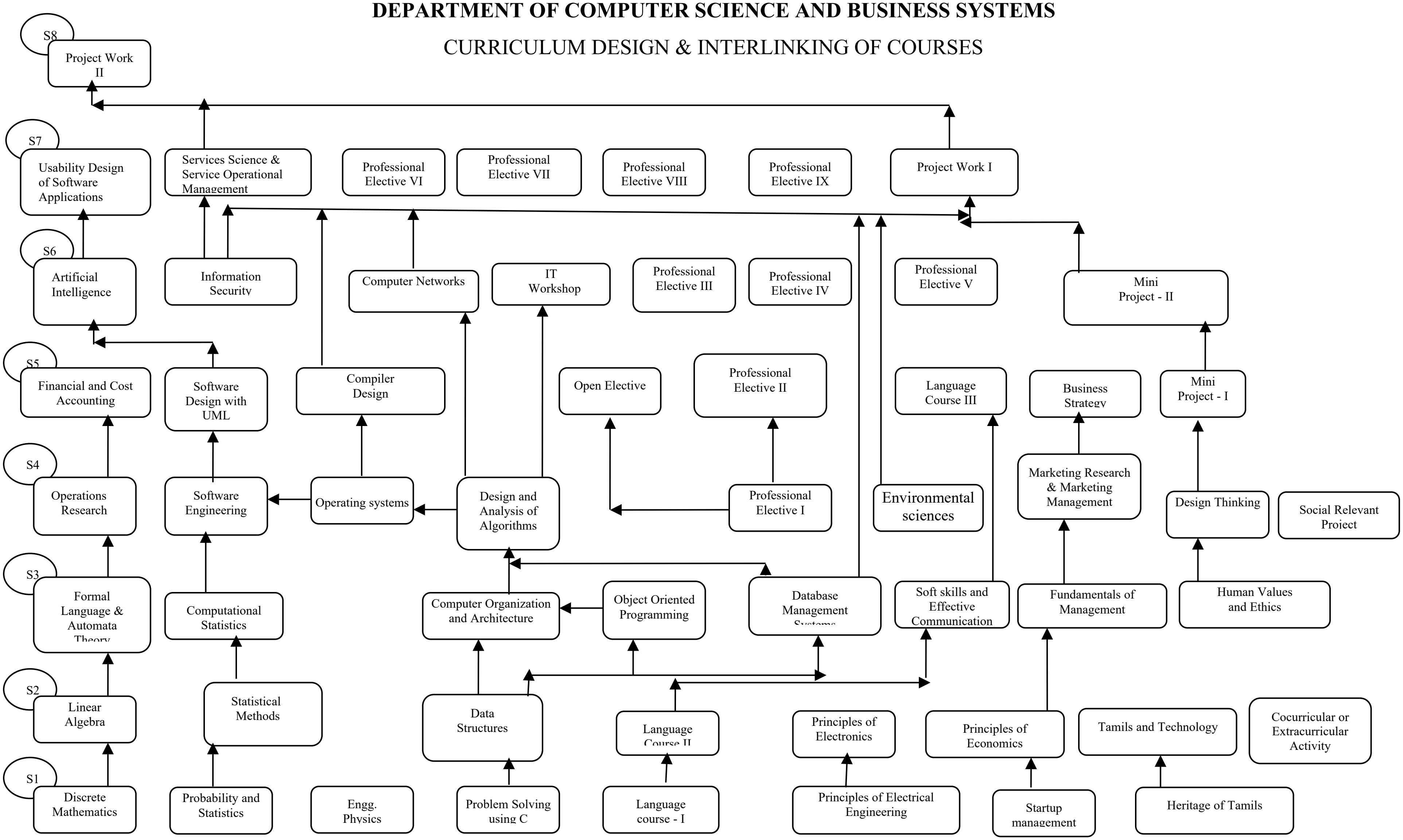
MAPPING OF PEOs AND POs

POs	a	b	c	d	e	f	g	h	i	j	k	l
PEO 1	X	X	X	X	X	X	X					
PEO 2	X	X	X	X	X	X					X	X
PEO 3								X	X	X	X	

CONNECTIVITY CHART

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS

CURRICULUM DESIGN & INTERLINKING OF COURSES



(Candidates admitted during the Academic Year 2024-2025)

DEPARTMENT OF COMPUTER SCIENCE AND BUSINESS SYSTEMS
Minimum Credits to be Earned: 163

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22CB101	DISCRETE MATHEMATICS	3	0	0	3	3	40	60	100	BS
22CB102	PROBABILITY AND STATISTICS	3	0	0	3	3	40	60	100	BS
22CB103	ENGINEERING PHYSICS	2	0	2	3	4	50	50	100	BS
22CB104	PRINCIPLES OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	BS
22HS105	BUSINESS COMMUNICATION AND VALUE SCIENCE - I	1	0	2	2	3	50	50	100	HSS
22CB106	PROBLEM SOLVING USING C	3	0	2	4	5	50	50	100	ES
22HS002	STARTUP MANAGEMENT	1	0	2	2	3	50	50	100	EEC
22HS003*	தமிழர் மரபு HERITAGE OF TAMILS	1	0	0	1	1	100	0	100	HSS
Total		**16**	**0**	**10**	**20**	**26**	**-**	**-**	**-**	**-**

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22CB201	LINEAR ALGEBRA	3	0	0	3	3	40	60	100	BS
22CB202	STATISTICAL METHODS	3	0	0	3	3	40	60	100	BS
22CB203	DATA STRUCTURES	3	0	2	4	5	50	50	100	PC
22CB204	PRINCIPLES OF ELECTRONICS	3	0	2	4	5	50	50	100	ES
22CB205	PRINCIPLES OF ECONOMICS	2	0	0	2	2	40	60	100	ES
22HS206	BUSINESS COMMUNICATION AND VALUE SCIENCE – II	1	0	2	2	3	50	50	100	HSS
22HS006*	தமிழரும் தொழில்நுட்பமும் TAMILS AND TECHNOLOGY	1	0	0	1	1	100	0	100	HSS
22HS009	COCURRICULAR OR EXTRACURRICULAR ACTIVITY	-	-	-	NC	-	100	0	100	HSS
Total		**16**	**0**	**8**	**19**	**24**	**-**	**-**	**-**	**-**

* The Lateral entry students have to complete these courses during III and IV semesters.

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CB301	FORMAL LANGUAGE AND AUTOMATA THEORY	3	1	0	4	4	40	60	100	PC
22CB302	COMPUTER ORGANIZATION AND ARCHITECTURE	3	1	0	4	4	40	60	100	ES
22CB303	OBJECT ORIENTED PROGRAMMING	3	0	2	4	5	50	50	100	PC
22CB304	COMPUTATIONAL STATISTICS	3	0	2	4	5	50	50	100	BS
22CB305	DATABASE MANAGEMENT SYSTEMS	3	0	2	4	5	50	50	100	PC
22CB306	FUNDAMENTALS OF MANAGEMENT	2	0	0	2	2	40	60	100	PC
22HS004	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
22HS005	SOFT SKILLS AND EFFECTIVE COMMUNICATION	0	0	2	1	2	60	40	100	EEC
Total		**19**	**2**	**8**	**25**	**29**	**-**	**-**	**-**	**-**

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CB401	OPERATING SYSTEMS	3	0	2	4	5	50	50	100	PC
22CB402	SOFTWARE ENGINEERING	3	0	2	4	5	50	50	100	PC
22CB403	DESIGN AND ANALYSIS OF ALGORITHMS	3	0	2	4	5	50	50	100	PC
22CB404	DESIGN THINKING	3	0	0	3	3	40	60	100	PC
22CB405	OPERATIONS RESEARCH	2	0	2	3	4	50	50	100	ES
22CB406	MARKETING RESEARCH AND MARKETING MANAGEMENT	2	0	0	2	2	40	60	100	PC
	PROFESSIONAL ELECTIVE I	3	0	0	3	3	40	60	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
22HS010	SOCIALLY RELEVANT PROJECT	-	-	-	NC	-	100	0	100	HSS
Total		**21**	**0**	**10**	**23**	**31**	**-**	**-**	**-**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CB501	COMPILER DESIGN	3	0	2	4	5	50	50	100	PC
22CB502	BUSINESS STRATEGY	2	0	0	2	2	40	60	100	PC
22CB503	SOFTWARE DESIGN WITH UML	2	0	2	3	4	50	50	100	PC
22CB504	FINANCIAL AND COST ACCOUNTING	2	0	0	2	2	40	60	100	PC
22HS505	BUSINESS COMMUNICATION AND VALUE SCIENCE – III	1	0	2	2	3	50	50	100	HSS
	PROFESSIONAL ELECTIVE II	3	0	0	3	3	40	60	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22CB508	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**16**	**0**	**8**	**20**	**24**	**-**	**-**	**-**	**-**

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CB601	COMPUTER NETWORKS	3	0	2	4	5	50	50	100	PC
22CB602	INFORMATION SECURITY	3	0	0	3	3	40	60	100	PC
22CB603	ARTIFICIAL INTELLIGENCE	3	0	2	4	5	50	50	100	PC
22CB604	IT WORKSHOP	2	0	2	3	4	50	50	100	PC
	PROFESSIONAL ELECTIVE III	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE IV	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE V	3	0	0	3	3	40	60	100	PE
22CB608	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**20**	**0**	**8**	**24**	**28**	**-**	**-**	**-**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CB701	USABILITY DESIGN OF SOFTWARE APPLICATIONS	3	0	0	3	3	40	60	100	PC
22CB702	SERVICES SCIENCE AND SERVICE OPERATIONAL MANAGEMENT	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE VI	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE VIII	3	0	0	3	3	40	60	100	PE
	PROFESSIONAL ELECTIVE IX	3	0	0	3	3	40	60	100	PE
22CB707	PROJECT WORK I	0	0	4	2	4	60	40	100	EEC
Total		**18**	**0**	**8**	**21**	**26**	**-**	**-**	**-**	**-**

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CB801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	**-**	**-**	**-**	**-**

ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
VERTICAL 1 DATA SCIENCE										
22CB001	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22CB002	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CB003	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CB004	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CB005	NATURAL LANGUAGE PROCESSING	2	0	2	3	4	50	50	100	PE
22CB006	COMPUTER VISION	2	0	2	3	4	50	50	100	PE
VERTICAL 2 FULL STACK DEVELOPMENT										
22CB007	OBJECT ORIENTED PROGRAMMING USING JAVA	2	0	2	3	4	50	50	100	PE
22CB008	MODERN WEB APPLICATIONS	3	0	0	3	3	40	60	100	PE
22CB009	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CB010	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
22CB011	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22CB012	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
22CB013	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL 3 CLOUD COMPUTING AND DATA CENTRE TECHNOLOGIES										
22CB014	CLOUD, MICROSERVICES AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
22CB015	INTERNET OF THINGS	3	0	0	3	3	40	60	100	PE
22CB016	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
22CB017	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
22CB018	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
22CB019	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
22CB020	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE

VERTICAL 4 ARTIFICIAL INTELLIGENCE, MACHINE LEARNING AND ROBOTICS										
22CB021	MACHINE LEARNING	3	0	0	3	3	40	60	100	PE
22CB022	ROBOTIC PROCESS AUTOMATION	3	0	0	3	3	40	60	100	PE
22CB023	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22CB024	COGNITIVE SCIENCE	3	0	0	3	3	40	60	100	PE
22CB025	PATTERN RECOGNITION	3	0	0	3	3	40	60	100	PE
22CB026	QUANTUM COMPUTING	3	0	0	3	3	40	60	100	PE
VERTICAL 5 MANAGEMENT										
22CB027	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS	3	0	0	3	3	40	60	100	PE
22CB028	FINANCIAL MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CB029	SUPPLY CHAIN MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CB030	IT PROJECT MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CB031	INTRODUCTION TO INNOVATION IP MANAGEMENT AND ENTREPRENEURSHIP	3	0	0	3	3	40	60	100	PE
22CB032	BEHAVIORAL ECONOMICS	3	0	0	3	3	40	60	100	PE
VERTICAL 6 MARKETING										
22CB002	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CB033	DIGITAL MARKETING	3	0	0	3	3	40	60	100	PE
22CB034	CONVERSATIONAL SYSTEMS	3	0	0	3	3	40	60	100	PE
22CB035	SOCIAL TEXT AND MEDIA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CB036	RISK ANALYTICS	3	0	0	3	3	40	60	100	PE
22CB037	ENTERPRISE SECURITY	3	0	0	3	3	40	60	100	PE
VERTICAL 7 DIVERSIFIED COURSES										
22CB038	DATA MINING AND ANALYTICS	3	0	0	3	3	40	60	100	PE
22CB039	BUSINESS COMMUNICATION AND VALUE SCIENCE - IV	2	0	2	3	4	50	50	100	PE
HONOR VERTICAL										
VERTICAL I DATA SCIENCE										
22CBH01	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE

22CBH02	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CBH03	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CBH04	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CBH05	NATURAL LANGUAGE PROCESSING	2	0	2	3	3	40	60	100	PE
22CBH06	COMPUTER VISION	2	0	2	3	3	40	60	100	PE
OPEN ELECTIVE COURSES										
22OCE01	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	3	40	60	100	OE
22OEC01	BASICS OF ANALOG AND DIGITAL ELECTRONICS	3	0	0	3	3	40	60	100	OE
22OEC02	MICROCONTROLLER PROGRAMMING	3	0	0	3	3	40	60	100	OE
22OEC03	PRINCIPLES OF COMMUNICATION SYSTEMS	3	0	0	3	3	40	60	100	OE
22OEC04	PRINCIPLES OF COMPUTER COMMUNICATION AND NETWORKS	3	0	0	3	3	40	60	100	OE
22OEI01	PROGRAMMABLE LOGIC CONTROLLER	3	0	0	3	3	40	60	100	OE
22OEI02	SENSOR TECHNOLOGY	3	0	0	3	3	40	60	100	OE
22OEI03	FUNDAMENTALS OF VIRTUAL INSTRUMENTATION	3	0	0	3	3	40	60	100	OE
22OEI04	OPTOELECTRONICS AND LASER INSTRUMENTATION	3	0	0	3	3	40	60	100	OE
22OME01	DIGITAL MANUFACTURING	3	0	0	3	3	40	60	100	OE
22OME02	INDUSTRIAL PROCESS ENGINEERING	3	0	0	3	3	40	60	100	OE
22OME03	MAINTENANCE ENGINEERING	3	0	0	3	3	40	60	100	OE
22OME04	SAFETY ENGINEERING	3	0	0	3	3	40	60	100	OE
22OBT01	BIOFUELS	3	0	0	3	3	40	60	100	OE
22OFD01	TRADITIONAL FOODS	3	0	0	3	3	40	60	100	OE
22OFD02	FOOD LAWS AND REGULATIONS	3	0	0	3	3	40	60	100	OE
22OFD03	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	OE
22OFD04	CEREAL, PULSES AND OIL SEED TECHNOLOGY	3	0	0	3	3	40	60	100	OE
22OFT01	FASHION CRAFTSMANSHIP	3	0	0	3	3	40	60	100	OE

22OFT02	INTERIOR DESIGN IN FASHION	3	0	0	3	3	40	60	100	OE
22OFT03	SURFACE ORNAMENTATION	3	0	0	3	3	40	60	100	OE
22OPH01	NANOMATERIALS SCIENCE	3	0	0	3	3	40	60	100	OE
22OPH02	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	40	60	100	OE
22OPH03	APPLIED LASER SCIENCE	3	0	0	3	3	40	60	100	OE
22OPH04	BIOPHOTONICS	3	0	0	3	3	40	60	100	OE
22OPH05	PHYSICS OF SOFT MATTER	3	0	0	3	3	40	60	100	OE
22OCH01	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	OE
22OCH02	POLYMER SCIENCE	3	0	0	3	3	40	60	100	OE
22OCH03	ENERGY STORING DEVICES	3	0	0	3	3	40	60	100	OE
22OMA01	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	40	60	100	OE
22OGE02	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	40	60	100	OE
22OGE03	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	40	60	100	OE
22OGE04	NATION BUILDING, LEADERSHIP AND SOCIAL RESPONSIBILITY	3	0	0	3	3	40	60	100	OE
22OBM01	OCCUPATIONAL SAFETY AND HEALTH IN PUBLIC HEALTH EMERGENCIES	3	0	0	3	3	40	60	100	OE
22OBM02	AMBULANCE AND EMERGENCY MEDICAL SERVICE MANAGEMENT	3	0	0	3	3	40	60	100	OE
22OBM03	HOSPITAL AUTOMATION	3	0	0	3	3	40	60	100	OE
22OAG01	RAINWATER HARVESTING TECHNIQUES	3	0	0	3	3	40	60	100	OE
22OEE01	VALUE ENGINEERING	3	0	0	3	3	40	60	100	OE
22OEE02	ELECTRICAL SAFETY	3	0	0	3	3	40	60	100	OE
ONE CREDIT COURSES										
22CB0XA	CRUD OPERATIONS IN MOBILE TECHNOLOGY	1	0	0	1	-	100	0	100	EEC
22CB0XB	AI ON EDGE COMPUTING	1	0	0	1	-	100	0	100	EEC
22CB0XC	CLOUD COMPUTING ON AMAZON WEB SERVICES (AWS)	1	0	0	1	-	100	0	100	EEC

22CB0XD	JAVASCRIPT FOR FULL STACK WEB DEVELOPMENT	1	0	0	1	-	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S.No	Category	Credit per semester								Total Credit	Credits in %	Range of total credits	
		I	II	III	IV	V	VI	VII	VIII			Min	Max
1	BS	12	6	4						22	13	15%	20%
2	ES	4	6	4	3					17	10	15%	20%
3	HSS	3	3	2		2				10	6	5%	10%
4	PC		4	14	17	11	17	7		70	43	30%	40%
5	PE				3	6	6	12		27	17	15%	20%
6	EEC	2		1		1	1	2	10	17	10	5%	10%
Total		21	19	25	23	20	24	21	10	163	100	-	-

ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CIA - Continuous Internal Assessment
SEE - Semester End Examination

22CB101 DISCRETE MATHEMATICS 3 0 0 3

Course Objectives

- Understand the basic concepts of propositions by various discrete structure techniques.
- Analyse the combinatorics techniques in solving the system by various methodology.
- Apply the different differential and integral techniques in solving the real time engineering problems.

Programme Outcomes (POs)

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 with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Formulate short proofs using the following methods: direct proof, indirect proof and proof by contradiction.
2. Represent characteristics of Sets, Group, Ring and Field.
3. Interpret the concepts of Permutations, Combinations and Mathematical induction.
4. Apply the language of graphs and trees to the real world problems.
5. Apply formalised arguments to clarify and assess real-world arguments.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1	1								1	
2	2	3	2	1								1	
3	2	1	3	1								1	
4	2	2	1	3								1	
5	1	2	2	3								1	

UNIT I 9 Hours
BOOLEAN ALGEBRA
Introduction of Boolean algebra, truth table, basic logic gate, basic postulates of Boolean algebra, principle of duality, canonical form, Karnaugh map.

UNIT II 9 Hours
ABSTRACT ALGEBRA
Set, relation, group, ring, field.

UNIT III **9 Hours**

COMBINATORICS

Basic counting, balls and bins problems, generating functions, recurrence relations. Proof techniques, principle of mathematical induction, pigeonhole principle.

UNIT IV **9 Hours**

GRAPH THEORY

Graphs and digraphs, complement, isomorphism, connectedness and reachability, adjacency matrix, Eulerian paths and circuits in graphs and digraphs, Hamiltonian paths and circuits in graphs and tournaments, trees; Planar graphs, Eulers formula, dual of a planer graph, independence number and clique number, chromatic number, statement of Four-color theorem.

UNIT V **9 Hours**

LOGIC

Propositional calculus - propositions and connectives, syntax; Semantics – truth assignments and truth tables, validity and satisfiability, tautology; Adequate set of connectives; Equivalence and normal forms; Compactness and resolution; Formal reducibility - natural deduction system and axiom system; Soundness and completeness.

Total: 45 Hours

Reference(s)

1. I. N. Herstein, Topics in Algebra, John Wiley and Sons, 2015
2. M. Morris Mano, Digital Logic & Computer Design, Pearson.
3. C. L. LiuMcGraw Hill, Elements of Discrete Mathematics, (Second Edition) New Delhi.
4. J. A. Bondy and U. S. R. Murty, Graph Theory with Applications, Macmillan Press, London.
5. L. Zhongwan, Mathematical Logic for Computer Science, World Scientific, Singapore.

22CB102 PROBABILITY AND STATISTICS 3 0 0 3

Course Objectives

- Understand the basic concepts of probability and the distributions with characteristics of one and two dimensional random variables
- Analyze the various data by different statistical sampling techniques.
- Develop enough confidence to identify and model mathematical patterns in real world and offer appropriate solutions, using the skills learned in their interactive and supporting environment.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Demonstrate and apply the basic probability axioms and concepts in their core areas of random phenomena.
2. Execute the concepts of probability distributions in an appropriate place of science and Engineering.
3. Exemplify the basics concepts of statistics through various representations of data.
4. Analyze the various collections of data in science / engineering problems using statistical inference techniques.
5. Apply differential and integral calculus concepts to calculate the area and volume by appropriate vector integral theorems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	1	2								1	
2	2	2	1	2								1	
3	2	2	2	3								1	
4	2	2	3	2								1	
5	1	3	3	2								1	

UNIT I 9 Hours

PROBABILITY AND MOMENTS

Probability: Concept of experiments, sample space, event. Definition of Combinatorial Probability, Conditional Probability, Bayes Theorem. Expected values and moments: mathematical expectation and its properties, Moments (including variance) and their properties, Moment generating function.

UNIT II **9 Hours**

PROBABILITY DISTRIBUTIONS

Discrete Probability distributions: Binomial, Poisson and Geometric distributions. Continuous Probability distributions: Uniform, Exponential, Normal, Chi-square, t and F distributions.

UNIT III **9 Hours**

STATISTICS

Introduction to Statistics: Definition of Statistics. Basic objectives, Applications in various branches of science with examples. Collection of Data: Internal and external data, Primary and secondary Data. Population and sample, Representative sample.

UNIT IV **9 Hours**

DESCRIPTIVE STATISTICS

Descriptive Statistics: Classification and tabulation of uni variate data, graphical representation, Frequency curves. Descriptive measures - central tendency and dispersion. Bivariate data. Summarization, marginal and conditional frequency distribution.

UNIT V **9 Hours**

CALCULUS

Basic concepts of Differential and integral calculus, application of double and triple integral.

Total: 45 Hours

Reference(s)

1. T Veerarajan, Probability, Statistics and Random Processes, Tata Mc Graw Hill Education,4th Edition, 2017
2. S.M.Ross, Introduction to Probability Models,11th Edition, Academic Press, New York,2014.
3. A.Goon, M.Gupta and B.Das Gupta, Fundamentals of Statistics, vol. I & vol.II, World Press Private Ltd.,1968.
4. B.S.Grewal, Higher Engineering Mathematics,43rd Edition, Khanna Publication,Delhi,2014.
5. A.M.Mood, F.A. Graybill and D.C. Boes, Introduction to the Theory of Statistics,3rd Edition, Tata Mc Graw Hill Education,1973

22CB103 ENGINEERING PHYSICS 2 0 2 3

Course Objectives

- Understand the characteristics of simple and damped harmonic motion and illustrate the interference, diffraction and polarization of light.
- Exemplify the dual nature of matter and apply the Schrodinger wave equation to determine the wave function of particle in one dimensional box and assess the crystallographic parameters of seven crystal systems.
- Compare the different types of lasers based on pumping method, active medium and energy levels and analyze the laws of thermodynamics and different thermodynamic processes.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Explain the different types of harmonic oscillations and compare electrical oscillator with mechanical oscillator.
2. Illustrate the interference, diffraction and polarization of light in Newton's rings, diffraction grating and double refraction respectively.
3. Apply the concepts of quantum mechanics to solve the Schrodinger time dependent and time independent wave equations.
4. Assess the crystallographic parameters of seven crystal systems and compare the unit cell characteristics of SC, BCC, FCC and HCP crystal structures.
5. Outline the different types of lasers and compare the different types of optical fibers based on mode and refractive index profile for data communication system.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2										1	
2	2	2						2				2	
3	2	2						2				1	
4	2	2						2					
5	2	2						2					

UNIT I 6 Hours

OSCILLATIONS

Periodic motion-simple harmonic motion-characteristics of simple harmonic motion-vibration of simple springs mass system. Resonance-definition., damped harmonic oscillator - heavy, critical and light damping, energy decay in a damped harmonic oscillator, quality factor, forced mechanical and electrical oscillators

UNIT II **6 Hours**

PHYSICAL OPTICS

Interference-principle of superposition-young's experiment: Theory of interference fringes-types of interference - Fresnel's prism-Newton's rings, Diffraction-Two kinds of diffraction - Difference between interference and diffraction-Fresnel's half period zone and zone plate-Fraunhofer diffraction at single slit-plane diffraction grating. Temporal and Spatial Coherence. Polarization of light: Polarization - Concept of production of polarized beam of light from two SHM acting at right angle; plane, elliptical and circularly polarized light, Brewster's law, double refraction.

UNIT III **6 Hours**

SEMICONDUCTOR AND ELECTROMAGNETISM

Conductor-Semiconductor-Insulator; Basic concept of Band theory. Basic Idea of Electromagnetisms: Continuity equation for current densities- Maxwell's equation in vacuum and non-conducting medium.

UNIT IV **6 Hours**

LASER AND FIBER OPTICS

Einstein's theory of matter radiation interaction and A and B coefficients; amplification of light by population inversion, different types of lasers: Ruby Laser, CO2 and Neodymium lasers; Properties of laser beams: mono-chromaticity, coherence, directionality and brightness, laser speckles, applications of lasers in engineering. Fiber optics and Applications, Types of optical fibers

UNIT V **6 Hours**

THERMODYNAMICS

Zeroth law of thermodynamics- first law of thermodynamics - brief discussion on application of first law- second law of thermodynamics and concept of Engine- entropy- change in entropy in reversible and irreversible processes.

EXPERIMENT 1 **4 Hours**

Evaluate the elastic nature of different solid materials for modern industrial applications like shock absorbers of vehicles.

EXPERIMENT 2 **4 Hours**

Analyze the photonic behaviour of thin materials for advanced optoelectronic applications like adjusting a patient's head, chest and neck positions as a medical tool.

EXPERIMENT 3 **4 Hours**

Assess the Hall Effect behaviour in material characterizations like number carrier concentration, mobility and type of charge carriers in various metals and semiconductor.

EXPERIMENT 4 **4 Hours**

Investigate the light induced electron emission effect in light sensor applications like conveyer belt, automatic door closer and bar code scanner.

EXPERIMENT 5 **4 Hours**

Measure the characteristics of laser light for modern industrial applications like navigation, Medicine and imaging.

EXPERIMENT 6 **5 Hours**

Analyse the fiber optic cable parameters in the field of communications like internet connectivity (Fiber-to-the-home), medical imaging techniques like endoscopy.

EXPERIMENT 7 **5 Hours**

Evaluate the magnetic field strength for medical and industrial applications like MRI and Magnetic levitation train respectively.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Basics of laser physics: for students of science and engineering http://www.springer.com/978-3-319- 50650-0
2. AjoyGhatak, Optics, 5th Ed., Tata McGraw Hill, 2012
3. Arthur Beiser, Shobhit Mahajan and S Rai Choudhury, Concepts of Modern Physics, 6th Edition, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 2014
4. B. K. Pandey and S. Chaturvedi, Engineering Physics, 1st edition, Cengage Learning India Pvt Ltd., New Delhi, 2017.
5. Halliday and Resnick, Fundamentals of Physics, 11 th edition, John Wiley and Sons, Inc, 2018

22CB104 **PRINCIPLES OF ELECTRICAL ENGINEERING** **2 0 2 4**

Course Objectives

- To understand the basic concepts of electric circuits
- To understand the basic concepts of magnetic circuits.
- To identify the types of sensors and measure quantities in AC and DC systems

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems..

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Understand the basic concepts and terminology of electrical quantities
2. Analyze the DC circuit using various network theorems
3. analyze the electrical parameters of AC circuits with R-L-C elements.
4. Analyze the Static and dynamic characteristics of Electro-static and Electromagnetic fields.
5. Apply the concept of sensors in measurement of various electrical quantities

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2										1	1
2	2	2		2									1
3	2	2		2									1
4	2	2		2									1
5	2	2	2		2							1	2

UNIT I **6 Hours**

INTRODUCTION

Fundamental linear passive and active elements to their functional current-voltage relation, voltage source and current sources, ideal and practical sources, Kirchhoff-s laws and applications to network solutions using mesh and nodal analysis, Concept of work, power, energy, and conversion of energy.

UNIT II **6 Hours**

BASIC NETWORKS

Current-voltage relations of the electric network by mathematical equations to analyze the network (Thevenin's theorem, Nortons Theorem, Maximum Power Transfer theorem) Simplifications of networks using series-parallel, Star/Delta transformation. Superposition theorem.

UNIT III **6 Hours**

CONCEPT OF AC Circuits

AC waveform definitions, form factor, peak factor, phasor representation in polar and rectangular form, concept of impedance, admittance, complex power, power factor, single phase and three phase concept.

UNIT IV **6 Hours**

ELECTROSTATICS AND ELECTRO-MECHANICS

Electrostatic field, electric field strength, concept of permittivity in dielectrics, energy stored in capacitors, charging and discharging of capacitors. Electro Magnetism, magnetic field and Faradays law. Magnetic materials and B-H curve. Self and mutual inductance, Amperes law, Study of R-L, R-C, RLC series circuit, R-L-C parallel circuit. Electromechanical energy conversion.

UNIT V **6 Hours**

MEASUREMENTS AND SENSORS

Measuring devices/sensors and transducers (Piezoelectric and thermo-couple) related to electrical signals, Elementary methods for the measurement of electrical quantities in DC and AC systems (Current & Single-phase power). Concept of indicating and integrating instruments.

EXPERIMENT 1 **6 Hours**

Design and build a simple godown wiring circuit with MCB, LED tube light, remote controlled ceiling fan, exhaust fan, calling bell and three phase induction motor.

EXPERIMENT 2 **6 Hours**

Design and implement a circuit to measure room temperature.

EXPERIMENT 3 **6 Hours**

Design and implement a simple audio amplifier circuit.

EXPERIMENT 4 **6 Hours**

Design and build a simple flash light circuit used for cameras.

EXPERIMENT 5 **6 Hours**

Design and implement speed controller for a three-phase induction motor for Textile mills.

Total: 30 + 30 = 60 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010
3. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010
4. Muthusubramanian & Salivahanan, Basic Electrical and Electronics Engineering and Communication Engineering, Seventh Edition, Tata McGraw Hill Education Private Limited, 2011
5. William H. Hayt, Jr. John A. Buck, Engineering Electromagnetics, McGraw Hill Higher Education, 8th revised Edition, 2011.
6. K. A. Gangadhar, P.M. Ramanathan, Electromagnetic Field Theory, Khanna Publishers, Sixteenth Edition, 2011.

22HS105 BUSINESS COMMUNICATION AND VALUE SCIENCE - I 1 0 2 2

Course Objectives

- Augment students overall communication and interpersonal skills by engaging them in group activities and thus aid in helping them to emerge as professionals.
- Focus on the development of basic fluency in English, usage of words and also introduce them to the concept and importance of interpersonal skills so as to effectively present their personalities.

Programme Outcomes (POs)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Speak fluently in English without errors in tenses and hence present themselves as effective English communicators. They will be able to learn the 12 tenses and use them appropriately.
2. Differentiate between active and passive vocabulary and be able to use the 60 words discussed in class for their daily conversation and 40 words also given as assignments
3. The ability to process their ideas and thoughts (verbal communication) into written communication in an effective, coherent and logical manner within a stipulated time and specific word limit of 100-150 words for paragraph writing
4. Present them in a certain manner by using the 50-55 phrases discussed in class appropriately for group discussions, personal interviews during the campus recruitment process/competitive exams.
5. Enhance their communication skills by acquainting with the 2 important aspects of communication and helping them to overcome the 10 most common barriers of communication.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1								1				1	
2								2				1	
3								3				1	
4									1	1		1	
5									2	2		1	

UNIT I **3 Hours**

ESSENTIAL GRAMMAR I

Tenses: Basic forms and use, sentence formation (general & Technical), Common errors, Parts of speech through context, Direct and reported speech structures and voices. Vocabulary Enrichment: Exposure to words from General Service List (GSL) by West, Academic word list (AWL) technical specific terms related to the field of technology, phrases, idioms, significant abbreviations formal business vocabulary Phonetic: Pronunciation, Reduction of MTI in spoken English, Question formation with emphasis on common errors made during conversation

UNIT II **3 Hours**

WRITTEN COMMUNICATION-I

Letter Writing -Formal and Informal letter writing, application letters, Report writing academic and business report, Job application letter

UNIT III **3 Hours**

COMMUNICATION SKILLS

Importance of effective communication, types of communication- verbal and non - verbal, barriers of communication, effective communication, Listening Skills: Law of nature- Importance of listening skills, Difference between listening and hearing, Types of listening.

UNIT IV **3 Hours**

SELF - AWARENESS

Self - Assessment, Self - Appraisal, SWOT, Goal setting - Personal & career- Self-Assessment, Self-Awareness, Perceptions and Attitudes, Positive Attitude, Values and Belief Systems, Self-Esteem, Self - appraisal, Personal Goal setting, Career Planning, Personal success factors, Handling failure, Depression and Habit, relating SWOT analysis & goal setting, and prioritization. Socio-Cultural and Cross-Cultural Sensitivities at the Workplace: What is Inclusion? Women's contributions in Industry, work issues faced by women, what is sexual harassment, what is appropriate behavior for everyone at work

UNIT V **3 Hours**

INTERPERSONAL SKILLS I

Team work, Team effectiveness, Group discussion, Decision making - Team Communication. Team, Conflict Resolution, Team Goal Setting, Team Motivation Understanding Team Development, Team Problem Solving, Building the team dynamics. Multicultural team activity
Time Management: The Time management matrix, apply the Pareto Principle (80/20 Rule) to time management issues, to prioritize using decision matrices, to beat the most common time wasters, how to plan, how to handle interruptions, to maximize your personal effectiveness, how to say no to Time wasters Values of a good manager: Understanding Corporate Values and behavior; Personal / Human Values; Pride and grace in Nationalist

EXPERIMENT 1 **2 Hours**

Self-Introduction

EXPERIMENT 2 **2 Hours**

Likes, Dislikes, and Social goals (strengths, ambition)

EXPERIMENT 3 **2 Hours**

Offering opinions (GD, disagreeing politely, accepting opinions)

EXPERIMENT 4 **2 Hours**

Asking questions (Formal writing, formal events)

EXPERIMENT 5 **2 Hours**

Answering questions (politeness markers)

EXPERIMENT 6 **2 Hours**

Asking permission (leave, OD)

EXPERIMENT 7 **2 Hours**

Communication etiquette (Telephone, E-mail

EXPERIMENT 8 **2 Hours**

Banks/ Reservation/ Application forms (Travel) (why would you like to join the course? Self-expression- Writing

EXPERIMENT 9 **2 Hours**

Constructive criticism, respond to compliment

EXPERIMENT 10 **2 Hours**

Convincing (Interactive group game) and persuading (literature, Debate)

EXPERIMENT 11 **2 Hours**

Accepting

EXPERIMENT 12 **2 Hours**

Narration with Discourse Markers and connectives (offer a commentary on a research project, compare and contrast-writing skills)

EXPERIMENT 13 **2 Hours**

Description with describing markers (story mapping, mind mapping, create a web page to sell own product, write food, film reviews, creating hashtags)

EXPERIMENT 14 **2 Hours**

Public events (MoC, Welcome address, Vote of Thanks, Body Language

EXPERIMENT 15 **2 Hours**

Seminar/ Presentation

Total: 15 + 30 = 45 Hours

Reference(s)

1. Business Communication Dr. Saroj Hire math
2. English vocabulary in use Alan McCarthy and Dell
3. Strategic Writing by Charles Marsh
4. The Seven Basic Plots by Christopher Booker

22CB106 **PROBLEM SOLVING USING C** **3 0 2 4**

Course Objectives

- Understand the basics of problem-solving methods and programming languages.
- Gain knowledge about the different primitive and user defined data types
- Impart knowledge about the structural programming concepts

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Explore the basics of problem solving.
2. Develop programs using control statements.
3. Implement the concepts of functions.
4. Exemplify the concepts of Arrays and pointers.
5. Explore the concepts of structures and basics of linux system interface.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2			2								2
2	1	2			2								2
3	1	2			2								1
4	1	2			2								2
5	1	2			2								1

UNIT I **9 Hours**

GENERAL PROBLEM SOLVING CONCEPTS AND IMPERATIVE LANGUAGE

Algorithm, and Flowchart for problem solving with Sequential Logic Structure, Decisions and Loops. Imperative languages: Introduction to imperative language; syntax and constructs of a specific language (ANSI C) .Types Operator and Expressions with discussion of variable naming and Hungarian Notation: Variable Names, Data Type and Sizes (Little Endian Big Endian), Constants, Declarations, Arithmetic Operators, Relational Operators, Logical Operators, Type Conversion, Increment Decrement Operators, Bitwise Operators, Assignment Operators and Expressions, Precedence and Order of Evaluation, proper variable naming and Hungarian Notation

UNIT II **9 Hours**

CONTROL FLOW WITH DISCUSSION ON STRUCTURED AND UNSTRUCTURED PROGRAMMING

Statements and Blocks, If-Else-If, Switch, Loops while, do, for, break and continue, Goto Labels, structured and un- structured programming.

UNIT III **9 Hours**

FUNCTIONS AND PROGRAM STRUCTURE WITH DISCUSSION ON STANDARD LIBRARY

Basics of functions, parameter passing and returning type, C main return as integer, External, Auto, Local, Static, Register Variables, Scope Rules, Block structure, Initialization, Recursion, Preprocessor, Standard Library Functions and return types

UNIT IV **9 Hours**

POINTERS AND ARRAYS

Pointers and address, Pointers and Function Arguments, Pointers and Arrays, Address Arithmetic, character Pointers and Functions, Pointer Arrays, Pointer to Pointer, Multi-dimensional array and Row/column major formats, Initialisation of Pointer Arrays, Command line arguments, Pointer to functions, complicated declarations and how they are evaluated.

UNIT V **9 Hours**

STRUCTURES

Basic Structures, Structures and Functions, Array of structures, Pointer of structures, Self-referral Structures, Table look up, Typedef, Unions, Bit-fields Input and Output: Standard I/O, Formatted Output printf, Formated Input scanf, Variable length argument list, file access including FILE structure, fopen, stdin, sdtout and stderr, Error Handling including exit, perror and error.h, Line I/O, related miscellaneous functions

EXPERIMENT 1 **4 Hours**

Develop a C program for generating the electricity bill using Decision making and looping statements.

EXPERIMENT 2 **5 Hours**

Construct a C program to store and display the temperature reading on each floor of 5 storey building using Array concepts.

EXPERIMENT 3 **4 Hours**

Write a C program to count the total number of words translated by a language translator using Strings.

EXPERIMENT 4 **4 Hours**

Develop a C program to calculate the area of different geometric shapes using function and recursive function.

EXPERIMENT 5 **4 Hours**

Write a C program to generate and print the first “n” terms of the Fibonacci series, and convert mile to kilometre conversion with a number from Fibonacci series using Pointers.

EXPERIMENT 6 **4 Hours**

Design a program to computerize and automate the operations performed in a library over the information about the book name, Author, ISBN, price using the structure concept.

EXPERIMENT 7 **5 Hours**

Construct a C program to move or copy the contents of a file to another file in a computer system to backup the required documents.

Total: 45 + 30 = 75 Hours

Reference(s)

1. Herbert Schildt, C: The Complete Reference, Fourth Edition, McGraw Hill, 2017.
2. Yashavant Kanetkar, Let Us C, Sixteenth Edition, BPB Publications, 2017.
3. B. W. Kernighan and D. M. Ritchi, The C Programming Language, Second Edition, PHI, 1998
4. B. Gottfried, Programming in C, Third Edition, Schaum's Outline Series, 2017.

22HS002	**STARTUP MANAGEMENT**	**1 0 2 2**

Course Objectives

- Promote entrepreneurial spirit and motivate to build startups.
- Provide insights on markets and the dynamics of buyer behaviour.
- Train to develop prototypes and refine them to a viable market offering.
- Support in developing marketing strategies and financial outlay.
- Enable to scale up the porotypes to commercial market offering.

Programme Outcomes (POs)

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

Course Outcomes (COs)

1. Generate valid and feasible business ideas
2. Create Business Model Canvas and formulate positioning statement
3. Invent prototypes that fulfills an unmet market need
4. Formulate business strategies and create pitch decks
5. Choose appropriate strategies for commercialization

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1							1	2	1				
2							2	2	1	1			
3							3	3	1	2			
4							1	3	1	2			
5								2	3	2			

UNIT I **3 Hours**

BUSINESS MODELS AND IDEATION

Startups: Introduction, Types of Business Modes for Startups. Ideation: Sources of Ideas, Assessing Ideas, Validating Ideas, Tools for validating ideas, Role of Innovation and Design Thinking

UNIT II **3 Hours**

UNDERSTANDING CUSTOMERS

Buyer Decision Process, Buyer Behaviour, Building Buyer Personas, Segmenting, Targeting and Positioning, Value Proposition (Business Model Canvas), Information Sourcing on Markets, Customer Validation

UNIT III **3 Hours**

DEVELOPING PROTOTYPES

Prototyping: Methods-Paper and Digital, Customer Involvement in Prototyping, Product Design Sprints, Refining Prototypes

UNIT IV **3 Hours**

BUSINESS STRATEGIES AND PITCHING

Design of Marketing Strategies and Campaigns, Go-To-Market Strategy, Financial KPIs Financial Planning and Budgeting, Assessing Funding Alternatives, Pitching, Preparing Pitch Decks

UNIT V **3 Hours**

COMMERCIALIZATION

Implementation: Prototype to Commercialization, Test Markets, Institutional Support, Registration Process, IP Laws and Protection, Legal Requirements, Type of Ownership, Building and Managing Teams, Defining role of investors

EXPERIMENT 1 **1 Hours**

Analysis of various business sectors

EXPERIMENT 2 **2 Hours**

Developing a Design Thinking Output Chart

EXPERIMENT 3 **1 Hours**

Creating Buyer Personas

EXPERIMENT 4 **3 Hours**

Undertake Market Study to understand market needs and assess market potential

EXPERIMENT 5 **2 Hours**

Preparation of Business Model Canvas

EXPERIMENT 6 **15 Hours**

Developing Prototypes

EXPERIMENT 7 **2 Hours**

Organizing Product Design Sprints

EXPERIMENT 8 **2 Hours**

Preparation of Business Plans

EXPERIMENT 9 **2 Hours**

Preparation of Pitch Decks

Total: 15 + 30 = 45 Hours

Reference(s)

1. Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Penguin Random House India, 2020
3. Ronnie Screwvala, Dream with Your Eyes Open: An Entrepreneurial Journey, Rupa Publications, 2015

4. Stephen Carter, The Seed Tree: Money Management and Wealth Building Lessons for Teens, Seed Tree Group, 2021
5. Kotler Philip, Marketing Management, Pearson Education India, 15th Edition
6. Elizabeth Verkey and Jithin Saji Isaac, Intellectual Property, Eastern Book Company, 2nd Edition, 2021

22HS003	**HERITAGE OF TAMILS**	**1 0 0 1**

Course Objectives

- Describe the linguistic diversity in India, highlighting Dravidian languages and their features.
- Summarize the evolution of art, highlighting key transitions from rock art to modern sculptures.
- Examine the role of sports and games in promoting cultural values and community bonding.
- Discuss the education and literacy systems during the Sangam Age and their impact.
- Outline the importance of inscriptions, manuscripts, and the print history of Tamil books in preserving knowledge and culture.

Program Outcomes(POs)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

Course Outcomes (COs)

1. Understand the concept of language families in India, with a focus on Dravidian languages.
2. Trace the evolution of art from ancient rock art to modern sculptures in Tamil heritage.
3. Identify and differentiate various forms of folk and martial arts in Tamil heritage.
4. Understand the concepts of Flora and Fauna in Tamil culture and literature.
5. Evaluate the contributions of Tamils to the Indian Freedom Struggle.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO12	PSO1	PSO2
1								2	3				
2								2	3				
3								2	3				
4								2	3				
5								2	3				

UNIT I **3 Hours**

LANGUAGE AND LITERATURE

Language Families in India - Dravidian Languages – Tamil as a Classical Language – Classical Literature in Tamil – Secular Nature of Sangam Literature – Distributive Justice in Sangam Literature - Management Principles in Thirukural - Tamil Epics and Impact of Buddhism & Jainism in Tamil Land - Bakthi Literature Azhwars and Nayanmars - Forms of minor Poetry - Development of Modern literature in Tamil - Contribution of Bharathiyar and Bharathidhasan.

UNIT II **3 Hours**

HERITAGE - ROCK ART PAINTINGS TO MODERN ART – SCULPTURE

Hero stone to modern sculpture - Bronze icons - Tribes and their handicrafts - Art of temple car making - Massive Terracotta sculptures, Village deities, Thiruvalluvar Statue at Kanyakumari, Making of musical instruments - Mridhangam, Parai, Veenai, Yazh and Nadhaswaram - Role of Temples in Social and Economic Life of Tamils.

UNIT III **3 Hours**

FOLK AND MARTIAL ARTS

Therukoothu, Karagattam, Villu Pattu, Kaniyan Koothu, Oyillattam, Leather puppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV **3 Hours**

THINAI CONCEPT OF TAMILS

Flora and Fauna of Tamils & Aham and Puram Concept from Tholkappiyam and Sangam Literature - Aram Concept of Tamils - Education and Literacy during Sangam Age - Ancient Cities and Ports of Sangam Age - Export and Import during Sangam Age - Overseas Conquest of Cholas.

UNIT V **3 Hours**

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

Contribution of Tamils to Indian Freedom Struggle - The Cultural Influence of Tamils over the other parts of India – Self-Respect Movement - Role of Siddha Medicine in Indigenous Systems of Medicine – Inscriptions & Manuscripts – Print History of Tamil Books.

Total: 15 Hours

Reference(s)

1. Dr.K.K.Pillay , Social Life of Tamils, A joint publication of TNTB & ESC and RMRL.
2. Dr.S.Singaravelu, Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr.S.V.Subatamanian, Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr.M.Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies.
5. Keeladi, Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
6. Dr.K.K.Pillay, Studies in the History of India with Special Reference to Tamil Nadu.
7. Porunai Civilization, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
8. R.Balakrishnan, Journey of Civilization Indus to Vaigai, RMRL.

22HS003 **தமிழர் மரபு** **1 0 0 1**

பாடத்திட்டத்தின் நோக்கம்

1. இந்திய மொழிக்குடும்பத்துள் திராவிட மொழிகள் தனித்து இயங்கும் தன்மையை அதன் சிறப்புகள் வழி அறிதல்.
2. தொன்றுதொட்டு தமிழர், கலையில் அடைந்த வளர்ச்சியை இயம்புதல்.
3. சங்ககால தமிழரின் கற்றல் திறத்தை இலக்கியங்கள் வழி ஆராய்தல்.

கற்றலின் விளைவு

1. இந்திய மொழிக்குடும்பத்துள் திராவிட மொழிகள் தனித்து இயங்கும் தன்மையை அதன் சிறப்புகள் வழி அறிதல்.
2. தொன்றுதொட்டு தமிழர், கலையில் அடைந்த வளர்ச்சியை இயம்புதல்.
3. சங்ககால தமிழரின் கற்றல் திறத்தை இலக்கியங்கள் வழி ஆராய்தல்.
4. தமிழ் மொழியின் சிறப்புகளை அதன் படைப்பிலக்கியங்கள் மூலம் அறிந்து கொள்ளுதல்.
5. கற்காலம் தொடங்கி, இக்காலம் வரை சிற்பக்கலை அடைந்த வளர்ச்சியை கண்டுகொள்ளல் .
6. தமிழர் தம் வாழ்வில் எங்கனம் இயற்கையை வணங்கி போற்றினர் என்பதை திணை கோட்பாட்டின் வழி தெளிதல்.
7. இந்திய விடுதலை போரில் தமிழர் ஆற்றிய பங்கினை தெரிந்து கொள்ளுதல்.

அலகு I மொழி மற்றும் இலக்கியம்: **3**

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

அலகு II மரபு – பாறை ஓவியங்கள் முதல் நவீன ஓவியங்கள் வரை – சிற்பக் கலை: **3**

நடுகல் முதல் நவீன சிற்பங்கள் வரை – ஐம்பொன் சிலைகள்– பழங்குடியினர் மற்றும் அவர்கள் தயாரிக்கும் கைவினைப் பொருட்கள், பொம்மைகள் – தேர் செய்யும் கலை – சுடுமண் சிற்பங்கள் – நாட்டுப்புறத் தெய்வங்கள் – குமரிமுனையில் திருவள்ளுவர் சிலை – இசைக் கருவிகள் – மிருதங்கம், பறை, வீணை, யாழ், நாதஸ்வரம் – தமிழர்களின் சமூக பொருளாதார வாழ்வில் கோவில்களின் பங்கு.

அலகு III நாட்டுப்புறக் கலைகள் மற்றும் வீர விளையாட்டுகள்: 3

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

அலகு IV தமிழர்களின் திணைக் கோட்பாடுகள்: 3

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

அலகு V இந்திய தேசிய இயக்கம் மற்றும் இந்திய பண்பாட்டிற்குத் தமிழர்களின் பங்களிப்பு: 3

இந்திய விடுதலைப்போரில் தமிழர்களின் பங்கு – இந்தியாவின் பிறப்பகுதிகளில் தமிழ்ப் பண்பாட்டின் தாக்கம் – சுயமரியாதை இயக்கம் – இந்திய மருத்துவத்தில், சித்த மருத்துவத்தின் பங்கு – கல்வெட்டுகள், கையெழுத்துப்படிகள் - தமிழ்ப் புத்தகங்களின் அச்சு வரலாறு.

TOTAL : 15 PERIODS

TEXT-CUM-REFERENCE BOOKS

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

22CB201 **LINEAR ALGEBRA** **3 0 0 3**

Course Objectives

- Understand the basic concepts of matrices and their Eigen values and Eigen vectors to solve the system of equations.
- Analyze the system of vectors by different vector space techniques.
- Apply the concepts of linear algebra in the field of computer science.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2.To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Represent characteristics of matrices and determinants with their properties.
2. Analyze the characteristics of a linear system with Eigen values and vectors.
3. Implement the various matrix techniques in solving the system of linear equations.
4. Identify the vector spaces to represent the systems geometrically.
5. Analyze the systems by vector space techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2										1	1
2	2	2										1	1
3	2	3										2	1
4	1	2										1	2
5	2	2										2	1

UNIT I **9 Hours**

MATRICES

Determinants - Properties of determinants - Matrices - Operations in matrices - Hermitian and unitary matrices - Rank of a matrix - Solution of system of Linear equations: Cramers rule - Matrix Inversion method - Rank method.

UNIT II **9 Hours**

EIGEN VALUES AND EIGEN VECTORS

Eigen Values and Eigen Vectors of a real matrix - Properties of Eigen Values- Cayley - Hamilton Theorem.

UNIT III **9 Hours**

MATRIX DECOMPOSITION

Positive definite matrix -Gauss Elimination method - Gauss Jordan method - LU decomposition - Singular value decomposition.

UNIT IV **9 Hours**

VECTOR SPACES

Vector spaces - Sub spaces - Linear combinations and linear system of equations - Linear independence and linear dependence - Linear Transformations - Basis and dimensions.

UNIT V **9 Hours**

INNER PRODUCT SPACES

Principal component analysis- Orthogonality of vectors - Projections - Gram-Schmidt orthogonalization - QR decomposition- introduction to their applications in Image Processing and Machine learning

Total: 45 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication, 2017.
3. Peter V. O Neil, Advanced Engineering Mathematics, Seventh Edition, Thomson Learning, 2011.
4. Michael. D. Greenberg, Advanced Engineering Mathematics, Second Edition, Pearson, 2002.
5. Gilbert Strang, Introduction to linear algebra, Fifth Edition, ANE Books, 2016.
6. https://machinelearningmastery.com/introduction-matrices-machine-learning/

22CB202 STATISTICAL METHODS 3 0 0 3

Course Objectives

- Learn the fundamental concepts of linear statistical models, estimation methods, Non parametric inference.
- Understand the fundamental concepts of programming in R.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2.To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Demonstrate and apply the basic concepts of Statistical techniques and Linear Statistical methods
2. Execute the basic concepts of Design of experiments and Methods of Estimation
3. Exemplify the basic concepts of non parametric inference in testing of hypothesis
4. Analyze the various concepts of time series analysis and Forecasting techniques in Statistical Modeling
5. Apply the R statistical language with fundamental concepts, major R data analysis and create visualizations using R

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2										2	1
2	1	2										1	2
3	2	3										1	2
4	2	2										2	1
5	1	3										1	1

UNIT I 9 Hours

SAMPLING TECHNIQUES

Random sampling-Sampling from finite and infinite populations- Estimates and standard error (sampling with replacement and sampling without replacement)- Sampling distribution of sample mean- Stratified random sampling. Linear Statistical Models: Linear regression -Correlation- Rank correlation

UNIT II 9 Hours

DESIGN OF EXPERIMENTS AND ESTIMATION

Analysis of variance - Completely randomized design - Randomized block design. Estimation: Point estimation- criteria for good estimates (un-biasedness, consistency)- Methods of estimation including maximum likelihood estimation. Sufficient Statistic- Complete sufficiency- application in estimation

UNIT III **9 Hours**

NON-PARAMETRIC INFERENCE

Comparison with parametric inference- Use of order statistics-Sign test- Wilcoxon signed rank test- Mann-Whitney test- Run test- Kolmogorov-Smirnov test. Spearman's and Kendall's test- Tolerance region

UNIT IV **9 Hours**

TIME SERIES ANALYSIS

Basics of Time Series Analysis- Stationary- ARIMA Models: Least Square method and maximum likelihood Identification - Estimation - Forecasting

UNIT V **9 Hours**

R STATISTICAL PROGRAMMING LANGUAGE

Introduction to R- Functions- Control flow and Loops- Working with Vectors and Matrices- Reading in Data- Writing Data- Working with Data- Manipulating Data- Simulation- Linear model-Data Frame-Graphics in R

Total: 45 Hours

Reference(s)

1. R. Miller, J.E. Freund and R. Johnson, Probability and Statistics for Engineers, Fourth Edition, Pearson, 2015.
2. D N Elhance and B M Aggarwal, Fundamentals of Statistics (Vol. I & Vol. II), The Word Press, 2008
3. Chris Chatfield, The Analysis of Time Series, Third Edition, Chapman & Hall/CRC Press, 2010
4. D.C. Montgomery and E.Peck , Introduction to Linear Regression Analysis, Third Edition, Wiley, 2010
5. Garrett Grolemund, Hands-on Programming with R, Shroff Publishers & Distributors Pvt Ltd, 2018.

22CB203 DATA STRUCTURES 3 0 2 4

Course Objectives

- Understand the basics of abstract data types.
- Impart knowledge about the principles of linear and nonlinear data structures.
- Build an application using sorting and searching.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1.Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2.To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Explore the basics of data structures and algorithm analysis.
2. Demonstrate the concept of linear data structures.
3. Demonstrate the concept of non- linear data structures.
4. Design algorithms for various searching and sorting techniques.
5. Exemplify the concept of files and its operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	3			1							1	1
2	2	2	3		2							1	3
3	2	3	3		2							2	3
4	2	3	3		2							2	3
5	2	3	3		2							2	3

UNIT I **9 Hours**
BASIC TERMINOLOGIES
Algorithm specification, Recursion, Performance analysis, Asymptotic Notation - The Big-O, Omega and Theta notation, Programming Style, Refinement of Coding - Time-Space Trade Off, Testing, Data Abstraction.

UNIT II **9 Hours**
LINEAR DATA STRUCTURE
Array, Stack, Queue, Linked-list and its types, Various Representations, Operations & Applications of Linear Data Structures.

UNIT III **9 Hours**

NON-LINEAR DATA STRUCTURE

Trees (Binary Tree, Threaded Binary Tree, Binary Search Tree, B & B+ Tree, AVL Tree, Splay Tree) and Graphs (Directed, Undirected), Various Representations, Operations (search and traversal algorithms and complexity analysis) & Applications of Non-linear Data Structures.

UNIT IV **9 Hours**

SEARCHING AND SORTING ON VARIOUS DATA STRUCTURES

Sequential Search, Binary Search, Breadth First Search, Depth First Search, Insertion Sort, Selection Sort, Shell Sort, Divide and Conquer Sort, Merge Sort, Quick Sort, Heap Sort.

UNIT V **9 Hours**

FILES

Definition, File Organization: Sequential file Organization, Direct file Organization, Indexed Sequential, Hashed and accessing schemes.

EXPERIMENT 1 **5 Hours**

Towers of Hanoi using user defined stacks.

EXPERIMENT 2 **5 Hours**

Reading, writing, and addition of polynomials.

EXPERIMENT 3 **5 Hours**

Line editors with line count, word count showing on the screen.

EXPERIMENT 4 **5 Hours**

Trees with all operations.

EXPERIMENT 5 **5 Hours**

All graph algorithms.

EXPERIMENT 6 **5 Hours**

Saving / retrieving non-linear data structure in/from a file.

Total: 45+30 =75 Hours

Reference(s)

1. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2009.
2. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011.
3. Y.Langsam, M.J.Augenstein and A.M.Tenenbaum, Data Structures using C, PHI, 2007.
4. Aho, J.E.Hopcroft and J.D.Ullman, Data Structures and Algorithms, Pearson education, Asia, 2010.
5. Open Data Structures: An Introduction (Open Paths to Enriched Learning), 31st ed.

22CB204 PRINCIPLES OF ELECTRONICS 3 0 2 4

Course Objectives

- Understand about current, voltage and power, basic laws in circuits.
- Understand about semiconductor materials and its application
- Understand working principal of BJT and FET
- Understand about Integrated circuit and its application
- Understand about the fundamentals of Electronics and its applications.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1.Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2.To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Apply Voltage-Current laws and transformation techniques to solve linear electric circuits.
2. Apply the diodes in rectifier and regulator applications and also analyze its characteristics.
3. Explain the working of Bipolar Junction and Field Effect Transistors with different configurations and also analyze their characteristics.
4. Illustrate the working of analog IC with different configurations and its applications.
5. Simplification of Boolean expressions using K-map and implementation of combinational & sequential circuits.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2			2							2	1
2	3	2			2							1	2
3	2	2			2							1	2
4	3	2			2							2	1
5	2	2			2							1	1

UNIT I 6 Hours
ELECTRIC CIRCUITS

Definition of Voltage, Current, Power & Energy, Ohmslaw, Kirchoffs Law & its applications simple problems, Simple mesh and Node problems, Generation of Alternative EMF, Average value of current and voltage, Form Factor, Peak Factor.

UNIT II **9 Hours**

SEMICONDUCTOR DIODE AND ITS APPLICATION

Conductor, Semiconductors & Insulators, Semiconductors: intrinsic & extrinsic, energy band diagram, P&N-type semiconductors, drift & diffusion carriers. Characteristics of PN Junction Diode and Zener diode, Rectifier Circuits Half wave, Full wave circuits, Efficiency, PIV, Ripple factor and AC and DC current and voltage in rectifier.

UNIT III **10 Hours**

BIPOLARJUNCTION AND FIELDEFFECTTRANSISTOR

Structure and working of bipolar junction transistor, CB,CC,CE configurations, relation between alpha and beta, Concept of transistor as an amplifier and transistor as a switch, Field Effect Transistors: Construction and characteristics of JFET-parameters of JFET-MOSFET – Depletion & enhancement modes Construction and characteristics.

UNIT IV **10 Hours**

FEED BACK AMPLIFIER, AND OPERATIONAL AMPLIFIERS

Concept (Block diagram), properties, positive and negative feedback, loop gain, open loop gain, feedback factors, Introduction to integrated circuits: operational amplified and its terminal properties; Application of operational amplifier; inverting and non-inverting mode of operation, Adders, Subtractors, Voltage follower, Comparator, Integrator, Differentiator.

UNIT V **10 Hours**

DIGITAL ELECTRONICS FUNDAMENTALS

Difference between analog and digital signals, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables, logic expressions, Logic simplification using K- map, Logic ICs, half and full adder/subtractor, multiplexers, demultiplexers, flip-flops, shift registers, counters.

EXPERIMENT 1 **3 Hours**

To plot V-I characteristics of PN junction diode.

EXPERIMENT 2 **3 Hours**

To plot regulation characteristics of half wave rectifier.

EXPERIMENT 3 **3 Hours**

To plot regulation characteristics of Full wave rectifier.

EXPERIMENT 4 **3 Hours**

To plot input-output characteristics of CE configuration of BJT.

EXPERIMENT 5 **3 Hours**

To study Biasing techniques of BJT- to find stability factor of self-bias, collector to base bias, fixed bias circuits.

EXPERIMENT 6 **3 Hours**

To plot frequency response of single stage FET amplifier (CS/CD configuration) and find its bandwidth.

EXPERIMENT 7 **3 Hours**

To study Colpitts Oscillator.

EXPERIMENT 8 **3 Hours**

Study of OP-AMP circuits: Inverting and Non-inverting Amplifier.

EXPERIMENT 9 **3 Hours**

Study of basic logic gates and De-Morgan's Theorem.

EXPERIMENT 10 **3 Hours**

Study of half adder and full adder.

Total: 45+30 =75 Hours

Reference(s)

1. William Hayt, J V Jack, E Kemmerly and Steven M Durbin, Engineering Circuits Analysis, Tata McGraw-Hill, 2013.
2. L Robert Boylestead, Louis Nashelsky, "Electronic Devices and Circuit Theory" Pearson Education,2012.
3. J Millman, C. Halkias & Satyabrata JIT "Electronic Devices and Circuits", Tata McGraw-Hill,2010.
4. Ramakant A. Gayakwad, OP-AMP and Linear IC's, Prentice Hall of India, 2002.
5. Thomas L. Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015.

22CB205 PRINCIPLES OF ECONOMICS 2 0 0 2

Course Objectives

- Exemplify the demand curves of households and supply curves of firms with the principles.
- Differentiate Price ceilings, price floors and compare income effects, substitute effects.
- Analyze the Keynesian's process of multiplier theory in macroeconomics.

Programme Outcomes (POs)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PSO1.Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2.To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. To explain the functioning of elasticity of demand in micro economics.
2. To analyze the supporting of price, income and substitution effects in the consumers and producer's surplus.
3. To compare the equilibrium of a firm under perfect competition, monopoly and monopolistic competition.
4. To study the concepts of demand for money and supply of money with appropriate model in macro economic analysis.
5. To examine and evaluate the problems of voluntary and involuntary unemployment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1						1						1	2
2						2						1	3
3						1						1	2
4						2						1	2
5						2						1	2

UNIT I **6 Hours**

MICRO ECONOMICS

Principles of Demand and Supply Supply Curves of Firms Elasticity of Supply; Demand Curves of Households Elasticity of Demand; Equilibrium and Comparative Statics (Shift of a Curve and Movement along the Curve).

UNIT II **6 Hours**

WELFARE ANALYSIS

Consumers and Producers Surplus- Price Ceilings and Price Floors; Consumer Behaviour - Axioms of Choice-Budget Constraints and Indifference Curves; Consumers Equilibrium Effects of a Price Change, Income and Substitution Effects Derivation of a Demand Curve.

UNIT III **6 Hours**

APPLICATIONS

Tax and Subsidies - Inter temporal Consumption -Suppliers- Income Effect; Theory of Production - Production Function and Isoquants - Cost Minimization; Cost Curves - Total, Average and Marginal Costs - Long Run and Short Run Costs; Equilibrium of a Firm Under Perfect Competition; Monopoly and Monopolistic Competition.

UNIT IV **6 Hours**

MACRO ECONOMICS

National Income and its Components - GNP, NNP, GDP, NDP Consumption Function; Investment; Simple Keynesian Model of Income Determination and the Keynesian Multiplier; Government Sector -Taxes and Subsidies; External Sector - Exports and Imports; Money -Definitions; Demand for Money Transaction and Speculative Demand; Supply of Money - Banks Credit Creation Multiplier; Integrating Money and Commodity Markets - IS, LM Model.

UNIT V **6 Hours**

BUSINESS CYCLES AND STABILIZATION

Monetary and Fiscal Policy - Central Bank and the Government; the Classical Paradigm - Price and Wage Rigidities - Voluntary and Involuntary Unemployment.

Total: 30 Hours

Reference(s)

1. Pindyck, Robert S and Daniel L. Rubinfeld, Microeconomics, Eighth Edition, 2013.
2. Dornbusch, Fischer and Startz, Macroeconomics, Tenth Edition, Tata Mcgraw Hill, 2012.
3. Paul Anthony Samuelson, William D. Nordhaus, Economics, Nineteenth Edition, McGraw-Hill Education, 2010.
4. Hal R, Varia, Intermediate Microeconomics: A Modern Approach, Eighth Edition Affiliated East-West Press, 2006.
5. N. Gregory Mankiw, Principles of Macroeconomics, Seventh Edition, Cengage Learning, 2018.

22HS206 BUSINESS COMMUNICATION AND VALUE SCIENCE - II 1 0 2 2

Course Objectives

- Augment students' overall communication and interpersonal skills by engaging them in group activities and thus aid in helping them to emerge as professionals.
- Develop students' expertise on public speaking skills and to deal positively with criticism and so as to effectively present their personalities.

Programme Outcomes (POs)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Speak fluently in English without errors in the sentence construction and hence present themselves as effective English communicators. They will be able to learn 20-25 common errors made in parts of speech and also use 10 modal verbs efficiently during professional communication.
2. Differentiate between vocabulary used as adjectives, verbs and adverbs and be able to use the 60-70 words for their daily conversation.
3. Overcome the fear of speaking and will be aware of the 3 types of public speaking necessary according to the contemporary requirements. They would be able to deliver a public speech according to the need of the audience and also be aware of positive body language to be manifested during a speech.
4. Deal with the deeper parameters of working in teams like team motivation, multicultural team activity and team conflict resolution
5. Analyze them relating to their hobbies and strengths and hence set realistic goals in terms of personal and professional growth. They will be able to identify at least 5-7 strengths and a couple of goals to be achieved that will enable their lives to be directed appropriately.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1								1				1	
2								2				1	
3								3				1	
4									1	1		1	
5									2	2		1	

UNIT I 3 Hours

ESSENTIAL GRAMMAR - II

Application of tenses, Auxiliaries- correct usage and importance in formal communication, Business Vocabulary - Vocabulary exercises through web-based applications. Written Communication - II: Email writing- Formal and Informal, email writing structure, Inquiry letters, Instruction letters, complaint letters, Routine business letters, Sales Letters etc. Technical writing, Essay writing, Paragraph writing.

UNIT II **3 Hours**

VOCABULARY - II

Vocabulary exercises through web-based applications, Usage and application through mock meetings Situational Conversation: Application of grammar and correct spoken English according to context/ situation and application in business scenario.

UNIT III **3 Hours**

FUNDAMENTALS OF EFFECTIVE COMMUNICATION

Public Speaking: fundamentals of effective public speaking, types- Extempore speech, manuscript speech, and ways to enhance public speaking skills, storytelling, oral review. Presentation Skills: PowerPoint presentations, Effective ways to structure the presentation, importance of body language. Leadership Skills, Leader's Role, Responsibilities And Skill Required: Understanding good Leadership behaviours, Learning the difference between Leadership and Management, Gaining insight into your Patterns, Beliefs and Rules, Defining Qualities and Strengths of leadership, Determining how well you perceive what's going on around you, interpersonal Skills and Communication Skills, Learning about Commitment and How to Move Things Forward, Making Key Decisions, Handling Your and Other People's Stress, Empowering, Motivating and Inspiring Others, Leading by example, effective feedback. Problem Solving Skill: Problem solving skill, Confidence building.

UNIT IV **3 Hours**

CORPORATE / BUSINESS ETIQUETTES

Corporate grooming & dressing, etiquettes in social & office Setting-Understand the importance of professional behaviour at the work place, Understand and Implement etiquettes in workplace, presenting oneself with finesse and making others comfortable in a business setting. Importance of first impression, Grooming, Wardrobe, Introduction to Ethics in engineering and ethical reasoning, rights and responsibilities.

UNIT V **3 Hours**

DIVERSITY AND INCLUSION PART II

Socio-Cultural and Cross-Cultural Sensitivities at the Workplace: PwD and LGBT at the workplace, Learning disabilities at the workplace; Caste, class, regionalism, religion and poverty: the different identities of Indian employees and employers and how to include everyone; Global diversity identities of race, religion, nationhood; Appropriate Social Media Use
Values Sciences Part II: Values of a good manager: Ethics in Business; Embodying organizational pride with grace.

EXPERIMENT 1 **2 Hours**

Module 1: Self-Introduction

EXPERIMENT 2 **2 Hours**

Module 2: Likes, Dislikes, and Social goals (strengths, ambition)

EXPERIMENT 3 **2 Hours**

Module 3: Offering opinions (GD, disagreeing politely, accepting opinions)

EXPERIMENT 4 **2 Hours**

Module 4: Asking questions (Formal writing, formal events)

EXPERIMENT 5 **2 Hours**

Module 5: Answering questions (politeness markers)

EXPERIMENT 6 **2 Hours**
Module 6: Asking permission (leave, OD)

EXPERIMENT 7 **2 Hours**
Module 7: Communication etiquette (Telephone, E-mail)

EXPERIMENT 8 **2 Hours**
Module 8: Banks/ Reservation/ Application forms (Travel) (why would you like to join the course? Self-expression- Writing

EXPERIMENT 9 **2 Hours**
Module 9: Constructive criticism, respond to compliment

EXPERIMENT 10 **2 Hours**
Module 10: Convincing (Interactive group game) and persuading (literature, Debate)

EXPERIMENT 11 **2 Hours**
Module 11: Accepting

EXPERIMENT 12 **2 Hours**
Module 12: Narration with Discourse Markers and connectives (offer a commentary on a research project, compare and contrast-writing skills)

EXPERIMENT 13 **2 Hours**
Module 13: Description with describing markers (story mapping, mind mapping, create a web page to sell own product, write food, film reviews, creating hashtags)

EXPERIMENT 14 **2 Hours**
Module 14: Public events (MoC, Welcome address, Vote of Thanks, Body Language

EXPERIMENT 15 **2 Hours**
Module 15: Seminar/ Presentation

Total: 15+30 =45 Hours

Reference(s)

1. Business Communication Today by Bovee, Thill, Raina
2. APAART: Speak Well 1 (English Language and Communication)
3. APAART: Speak Well 2 (Soft Skills)
4. Strategic Communication by Charles Marsh
5. English vocabulary in use Alan Mccarthy and Odell
6. Business Communication Dr. Saroj Hiremath

22HS006 **TAMILS AND TECHNOLOGY** **1 0 0 1**

Course Objectives

- Analyse graffiti on potteries as a form of historical and cultural documentation during the Sangam Age.
- Investigate the building materials and the historical context of Hero stones during the Sangam Age by Analysing the details of stage constructions in Silappathikaram and their cultural significance.
- Examine ancient knowledge of oceans and its impact on Tamil society.

Program Outcomes (POs)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

Course Outcomes (COs)

1. Understand the significance of the weaving industry during the Sangam Age and its cultural importance.
2. Understand the significance of dams, tanks, ponds, and sluices in the agricultural and irrigation practices of the Chola Period.
3. Explore the architectural designs and structural construction methods used in household materials during the Sangam Age.
4. Explore the art of shipbuilding in ancient Tamil culture and its role in maritime trade and transportation.
5. Trace the development of scientific terminology and vocabulary in Tamil language.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1								2	3				
2								2	3				
3								2	3				
4								2	3				
5								2	3				

UNIT I **3 Hours**

WEAVING AND CERAMIC TECHNOLOGY

Weaving Industry during Sangam Age – Ceramic technology – Black and Red Ware Potteries (BRW) – Graffiti on Potteries.

UNIT II **3 Hours**

DESIGN AND CONSTRUCTION TECHNOLOGY

Designing and Structural construction House & Designs in household materials during Sangam Age - Building materials and Hero stones of Sangam age – Details of Stage Constructions in Silappathikaram - Sculptures and Temples of Mamallapuram - Great Temples of Cholas and other worship places - Temples of Nayaka Period - Type study (Madurai Meenakshi Temple)- Thirumalai Nayakar Mahal - Chetti Nadu Houses, Indo - Saracenic architecture at Madras during British Period.

UNIT III **3 Hours**

MANUFACTURING TECHNOLOGY

Art of Ship Building - Metallurgical studies - Iron industry - Iron smelting, steel - Copper and gold - Coins as source of history - Minting of Coins – Beads making-industries Stone beads -Glass beads - Terracotta beads -Shell beads/ bone beats - Archeological evidences - Gem stone types described in Silappathikaram.

UNIT IV **3 Hours**

AGRICULTURE AND IRRIGATION TECHNOLOGY

Dam, Tank, ponds, Sluice, Significance of Kumizhi Thoompu of Chola Period, Animal Husbandry - Wells designed for cattle use - Agriculture and Agro Processing - Knowledge of Sea - Fisheries – Pearl - Conche diving - Ancient Knowledge of Ocean - Knowledge Specific Society.

UNIT V **3 Hours**

SCIENTIFIC TAMIL & TAMIL COMPUTING

Development of Scientific Tamil - Tamil computing – Digitalization of Tamil Books – Development of Tamil Software – Tamil Virtual Academy – Tamil Digital Library – Online Tamil Dictionaries – Sorkuvai Project.

Total: 15 Hours

Reference(s)

1. Dr.K.K.Pillay , Social Life of Tamils , A joint publication of TNTB & ESC and RMRL
2. Dr.S.Singaravelu , Social Life of the Tamils - The Classical Period, International Institute of Tamil Studies.
3. Dr.S.V.Subatamanian , Dr.K.D. Thirunavukkarasu, Historical Heritage of the Tamils, International Institute of Tamil Studies.
4. Dr.M.Valarmathi , The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies
5. Keeladi - 'Sangam City Civilization on the banks of river Vaigai', Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
6. Dr.K.K.Pillay, Studies in the History of India with Special Reference to Tamil Nadu.
7. Porunai Civilization, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
8. R.Balakrishnan , Journey of Civilization Indus to Vaigai, RMRL

22HS006 **தமிழரும் தொழில்நுட்பமும்** **1 0 0 1**

பாடத்திட்டத்தின் நோக்கம்

1. சங்க காலத்தில் வரலாறு மற்றும் கலாச்சார ஆவணங்களின் ஒரு வடிவமாக, மட்பாண்டங்கள் மீதான கிராஃபிட்டியை பகுப்பாய்வு செய்தல்.
2. சிலப்பதிகாரத்தில் கட்டப்பட்ட மேடை கட்டுமானங்களின் விவரங்களையும் அவற்றின் கலாச்சார முக்கியத்துவத்தையும் பகுப்பாய்வு செய்வதன் மூலம், சங்க காலத்தில் மாவீரர் கற்களின் கட்டுமானப் பொருட்கள் மற்றும் வரலாற்று சூழலை ஆராய்தல்.
3. சமுத்திரங்கள் பற்றிய பண்டைய அறிவையும், தமிழ் சமூகத்தில் அதன் தாக்கத்தையும் ஆராய்வது ஆகியவை இப்பாடத்திட்டத்தின் நோக்கம் ஆகும்.

கற்றலின் விளைவு

1. சங்க காலத்தில் நெசவுத் தொழிலின் முக்கியத்துவத்தையும் அதன் கலாச்சார முக்கியத்துவத்தையும் புரிந்து கொள்ளல்.
2. சோழர் கால விவசாய மற்றும் நீர்ப்பாசன நடைமுறைகளில் அணைகள், குளங்கள் மற்றும் மதகுகளின் முக்கியத்துவத்தைப் புரிந்து கொள்ளல்.
3. சங்க காலத்தில் வீட்டுப் பொருட்களில் பயன்படுத்தப்பட்ட கட்டடக்கலை வடிவமைப்புகள் மற்றும் கட்டமைப்பு கட்டுமான முறைகளை ஆராய்தல்.
4. பண்டைய தமிழ் கலாச்சாரத்தில், கப்பல் கட்டும் கலை, கடல் வர்த்தகம் மற்றும் போக்குவரத்தில் அதன் பங்கை ஆராய்தல்.
5. தமிழ் மொழியில் அறிவியல் சொற்களஞ்சியம் மற்றும் சொல்லகராதியின் வளர்ச்சியைக் கண்டறிதல்.

அலகு I நெசவு மற்றும் பானைத் தொழில்நுட்பம்: **3**

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

அலகு II வடிவமைப்பு மற்றும் கட்டிடத் தொழில்நுட்பம்: **3**

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

அலகு III **உற்பத்தித் தொழில் நுட்பம்**: **3**

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

அலகு IV **வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்**: **3**

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

அலகு V **அறிவியல் தமிழ் மற்றும் கணித்தமிழ்**: **3**

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

TOTAL : 15 PERIODS

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

22CB301 FORMAL LANGUAGE AND AUTOMATA THEORY 3 1 0 4

Course Objectives

- Understand different formal language classes and their relationships
- Construct the mathematical models and grammars to recognize formal languages
- Analyse the undecidability and complexity of computational problems

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3. Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4. Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PSO1 To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

Course Outcomes (COs)

1. Design finite automata to recognize regular languages and prove their equivalence
2. Construct push down automata to accept context free languages and prove their equivalence
3. Generate Linear bounded automata and Turing Machines for a given computation and languages
4. Analyse the undecidability of languages
5. Examine the problems based on their complexity

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3											1	
2	1	3	3										
3			2	1									
4		2	1	3								1	
5	2	3										2	

UNIT I **10 Hours**

REGULAR LANGUAGES AND FINITE AUTOMATA

Alphabet-languages and grammars- Productions and derivation-Chomsky hierarchy of languages. Regular expressions and languages- Deterministic Finite Automata (DFA) and equivalence with regular expressions-Nondeterministic Finite Automata (NFA) and equivalence with DFA- Regular grammars and equivalence with finite automata - Properties of regular languages - Kleene""s theorem
- Pumping lemma for regular languages- Myhill- Nerode theorem and its uses- Minimization of finite automata.

10 Hours

UNIT II

CONTEXT-FREE LANGUAGES AND PUSHDOWN AUTOMATA

Context-free grammars (CFG) and languages (CFL)- Chomsky and Greibach normal forms - Nondeterministic pushdown automata (PDA) and equivalence with CFG - Parse trees- Ambiguity in CFG - Pumping lemma for context-free languages - Deterministic pushdown automata- Closure properties of CFLs.

10 Hours

UNIT III

TURING MACHINES

Context-sensitive grammars (CSG) and languages - Linear bounded automata and equivalence with CSG. The basic model for Turing machines (TM) - Turing recognizable (recursively enumerable) and Turing-decidable (recursive) languages and their closure properties - Variants of Turing machines - Nondeterministic TMs and equivalence with deterministic TMs - Unrestricted grammars and equivalence with Turing machines -TMs as enumerators.

UNIT IV **8 Hours**

UNDECIDABILITY

Church-Turing thesis -Universal Turing machine - The universal and diagonalization languages - Reduction between languages- Rice's theorem -Undecidable problems about languages.

UNIT V **7 Hours**

COMPLEXITY THEORY

Introductory ideas on Time complexity of deterministic and nondeterministic Turing machines - P and NP, NP- completeness - Cooks Theorem, other NP - Complete problems.

Total: 45+15 =75 Hours

Reference(s)

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation , Pearson Education, Third Edition, 2014
2. Harry R. Lewis and Christos. H.Papadimitriou, Elements of The theory of Computation, Pearson Education/PHI, 2007
3. John C. Martin, Introduction to Languages and the Theory of Computation, TMH, 2007
4. Micheal Sipser, Introduction of the Theory and Computation, Thomson Brokecole, 2005

22CB302 COMPUTER ORGANIZATION AND ARCHITECTURE 3 1 0 4

Course Objectives

- Understand of the basic structure and operation of a digital computer.
- Impart knowledge about the operation of the arithmetic unit including the algorithms & implementation addition, subtraction, multiplication & division.
- Acquire knowledge about the diverse ways of communicating with I/O devices and standard I/O Interfaces.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3.Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values
PSO2.To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Identify the basic structure of a digital computer and instruction sets with addressing modes.
2. Illustrate the arithmetic operations of binary number system with its design.
3. Recognize the organization of the basic processing unit and examine the basic concepts of pipe-lining.
4. Explicate the standard I/O interfaces and peripheral devices.
5. Determine the performance of different types of memory.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1										1
2	1	2	3									1	
3	1	1	2									2	
4	1	2	3										
5	1	2	2										

UNIT I 9 Hours

COMPUTER ARCHITECTURE

Functional blocks of a computer: CPU, memory, input-output subsystems, control unit. Instruction set architecture of a CPU: Registers, instruction execution cycle, RTL interpretation of instructions, addressing modes, instruction set. Outlining instruction sets of some common CPUs. Data representation: Signed number representation, fixed and floating point representations, character representation.

UNIT II 9 Hours

COMPUTER ARITHMETIC

Integer addition and subtraction, ripple carry adder, carry look-ahead adder, etc. multiplication: shift-and-add, Booth multiplier, carry save multiplier, etc. Division restoring and non-restoring techniques, floating point arithmetic, IEEE 754 format.

UNIT III **9 Hours**

CONTROL UNIT AND PIPELINING

Introduction to x86 architecture. CPU control unit design: Hardwired and micro-programmed design approaches, design of a simple hypothetical CPU. Pipelining: Basic concepts of pipelining, throughput and speedup, pipeline hazards. Parallel Processors: Introduction to parallel processors, Concurrent access to memory and cache coherency.

UNIT IV **9 Hours**

PERIPHERAL DEVICES AND THEIR CHARACTERISTICS

Input-output subsystems, I/O device interface, I/O transfers program controlled, interrupt driven and DMA, privileged and non-privileged instructions, software interrupts and exceptions. Programs and processes: role of interrupts in process state transitions, I/O device interfaces: SCII, USB.

UNIT V **9 Hours**

MEMORY ORGANIZATION AND SYSTEM DESIGN

Memory interleaving, concept of hierarchical memory organization, cache memory, cache size vs. block size, mapping functions, replacement algorithms, write policies. Memory system design: Semiconductor memory technologies, memory organization.

Total: 45+15=75 Hours

Reference(s)

1. Morris Mano,"Computer System Architecture", 3rd Edition, Prentice Hall of India, New Delhi,2014
2. David A. Patterson and John L. Hennessy, Computer Organization and Design: The Hardware/Software Interface, Elsevier, 5th Edition 2013
3. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Naraig Manjikian, Computer Organization and Embedded Systems, McGraw-Hill, 6th Edition 2014
4. John P. Hayes, Computer Architecture and Organization, McGraw-Hill ,3rd Edition,2013
5. William Stallings, Computer Organization and Architecture Ã¢?? Designing for Performance, 10th Edition, Pearson Education, 2015.
6. Vincent P. Heuring and Harry F. Jordan, Computer System Design and Architecture, Prentice Hall,2 nd Edition, 2004

22CB303 OBJECT ORIENTED PROGRAMMING 3 0 2 4

Course Objectives

- Understand the features of Object oriented programming
- Recognize the need of the concepts inheritance and polymorphism
- Develop C++ applications using OOP concepts, files, templates and exceptions

Programme Outcomes (POs)

PO1. Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2. Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3. Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

Course Outcomes (COs)

1. Differentiate Structured programming and Object Oriented Programming
2. Interpret the features of object oriented programming and basic structure of C++ program.
3. Illustrate operator overloading, Inheritance and virtual functions
4. Develop applications with concepts of files, templates and exceptions.
5. Understand Object Oriented Design and Modeling

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	3			1							1	
2	1	1	2		2							1	
3	1	2	2		2							1	
4	1	2	3		2								
5	2	1	2		2								

UNIT I 9 Hours

INTRODUCTION TO OBJECT ORIENTED PROGRAMMING

Single line comments, Local variable declaration within function scope, function declaration, function overloading, stronger type checking, Reference variable, parameter passing -value vs reference, passing pointer by value or reference, Operator new and delete, the typecasting operator, Inline Functions in contrast to macro, default arguments

UNIT II 9 Hours

CONCEPTS OF OBJECT ORIENTED PROGRAMMING

Necessity for OOP, Data Hiding, Data Abstraction, Encapsulation, Procedural Abstraction, Class and Object, Scope of Class and Scope Resolution Operator, Member Function of a Class, private, protected and public Access Specifier, this Keyword, Constructors and Destructors, friend class, error handling (exception)

UNIT III **9 Hours**

ESSENTIALS OF OBJECT ORIENTED PROGRAMMI

Operator overloading, Inheritance, Single and Multiple, Class Hierarchy, Pointers to Objects, Assignment of an Object to another Object, Polymorphism through dynamic binding, Virtual Functions, Overloading, overriding and hiding

UNIT IV **9 Hours**

FILES, I/O AND GENERIC PROGRAMMING

Streams, Files, Library functions, formatted output Template concept, class template, function template, template specialization

UNIT V **9 Hours**

OBJECT ORIENTED DESIGN AND MODELING

UML concept, Use case for requirement capturing, Class diagram, Activity diagram and Sequence Diagram for design, Corresponding C++ code from design.

EXPERIMENT 1 **5 Hours**

Implementation of classes and objects with constructors and destructors.

EXPERIMENT 2 **5 Hours**

Implementation of operator and function overloading.

EXPERIMENT 3 **5 Hours**

Implementation of types of Inheritance.

EXPERIMENT 4 **5 Hours**

Implementation of two different classes for adding a private data member using friend function.

EXPERIMENT 5 **5 Hours**

Implementation of file handling operations.

EXPERIMENT 6 **5 Hours**

Implementation of templates and UML diagrams.

Total: 45+30 =75 Hours

Reference(s)

1. Bjarne Stroustrup, The C++ Programming Language:3rd Edition, PearsonEducation, 2015
2. Debasish Jana, C++ and Object-Oriented Programming Paradigm, 3rd Edition, Prentice Hall of India, New Delhi,2014.
3. Bjarne Stroustrup, Programming Principles and Practice Using C++, 2nd Edition, Addison Wesley, 2014.
4. Bjarne Stroustrup, The Design and Evolution of C++, Addison-Wesley Professional,2013

22CB304 COMPUTATIONAL STATISTICS 3 0 2 4

Course Objectives

- Learn the fundamental concepts of computational statistical models, multivariate regression, Principal component analysis
- Understand the fundamental concepts of Python , Data aggregation and Visualization in Python

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3.Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4.Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PSO2.To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand the basic concepts of Statistical techniques and multivariate regression models.
2. Understand the basic concepts of Discriminant analysis and Principal component analysis
3. Understand the concepts of factor analysis and segmentation analysis
4. Understand the introductory ,concepts of Python and Data wrangling techniques in Computational Statistics
5. Understand the fundamental concepts of data aggregation and create visualizations using Python

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2												
2	1	3											1
3			3	1									2
4		2		3									1
5		2		2									

UNIT I 9 Hours

MULTIVARIATE NORMAL DISTRIBUTION AND MULTIVARIATE REGRESSION

Multivariate Normal Distribution- Multivariate Normal Distribution- Conditional Distribution- Estimation of parameters. Multiple Linear Regression Model- Standard multiple regression models collinearity- outliers, non-normality and autocorrelation. Multivariate Regression- Parameter estimation- Multivariate Analysis of variance and covariance

UNIT II 9 Hours

DISCRIMINANT ANALYSIS AND PRINCIPAL COMPONENT ANALYSIS

Discriminant Analysis- Statistical background, linear discriminant function analysis- Estimating linear discriminant functions and their properties. Principal Component Analysis- Principal components- Algorithm for conducting principal component analysis- H-plot

UNIT III **9 Hours**

FACTOR ANALYSIS AND SEGMENTATION ANALYSIS

Factor Analysis- Factor analysis model, Extracting common factors, determining number of factors, Transformation of factor analysis solutions, Factor scores.Clustering and Segmentation Analysis- Introduction, Types of clustering, Correlations and distances, clustering by partitioning methods, hierarchical clustering, overlapping clustering, K-Means Clustering

UNIT IV **9 Hours**

PYTHON CONCEPT AND DATA WRANGLING

Python Concepts- Data Structures- Classes- Interpreter, Program Execution, Statements, Expressions, Flow Controls, Functions, Numeric Types, Sequences and Class Constructors, Text & Binary Files - Reading and Writing. Data Wrangling- Combining and Merging Datasets, Reshaping and Pivoting, Data Transformation, String Manipulation, Regular Expressions

UNIT V **9 Hours**

DATA AGGREGATION AND VISUALIZATION IN PYTHON

Data Aggregation, Group Operations, Time series- Groupby Mechanics, Data Aggregation, Group wise Operations and Transformations, Pivot Tables and Cross Tabulations, Time Series Basics, Data Ranges, Frequencies and Shifting. Visualization in Python- Matplotlib package, Plotting Graphs, Controlling Graph, Adding Text, More Graph Types, Getting and setting values, Patches

EXPERIMENT 1 **4 Hours**

Basic Python Programs

EXPERIMENT 2 **4 Hours**

Program using String Operations

EXPERIMENT 3 **4 Hours**

Program on python Data structures

EXPERIMENT 4 **4 Hours**

Perform various numpy operations and special functions

EXPERIMENT 5 **4 Hours**

Draw statistical graphics using seaborn

EXPERIMENT 6 **5 Hours**

Implement k-means, logistic and time series algorithm using Scikit-learn

EXPERIMENT 7 **5 Hours**

Visualization in python using matplotlib

Total: 45+30 =75 Hours

Reference(s)

1. T.W. Anderson, An Introduction to Multivariate Statistical Analysis PHI India 2014.
2. J.D. Jobson, Applied Multivariate Data Analysis , Vol I & II, 1992
3. Magnus Lie Hetland,Beginning Python: From Novice to Professional, 2nd Edition, 2005
4. A.S. Mulaik, The Foundations of Factor Analysis, 2nd Edition, CRC Press, 2014
5. D.C. Montgomery and E.A. Peck, Introduction to Linear Regression Analysis,5th Edition, Willey , 2012
6. Wes Mc Kinney,Python for Data Analysis, 2nd Edition, REILLY, 2017

22CB305 DATABASE MANAGEMENT SYSTEMS 3 0 2 4

Course Objectives

- Understand the database architecture, data models, conceptualize and design database.
- Process the SQL queries and optimize it.
- Impart knowledge in transaction processing and database security.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2.Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3.Design/ Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5.Modern Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO2.To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand the architecture of database and the models for designing database.
2. Develop solutions to a broad range of query and remove the anomalies using normalization.
3. Understand database query processing and storage strategies.
4. Analyze the basic issues of transaction processing, concurrency control and recovery.
5. Outline the concept of database security.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2		3		3								3
2	2	3	3		3								3
3	2	3	2		3								2
4	2	2	2										
5	2	2	2										2

UNIT I 9 Hours

DATABASE ARCHITECTURE AND DATA MODEL

Introduction to Database - Hierarchical, Network and Relational Models. Database system architecture: Data Abstraction, Data Independence, Data Definition Language (DDL), Data Manipulation Language (DML) Data models: Entity-relationship model, network model, relational and object-oriented data models, integrity constraints, data manipulation operations.

UNIT II 12 Hours

RELATIONAL QUERY AND DATABASE DESIGN

Relational query languages: Relational algebra, Tuple and domain relational calculus,SQL3, DDL and DML constructs, Open source and Commercial DBMS - MYSQL,SQL server. Relational database design: Domain and data dependency, Armstrong’s axioms, Functional Dependencies, Normal forms, Dependency preservation, Lossless design.

UNIT III **8 Hours**

QUERY PROCESSING AND STORAGE

Query processing and optimization: Evaluation of relational algebra expressions, Query equivalence, Join strategies, Query optimization algorithms. Storage strategies: Indices, B-trees, Hashing.

UNIT IV **8 Hours**

TRANSACTION PROCESSING

Concurrency control, ACID property, Serializability of scheduling, Locking and timestamp-based schedulers, Multi-version and optimistic Concurrency Control schemes, Database recovery.

UNIT V **8 Hours**

DATABASE SECURITY

Authentication, Authorization and access control, DAC, MAC and RBAC models, Intrusion detection, SQL injection.

EXPERIMENT 1 **5 Hours**

Working with SQL commands like DDL, DML, TCL, and DCL.

EXPERIMENT 2 **5 Hours**

Execute simple queries using joins and Integrity constraints.

EXPERIMENT 3 **5 Hours**

Create database relation and check for normal forms

EXPERIMENT 4 **5 Hours**

Implement Cursor and trigger in PL/SQL block.

EXPERIMENT 5 **5 Hours**

Write PL/SQL block Programs using exception handling

EXPERIMENT 6 **5 Hours**

Design a PL/SQL blocks using subprograms namely functions and procedures

Total: 45+30 =75 Hours

Reference(s)

1. Database System Concepts. Abraham Silberschatz, Henry F. Korth and S. Sudarshan.
2. Principles of Database and Knowledge - Base Systems, Vol 1 by J. D. Ullman.
3. Fundamentals of Database Systems. R. Elmasri and S. Navathe.
4. Foundations of Databases. Serge Abiteboul, Richard Hull, VictorVianu.

22CB306 FUNDAMENTALS OF MANAGEMENT 2 0 0 2

Course Objectives

- To understand the basics of management and its theories.
- To analyse the individual behaviour in organizational setting to motivate the multicultural workforce
- To acquaint with the concepts of ethics, governance and social responsibilities in the business

Programme Outcomes (POs)

PO8.Ethics: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9.Individual and Team Work: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO11. Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.
PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values
PSO2.To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Able to understand the evolutions of management and apply the concept of management principles in the decision-making process.
2. Effectively manage the business by understanding the functions of management and to identify the factors influencing employee's behaviour in the organizations
3. Able to design the effective organizational structure to achieve the objectives of the organization
4. Assess the impact of organizational decisions and activities on the society
5. Able to understand and develop the leadership qualities to influence and lead the organization across the globe

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1								1	1		2	2	
2								2	3		1	3	
3								1	1		1	1	1
4								3	2		1	1	
5								2	3		1	2	

UNIT I 6 Hours

MANAGEMENT THEORIES

Concept and Foundations of Management, Evolution of Management Thoughts [Pre-Scientific Management Era (before 1880), Classical management Era (1880-1930), Neo-classical Management Era (1930-1950), Modern Management era (1950-onward). Contribution of Management Thinkers: Taylor, Fayol, Elton Mayo etc.

UNIT II **6 Hours**

FUNCTIONS OF MANAGEMENT

Planning, Organizing, Staffing, Directing, Controlling, Leadership - Concept, Nature, Importance, Attributes of a leader, developing leaders across the organization, Leadership Grid.

UNIT III **6 Hours**

ORGANIZATIONAL DESIGN

Classical, Neoclassical and Contingency approaches to organizational design; Organizational theory and design, Organizational structure (Simple Structure, Functional Structure, Divisional Structure, Matrix Structure).

UNIT IV **6 Hours**

ORGANIZATION BEHAVIOR

Introduction, Personality, Perception, Learning and Reinforcement, Motivation, Group Dynamics, Power & Influence, Work Stress and Stress Management, Decision Making, Problems in Decision Making, Decision Making, Organizational Culture, Managing Cultural Diversity

UNIT V **6 Hours**

MANAGERIAL ETHICS

Ethics and business, Ethics of Marketing and advertising, Ethics of Finance and accounting, Decision making frameworks, business and social responsibility, International standards, Corporate Governance, Corporate Citizenship , Corporate social responsibility

Total: 30 + 30 = 60 Hours

Reference(s)

1. Richard L. Daft, Understanding the Theory and Design of Organization, Eleventh Edition, Cengage Learning India Private Limited, 2020
2. Stephen P. Robbins, Timothy A. Judge, Neharika Vohra, Organizational Behaviour, Eighteenth Edition, Pearson India, 2019.

2HS004 HUMAN VALUES AND ETHICS 2 0 0 2

Course Objectives

- Understand the concept of good values and comprehend the importance of value-based living.
- Recognize the culture of peace through education.
- Identify and apply the practices for value development and clarification.

Programme Outcomes (POs)

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.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Understand the importance of human values and ethics in life.
2. Execute the importance of harmonious living in a diverse society.
3. Analyze the sensitivity to the crying needs of society such as ungodliness, corruption, poverty, and suffering, and play a vital role in eradicating them.
4. Plan intellectually mature, morally upright, ethically correct, and spiritually inspired decisions.
5. Execute a correct balance between professional excellence and social commitment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1								3	2	1		1	1
2								3	2	1		1	1
3								3	2	1		1	1
4								3	2	1		1	1
5								3	2	1		1	1

UNIT I 6 Hours

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

Importance of Human Values & Ethics in 21st Century - Understanding the theory of basic human values and ethics -Openness to change -Self enhancement -Conservation -Self transcendence - Schwartz Value Survey: Self-Assessment

UNIT II 6 Hours

EMBRACING THE COMMON ETIQUETTE

Altruism- Integrity-Freedom-Justice-Honesty-Truthfulness-Responsibility-Compassion

UNIT III 6 Hours

CONTINUOUS HAPPINESS AND PROSPERITY

An overview on basic Human Aspirations- Understanding and living in harmony at various levels of life-Embracing self-love and wellness-Understanding harmony in the family and society

UNIT IV **6 Hours**

UNIVERSAL HUMAN VALUES AND PROFESSIONAL ETHICS

Reflection on growing global multifold problems: poverty, pollution, hunger, disease, unemployment, caste system, child labour, gender equality, politics and violence. Understanding the challenges in cultural, personal, social, political, and economic environment

UNIT V **6 Hours**

UNDERSTANDING HARMONY IN THE NATURE AND EXISTENCE - WHOLE EXISTENCE AS CO-EXISTENCE

Understanding the harmony in the Nature- Holistic perception of harmony at all levels of existence- Practice Exercises and Case Studies will be taken up in Practice Sessions

Total: 30 Hours

Reference(s)

1. Martin, G. The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin. 2011.
2. Gupta, N. L. Human Values For The 21St Century. India: Anmol Publications Pvt. Limited. 2002.
3. Mishra, A. Happiness Is All We Want. India: Bloomsbury Publishing.2017.
4. Universal Human Values. (n.p.): Booksclinic Publishing. 2023.
5. A Textbook on Professional Ethics And Human Values. India: New Age International (P) Limited.2007.

22HS005 SOFT SKILLS AND EFFECTIVE COMMUNICATION 0 0 2 1

Course Objectives

- Communicate proficiently in formal discussions at the workplace.
- Describe experiences and events, and briefly give reasons and explanations for opinions and plans.
- Interact with a degree of fluency and spontaneity that results in efficacious communication
- Convey agreement and disagreement in a polite but firm manner
- Communicate with coherence and imagination in both written and spoken formats

Programme Outcomes (POs)

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.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Enhance confidence in expressing thoughts in grammatically proper language and etiquette in waiting for the opportunity to provide input
2. Effectively communicate in English on formal occasions and proficiency in the use of link words and other discourse markers
3. Provide constructive feedback and file logical complaints
4. Analyse the understanding of oral and written communication in real-world situations.
5. Apply the improved spelling and punctuation in writing and heightened understanding of tone, pitch and stress in oral formats.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1									2	3		1	1
2									2	3		1	1
3									2	3		1	1
4									2	3		1	1
5									2	3		1	1

UNIT I 10 Hours
SELF-EXPRESSION

Group discussion/ Peer discussion - Communicating decisions and opinions - Tone, Pitch, Stress - Agreeing, Disagreeing, Suggesting, Speculating - Comparing and Contrasting - Comparatives and Superlatives - Discourse markers – Interjections - Decision making - Synthesis - Higher order thinking Group discussion/Peer discussion - Effective Communication Types of communication - Written vs Spoken - Contractions Intonation Stress Active voice - Question tags - Confidence and body language Guided writing- Outlining Main Points - Group discussion/Peer discussion - Avoiding common errors Reduction of MTI - Common errors - Barriers to communication Accent

UNIT II 10 Hours
CREATIVE EXPRESSION

JAM, Debate, Review writing, Social media posts Synonyms - Antonyms Cloze test Phrasal verbs Spotting errors Collocation - Commonly mispronounced.

UNIT III **10 Hours**

FORMAL EXPRESSION

Writing: Giving written feedback, Review writing, and Letter of complaint. Speaking: Giving constructive feedback and offering suggestions, asking for inputs, commenting politely on appropriate phrases - Giving written feedback, Review writing, and Letter of complaint. Critical reasoning - Modal verbs - Polite ways to express negatives

Total: 30 Hours

Reference(s)

1. Word Power Made Easy by Norman Lewis, W. R. Goyal Pub. & Distributors, 2009.
2. Sasikumar, V, et al., A Course in Listening & Speaking Foundation Books, 2005.
3. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
4. Prasad, Hari Mohan. A Handbook of Spotting Errors, Mcgraw Hill Education, 2010.
5. Personality Development & Soft Skills, Barun K. Mitra, Oxford University Press, 2012
6. Business English by Ken Taylor, Orient Blackswan, 2011.

22CB401 OPERATING SYSTEMS 3 0 2 4

Course Objectives

- To make the students learn different types of operating systems along with the components and services provided
- To understand the concept of process management and implementation of process scheduling in a multiprogramming environment using threads and scheduling algorithms
- To provide knowledge on the structure and operations of memory management and storage management

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/ Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Infer the knowledge on evolution of operating systems from primitive batch systems to sophisticated multi-user systems and implement the usage of different system calls to manage the resources.
2. Analyze the mechanism of threads with the process of scheduling algorithms used in a multiprogramming environment.
3. Outline the mechanism of inter process communication using shared memory, message passing and analyze the activities of process synchronization, deadlock to increase the system performance.
4. Design the hardware component to implement the virtual memory environment with the base knowledge of memory management methodologies.
5. Prefer a most suitable file system and the ordered perspective module of disk management methods for computing and storage scenario.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1		1		1								1
2	1	1	2		1							1	2
3	1	1	3		1	1							3
4	1		3		1							1	2
5	1		2		2								2

UNIT I **6 Hours**
INTRODUCTION
Concept of Operating Systems (OS), Generations of OS, Types of OS, OS Services, Interrupt handling and System Calls, Basic architectural concepts of an OS, Concept of Virtual Machine, Resource Manager view, process view and hierarchical view of an OS.

UNIT II **11 Hours**
PROCESS MANAGEMENT SYSTEM
Definition, Process Relationship, Different states of a Process, Process State transitions, Process Control Block (PCB), Context switching, Threads: Definition, Various states, Benefits of threads, Types of threads, Concept of multi-threads, Process Scheduling: Foundation and Scheduling objectives, Types of Schedulers, Scheduling criteria: CPU utilization, Throughput, Turnaround Time, Waiting Time, Response Time, Scheduling algorithms: Pre-emptive and non-pre-emptive, FCFS, SJF, RR; Multiprocessor scheduling: Real Time scheduling: RM and EDF.

UNIT III **9 Hours**
IPC AND DEADLOCKS
Concurrent processes, precedence graphs, Critical Section, Race Conditions, Mutual Exclusion, Hardware Solution, Semaphores, Strict Alternation, Peterson"s Solution, The Producer / Consumer Problem, Event Counters, Monitors, Message Passing, Classical IPC Problems: Reader"s& Writer Problem, Dining Philosopher Problem, Barber"s shop problem, Deadlocks: Definition, Necessary and sufficient conditions for Deadlock, Deadlock Prevention, Deadlock Avoidance: Banker"s algorithm, Deadlock detection and Recovery, Concurrent Programming: Critical region, conditional critical region, monitors, concurrent languages, communicating sequential process (CSP); Deadlocks - prevention, avoidance, detection and recovery.

UNIT IV **10 Hours**
MEMORY MANAGEMENT SYSTEM
Memory Management: Basic concept, Logical and Physical address maps, Memory allocation: Contiguous Memory allocation - Fixed and variable partition - Internal and External fragmentation and Compaction, Virtual Memory: Basics of Virtual Memory - Hardware and control structures - Locality of reference, Page allocation, Partitioning, Paging, Page fault, Working Set, Segmentation, Demand paging, Page Replacement algorithms: Optimal, First in First Out (FIFO), Second Chance (SC), Not recently used (NRU) and Least Recently used (LRU), I/O Hardware: I/O devices, Device controllers, Direct Memory Access, Principles of I/O.

UNIT V **9 Hours**
FILE AND DISK MANAGEMENT SYSTEM
File Management: Concept of File, Access methods, File types, File operation, Directory structure, File System structure, Allocation methods (contiguous, linked, indexed),Free - space management (bit vector, linked list, grouping), directory implementation(linear list, hash table), efficiency and performance, Disk Management: Disk structure, Disk scheduling - FCFS, SSTF, SCAN, C - SCAN, Disk reliability, Disk formatting, Boot - block, Bad blocks.

EXPERIMENT 1 **3 Hours**
Create a shell script to collect and display system information to a log file.

EXPERIMENT 2 **3 Hours**
Create a shell script to move a file from one directory to another directory.

EXPERIMENT 3 **4 Hours**
Implement a CPU scheduler for a batch processing system using the FCFS, SJF & Priority algorithm.

EXPERIMENT 4 **3 Hours**
Implement a producer-consumer problem using semaphores in a shared buffer.

EXPERIMENT 5 **4 Hours**
Implement a resource manager for a distributed system using the Banker's algorithm.

EXPERIMENT 6 **4 Hours**
Implement a simple web server using POSIX threads.

EXPERIMENT 7 **3 Hours**
Implement the First fit and Best fit algorithm to allocate memory to processes.

EXPERIMENT 8 **3 Hours**
Implement a dynamic page replacement algorithm using LRU & Optimal.

EXPERIMENT 9 **3 Hours**
Implement a dynamic allocation of disk using scheduling algorithms.

Total: 45 + 30 = 75 Hours

Reference(s)

1. Operating System Concepts Essentials. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne.
2. Operating Systems: Internals and Design Principles. William Stallings.
3. Operating System: A Design-oriented Approach. Charles Patrick Crowley.
4. Operating Systems: A Modern Perspective. Gary J. Nutt.
5. Design of the Unix Operating Systems. Maurice J. Bach.

22CB402 **SOFTWARE ENGINEERING** **3 0 2 4**

Course Objectives

- 1. Understand the need for different software development life cycle models
- 2. Impart knowledge on software requirement analysis, estimation, design and testing
- 3. Acquire knowledge on object-oriented analysis, design and measurements

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/ Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PSO1: To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Analyse and identify a suitable software development life cycle model for an application
2. Develop software requirements specification and cost estimation for an application.
3. Design high quality software for an application based on quality models.
4. Apply different testing methods to identify errors during software development.
5. Apply object-oriented methodologies and unified modelling language in software development.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	3			1								1
2	1	2	3		2					2			2
3		2	3		2				1			1	3
4		2	2		2				1	2			2
5		2	2		1							1	1

UNIT I **6 Hours**

INTRODUCTION

Programming in the small vs. programming in the large-Software project failures and importance of software quality and timely availability-Engineering approach to software development-Role of software engineering towards successful execution of large software projects-Emergence of software engineering as a discipline-Basic concepts of life cycle models-different models and milestones.

UNIT II **11 Hours**

SOFTWARE PROJECT MANAGEMENT AND ESTIMATION TECHNIQUES

Project management: Software project planning identification of activities and resources-Concepts of feasibility study-Techniques for estimation of schedule and effort-Introduction to Software Requirements Specifications (SRS) and requirement elicitation techniques-Techniques for requirement modeling decision tables, event tables, state transition tables, Petri nets-Requirements documentation through use cases.Estimation techniques: Software cost estimation models and concepts of software engineering economics-Techniques of software project control and reporting-Introduction to measurement of software size- Introduction to software metrics and metrics based control methods.

UNIT III **9 Hours**

SOFTWARE QUALITY AND RELIABILITY

Introduction to the concepts of risk and its mitigation -Internal and external qualities-Process and product quality-Principles to achieve software quality-Introduction to different software quality models like McCall, Boehm, FURPS / FURPS+, Dromey, ISO 9126-Introduction to Capability Maturity Models (CMM and CMMI)-Introduction to software reliability, reliability models and estimation-Measures of code and design quality-Configuration management

UNIT IV **10 Hours**

SOFTWARE TESTING

Introduction to faults and failures-Basic testing concepts-Concepts of verification and validation-Black box and white box tests-White box test coverage code coverage, condition coverage, branch coverage-Basic concepts of black-box tests equivalence classes, boundary value tests, usage of state tables-Testing use cases-Transaction based testing-Testing for non-functional requirements volume, performance and efficiency-Concepts of inspection.

UNIT V **9 Hours**

OBJECT ORIENTED ANALYSIS, DESIGN AND CONSTRUCTION

Concepts the principles of abstraction, modularity, specification, encapsulation and information hiding - concepts of abstract data type- Introduction to UML-Class Responsibility Collaborator (CRC) model-Quality of design-Design measurements - Concepts of design patterns-Refactoring-Object oriented construction principles-Object oriented metrics.

EXPERIMENT 1 **3 Hours**

Design and develop a software web application for a UG student to register for their course by using any suitable languages.

EXPERIMENT 2 **4 Hours**

Design and implement a software web application for online ticket reservation using any software development model.

EXPERIMENT 3 **3 Hours**

Design and develop a software requirement specification (SRS) for analyzing the performance of UG students.

EXPERIMENT 4 **4 Hours**

Design and implement a simple medicine prescription system using a programming language of your choice.

EXPERIMENT 5 **4 Hours**

Implement the medicine prescription system using an object-oriented programming language i.e., UML diagrams.

EXPERIMENT 6 **3 Hours**
Develop and test the ATM system for non-functional requirements, such as performance and security.

EXPERIMENT 7 **3 Hours**
Use object-oriented design principles to design the platform assignment system in railway stations using UML diagrams.

EXPERIMENT 8 **3 Hours**
Develop and test for the Platform assignment system in railway stations by using black box and white box test methods.

EXPERIMENT 9 **3 Hours**
Develop a test plan for an office stock maintenance system using Class Responsibility Collaborator (CRC) model.

Total: 45 + 30 = 75 Hours

Reference(s)

1. 1. Ian Sommerville, Software Engineering, Pearson Education, 2016.
2. 2. Ivar Jacobson, Object Oriented Software Engineering: A Use Case Driven Approach, Addison- Wesley Professional, 1992.
3. 3. Carlo Ghezzi, Jazayeri Mehdi and Mandrioli Dino, Fundamentals of Software Engineering, Pearson Education, 2002.
4. 4. Michael Jackson, Software Requirements and Specification: A Lexicon of Practice, Principles and Prejudices, Addison-Wesley Professional, 1995.
5. 5. Ivar Jacobson, Grady Booch and James Rumbaugh, The Unified Development Process, Addison-Wesley Professional, 1999.
6. 6. Erich Gamma, Richard Helm, Ralph Johnson and John Vlissides, Design Patterns: Elements of Object-Oriented Reusable Software, Addison-Wesley Professional, 1994.

22CB403 DESIGN AND ANALYSIS OF ALGORITHMS 3 0 2 4

Course Objectives

- Understand the basic concepts of various algorithm design techniques
- Impart knowledge on runtime analysis of algorithms
- Empathize the limits of computation

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/ Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1: Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Analyse the algorithm efficiency by means of mathematical notations specialization to the solution of complex engineering problems.
2. Classify the fundamentals of Algorithmic problem-solving methods
3. Analyse the different techniques in the design of Graph Algorithms
4. Criticize the various algorithms design techniques of NP complete with NP hard problems
5. Examine the different approaches of advanced problem-solving methods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2	2		1							1	
2	3	3	3		2							1	2
3	3	3	3		2							2	1
4	2	3	3		3							2	2
5	1	2	3		1							2	2

UNIT I 9 Hours

INTRODUCTION

Characteristics of Algorithm, Analysis of Algorithm, Asymptotic analysis of Complexity Bounds-Best, Average and Worst-Case behavior, Performance Measurements of Algorithm, Time and Space Trade-Offs, Analysis of Recursive Algorithms through Recurrence Relations, Substitution Method, Recursion Tree Method, and Masters Theorem

UNIT II 9 Hours

FUNDAMENTAL ALGORITHMIC STRATEGIES - I

Brute-Force, Divide and conquer, Heuristics, Greedy Methodologies, Illustrations of these techniques for Problem Solving.

UNIT III **9 Hours**

FUNDAMENTAL ALGORITHMIC STRATEGIES - II

Dynamic Programming, Branch and Bound and Backtracking Methodologies, Illustrations of these techniques for Problem Solving, Bin Packing, Knapsack, Travelling Salesman Problem.

UNIT IV **9 Hours**

GRAPH AND TREE ALGORITHMS

Traversal algorithms: Depth First Search (DFS) and Breadth First Search (BFS)- Shortest path algorithms, Transitive closure, Heap Sort, Topological sorting, Network Flow Algorithm.

UNIT V **9 Hours**

TRACTABLE AND INTRACTABLE PROBLEMS AND ADVANCED TOPICS

Computability of Algorithms, Computability classes, P, NP, NP Complete and NP Hard- Standard NP complete Problems and Reduction Techniques- Approximation algorithms, Randomized algorithms.

EXPERIMENT 1 **6 Hours**

Online bookstore that needs to manage the book. The book is sorted based on book ID using Quick Sort, implemented by the C program.

EXPERIMENT 2 **6 Hours**

NPTEL DAA Course instructor wants to organize the exam scores in ascending order using merge sort in the C program.

EXPERIMENT 3 **6 Hours**

Implement the 0/1 Knapsack problem in C to maximize the value of items in a grocery shopping bag.

EXPERIMENT 4 **6 Hours**

Planning a trip from erode to Coorg. Find the shortest paths to reach Coorg using Dijkstra's algorithm in the C program.

EXPERIMENT 5 **6 Hours**

D mart store, when a customer hands you a bill for items with various prices, the cashier provides change using the subset sum problem implemented in the C program.

Total: 45 + 30 = 75 Hours

Reference(s)

1. E. Horowitz, S. Sahni, Fundamental of Computer Algorithms, 2nd edition, Jan 2008.
2. A. Aho, J. Hopcroft and J. Ullman, The Design and Analysis of Computer Algorithms, June 1974.
3. T. H. Cormen, C. E. Leiserson and R. L. Rivest, Introduction to Algorithms, 2nd edition, 1990.
4. S. Baase, Computer Algorithms-Introduction to Design and Analysis, Dec 1999.
5. D. E. Knuth, The Art of Computer Programming, Vol. 1, Vol. 2 and Vol. 3, Dec 2005.
6. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Dec 2010.

22CB404 **DESIGN THINKING** **3 0 0 3**

Course Objectives

- Understand and compare the important of design thinking
- Identify the steps in the design thinking (DT) process

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO3: Design/ Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO10: Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-long learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

PSO1: Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Interpret the importance of design thinking and steps in the DT process
2. Analyse empathizes phase of design thinking
3. Compare the different perspectives on personas in the define phase
4. Analyse the ideate phase of design thinking
5. Recognize the importance of the prototype and testing phase in DT

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2		3			1				2	1	1	
2	2		3			1				2	1	1	1
3	2		2			1				2	1		1
4	2		3			1				2	1	1	
5	2		1			1				2	1		2

UNIT I **9 Hours**

INTRODUCTION

Introduction-Importance of Design Thinking (DT) -Design Thinking for business-Design Thinking for an Individual-Steps in the DT process- Empathize-Define-Ideate-Prototype-Test.

UNIT II **9 Hours**

EMPATHY PHASE

Empathy Phase - Steps in the empathize phase of DT- Empathy- What, How, Why-Different types to developing Empathy towards People-Steps required to conduct an immersion activity-How to empathize- Introduction to Immersion Activity-Conducting an immersion activity-DT question template for Immersion activity

UNIT III **9 Hours**

DEFINE PHASE

Creating personas- Steps to create personas in the define phase of DT- Creating your own Persona- Four Different Perspectives on Personas-Goal-directed Personas, Role-Based Personas, Engaging Personas, Fictional Personas-Steps to create your Engaging Personas and Scenarios -Steps to create problem statements in the define phase of DT -Problem statements-Defining problem statements- Problem statements in define phase of DT

UNIT IV **9 Hours**

IDEATE PHASE

How to Ideate-Steps in the ideate phase of DT-Applying the steps in the ideate phase of DT-Ideation games- Six Thinking Hats and Million-dollar idea -Ideate to find solution-Characteristics Required for Successful Ideation-Doodling for expressing ideas-Importance of storytelling in presenting ideas and prototypes-Storytelling in DT

UNIT V **9 Hours**

PROTOTYPE AND TESTING PHASE

Importance of the prototype phase in DT-Prototype your idea-Create a prototype-Types of Prototyping-Low-Fidelity Prototyping and High-Fidelity Prototyping-Guidelines for Prototyping-Service value proposition-Creating a value proposition statement-Testing in Design Thinking-Test the Prototype -Role of DT in your work -DT for better coding -Agile and DT complement each other to deliver customer Satisfaction-Satori

Total: 45 + 30 = 75 Hours

Reference(s)

1. Mauricio Vianna, Ysmar Vianna, Isabel K. Adler, Brenda Lucena and Beatriz Russo, Design Thinking: Business innovation, First Edition,MJV Press, 2014.
2. Mads Soegaard, The Basics of User Experience Design by Interaction Design Foundation, Kindle Edition,2018.
3. Nir Eyal, Hooked: How to Build Habit-Forming Products, Kindle Edition, Penguin Publishers, 2011.
4. Judkins, The Art of Creative Thinking, Kindle Edition, Hachette Book Publishing,2015.
5. Dan Senor and Saul Singer, Start Up Nation, Kindle Edition, Twelve Publishers,2011.
6. Simon Sinek, Start with Why, Kindle Edition, Portfolio Publishers, 2011.

22CB405 OPERATIONS RESEARCH 2 0 2 3

Course Objectives

- Learn the fundamental concepts of operations research, solving technique, analyze the results and propose recommendations in understandable to the decision - making processes in Management and Engineering.
- Understand and apply the methodologies of the Queueing theory and simulation.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/ Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1: Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand the basic concepts of operational research techniques from the verbal description of the real system.
2. Understand the mathematical tools that are needed to solve optimization problems for transhipment problems.
3. Understand the concepts of network use PERT and CPM techniques to plan, schedule and control project activities.
4. Identify and apply the queuing methodologies to optimize the result of the waiting line.
5. Understand the fundamental concepts related to random number generation in simulation techniques.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2	1		1							1	
2	1	3	1		1								1
3	2	2	2		2							1	1
4	2	3			1							2	
5	2	3			1							1	

UNIT I **6 Hours**

LINEAR PROGRAMMING

Linear programming - Examples from industrial cases, formulation & definitions, Matrix form. Basic concepts, Special cases - infeasibility, unboundedness, redundancy and degeneracy, Sensitivity analysis. Simplex Algorithm - slack, surplus & artificial variables, computational details, big - M method, identification and resolution of special cases through simplex iterations. Duality - formulation, results, fundamental theorem of duality, dual - simplex and primal - dual algorithms.

UNIT II **6 Hours**

TRANSPORTATION AND ASSIGNMENT PROBLEMS

TP - Examples, Definitions - decision variables, supply & demand constraints, formulation, Balanced & unbalanced situations, Solution methods - NWCR, minimum cost and VAM, test for optimality (MODI method), degeneracy and its resolution. AP - Examples, Definitions - decision variables, constraints, formulation, Balanced &unbalanced situations, Solution method - Hungarian, test for optimality (MODI method), degeneracy & its resolution.

UNIT III **6 Hours**

PERT - CPM AND INVENTORY CONTROL

Project definition, Project scheduling techniques - Gantt chart, PERT & CPM, Determination of critical paths, Estimation of Project time and its variance in PERT using statistical principles, Concept of project crashing/time - cost trade - off. Inventory Control: Functions of inventory and its disadvantages, ABC analysis, Concept of inventory costs, Basics of inventory policy (order, lead time, types), Fixed order-quantity models - EOQ, POQ & Quantity discount models. EOQ models for discrete units, sensitivity analysis and Robustness.

UNIT IV **6 Hours**

QUEUING THEORY

Definitions - queue (waiting line), waiting costs, characteristics (arrival, queue, service discipline) of queuing system, queue types (channel vs. phase). Kendall's notation, Little's law, steady state behavior, Poisson's Process & queue, Models with examples - M/M/1 and its performance measures; M/M/m and its performance measures.

UNIT V **6 Hours**

SIMULATION METHODOLOGY

Definition and steps of simulation, random number, random number generator, Discrete Event System Simulation - clock, event list, Application in Scheduling, Queuing systems and Inventory systems.

EXPERIMENT 1 **4 Hours**

Classify the LPP and develop a mathematical formulation of daily requirements of raw material usage in the paint factory.

EXPERIMENT 2 **4 Hours**

Implement a graphical method to evaluate the production in furniture industry.

EXPERIMENT 3 **4 Hours**

Analyze the quality of the product for the proposed linear programming technique in crop yield monitoring system.

EXPERIMENT 4 **4 Hours**

Design and analyze the minimum cost of product mix in healthcare industry.

EXPERIMENT 5 **4 Hours**

Determine the optimality of the product for maximization and minimization in the chocolate manufacturing company.

EXPERIMENT 6 **4 Hours**

Determine and implement the proposed technique to minimize the cost of transporting in Logistics and Supply Chain Management.

EXPERIMENT 7 **3 Hours**

Analyze the minimum total cost of assigning salesforce to the grow its mortgage lending business in the bank's management system.

EXPERIMENT 8 **3 Hours**

Develop an optimum solution for transporting goods for a pharmaceutical company

Total: 30 + 30 = 60 Hours

Reference(s)

1. Murthy K G, Linear Programming, Tata Mc Graw Hill Education,4th Edition, 2017.
2. Hadley G, Introduction to Linear Programming Models,11th Edition, Academic Press, New York,2012.
3. Wagner H M, Principles of OR with Application to Managerial Decisions, World Press Private Ltd.,1968.
4. F.S. Hiller and G.J. Lieberman, Introduction to Operations Research, 43rd Edition, Khanna Publication, Delhi,2014.
5. A. Ravi Ravindran, Operations Research and Management Science, Hand Book,3rd Edition, TataMc Graw Hill Education,1999.
6. Thomas L. Saaty, Elements of Queuing Theory, McGraw-Hill, 1961.

22CB406 MARKETING RESEARCH AND MARKETING MANAGEMENT 2 0 0 2

Course Objectives

- To gain insight on fundamental concepts of marketing.
- Comprehend the dynamics of marketing and analyse how its various components interact with each other in the real world.
- Impart knowledge about the principles of marketing research.

Programme Outcomes (POs)

PO3: Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10: Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PSO1: To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. To explain the functioning of elasticity of demand in micro economics.
2. Comprehend the dynamics of marketing and analyse how its various components interact with each other in the real world
3. Leverage marketing concepts for effective decision making
4. Understand the basic concepts, principles, statistical tools of marketing research
5. Execute various strategies of Internet Marketing.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1			1			2			1	1		2	1
2			2	2		1			1	1		2	2
3			2	2						2		2	3
4				3		1			1	1		2	4
5			2			1			1	2		2	5

UNIT I **7 Hours**

MARKETING CONCEPTS AND APPLICATIONS

Marketing Concepts and Applications: Introduction to Marketing & Core Concepts, Marketing of Services, Importance of marketing in service sector-Marketing Planning & Environment: Elements of

Marketing Mix, Analysing needs & trends in Environment - Macro, Economic, Political, Technical & Social- Understanding the consumer: Determinants of consumer behaviour, Factors influencing consumer behavior- Market Segmentation: Meaning & Concept, Basis of segmentation, selection of segments, Market Segmentation strategies, Target Marketing, Product Positioning.

UNIT II **5 Hours**
MARKETING MIX
MARKETING MIX- Concept, elements, 7 Ps of marketing-Product Management: Product decision and strategies, Packaging, Product Life cycle concept, New Product development & strategy, Stages in New Product development, Branding.

UNIT III **7 Hours**
MARKETING RESEARCH
Introduction, type of Market Research, Scope, Objectives and Limitations Marketing Research Techniques, Survey Questionnaire design and drafting, Pricing Research, Media Research, qualitative Research. Data analysis- Use of various statistical tools, descriptive and inference statistics, statistical hypothesis testing, multivariate analysis, discriminant analysis, cluster analysis, segmenting and positioning, factor analysis.

UNIT IV **6 Hours**
BUSINESS TO BUSINESS MARKETING
Business to Business Marketing-Fundamental of business markets, Organizational buying process. Business buyer needs. Market and sales potential. Product in business markets. Relationship, networks and customer relationship management. Business to Business marketing strategy.

UNIT V **5 Hours**
INTERNET MARKETING
Introduction to Internet Marketing. Mapping fundamental concepts of Marketing (7Ps, STP); Strategy and Planning for Internet Marketing.

Total: 45 + 30 = 75 Hours

Reference(s)

1. Rajan Saxena, Marketing Management, McGraw Hill Education,6th edition, 2019.
2. S.A. Sherlekar, Marketing Management, Himalaya Publishing House, 2014.
3. Research for Marketing Decisions by Paul Green, Donald, Tull.
4. Business Statistics, A First Course, David M Levine at al, Pearson Publication.
5. Marketing Management, Philip Kotler.
6. Service Marketing, S.M. Zha.

22HS007 **ENVIRONMENTAL SCIENCE** **2 0 0 2**

Course Objectives

- Understand the interdisciplinary and holistic nature of the environment
- Identify the significance of natural resources and environment on the quality of life and stimulate the quest for sustainable development
- Assess the socio-economic, political and ethical issues in environmental science

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PSO1: To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Explain the importance of interdisciplinary nature of environment studies, uses and exploitation of natural resources.
2. Analyze the different types of ecosystems and biodiversity, its values and also role of professionals in protecting the environment from degradation.
3. Identify the existing environmental challenges related to pollution and its management.
4. Select suitable strategies for sustainable management of components of environmental science.
5. Correlate the impacts of population and human activities on environment.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2				1							1
2	1	1	1									1	2
3	2	2	1			1							3
4	1		1			1						1	4
5	2												5

UNIT I **6 Hours**
NATURAL RESOURCES

Forest resources: Use - over exploitation - deforestation - case studies. Water resources: Use - over utilization of surface and ground water - conflicts over water. Mineral resources: Use - exploitation - environmental effects of extracting and using mineral resources - case studies. Food resources: Effects of modern agriculture - fertilizer-pesticide problems (eutrophication, blue baby syndrome, biomagnification). Energy resources: renewable (solar, wind, and hydro).

UNIT II **6 Hours**

ECOSYSTEMS AND BIODIVERSITY

Concept of an ecosystem: Structure and function of an ecosystem - producers - consumers - decomposers - food chains - food webs and ecological pyramids. Types of ecosystem: Introduction - characteristic features: desert ecosystem. Biodiversity - value of biodiversity - threats to biodiversity - endangered and endemic species - Conservation of biodiversity: In-situ and ex-situ conservation of biodiversity.

UNIT III **6 Hours**

ENVIRONMENTAL POLLUTION

Pollution: Definition - causes - effects - control measures of air pollution - water pollution: (Sewage water treatment by activated sludge and trickling filter process) - noise pollution- thermal pollution. Disaster management: causes - effects - control measures of floods Ã¢?? earthquake

UNIT IV **7 Hours**

SOCIAL ISSUES AND ENVIRONMENT

Sustainable development: Definition - Unsustainable to sustainable development - solid waste management - causes - effects - 5R Principles (landfills, incineration, composting). Water conservation - rain water harvesting - watershed management. Climate change - global warming - acid rain - ozone layer depletion. E-waste.

UNIT V **5 Hours**

HUMAN POPULATION AND ENVIRONMENT

Human population: Population growth - characteristics - variation among nations - population explosion - value education - HIV / AIDS. Role of information technology in environment and human health - occupational safety and health administration (OSHA).

Total: 45 + 30 = 75 Hours

Reference(s)

1. Anubha Kaushik, C.P. Kaushik, Environmental Science and Engineering, 4th Multi Colour Edtion, New Age International Publishers, New Delhi, 2014.
2. Raven, P.H., Hassenzahl, D.M. & Berg, L.R. 2012, Environment, 8th edition, John Wiley & Sons.
3. T. G. Jr. Miller, S. Spoolman, New Environmental Science, 14th Edition, Wadsworth Publishing Co, New Delhi, 2014.
4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2011. Environmental and Pollution Science. Academic Press.
5. A. K. De, Environmental Chemistry, 7th Edition, New age international publishers, New Delhi, 2014.

22CB501 **COMPILER DESIGN** **3 0 2 4**

Course Objectives

- Acquire knowledge in different phases of a compiler and its application.
- Understand the categorization of tokens using lexical analyzer and pattern recognition using parsers.
- Familiar with the optimization methods and code generation schemes.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Analyze the output generated in each phase of the compiler and construct finite automata for regular expression.
2. Construct Top down and Bottom-up parser for Context free grammars.
3. Generate intermediate code for programming constructs.
4. Analyze the memory allocation in the symbol table and improve the code using optimization techniques.
5. Analyze the issues in code generation.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	3	1									2
2	2	3	3	1									2
3		2	2	1									2
4		2		2	1								2
5		2		2	1								2

UNIT I **9 Hours**

INTRODUCTION

Phases of compilation and overview-Lexical Analysis (scanner), Regular languages - Finite Automata-Regular expressions - Relating regular expressions and finite automata-Scanner generator (Lex, flex).

UNIT II **10 Hours**

SYNTAX ANALYSIS (PARSER)

Context-free languages and grammars, Push-down Automata-LL(1) grammars and top-down parsing, Operator grammars-LR(0)-SLR(1)-LR(1)-LALR(1) grammars and bottom-up parsing, Ambiguity and LR parsing, LALR(1) parser generator(yacc, bison).

UNIT III **9 Hours**

SEMANTIC ANALYSIS AND INTERMEDIATE CODE GENERATION

Attribute grammars-Syntax directed definition - Evaluation and flow of attribute in a syntax tree. Intermediate Code Generation: Translation of different language features, different types of intermediate forms.

UNIT IV **9 Hours**

CODE IMPROVEMENT (OPTIMIZATION)

Symbol Table-Basic structure, Symbol attributes and management, Run-time environment, Procedure activation, Parameter passing, Value return, Memory allocation, Scope, Code Improvement (optimization)-Control-flow, Data-flow dependence, Local optimization, Global optimization, Loop optimization, Peep-hole optimization, etc

UNIT V **8 Hours**

ARCHITECTURE DEPENDENT CODE IMPROVEMENT

Instruction scheduling for pipeline-Loop optimization for cache memory etc, Register allocation and target code generation.

EXPERIMENT 1 **3 Hours**

Develop lexical analyzer for the source code of addition of n numbers into tokens to prepare the code for later stages.

EXPERIMENT 2 **4 Hours**

Implement Text Processing with Lex for Counting Metrics and Validating Mobile Numbers and Email Addresses.

EXPERIMENT 3 **4 Hours**

Implement a program for syntax checking for looping statements and control statements used in sorting algorithms (merge sort, insertion sort etc.,) using LEX and YACC.

EXPERIMENT 4 **4 Hours**

Implement a program for syntax checking for declaration statements and functions used in sorting algorithms using LEX and YACC.

EXPERIMENT 5 **3 Hours**

Develop a desk calculator program using LEX and YACC to evaluate arithmetic expressions.

EXPERIMENT 6 **4 Hours**

Develop a program using LEX and YACC to generate Three Address Code (TAC) for a quick sort function in a custom-defined programming language.

EXPERIMENT 7 **4 Hours**

Develop a program to implement and demonstrate various code optimization techniques on a quick sort algorithm written in a high-level programming language.

EXPERIMENT 8 **4 Hours**

Develop a program using LEX and YACC to implement code generation techniques for generating optimized intermediate code for the quick sort algorithm from a custom-defined high-level language.

Total: 45+30 =75 Hours

Reference(s)

1. V. Aho, R. Sethi and J. Ullman, Compilers: Principles, Techniques and Tools, Dec 2005
2. Levine R. John, Tony Mason and Doug Brown, Lex &Yacc, Jan 1992
3. Bjarne Stroustrup, The Design and Evolution of C++, April 1994

22CB502 BUSINESS STRATEGY 2 0 0 2

Course Objectives

- To help the students to learn the process of strategic management.
- To scan internal and external environment with the help of appropriate tools for strategic decision making.
- To expose students to the strategic ideas of diversification and growth in management.
- To help students develop skills for applying management concepts as a solution to the business problems.
- To enable the students to have an insight into strategic implementation and control.

Programme Outcomes (POs)

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Apply the fundamental concepts of business management strategic.
2. Apply holistic approach by integrating various perspectives to develop appropriate organizational policies and strategies.
3. Analyze and make decisions in through various tools and techniques.
4. Predict the growth avenues against the backdrop of the opportunities.
5. Develop the skills on implementation of strategy through organizational structure and control systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1					1			1					1
2					2			2					2
3					1			1					1
4					2			2					2
5					2			2					2

UNIT I **6 Hours**

INTRODUCTION TO STRATEGIC MANAGEMENT

Importance of Strategic Management-Vision and Objectives-Schools of thought in Strategic Management-Strategy Content, Process, and Practice-Fit Concept and Configuration Perspective in Strategic Management

UNIT II **6 Hours**

INTERNAL ENVIRONMENT OF FIRM

Recognizing a Firms Intellectual Assets-Core Competence as the Root of Competitive Advantage-Sources of Sustained Competitive Advantage-Business Processes and Capabilities-based Approach to Strategy

UNIT III **6 Hours**

EXTERNAL ENVIRONMENTS OF FIRM

Competitive Strategy -Five Forces of Industry Attractiveness that Shape Strategy -The concept of Strategic Groups, and Industry Life Cycle-Generic Strategies-Generic Strategies and the Value Chain

UNIT IV **6 Hours**

CORPORATE STRATEGY, AND GROWTH STRATEGIES

The Motive for Diversification-Related and Unrelated Diversification-Business Portfolio Analysis-Expansion, Integration and Diversification-Strategic Alliances, Joint Ventures, and Mergers & Acquisitions

UNIT V **6 Hours**

STRATEGY IMPLEMENTATION

Structure and Systems -The 7S Framework -Strategic Control and Corporate Governance

Total: 30 Hours

Reference(s)

1. Robert M. Grant, Contemporary Strategic Management, 7th Edition Blackwell, 2012
2. M.E. Porter, Competitive Strategy, first Edition, THE FREE PRESS,1980.
3. Richard Rumelt, Competitive Advantage, 2011
4. Richard Rumelt, Good Strategy Bad Strategy: The Difference and Why It Matters, Profile Books,2011.

22CB503	SOFTWARE DESIGN WITH UML	2 0 2 3

Course Objectives

- Understand the basics of UML diagrams.
- Impart knowledge about the principles of object-oriented methodologies.
- Build a conceptual model during analysis and design.

Programme Outcomes (POs)

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Analyse the object-oriented technologies in software development process using real world scenarios.
2. Apply the concept of object-oriented software development for requirement analysis using case modelling.
3. Implement sequence diagram and collaboration diagram to identify objects from flow of events.
4. Design the object-oriented Methodologies with interaction diagrams.
5. Design dynamic, component diagram and deployment models for object-oriented system development.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1		3	2		1								1
2		2	3		2								1
3		2	3		1								1
4		2	3		1								1
5		2	3		1								1

UNIT I **6 Hours**

INTRODUCTION TO ON OBJECT ORIENTED TECHNOLOGIES AND THE UML METHOD

Software development process: The Waterfall Model vs. The Spiral Model - The Software Crisis, description of the real world using the Objects Model- Classes, inheritance and multiple configurations- Quality software characteristics- Description of the Object-Oriented Analysis process vs. the Structure Analysis Model.

UNIT II **6 Hours**

INTRODUCTION TO THE UML LANGUAGE AND CASE MODELLING

UML Language: Standards- Elements of the language- General description of various models- The process of Object-Oriented software development - Description of Design Patterns – Technological

Description of Distributed Systems. Case Modeling: Analysis of system requirements- Actor definitions- Writing a case goal- Use Case Diagrams- Use Case Relationships.

UNIT III **6 Hours**

TRANSFER FROM ANALYSIS TO DESIGN IN THE CHARACTERIZATION STAGE INTERACTION DIAGRAMS

Description of goal - Defining UML Method, Operation, Object Interface, Class - Sequence Diagram - Finding objects from Flow of Events - Describing the process of finding objects using a Sequence Diagram - Describing the process of finding objects using a Collaboration Diagram.

UNIT IV **6 Hours**

TRANSFER FROM ANALYSIS TO DESIGN IN THE CHARACTERIZATION STAGE INTERACTION DIAGRAMS

The Class Diagram Model: Attributes descriptions - Operations descriptions - Connections descriptions in the Static Model-Association, Generalization, Aggregation, Dependency, Interfacing, Multiplicity. Package Diagram Model: Description of the model-White box, black box - Connections between packagers - Interfaces-Create Package Diagram - Drill Down.

UNIT V **6 Hours**

DYNAMIC, COMPONENT DIAGRAM AND DEPLOYMENT MODELS

Dynamic Model: Description of the State Diagram - Events Handling - Description of the Activity Diagram - Exercise in State Machines. Component Diagram Model: Physical Aspect - Logical Aspect- Connections and Dependencies - User face - Initial DB design in a UML environment. Deployment Model: Processors - Connections - Components - Tasks - Threads - Signals and Events.

EXPERIMENT 1 5 Hours

Design a Use Case diagram for the Online Railway Ticket Booking application by including the passenger operation (User registration, Search Train, View Train, Ticket Booking and Ticket Cancellation) and admin operations (Train, User, Booking management and Report generation) Identify Use Cases and develop the Use Case model.

EXPERIMENT 2 5 Hours

Design a Class diagram for the Online Railway Ticket Booking application by including the passenger and admin operations.

EXPERIMENT 3 5 Hours

Design a sequence diagram for Ticket Booking, Make Payment and Cancellation of Tickets and show the interactions between the objects.

EXPERIMENT 4 5 Hours

Design a state and activity diagram for Ticket Booking, Make Payment and Cancellation of Tickets.

EXPERIMENT 5 5 Hours

Design a package diagram for the online railway ticket booking application aligned with class diagram by including User interface layer, Domain layer and Technical services layer.

EXPERIMENT 6 5 Hours

Develop a simple, user-friendly online ticket booking application that aligns with the use case and class diagrams. Perform unit, integration, and system testing to ensure that the application meets the specified requirements.

Total: 30+30 =60 Hours

Reference(s)

1. Object-Oriented Software Engineering: using UML, Patterns, and Java. Bernd Bruegge and Allen H. Dutoit.
2. Design Patterns: Elements of Reusable Object-Oriented Software. Erich Gamma, Richard Helm, Ralph Johnson, and John M. Vlissides.

22CB504 FINANCIAL AND COST ACCOUNTING 2 0 0 2

Course Objectives

- To enable students to read and understand Financial Statements.
- To provide insights about the concepts of Financial Management and its application for managerial decision making.
- To provide an in-depth study Accounting Principles and Techniques for Managerial Decision Making.
- To acquaint the students with fundamental principles of accounting.
- To enhance the knowledge of students in the areas of Costing, Budgeting and Marginal Costing Techniques.

Programme Outcomes (POs)

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Understand and explain the conceptual framework of Financial & Cost Accounting.
2. Apply the basic concepts in Preparation of Final Accounts using the principle of GAAP.
3. Analyze and interpretation of Income Statement and Balance Sheet.
4. Evaluate the overheads and other costs across various products.
5. Gain insights about the need of Material cost & Methods to control Manufacturing cost.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1										1			1
2										2			2
3				3						2			2
4				3						3			3
5				2						3			3

UNIT I 6 Hours

ACCOUNTING CONCEPT

Introduction, Techniques and Conventions, Financial Statements- Understanding and Interpreting Financial Statements.

UNIT II 6 Hours

ACCOUNTING PROCESS

Book Keeping and Record Maintenance - Fundamental Principles and Double Entry - Journal, Ledger, Trial Balance, Balance Sheet, Final Accounts - Cash Book and Subsidiary Books - Rectification of Errors.

UNIT III **6 Hours**

FINANCIAL STATEMENTS

Form and Contents of Financial Statements, Analyzing and Interpreting Financial Statements, Accounting Standards. Class Discussion: Corporate Accounting Fraud- A Case Study of Satyam Cash Flow and Fund Flow Techniques: Introduction, how to prepare, Difference between them.

UNIT IV **6 Hours**

COSTING SYSTEMS

Elements of Cost, Cost behavior,Cost Allocation, OH Allocation, Unit Costing, Process Costing, Job Costing, Absorption Costing, Marginal Costing, cost volume Profit Analysis, Budgets, ABC Analysis, Class Discussion-Application of costing concepts in the service sector.

UNIT V **6 Hours**

COMPANY ACCOUNTS AND ANNUAL REPORTS

Audit Reports and Statutory Requirements-Directors Report-Notes to Accounts-Pitfalls.

Total: 30 Hours

References

1. Robert N Anthony, David Hawkins, Kenneth Marchant, Accounting Texts and Cases, McGrawHill.2017.

22HS505 BUSINESS COMMUNICATION AND VALUE SCIENCE - III 1 0 2 2

Course Objectives

- Develop technical writing skills.
- Practice self-analysis techniques like SWOT & TOWS.
- Understand key concepts of pluralism & cultural spaces.
- Sensitise the cross-cultural communication.
- Develop the science of nation building.

Programme Outcomes (POs)

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PSO1. To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Identify the best practices of technical writing & apply technical writing in real life scenarios.
2. Apply &analyze the basic principles of SWOT & life positions.
3. Identify & respect pluralism in cultural spaces.
4. Identify the common mistakes made in cross-cultural communication.
5. Understand, analyze& leverage the power of motivation in real life.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1								3				2	
2								3				2	
3								3				2	
4									2			2	
5									2			2	

UNIT I
SWOT Analysis **3 Hours**

Basic principles of SWOT and Life Positions - Apply SWOT in real life scenarios- Recognize how motivation helps real life- Leverage motivation in real life scenarios

UNIT II
Cultures in Collision **3 Hours**

Pluralism in cultural spaces- Differentiate between the different cultures of India - Define the terms global, local and translocational - Differentiate between global, local and translocational culture Recognize the implications of cross-cultural communication- Common mistakes made in cross-cultural communication - The roles and relations of different genders

UNIT III
Technical Writing **3 Hours**

Role of science in nation building- Introduction to technical writing- Practice activity on technical writing - Assessment on technical writing

UNIT IV
AI and Communication **3 Hours**

AI (artificial intelligence) - Importance of AI- AI in Everyday Life- Communicating with machines - Identify the best practices of technical writing- technical writing in real life scenarios

UNIT V
Community Needs **3 Hours**

Project - Visit rural area / underprivileged parts of city to address some of the local issues; if relevant, suggest a practical technology solution to the issues.

EXPERIMENT 1 **6 Hours**

SWOT vs TOWS
The balancing act TED talks on Biomimicry and Stories
YouTube videos on Maslows Theory

EXPERIMENT 2 **6 Hours**

Rhythms of India (Cultures in India)
Cross-cultural Communication

EXPERIMENT 3 **6 Hours**

Role of science in Nation Building

EXPERIMENT 4 **6 Hours**

Role of science (post-independence)
Practice activity on Technical Writing

EXPERIMENT 5 **6 Hours**

AI in Everyday Life
Design your college in the year 2090

Total: 15+30 =45 Hours

Reference(s)

1. Raman, Meenakshi and Sangeeta Sharma. Fundamentals of Technical Communication. (2014)
2. Fine, Lawrence G. The SWOT Analysis: Using Your Strength to Overcome Weaknesses, Using Opportunities to Overcome Threats. (2009).

22CB508 **MINI PROJECT I** **0 0 2 1**

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analysing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Formulate a real-world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, and techniques that contribute to obtaining the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis of the cost effectiveness.
5. Prepare the report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2	1	1	2	2	2	2	2	2		1	1
2	1	2	1	1	2	2	2	2	2	2		1	1
3	1	2	1	1	2	2	2	2	2	2	2	1	1
4	1	2	1	1	2	2	2	2	2	2	2	1	1
5	1	2			2	2	2	2	2	2		1	1

22CB601 **COMPUTER NETWORKS** **3 0 2 4**

Course Objectives

- Understand the network protocols, architecture and applications
- Gain knowledge about the functions of different network layers
- Familiar with the various aspects of computer networks

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PSO1: Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Apply the basic concept in modern data communication and computer networking.
2. Apply the functions of different layers and in-depth knowledge of data link layer.
3. Analyze the different protocols and network layer components.
4. Criticize the basic functions of transport layer and congestion in networks.
5. Analyze the working of application layer along with the protocols used.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2			3	2						2	1
2	3	2			3	2						2	1
3	3				3	2						2	1
4	3	2			3	2						2	1
5	3				3	2						2	1

UNIT I **10 Hours**

INTRODUCTION

Computer networks and distributed systems-Classifications of computer networks-Preliminaries of layered network structures-Data communication Components -Representation of data and its flow-Various Connection Topology-Protocols and Standards-OSI model, Transmission Media-LAN-Wired LAN-Wireless LAN-Virtual LAN-Techniques for Bandwidth Utilization-Multiplexing-Frequency division-Time division and Wave Division-Concepts on spread spectrum.

UNIT II **9 Hours**

DATA LINK LAYER AND MEDIUM ACCESS SUB LAYER

Fundamentals of Error Detection and Error Correction-Block Coding-Hamming Distance-CRC-Flow Control and Error control protocols-Stop and Wait-Go-back-N ARQ-Selective Repeat ARQ-Sliding Window-Piggybacking-Random Access-Multiple access protocols -Pure ALOHA-Slotted ALOHA-CSMA-CD-CDMA-CA

UNIT III **8 Hours**

NETWORK LAYER

Switching-Logical addressing-IPV4-IPV6-Address mapping-ARP-RARP-BOOTP and DHCP-Delivery-Forwarding and Unicast Routing protocols.

UNIT IV **8 Hours**

TRANSPORT LAYER

Process to Process Communication-User Datagram Protocol (UDP)-Transmission Control Protocol (TCP)-Stream Control Transmission Protocol (SCTP)-Congestion Control-Quality of Service (QoS)-QoS improving techniques-Leaky Bucket and Token Bucket algorithms.

UNIT V **10 Hours**

APPLICATIONLAYER

DNS-DDNS-TELNET-EMAIL-FTP-WWW-HTTP-SNMP-Bluetooth-Firewalls-Network Security-Electronic mail-directory services and network management-Basic concepts of Cryptography

EXPERIMENT 1 **3 Hours**

Study of system administration and network administration

EXPERIMENT 2 **3 Hours**

Study of socket programming and client server model using UDP and TCP

EXPERIMENT 3 **3 Hours**

Implementation of sliding window protocol and stop and wait protocol

EXPERIMENT 4 **3 Hours**

Applications using TCP Sockets like

a. File transfer
b. Remote command execution
c. Chat
d. Concurrent server

EXPERIMENT 5 **3 Hours**

Create a socket for HTTP for webpage upload and download

EXPERIMENT 6 **3 Hours**

Implementation of Subnetting Applications

a. DNS
b. SNMP

EXPERIMENT 7 **3 Hours**

Study of Network Simulator-3(NS3)

EXPERIMENT 8 **3 Hours**

Study of PUTTY (NETWORK FILE TRANSFER APPLICATION)

EXPERIMENT 9 **3 Hours**

Perform a case study about ETTERCAP (NETWORK SECURITY TOOL).

EXPERIMENT 10 **3 Hours**

Write a code simulating PING and TRACEROUTE commands.

Total: 45 +15 = 75 Hours

Reference(s)

1. A. Tannenbaum, Computer Networks, Pearson, Fifth edition, 2013.
2. William Stallings, Data and Computer Communication, Prentice Hall,2007.
3. Kaufman, R. Perlman and M. Speciner, Network Security, Pearson ,2016.
4. W. Richard Stevens, UNIX Network Programming, Vol. 1, 2 & 3, First Edition, Prentice-Hall,2004.

22CB602 INFORMATION SECURITY 3 0 0 3

Course Objectives

- Understand information security's importance in our data-driven digital world.
- Acquire the knowledge of key concepts of information security and how they work.
- Develop a Security mindset learn how to critically analyze situations of computer and network usage from a security perspective, identifying the salient issues, technologies, policies, laws, standards, and practices.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.
PSO1: Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Examines the business drivers behind the information security analysis design process
2. Predict the major competence for each of the levels of security algorithms
3. Apply the suitable tree and graph algorithms in security technologies
4. Apply the suitable NP-hard data structure approaches for tractable and intractable problems
5. Analyze the different advanced algorithms for the security process

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2		2								2			2
2	2	2	3				2							2
3		2	2	2	2									2
4		3	2	3	1		2						2	
5		2	1	2			2							1

UNIT I **7 Hours**

OVERVIEW OF SECURITY PARAMETERS

Overview: Confidentiality, integrity and availability - Security violation and threats- Security policy and procedure- Assumptions and Trust- Security Assurance, Implementation and Operational Issues-Security Life Cycle.

UNIT II **10 Hours**

ACCESS CONTROL MODELS AND SECURITY POLICIES

Access Control Models: Discretionary, mandatory, role-based and task-based models, unified models, access control algebra, temporal and spatio-temporal models. Security Policies: Confidentiality policies, integrity policies, hybrid policies, non-interference and policy composition, international standards.

UNIT III **10 Hours**

SYSTEM DESIGN

Systems design: Design principles, representing identity, control of access and information flow, confinement problem. Assurance: Building systems with assurance, formal methods, evaluating systems.

UNIT IV **10 Hours**

LOGIC BASED SYSTEM

Malicious logic, vulnerability analysis, auditing, intrusion detection. Applications: Network security, operating system security, user security, program security. Special Topics: Data privacy, introduction to digital forensics, enterprise security specification.

UNIT V **8 Hours**

OPERATING SYSTEMS SECURITY AND DATABASE SECURITY

Operating Systems Security: Security Architecture, Analysis of Security in Linux/Windows. Database Security: Security Architecture, Enterprise security, Database auditing.

Total: 45 Hours

Reference(s)

1. Security Engineering, Ross Anderson.
2. Computer Security: Art and Science, M. Bishop, Pearson Education.
3. Information Security: Principles and Practice, M. Stamp.
4. Security in Computing, C.P. Pfleeger, S.L. Pfleeger, J. Margulies.
5. Secure Programming HOWTO, David Wheeler.
6. Browser Security Handbook, Michael Zalewski.

22CB603 ARTIFICIAL INTELLIGENCE 3 0 2 4

Course Objectives

- Provide comprehensive and in-depth knowledge of AI principles and techniques by introducing AI fundamental problems.
- Understand the basic concepts of analytic functions and method of construction in complex analysis.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1: Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Compare AI with human intelligence and traditional information processing, and discuss its strengths and limitations and its application to complex and human-centered problems
2. Analyse the structures and algorithms selection in Artificial Intelligence techniques related to searching techniques
3. Analyse the Importance of constraint satisfaction problem
4. Develop the predicate logic to solve knowledge representation issues.
5. Develop the probabilistic reasoning and planning techniques for the various systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	3	3		2							1	
2	1	3			3							1	1
3	1	3			2							1	
4	2	2	2		2							1	1
5	2	3	2		3							1	

UNIT I 7 Hours

INTRODUCTION AND OVERVIEW OF ARTIFICIAL INTELLIGENCE

Problems of AI- AI technique, -Tic - Tac - Toe Problem-Intelligent Agents- Agents & environment-nature of environment- structure of agents- goal based agents- utility based agents- learning agents.

UNIT II **11 Hours**

PROBLEM SOLVING AND SEARCH TECHNIQUES

Defining the problem as state space search- production system- problem characteristics- issues in the design of search programs. Problem solving agents- searching for solutions- uniform search strategies: breadth first search, -depth first search- depth limited search- bidirectional search-comparing uniform search strategies. Heuristic search strategies Greedy best-first search- A* search-AO* search- memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search-simulated annealing search- local beam search

UNIT III **9 Hours**

CONSTRAINT SATISFACTION PROBLEMS

Local search for constraint satisfaction problems- Adversarial search- Games, optimal decisions & strategies in games- the minimax search procedure- alpha-beta pruning- additional refinements-iterative deepening. Expert Systems: Representing and using domain knowledge, expert system shells, and knowledge acquisition.

UNIT IV **9 Hours**

KNOWLEDGE REPRESENTATION

Knowledge representation issues- representation & mapping- approaches to knowledge representation. Using predicate logic- representing simple fact in logic- representing instant & ISA relationship-computable functions & predicates- resolution, natural deduction. Representing knowledge using rules-Procedural verses declarative knowledge- logic programming- forward verses backward reasoning-matching- control knowledge.

UNIT V **9 Hours**

REASONING

Probabilistic reasoning: Representing knowledge in an uncertain domain, the semantics of Bayesian networks, Dempster-Shafer theory, Planning Overview, components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques.

EXPERIMENT 1 **3 Hours**

Solving Missionaries and cannibal’s problems

EXPERIMENT 2 **3 Hours**

Solving Water Jug Problem

EXPERIMENT 3 **3 Hours**

Solving 8 queens problem

EXPERIMENT 4 **3 Hours**

Travelling Salesman Problem

EXPERIMENT 5 **3 Hours**

Solving Wampus Problem using Logic

EXPERIMENT 6 **3 Hours**

Monkeys and Bananas Problem using Logic

EXPERIMENT 7 **3 Hours**

Bayesian Classification Problem

EXPERIMENT 8 **3 Hours**

Decision Tree Problem

EXPERIMENT 9 **3 Hours**
Developing a sentiment analysis system

EXPERIMENT 10 **3 Hours**
Development of Medical Expert system with Recommendation system

Total: 45 +15 = 75 Hours

Reference(s)

1. Stuart Russell and Peter Norvig, Artificial Intelligence: A Modern Approach 2016.
2. Artificial Intelligence, Russel, Pearson 2016.
3. Artificial Intelligence, Ritch & Knight, TMH.2008.
4. Introduction to Artificial Intelligence & Expert Systems, Patterson, PHI.
5. Logic & Prolog Programming, Saroj Kaushik, New Age International, 2007.
6. Expert Systems, Giarranto, VIKAS 1998.

22CB604 **IT WORKSHOP** **2 0 2 3**

Course Objectives

- Understand the basic working principles of MATLAB.
- Understand the workspace and miscellaneous commands of MATLAB.
- Analysing matrix, array and basic mathematical functions
- Applying the basic plotting done using MATLAB
- Apply the different programming logics which help to complete different plotting structures.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PSO1: Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2: To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Formulate the basic principles of MATLAB operations.
2. Represent the working session and multiple statements per line in MATLAB.
3. Represent the concepts of sub matrix and its operation.
4. Apply the language of graphs and trees to the real-world problems.
5. Apply formalized arguments based on conditional looping statements

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2										2	
2	2	2											2
3	3				2							1	
4	3									1		1	2
5	1				1								

UNIT I **6 Hours**

MATLAB

History - basic features - strengths and weaknesses - good programming practices and plan your code. Creating MATLAB variables - overwriting variable - error messages - making corrections - controlling the hierarchy of operations or precedence - controlling the appearance of floating point number.

UNIT II **6 Hours**

WORKSPACE AND MISCELLANEOUS COMMANDS

Managing the workspace - keeping track of your work session - entering multiple statements per line - miscellaneous commands.

UNIT III **6 Hours**

MATRIX, ARRAY AND BASIC MATHEMATICAL FUNCTIONS

Matrix generation, entering a vector, entering a matrix - matrix indexing, colon operator - linear spacing - creating a sub-matrix - dimension, matrix operations and functions matrix generators - special matrices- array and array operations - solving linear equations- other mathematical functions.

UNIT IV **6 Hours**

BASIC PLOTTNG

Overview - creating simple plots - adding titles - axis labels - and annotations - multiple data sets in one plot - specifying line styles and colours.

UNIT V **6 Hours**

INTRODUCTION TO PROGRAMMING

Introduction - M-File Scripts - script side-effects - M-File functions - anatomy of a M-File function - input and output arguments - input to a script file - output commands - Control flow and operators- if-end, structure - relational and logical operators-for-end, loop-while, end, loop-other flow structures, operator precedence, saving the output to a file-Debugging M-files-Debugging process, preparing for debugging, setting breakpoints, running with breakpoints-examining values-correcting and ending debugging-correcting an M-file, Implementation of various Image Processing Algorithms.

EXPERIMENT 1 **4 Hours**

Write a MATLAB program to generate Fourier series of a Square Wave.

EXPERIMENT 2 **4 Hours**

Write a MATLAB program to Calculate and plot using MATLAB Fourier Transform and Z-Transform of a given signal.

EXPERIMENT 3 **5 Hours**

Write a MATLAB program to plot the following continuous time and discrete time Signals. (i). Step Function (ii). Impulse Function (iii). Exponential Function (iv). Ramp Function (v). Sine Function.

EXPERIMENT 4 **4 Hours**

Write a MATLAB program to plot magnitude and phase response of a given system.

EXPERIMENT 5 **4 Hours**

Write a MATLAB program to Calculate and plot using MATLAB Fourier Transform and Z-Transform of a given signal.

EXPERIMENT 6 **5 Hours**

Write a MATLAB program to obtain Cross correlation of sequence x(n) and y(n) & autocorrelation of a sequence x (n) of the given sequences & verify the property.

EXPERIMENT 7 **4 Hours**

Write a MATLAB program to obtain linear convolution of the given sequences.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Digital Image Processing using MATLAB. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Pearson Education, Inc., 2004.
2. MATLAB: A Practical Introduction to Programming and Problem Solving. Stormy Attaway, Butterworth-Heinemann, 2017.

22CB607 **MINI PROJECT II** **0 0 2 1**

Course Objectives

- Identify the problem statement and apply the engineering concepts to find the solution.
- Improve the analysing capability of the students.
- Increase the exuberance in finding the solution to various problems.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Formulate a real-world problem, identify the requirement and develop the design solutions.
2. Identify technical ideas, strategies and methodologies
3. Utilize the new tools, algorithms, and techniques that contribute to obtaining the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis of the cost effectiveness.
5. Prepare the report and present oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2	1	2	2		2	2	2			1	1
2	1	2	1	2	2		2	2	2			1	1
3	1	2	1	2	2		2	2	2	2		1	1
4	1	2	1	2	2		2	2	2	2		1	1
5	1	2		2	2		2	2	2			1	1

22CB001 EXPLORATORY DATA ANALYSIS 2 0 2 3

Course Objectives

- To outline an overview of exploratory data analysis.
- To implement data cleaning and preparation techniques.
- To perform descriptive statistics and data visualization techniques to present insights from the data.
- To apply univariate, bivariate, multivariate, correlation, and time series data exploration and analysis techniques
- To use dimensionality reduction techniques for simplifying complex datasets and visualize high-dimensional data.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

Course Outcomes (COs)

1. Understand the fundamentals of exploratory data analysis.
2. Implement the data cleaning and preparation techniques.
3. Apply advanced data visualization techniques to explore complex relationships and patterns in the data.
4. Analyze and interpret relationships between variables using EDA analysis techniques to gain insights into complex data patterns.
5. Apply dimensionality reduction techniques, such as Principal Component Analysis (PCA), to simplify complex datasets and extract essential features.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	3	3	3							1	
2	2	2	2	3	3							2	
3	2	3	3	2	3							2	
4	2	2	2	2	3							2	
5	2	2	3	2	1							2	

UNIT I **6 Hours**

EXPLORATORY DATA ANALYSIS

Overview of Exploratory Data Analysis - importance of EDA - data analysis process: data collection, data cleaning, and data exploration - Introduction to common data types and formats - Introduction to Python - data analysis libraries.

UNIT II **6 Hours**

DATA CLEANING AND PREPARATION

Introduction to data quality issues and common data cleaning techniques - Handling missing data and outliers - Data transformation techniques - Feature engineering and variable creation.

UNIT III **6 Hours**

DESCRIPTIVE STATISTICS AND DATA VISUALIZATION

Descriptive statistics: measures of central tendency, dispersion, and shape - Data visualization principles and best practices - Exploratory data visualization using Matplotlib and Seaborn.

UNIT IV **6 Hours**

EXPLORATORY DATA ANALYSIS TECHNIQUES

Univariate analysis: exploring single variables - Bivariate analysis: exploring relationships between variables - Multivariate analysis: analyzing relationships among multiple variables - Exploring time series data.

UNIT V **6 Hours**

DIMENSIONALITY REDUCTION TECHNIQUES

Introduction to dimensionality reduction - Principal Component Analysis (PCA) and its applications - Distributed Stochastic Neighbour Embedding (t-SNE) for visualization.

EXPERIMENT 1 **6 Hours**

Apply the data preprocessing methods on the given student test performance dataset and visualize the results.

EXPERIMENT 2 **6 Hours**

Perform univariate analysis to analyze the distribution of each variable in students exam results dataset and visualize the results

EXPERIMENT 3 **6 Hours**

Visualize the relationship between the features on students' exam results analysis dataset using bivariate analysis

EXPERIMENT 4 **6 Hours**

Visualize the relationship between the features on students' exam results analysis dataset using multivariate analysis.

EXPERIMENT 5 **6 Hours**

Implement the program to reduce the dimensionality of the MNIST dataset and visualize the reduced data using a scatter plot.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Provost, Foster, and Tom Fawcett.Data Science for Business: What you need to know about data mining and data-analytic thinking Reilly Media, 2013. (Unit 1)
2. McKinney, Wes.Python for Data Analysis.Reilly Media,2022. (Unit 1, 3, 5)
3. Knaflic, Cole Nussbaumer. Storytelling with data A data visualization guide for business professionals.John Wiley Sons, 2015. (Unit 2)
4. Kazil, Jacqueline, and Katharine Jarmul.Data wrangling with python tips and tools to make your life easier. Reilly Media, Inc.2016. (Unit 3)
5. Wickham, Hadley, and Garrett Grolemund. R for data science import, tidy, transform, visualize, and model data.Reilly Media, Inc.2016. (Unit 4, 5)
6. Matthew O. Ward, Georges Grinstein, Daniel Keim, Interactive Data Visualization Foundations, Techniques, and Applications, 2nd Edition, CRC press, 2015.

22CB002 **RECOMMENDER SYSTEMS** **3 0 0 3**

Course Objectives

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender systems
- To learn about collaborative filtering
- To make students design and implement a recommender system.
- To learn collaborative filtering.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3. Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand the basic concepts of recommender systems.
2. Implement machine-learning and data-mining algorithms in recommender systems data sets.
3. Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.
4. Implement a simple recommender system.
5. Learn about Evaluating Paradigms of recommender systems and its applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2	1	2	1								1
2	1	2	1	1	1								1
3	2	3	1	1	1								2
4	3	2	2	2	1								2
5	2	2	1	2	1								1

UNIT I **9 Hours**

INTRODUCTION

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems - similarity measures - Dimensionality reduction - Singular Value Decomposition (SVD).

UNIT II **9 Hours**

CONTENT-BASED RECOMMENDATION SYSTEMS

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

UNIT III **9 Hours**

COLLABORATIVE FILTERING

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection.

UNIT IV **9 Hours**

ATTACK-RESISTANT RECOMMENDER SYSTEMS

Introduction - Types of Attacks - Detecting attacks on recommender systems - Individual attack- Group attack - Strategies for robust recommender design - Robust recommendation algorithms.

UNIT V **9 Hours**

EVALUATING RECOMMENDER SYSTEMS

Evaluating Paradigms - User Studies - Online and Offline evaluation - Goals of evaluation design- Design Issues - Accuracy metrics - Limitations of Evaluation measures.

Total: 45 Hours

Reference(s)

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Dietmar Jannach, Markus Zanker, Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3. Francesco Ricci , Lior Rokach, Bracha Shapira, Recommender Systems Handbook, 1st ed, Springer (2011),
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.

22CB003 **BIG DATA ANALYTICS** **3 0 0 3**

Course Objectives

- Acquire a deep understanding of big data and NoSQL.
- Develop expertise in map reduce analytics using Hadoop and related tools
- Explore the Hadoop related tools for Big Data Analytics.

Programme Outcomes (POs)

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 analyse 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.

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.

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Understand the big data and use cases from selected business domains.
2. Understand NoSQL big data management.
3. Utilize map reduce analytics and related tools.
4. Understand the basics of Hadoop.
5. Apply the usage of Hadoop related tools for Big Data Analytics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	1		1							2	1
2	2	2	3		3							2	2
3	1	3	3		3							2	2
4	2	2	2		3							1	2
5	2	2	1		3							1	3

UNIT I **9 Hours**

UNDERSTANDING BIG DATA

Introduction to big data - Convergence of key trends - Unstructured data - Industry examples of big data Web analytics - Big data applications - Big data technologies - Introduction to Hadoop - Open source technologies - Cloud and big data - Mobile business intelligence - Crowd sourcing analytics- Inter and trans firewall analytics.

UNIT II **9 Hours**

NOSQL DATA MANAGEMENT

Introduction to NoSQL - Aggregate data models - Key-value and document data models - Relationships - Graph databases - Schema less databases - Materialized views - Distribution models - Master slave replication - Consistency - Cassandra - Cassandra data model - Cassandra examples - Cassandra clients

UNIT III **9 Hours**

MAP REDUCE APPLICATIONS

MapReduce workflows - Unit tests with MRUnit - Test data and local tests - Anatomy of MapReduce job run - Classic Map-reduce - YARN - Failures in classic Map-reduce and YARN - Job scheduling - Shuffle and sort - Task execution - MapReduce types - Input formats - Output formats.

UNIT IV **9 Hours**

BASICS OF HADOOP

Data format - Analyzing data with Hadoop - Scaling out - Hadoop streaming - Hadoop pipes - Design of Hadoop distributed file system (HDFS) - HDFS concepts - Java interface - Data flow - Hadoop I/O - Data integrity - Compression - Serialization - Avro - File-based data structures – Cassandra - Hadoop integration.

UNIT V **9 Hours**

HADOOP RELATED TOOLS

Hbase - Data model and implementations - Hbase clients - Hbase examples - Praxis. Pig – Grunt - Pig data model - Pig Latin - Developing and testing Pig Latin scripts. Hive - Data types and file formats - HiveQL data definition - HiveQL data manipulation - HiveQL queries.

Total: 45 Hours

Reference(s)

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, Big Data, Big Analytics Emerging Business Intelligence and Analytic Trends for Todays Businesses", Wiley,2013.
2. Eric Sammer, Hadoop Operations,Reilley, 2012.
3. Sadalage, Pramod J. NoSQL distilled, 2013
4. E. Capriolo, D. Wampler, and J. Rutherglen, Programming Hive, Reilley, 2012.
5. Lars George, HBase: The Definitive Guide, Reilley, 2011.
6. Eben Hewitt,Cassandra The Definitive Guide,Reilley, 2010.

22CB004 NEURAL NETWORKS AND DEEP LEARNING 2 0 2 3

Course Objectives

- To understand the major concepts in deep neural networks.
- To apply Convolutional Neural Network architectures for any real-life applications
- To analyze the key computations underlying deep learning to build and train deep neural networks for various tasks.

Programme Outcomes (POs)

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 analyse 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.
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.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Apply Convolution Neural Network for any suitable applications.
2. Analyze the various categories of associative memory and unsupervised learning networks.
3. Apply Convolutional Neural Networks and its variants for any suitable applications.
4. Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
5. Apply autoencoders and generative models for suitable applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		1								2	
2	2	2	3		3								2	
3	1	3	3		3								2	
4	2	2	2		3								2	
5	2	2	1		3								2	

UNIT I **6 Hours**

UNDERSTANDING NEURAL NETWORKS

Neural Networks - Application Scope of Neural Networks - Artificial Neural Network: An Introduction Evolution of Neural Networks - Basic Models of Artificial Neural Network - Important Terminologies of ANNs - Supervised Learning Network.

UNIT II **6 Hours**

ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS

Training Algorithms for Pattern Association - Autoassociative Memory Network – Heteroassociative Memory Network - Bidirectional Associative Memory (BAM) - Hopfield Networks - Kohonen Self - Organizing Feature Maps - Learning Vector Quantization - Counterpropagation Networks - Adaptive Resonance Theory Network.

UNIT III **6 Hours**

THIRD-GENERATION NEURAL NETWORKS

Spiking Neural Networks - Convolutional Neural Networks - Deep Learning Neural Networks – Extreme Learning Machine Model - Convolutional Neural Networks: The Convolution Operation – Motivation Pooling - Variants of the basic Convolution Function - Computer Vision

UNIT IV **6 Hours**

DEEP FEEDFORWARD NETWORKS

History of Deep Learning - A Probabilistic Theory of Deep Learning - Gradient Learning Chain Ruleand Backpropagation - Regularization Dataset - Augmentation Noise - Robustness Early Stopping - Bagging and Dropout batch normalization -Transposed convolution, object detection, semantic segmentation.

UNIT V **6 Hours**

RECURRENT NEURAL NETWORKS

Recurrent Neural Networks - Introduction Recursive Neural Networks - Bidirectional RNNs - DeepRecurrent Networks Applications: Image Generation, Image Compression, Natural LanguageProcessing - Long-short term memory (LSTM) - Complete Auto encoder - Generative adversarial networks – Transfer Learning

EXPERIMENT 1

Implement simple vector addition in TensorFlow. **3 Hours**

EXPERIMENT 2

Implement a regression model in Keras. **3 Hours**

EXPERIMENT 3

Implement a perceptron in TensorFlow/Keras Environment. **3 Hours**

EXPERIMENT 4

Implement a Feed-Forward Network in TensorFlow/Keras. **3 Hours**

EXPERIMENT 5

Implement an Image Classifier using CNN in TensorFlow/Keras. **3 Hours**

EXPERIMENT 6

Improve the Deep learning model by fine tuning hyper parameters. **3 Hours**

EXPERIMENT 7

Implement a Transfer Learning concept in Image Classification. **3 Hours**

EXPERIMENT 8

Using a pre trained model on Keras for Transfer Learning **3 Hours**

EXPERIMENT 9

Perform Sentiment Analysis using RNN **3 Hours**

EXPERIMENT 10

Implement an LSTM based Autoencoder in TensorFlow/Keras. **3 Hours**

Total: 30 + 30 = 60 Hours

Reference(s)

1. S Rajasekaran, G A Vijayalakshmi Pai, Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and pplications, PHI Learning, 2017
2. Charu C. Aggarwal, Neural Networks and Deep Learning A Textbook, Springer International Publishing, 1st Edition, 2018.
3. James A Freeman, David M S Kapura, Neural Networks Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.
4. Magnus Ekman, Addison-Wesley, Learning Deep Learning, 2021.
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
6. Francois Chollet,Deep Learning with Python, Second Edition, Manning Publications, 2021.
7. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020.

22CB005 **NATURAL LANGUAGE PROCESSING** **2 0 2 3**

Course Objectives

- To understand the fundamental concepts for natural language processing and automatic speech recognition
- To understand technologies involved in developing speech and language applications.
- To demonstrate the use of deep learning for building applications in speech and natural language processing

Programme Outcomes (POs)

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 analyse 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.
PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Understand basic knowledge, theories and methods in natural language processing.
2. Implement basic and some advanced text processing and feature representation techniques
3. Implement, and evaluate advanced NLP applications, including sentiment classification, named entity recognition, text summarization, machine translation, and modern deep learning models.
4. Apply fundamental principles of speech production and perception and analyze speech signals.
5. Design automatic speech recognition systems and develop applications for speaker recognition.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	1		3							2	
2	2	2	3		3							2	
3	1	3	3		3							2	
4	2	2	2		3							2	
5	2	2	1		3							2	

UNIT I **6 Hours**

INTRODUCTION TO NATURAL LANGUAGE PROCESSING

Overview of NLP - Introduction to Levels of NLP - Morhpology: Derivational &Inflectional Morphology - POS tagging - Parsing: Shallow and Dependency Parsing, Semantics: Word Level Semantics and Thematic roles.

UNIT II **6 Hours**

TEXT PROCESSING AND FEATURE REPRESENTATION

Introduction to Corpora - Sentence Segmentation - Stemming: Porter Stemmer, Bag of words and Vector Space Model, Topic Modeling, N-gram Language Model, Smoothing, Word Embeddings: Word2Vec, Glove and Fast text.

UNIT III **6 Hours**

APPLICATIONS OF NLP

Sentiment Classification using ML & DL models, Named Entity Recognition - CRF and LSTMs, Text Summarization - Statistical and Deep Learning models - Machine Translation - Encoder & Decoder Model, Attention Models, Question Answering - Knowledge based Q&A and Deep Learning models for Q&A.

UNIT IV **6 Hours**

SPEECH PROCESSING AND FEATURE REPRESENTATION OF SPEECH SIGNAL

Fundamentals of speech production – Perception of sound – Vocal tract model – Phonetics - Short-Time analysis of the signal – Energy – Zero crossing – Autocorrelation – Short time Fourier analysis - Mel Frequency Cepstral Coefficients, Perceptual linear prediction (PLP), Linear prediction cepstral coefficients (LPCC), Gammatone Frequency Cepstral Coefficients (GFCC), i-vector.

UNIT V **6 Hours**

AUTOMATIC SPEECH AND SPEAKER RECOGNITION

Automatic Speech recognition formulation: Isolated word recognition – Large vocabulary continuous speech recognition - HMM/GMM based speech recognition – DNN/HMM model - CNN based speech recognition - RNN language Models – Evaluation metrics, Speaker - Recognition model – Alexa/Google assistant-based application development.

EXPERIMENT 1

POS Tagging and Parsing using various python packages. **3 Hours**

EXPERIMENT 2

Implementing N-gram language models for next word prediction. **3 Hours**

EXPERIMENT 3

Implementing Word embedding based text classification. **3 Hours**

EXPERIMENT 4

Implementing CNN for sentiment analysis. **3 Hours**

EXPERIMENT 5 **3 Hours**

Implementing RNN for Named Entity recognition.

EXPERIMENT 6
Implementing text summarization using deep learning. **3Hours**

EXPERIMENT 7
Implementing chatbot using deep learning. **3 Hours**

EXPERIMENT 8
Developing speech recognition system to recognize voice commands **3 Hours**

EXPERIMENT 9
Developing speech recognition system to recognize continuous speech **3 Hours**

EXPERIMENT 10
Implementing CNN based speech recognition using melspectal images. **3 Hours**

Total: 30 + 30 = 60 Hours

REFERENCE(S)

1. Dan Jurafsky, James H. Martin "Speech and Language Processing", Draft of 3rd Edition, Prentice Hall 2022.
2. Jacob Benesty, M. M. Sondhi, Yiteng Huang "Springer Handbook of Speech Processing", Springer, 2008.
3. Uday Kamath, John Liu, James Whitaker "Deep Learning for NLP and Speech Recognition" Springer, ,2019.
4. Steven Bird, Ewan Klein, Edward Loper "Natural Language Processing with Python", O'Reilly Media. 2009.
5. Ben Gold, Nelson Morgan, Dan Ellis "Speech and Audio Signal Processing: Processing and Perception of Speech and Music", John Wiley & Sons, 2011.

22CB006	COMPUTER VISION	2 0 2 3

Course Objectives

- To understand the fundamental concepts related to Image formation and processing
- To learn feature detection, matching and detection
- To become familiar with feature based alignment, motion estimation and 3D reconstruction
- To understand image based rendering and recognition.
- To learn to detect and analysis objects from motion or scene.

Programme Outcomes (POs)

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 analyse 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.
PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader indiverse 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 the 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.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Understand basic knowledge, theories and methods in image processing and computer vision.
2. Implement basic and some advanced image processing techniques in OpenCV.
3. Apply 2D feature-based based image alignment, segmentation, motion estimations and 3D image reconstruction techniques
4. Design and develop innovative image processing and computer vision applications.
5. Apply the concept in understanding the scene and process the background part of the image

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	1	1	1	1			2	1	3	2	2	
2	3	3	3	2	3		1	2	1	2	2	3	
3	3	3	2	2	3			1	1	2	2	3	
4	2	3	3	2	3			2	1	2	3	2	
5	2	3	3	2	2	2		2	1	2	3	3	

UNIT I **6 Hours**

INTRODUCTION TO IMAGE FORMATION AND PROCESSING

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms – Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II **6 Hours**

FEATURE DETECTION, MATCHING AND SEGMENTATION

Points and patches - Edge detection - Edges Lines Segmentation - Region Based Segmentation - Graph Based segmentation - Active contours - Split and merge Mean shift and modefinding - Normalized cuts Graph cuts and energy - Based methods.

UNIT III **6 Hours**

FEATURE-BASED ALIGNMENT AND 3D RECONSTRUCTION

2D and 3D feature-based alignment Pose estimation Geometric intrinsic calibration – Triangulation Two frame structure from motion - Shape from X Active range finding - Surface representations - Point based representations – Volumetric representations - Model based reconstruction.

UNIT IV **6 Hours**

IMAGE-BASED RENDERING AND RECOGNITION

View interpolation Layered depth images Light fields – Video based Rendering - Object detection - Face recognition - Instance recognition - Category recognition Context and scene understanding.

UNIT V **7 Hours**

MOTION ANALYSIS AND SCENE ANALYSIS

Optical Flow – Detection and Correspondence of Interest Points - Detection of MotionPatterns – Video Tracking – Motion Models to aid tracking: Kalman Filters - Stereo mapping - Image fusion - Detection of known objects by linear filters - Detection of unknown objects - Corner detection - Image tagging.

EXPERIMENT 1 **3 Hours**

Perform histogram equalization on the image.

EXPERIMENT 2

Perform the edge detection process and extract edges fromthe input image **3 Hours**

EXPERIMENT 3 **5 Hours**

Perform segmentation, extract and display the segmentedregion.

EXPERIMENT 4 **3 Hours**

Program to detect an object from the input frame.

EXPERIMENT 5

Program to track the object between two frames from image/video. **5 Hours**

EXPERIMENT 6

Program to demonstrate to understand a scene and generate caption. **5 Hours**

EXPERIMENT 7

Program to classify defective object from the correct object. **5 Hours**

Total: 30 + 30 = 60 Hours

REFERENCE(S)

1. Richard Szeliski, Computer Vision Algorithms and Applications, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. Christopher M. Bishop Pattern Recognition and Machine Learning, Springer, 2006.
5. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
6. Jurgen Beyerer, Fernando Puente Leon, Christian Frese," Machine Vision Automated Visual Inspection: Theory, Practice and Applications", 2016, Springer
7. AI Bovik, "The Essential Guide to Image Processing", 2009, Academic Press

22CB007 OBJECT ORIENTED PROGRAMMING USING JAVA 2 0 2 3

Course Objectives

- To Construct the features of Object-oriented programming
- To Recognize the need of the concept inheritance, polymorphism and interface.
- To Develop Java applications using files, templates, exceptions and event handling.

Programme Outcomes (POs)

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 analyse 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.

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.

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Apply the concept of class and objects to solve simple problems.
2. Identify the importance of inheritance and interface concepts.
3. Analyze the importance of exception handling and learn the importance of string handling
4. Apply the concept of Multithreading in concurrent programming
5. Develop applications using collections framework for managing user defined types in Java

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	2	2						1	3	2
2	3	3	3	2	2						2	3	2
3	3	3	3	2	2						1	3	2
4	3	3	3	2	2						3	3	2
5	3	3	3	2	2						2	3	2

UNIT I **6 Hours**

INTRODUCTION TO OOP AND JAVA

Overview of OOP – Object oriented programming paradigms – Features of Object Oriented Programming – Java Buzzwords – Overview of Java – Data Types, Variables and Arrays – Operators– Control Statements – Programming Structures in Java – Defining classes in Java – Constructors Methods -Access specifiers – Static members- Java Doc comments

UNIT II **6 Hours**

INHERITANCE, PACKAGES AND INTERFACES

Overloading Methods – Objects as Parameters – Returning Objects –Static, Nested and Inner Classes. Inheritance: Basics– Types of Inheritance -Super keyword -Method Overriding – Dynamic Method Dispatch –Abstract Classes – final with Inheritance. Packages and Interfaces: Packages – Packages and Member Access –Importing Packages – Interfaces.

UNIT III **6 Hours**

EXCEPTION HANDLING AND MULTITHREADING

Exception handling basics – Multiple catch Clauses – Nested try Statements – Java's Built-in Exceptions – User defined Exception. Multithreaded Programming: Java Thread Model–Creating a Thread and Multiple Threads – Priorities – Synchronization – Inter Thread Communication- Suspending –Resuming, and Stopping Threads –Multithreading. Wrappers – Auto boxing.

UNIT IV **6 Hours**

I/O, GENERICS, STRING HANDLING

I/O Basics – Reading and Writing Console I/O – Reading and Writing Files. Generics: Generic Programming – Generic classes – Generic Methods – Bounded Types – Restrictions and Limitations. Strings: Basic String class, methods and String Buffer Class.

UNIT V **6 Hours**

JAVAFX EVENT HANDLING, CONTROLS AND COMPONENTS

JAVAFX Events and Controls: Event Basics – Handling Key and Mouse Events. Controls: Checkbox, Toggle Button – Radio Buttons – List View – Combo Box – Choice Box – Text Controls – Scroll Pane. Layouts – Flow Pane – HBox and VBox – Border Pane – StackPane – GridPane. Menus – Basics – Menu – Menu bars – Menu Item.

EXPERIMENT 1 5 Hours

Implementation of classes and objects with constructors and destructors

EXPERIMENT 2 5 Hours

Implementation of operator and function overloading

EXPERIMENT 3 5 Hours

Implementation of types of Inheritance

EXPERIMENT 4 5 Hours

Implementation of two different classes for adding a private data member using friend function

EXPERIMENT 5 5 Hours

Implementation of file handling operations

EXPERIMENT 6 **5 Hours**

Implementation of java event handling, controls and components

Total: 30+30=60 Hours

Text Books

1. Herbert Schildt, “Java: The Complete Reference”, 11 th Edition, McGraw Hill Education, New Delhi, 2019
2. Herbert Schildt, “Introducing JavaFX 8 Programming”, 1 st Edition, McGraw Hill Education, New Delhi, 2015

Reference(s)

1. BjarneStroustrup, “The C++ Programming Language :3rd Edition, Pearson Education, 2015
2. Debasish Jana, C++ and Object-Oriented Programming Paradigm, 3rd Edition, Prentice Hall of India, New Delhi, 2014.
3. BjarneStroustrup, Programming Principles and Practice Using C++, 2nd Edition, Addison Wesley, 2014.
4. BjarneStroustrup, The Design and Evolution of C++, Addison-Wesley Professional, 2013.
5. O'Reilly Media, Head First Java" by Kathy Sierra and Bert Bates, 2nd Edition, 2021
6. Addison-Wesley Professional, "Effective Java" by Joshua Bloch 3rd Edition, 2017.
7. Pearson, "Java: How to Program" by Paul Deitel and Harvey Deitel, 11th Edition, 2017.
8. McGraw-Hill Education, "Java: The Complete Reference" by Herbert Schildt, 11th Edition 2018.
9. Pearson, “Objects First with Java: A Practical Introduction Using BlueJ" by David J. Barnes and Michael Kölling, 6th Edition 2016

21CB008 **MODERN WEB APPLICATIONS** **3 0 0 3**

Course Objectives

- Study about the design of web pages using frames and scripting languages.
- Develop dynamic web pages using JavaScript, PHP and MySQL.

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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.

PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling 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.

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Utilize the concept of the internet and World Wide Web.
2. Demonstrate the technologies used to create web pages.
3. Implement the FORM controls using PHP
4. Develop the web applications using PHP
5. Develop the web applications using MySQL and PHP

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2		3		2	2							
2	2		3		3	2						3	2
3	2		3		2	2						2	2
4	2		3		3	3						2	2
5	2		3		3	3						2	2

UNIT I **9 Hours**

INTRODUCTION TO INTERNET AND WORLD WIDE WEB

History of the Internet and World Wide Web,Web browsers,Web Servers,Uniform Resource Locator,Tools and web programming languages,Web standards,Categories of web applications,Tiered Architecture.

UNIT II **9 Hours**

HTML AND CSS

Basic HTML page,Text Formatting,Table, Headers,Linking, Images,List, Meta Elements.CSS-Inline,Internal and External Style Sheet,Bootstrap-CSS Text,CSS forms,CSS components drop down.

UNIT III **9 Hours**

JAVA SCRIPT AND XML

Introduction to Java Scripts, Objects in Java Script, Dynamic HTML with Java Script, Bootstrap-JS Alert,JS Button,JS popover. XML-Introduction,Structuring Data,Document Type Definition,XML Vocabularies,Document Object Model(DOM) with JavaScript,Extensible Stylesheet Language Transforms(XSL)

UNIT IV **9 Hours**

PHP PROGRAMS

Creating PHP Programs, Numbers and Strings, Literals and Variables, Operators and Functions. FORM - Creating Form Controls, Using values returned from forms using PHP.

UNIT V **9 Hours**

PHP DATABASE CONNECTIVITY

Connecting to MySQL Server, Selecting Databases, Checking for Errors, Closing the MySQL Server Connection. Manipulating data in MySQL using PHP - Inserting, Viewing, Updating and Deleting Records, Manipulating joined tables. User authentication - Creating Session, Authorization Level.

Total: 45 Hours

Reference(s)

1. Deitel P. J., Deitel H. M. and Deitel A. (2012) Internet and World Wide Web: How to Program, Fifth Edition, Pearson Prentice Hall,4th ed, 2008.
2. HTML & CSS: Design and Build Websites, Jon Duckett, John Wiley & Sons, 2011.
3. Naramore E., Gerner J., Scouarnec Y.L., et al., (2005) Beginning PHP5, Apache, MySQL Web Development: Programmer to Programmer, John Wiley & Sons Inc., ISBN: 9780764579660.
4. Sebesta R. W., Programming the World Wide Web, 8th edition, Pearson, 2015.
5. Pressman R. and Lowe D. (2008) Web Engineering: a practitioner"s approach, First Edition, Mc GrawHill
6. Kappel G., et al. (2006) Web Engineering: The Discipline of systematic Development of Web Applications, First Edition, John Wiley & Sons.

22CB009 **UI AND UX DESIGN** **3 0 0 3**

Course Objectives

- Study about designing web pages and understand the difference between UI and UX Design.
- To understand the concept of UX design and how it has evolved Able o to understand UX design process and methodology.
- Learning the Importance and scope of Interaction design, User centered design

Programme Outcomes (POs)

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 analyse 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.
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.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Understand to do user research, persona mapping, customer journey mapping
2. Design of interactive products Methods of interaction design Tools for interaction design
3. Design wireframes on paper and translate paper concepts into digital wireframes.
4. Apply and practice the techniques involved in designing digital wireframes using various UI elements.
5. Implement the process of conducting usability tests Learning steps for digital products.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1											1	1
2	1	2	2		1							2	1
3		3	3		1							2	1
4		2	2									1	2
5		2	2									1	2

UNIT I **9 Hours**

USER-CENTERED DESIGN PROCESS

Scripting Languages - HTML, CSS - Fundamentals of graphics design, principles of visual design - Overview of UI UX Design - Overview of the UX Design Process - Difference between User Interface (UI) vs User Experience (UX) - Defining problem and vision statement - Persona creation - Primary and Secondary persona - Requirement definition - Creative ideation - Brainstorming and ideation techniques - Scenarios and functionality extraction - Information Architecture - Task flows - Wireframe design.

UNIT II **9 Hours**

FUNDAMENTALS OF UI, HEURISTICS, AND INTERACTION DESIGN

Design Principles for UX and UI Design - UI Elements-Patterns - Material Design (Google) and Human Interface Design (Apple) guidelines - Interaction Principles Interaction Behaviour - Master the Brand Platforms Style Guides - Comments and current UI patterns - Understand problems and design solutions for e-commerce, social media, message, data, and dashboard design.

UNIT III **9 Hours**

ELEMENTARY SKETCHING

Principles of Sketching - Core Responsive Design - Wireframing vs Wireflows - Click through Wireframing Prototyping - Wireflow Creation - Work with different tools - Figma – Low-High Fidelity Design: Inclusive Design and Designing for Accessibility - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Designing animations and interactions.

UNIT IV **9 Hours**

UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING

Building a Design System - Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration - Use of grids in UI design - Design animations and interaction patterns for key UI elements.

UNIT V **9 Hours**

USABILITY EVALUATION AND PRODUCT DESIGN

Type of usability evaluation - Qualitative Quantitative evaluation - Guerilla testing , A/B Testing, Unmoderated remote usability testing, Card sorting, Session recording, think aloud Think aloud Introduction and advantages - Designing evaluation protocol - Conducting usability evaluation study - Conduct Usability Test explicit - Synthesize Test Findings - Practices in corporate World.

Total: 45 Hours

Reference(s)

1. Norman, Donald A. The Design of Everyday Things. Basic Books, 2002. ISBN: 9780465067107.
2. Nielsen, Jakob. Usability Engineering. Morgan Kaufmann, 1993. ISBN: 9780125184069.
3. Mullet, Kevin, and Darrell Sano. Designing Visual Interfaces Communication Oriented Techniques. Prentice Hall, 1994. ISBN 9780133033892.
4. Wilbent. O. Galitz ,The Essential Guide To User Interface Design, John Wiley Sons, 2001.
5. Ben Sheiderman, Design The User Interface, Pearson Education, 1998.
6. Alan Cooper, The Essential of User Interface Design, Wiley Dream Tech Ltd.,2002.

22CB010 **WEB FRAMEWORKS** **3 0 0 3**

Course Objectives

- Understand the architecture behind an Angular application and how to use it
- To understand the significance of using MongoDB as a database system
- To understand the role of React in designing front-end components
- Build a Web Server in Node and understand how it really works
- Develop a web application and API using web frameworks

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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.

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.

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.

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Apply modules and components and Animations for creating Forms and developing web pages
2. Create web applications by performing CRUD operations in database using web frameworks
3. Design Progressive Web Application with dynamic HTML web pages using Angular.
4. Designing single page applications with reusable UI components using React CSS and SaaS
5. Use Node Package Manager and Node packages for Server Side programming.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1		2		2				2	2		2	
2	1		1		3				2	2		3	
3	1		2		2				2	2		3	
4	1		1		3				2	2		2	
5	1		1		3				1	1		2	

UNIT I **9 Hours**

ANGULAR FRONT-END FRAMEWORK

Introduction - Setup – Architecture: Modules, Components, Services and DI fundamentals - Components and Templates - Configuration - Forms - Observables RxJS - Boot Strapping - Ng Modules - Dependency Injection - HTTP Client - Routing and Navigation – Animations.

UNIT II **9 Hours**

FRAMEWORKS WITH DATABASES

MongoDB - MongoDB Basics - Documents - Collections - Query Language - Installation - The mongo Shell - Schema Initialization - MongoDB Node.js Driver - Reading from MongoDB - Writing to MongoDB - CRUD operations - Projections - Indexing - Aggregation - Replication – Sharding - Creating backup - Deployment

UNIT III **9 Hours**

ANGULAR TECHNIQUES

Service workers PWA - Server side rendering - Angular Libraries - Schematics - CLI Builders - Angular Ivy - Web Workers

UNIT IV **9 Hours**

REACT

React Introduction - React ES6 - React Render HTML - React JSX - Components - React Classes - Composing Components - Passing Data - Dynamic Composition - React state - Setting State - Async State Initialization - Event Handling Communicating from Child to Parent - Stateless Components -Designing components - React Forms - React CSS - React SaaS

UNIT V **9 Hours**

NODE JS BACK-END FRAMEWORK

Node.js basics - Local and Export Modules - Node Package Manager - Node.js web server - Node.js File system - Node Inspector Node.js - EventEmitter - Frameworks for Node.js - Express.js Web App - Serving static Resource - Node.js Data Access

Total: 45 Hours

Reference(s)

1. Pro MERN Stack, Full Stack Web App Development with Mongo, Express, React, and Node, Vasan Subramanian, A Press Publisher, 2019.
2. Christoffer Noring, Pablo Deeleman,Learning Angular, Packt Publishing Limited, 2nd Revised edition edition, 2017.
3. Caleb Dayley Brad Dayley,Brendan Dayley ,Node.js, MongoDB and Angular Web Development, 2nd Edition,Pearson, 2018.
4. Shyam Seshadri, Angular: Up and Running- Learning Angular, Step by Step ,Reilly; First edition, 2018

22CB011 **APP DEVELOPMENT** **2 0 2 3**

Course Objectives

- To facilitate students to understand android SDK
- To help students to gain a basic understanding of Android application development
- To inculcate working knowledge of Android Studio development tool

Programme Outcomes (POs)

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 analyse 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.

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.

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Identify fundamental concepts of mobile programming that make it unique from programming for other platforms
2. Analyze the essential of Android Application with their anatomy and terminologies
3. Apply rapid prototyping techniques to design, develop and deploy the Android Applications
4. Analyze the essentials of User Interface Design in IoS with SqLite Database
5. Design the flutter applications on the Android marketplace for distribution.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2		1		3							1	
2	1	2	2		3							2	
3	1		2		3							2	
4	1	1	2		3							3	
5	1	2	2		3							3	

UNIT I **6 Hours**

INTRODUCTION TO ANDROID

The Android Platform, Android SDK, Eclipse Installation, Android Installation, building your First Android application, Understanding the Android Manifest file.

UNIT II **6 Hours**

ANDROID APPLICATION DESIGN ESSENTIALS

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Using Intent Filter, Permissions.

UNIT III **6 Hours**

COMMON ANDROID APIS

Testing Android applications, Publishing Android applications, Using Android Data and Storage APIs, managing data using Sqlite, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Applications to the World.

UNIT IV **6 Hours**

IOS USER INTERFACE DESIGN ESSENTIALS

Ios features, UI implementation, Touch frameworks, Data persistence using Core Data and SQLite, integrating calendar and address book with social media application, Using Wifi, iPhone marketplace.

UNIT V **6 Hours**

APP DEVELOPMENT WITH FLUTTER

Flutter Introduction, Create First Flutter Application, Exploring commonly used flutter widgets Container, Margin, Padding and Box Constraints, Custom Fonts, Column and Expanded Widgets, Image Asset, Raised Button, and Alert Dialog.

EXPERIMENT 1 **4 Hours**

Develop a simple application with one EditText so that the user can write some text in it. Create a button called Convert Text to Speech that converts the user input text into voice.

EXPERIMENT 2 **4 Hours**

Create an application to design a Visiting Card. The Visiting card should have a company logo at the top right corner. The company name should be displayed in Capital letters, aligned to the center. Information like the name of the employee, job title, phone number, address, email, fax and the website address is to be displayed. Insert a horizontal line between the job title and the phone number.

EXPERIMENT 3 **4 Hours**

Create a SIGNUp activity with Username and Password. Validation of password should happen based on the following rules

Password should contain uppercase and lowercase letters.

Password should contain letters and numbers.

Password should contain special characters.

Minimum length of the password the default value is 8

On successful SIGN UP proceed to the next Login activity. Here the user should SIGN IN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying Successful Login or else display a toast message saying Login Failed. The user is given only two attempts and after that display a toast message saying Failed Login Attempts and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.

EXPERIMENT 4 **4 Hours**

Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

EXPERIMENT 5 **5 Hours**

Develop an application to set an image as wallpaper. On click of a button, the wallpaper image should start to change randomly every 30 seconds.

EXPERIMENT 6 **5 Hours**

Create an activity like a phone dialler with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.

EXPERIMENT 7 **4 Hours**

Implement UI elements like Text Fields, Label, Toolbar, Status bar, Tabbar.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Reto Meier, Professional Android 2 Application Development, Wiley India Pvt Ltd.
2. Mark L Murphy, Beginning Android, Wiley India Pvt Ltd 3. R3. Android Application Development All in one for Dummies by Barry Burd.
3. Alberto Miola, Flutter Complete Reference Create beautiful, fast and native apps for any device ISBN-13 9780141044804.
4. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, Beginning iOS 6Development Exploring the iOS SDK, Apress, 2013.55.

22CB012 SOFTWARE TESTING AND AUTOMATION 3 0 0 3

Course Objectives

- Understand the importance of software testing in the software development process
- Analyze different testing methodologies and techniques to create test plans, test cases, and test scripts
- Apply automation testing tools and frameworks to design and implement automated test suites

Programme Outcomes (POs)

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 analyse 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.
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.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Understand the importance of testing in the software development process
2. Compare the different test case design strategies
3. Analyze the different levels of testing and their importance
4. Apply test management techniques and the role of a test specialist
5. Analyze the software test automation and its requirements

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1		1							1	
2	2	3	2		2							1	
3	2	2	2		2							1	
4	2	3	2		3							1	
5	3	2	1		3							2	

UNIT I **9 Hours**

INTRODUCTION

Basic definitions Software - Testing Principles - The Testers Role in a Software Development Organization - Origins of Defects - Cost of Defects - Defect Classes - The Defect Repository and Test Design - Defect Examples - Developer /Tester Support of Developing a Defect Repository.

UNIT II **9 Hours**

TEST CASE DESIGN STRATEGIES

Test Scenarios - Test Cases - Test case Design Strategies - Black Box Approach to Test Case Design - Using White Box Approach to Test design - Test Adequacy Criteria - Static testing vs. Structural testing - Code functional testing - Coverage and Control Flow Graphs - Covering Code Logic - Paths Code complexity testing - Additional White box testing approaches - Test Coverage.

UNIT III **9 Hours**

LEVELS OF TESTING

Types of testing - Manual and automation - Introduction to testing methods - White-box, Black box and Grey-box - Functional testing – Non-functional testing - Introduction to levels of testing - Unit Testing, Integration Testing, System Testing, User Acceptance Testing - Introduction to types of testing Regression Testing, Smoke Testing, Database Testing, Usability Testing, Load Testing, Stress Testing, Performance Testing, Compatibility Testing, Security Testing, Internationalization Testing, Localization Testing.

UNIT IV **9 Hours**

TEST MANAGEMENT

People and organizational issues in testing - Organization structures for testing teams - Testing services - Test Planning - Test Plan Components - Test Plan Attachments - Locating Test Items - Test management - Test process - Reporting Test Results - Introducing the test specialist - Skills needed by a test specialist - Building a Testing Group - The Structure of Testing Group - The Technical Training Program.

UNIT V **9 Hours**

TEST AUTOMATION

Software test automation - Design and Architecture for Automation - Automation testing - Automation Tools - Selenium Web Driver - Create Selenese Commands - TestNG - TestNG Annotations - Jmeter - Assertions in JMeter – Junit.

Total: 45 Hours

Reference(s)

1. Ilene Burnstein, Practical Software Testing, Springer International Edition, 2003.
2. Edward Kit, Software Testing in the Real World Improving the Process, Pearson Education, 1995.
3. Boris Beizer, Software Testing Techniques 2nd Edition, Van Nostrand Reinhold, New York,1990.
4. Aditya P. Mathur, Foundations of Software Testing Fundamental Algorithms and Techniques, Dorling Kindersley India Pvt. Ltd., Pearson Education, 2008.

22CB013 **DevOps** **3 0 0 3**

Course Objectives

- To introduce DevOps terminology, definition & concepts
- To understand the different Version control tools like Git, Mercurial
- To understand the concepts of Continuous Integration/ Continuous Testing/ Continuous Deployment)
- To understand Configuration management using Ansible
- Illustrate the benefits and drive the adoption of cloud-based DevOps tools to solve real-world problems

Programme Outcomes (POs)

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 analyse 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.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Understand different actions performed through Version control tools like Git.
2. Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven Gradle.
3. Ability to Perform Automated Continuous Deployment.
4. Ability to do configuration management using Ansible.
5. Understand to leverage Cloud-based DevOps tools using Azure DevOps.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	1	2	2							3	
2	3	3	3	3	2							2	
3	2	2	2	3	2							2	
4	2	2	2	2	2							2	
5	2	2	2	2	2							3	

UNIT I **7 Hours**

INTRODUCTION TO DEVOPS

Devops Essentials - Introduction to AWS, GCP, Azure - Version control systems Git and GitHub.

UNIT II **10 Hours**

COMPILE AND BUILD USING MAVEN

Introduction, Installation of Maven, POM files, Maven Build lifecycle, Build phases compile build, test, package Maven Profiles-Maven repositories local, central, global - Maven plugins Maven create and build Artifacts - Dependency Management - Installation of Gradle - understanding build using Gradle.

UNIT III **12 Hours**

CONTINUOUS INTEGRATION USING JENKINS

Install Configure Jenkins - Jenkins Architecture Overview - Creating a Jenkins Job - Configuring a Jenkins job - Introduction to Plugins - Adding Plugins to Jenkins commonly used plugins Git Plugin, Parameter Plugin - HTML Publisher - Copy Artifact, and Extended choice parameters. Configuring Jenkins to work with Java-Git- and Maven - Creating a Jenkins Build and Jenkins workspace.

UNIT IV **9 Hours**

CONFIGURATION MANAGEMENT USING ANSIBLE

Ansible Introduction – Installation - Ansible master/slave configuration - YAML basics - Ansible Modules - Ansible Inventory files - Ansible playbooks - Ansible Roles and ad hoc commands in Ansible.

UNIT V **7 Hours**

BUILDING DEVOPS PIPELINES USING AZURE

Create GitHub Account, Create Repository - Create Azure Organization - Create a new pipeline -Build a sample code Modify azure -pipelines- YAML file

Total: 45 Hours

Reference(s)

1. Roberto Vormittag, A Practical Guide to Git and GitHub for Windows Users From Beginner to Expert in Easy Step By Step Exercises, Second Edition, Kindle Edition, 2016.
2. Jason Cannon, Linux for Beginners an Introduction to the Linux Operating System and Command Line, Kindle Edition, 2014.
3. Hands-On Azure DevOps Cicd Implementation for Mobile, Hybrid, And Web Applications Using Azure DevOps And Microsoft Azure CICD Implementation for DevOps and Microsoft Azure
4. English Edition Paperback 1 January 2020 by Mitesh Soni.
5. Jeff Geerling, Ansible for DevOps Server and configuration management for humans, First Edition, 2015.
6. David Johnson, Ansible for DevOps Everything You Need to Know to Use Ansible for DevOps, Second Edition, 2016.

21CB014 CLOUD, MICROSERVICES AND APPLICATIONS 3 0 0 3

Course Objectives

- Acquire knowledge of cloud operation and services, security techniques provided by cloud computing.
- Understand the concepts of cloud native applications with micro services.
- Familiar with the cloud monitoring and security operation tools.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understanding the concept of guiding principle, utilization of cloud and pricing options of cloud.
2. Analyze the techniques help to do operation with cloud applications
3. Deploy the functions of cloud with the help of cloud application and its services.
4. Analyze the devops fundamental techniques and tools used for devops operation.
5. Apply the cloud monitoring and network monitoring tools.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2											
2			2										2
3		3	2		2								
4		2	2										3
5		3	3		2								2

UNIT I 10 Hours

CLOUD FUNDAMENTALS

Cloud Fundamentals- Cloud Service Components, Cloud service and Deployment Models - Cloud components Guiding Principle with respect to utilization, Security, Pricing and the applications of Cloud

UNIT II 10 Hours

APPLICATION ARCHITECTURE

Public Cloud Platforms overview and their usage -Application architectures-Monolithic and Distributed, Micro service fundamental and design approach, Cloud Native applications-12 Factors App. Application integration process, API Fundamental.

UNIT III **9 Hours**

CLOUD MICROSERVICES

Micro service, API management, spring boot Fundamental and design of micro service, API tools-. Developer Portal - Applications of Micro service and APIFICATION

UNIT IV **9 Hours**

DEVOPS FUNDAMENTALS

Devops fundamentals: Tools and Applications Containerization Process and application - DevOps Tools and their usage in cloud application development, Docker and Containerization Process

UNIT V **7 Hours**

CLOUD SECURITY AND MONITORING TOOLS

Cloud Security and Monitoring Tools.

Total: 45 Hours

Reference(s)

1. Barrie Sosinsky, Cloud Computing Bible,Wiley-India,2014.
2. Ronald L.Krutz and Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2013.
3. Anthony T Velte, Cloud Computing: A practical Approach, Tata McGraw Hill, 2009. 4. Halper Fern, Kaufman Marcia, Bloor Robin, Hurwit Judith, Cloud Computing for Dummies,Wiley India, 2009.
4. TimMather, SubraKumaraswamy, ShahedLatif, CloudSecutiy and Privacy,Oreilly, 2009.
5. IrakliNadareishvili, Ronnie Mitra,MattMcLarty, and Mike Amundsen, Microservice Architecture Aligning Principle, Practice and Culture,2016 Oreilly.
6. Magnus Larsson,Hand-on Microservices with spring Boot and Spring Cloud: Build and delopy Java Microservices using Spring Cloud, Istio, and Kubernetes,Pack 2019.

21CB015 **INTERNET OF THINGS** **3 0 0 3**

Course Objectives

- To understand the components and protocols used in IoT
- To understand the IoT reference Architecture
- Ability to understand the various applications of IoT in real-time

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

Course Outcomes (COs)

1. Apply the fundamental building blocks and use cases of IoT Applications
2. Apply the concept of Reference Architecture in IoT Applications
3. Utilize the sensors for monitor and control the IoT system applications
4. Analyze the networking and communication protocols used in IoT
5. Analyze the data processing and storage in IoT

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	1		2							3	
2	3	3	3		2							2	
3	2	2	2		2							2	
4	2	2	2		2							2	
5	2	2	2		2							3	

UNIT I **9 Hours**

INTRODUCTION TO IOT AND USE CASES

Understanding basic concepts of IoT, Consumer IoT vs Industrial Internet, Fundamental building blocks, Use Cases of IoT in various industry domains.

UNIT II **9 Hours**

ARCHITECTURE

IoT reference architectures, Industrial Internet Reference Architecture, Edge Computing, IoT Gateways, Data Ingestion, and Data Processing Pipelines, Data Stream Processing.

UNIT III **9 Hours**

SENSORS AND INDUSTRIAL SYSTEMS

Introduction to sensors and transducers, integrating sensors to sensor processing boards, introduction to industrial data acquisition systems, industrial control systems, and their functions.

UNIT IV **9 Hours**

NETWORKING AND COMMUNICATION FOR IOT

Recap of OSI 7-layer architecture and mapping to IoT architecture, Introduction to proximity networking technologies (ZigBee, Bluetooth, Serial Communication), Industrial network protocols (Modbus, CAN bus), Communicating with cloud applications (web services, REST, TCP/IP, and UDP/IP sockets, MQTT, Web Sockets, protocols. Message encoding (JSON, Protocol Buffers).

UNIT V **9 Hours**

IOT DATA PROCESSING AND STORAGE

Time Series Data and their characteristics, time-series databases, basic time-series analytics, data summarization, and sketching, dealing with noisy and missing data, anomaly, and outlier detection.

Total: 45 Hours

Reference(s)

1. The Internet of Things, Samuel Greengard, MIT Press Essential Knowledge Series, 2015.

22CB016 VIRTUALIZATION IN CLOUD COMPUTING 3 0 0 3

Course Objectives

- Analyze the basic concepts of virtualization technology to derive the best practice model for deploying cloud based applications
- Create an application by utilizing cloud platforms such as Amazon Web Services and Windows Azure
- Identify major security and privacy problems in cloud computing environment
- Apply the ability to use the architecture of cloud, service and delivery models
- Implement the key enabling technologies that help in the development of cloud.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

Course Outcomes (COs)

1. Analyze the concept of virtualization and its properties.
2. Apply different forms of virtualization.
3. Implement various architectures for implementing virtualization methods.
4. Create virtual machines and installing various operating systems.
5. Evaluate the performance of the virtual machines and deployed applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1		2	3										
2			1	3	2									1
3			2	1	3									2
4	1		2	1	3									2
5	1		3		2									2

UNIT I 9 Hours

UNDERSTANDING VIRTUALIZATION

Describing Virtualization-Microsoft Windows Drives Server Growth -Explaining Moore's Law-Understanding the Importance of Virtualization -Examining Today's Trends -Virtualization and Cloud Computing -Understanding Virtualization Software Operation -Virtualizing Servers -Virtualizing Desktops -Virtualizing Applications.

UNIT II **9 Hours**
HYPERVISORS
Describing a Hypervisor -Exploring the History of Hypervisors -Understanding Type 1 Hypervisors - Type 2 Hypervisors - Role of a Hypervisor -Holodecks and Traffic Cops -Resource Allocation -Comparing Today's Hypervisors -VMware ESX -Citrix Xen -Microsoft Hyper-V -Other Solutions.

UNIT III **9 Hours**
VIRTUALIZATION
Introduction to Virtual Machine - CPUs in a Virtual Machine -Memory in a Virtual Machine -Network Resources in a Virtual Machine - Storage in a Virtual Machine -Understanding How a Virtual Machine Works -Working with Virtual Machines -Virtual Machine Clones -Templates -Snapshots -OVF -Containers

UNIT IV **9 Hours**
CREATION OF VIRTUAL MACHINES & CONFIGURATIONS
Understanding Configuration Options-Installing Windows on a Virtual Machine- Installing Linux on a Virtual Machine-Installing VirtualBox Guest Additions- Managing CPUs for a Virtual Machine- Configuring VM CPU Options-Managing Storage for a Virtual Machine- Managing Networking for a Virtual Machine- Copying a Virtual Machine- Managing Additional Devices in Virtual Machines

UNIT V **9 Hours**
AVAILABILITY & APPLICATIONS IN A VIRTUAL MACHINE
Increasing Availability-Protecting a Virtual Machine-Protecting Multiple Virtual Machines-Protecting Data Centers - Examining Virtual Infrastructure Performance Capabilities -Deploying Applications in a Virtual Environment-Understanding Virtual Appliances and vApps -Open Stack and Containers.

Total: 45 Hours

Reference(s)

1. Matthew Portney, Virtualization Essentials, John Wiley & Sons, Second Edition, 2016
2. Kailash Jayaswal, Jagannath Kallakurchi,Donald J.Houde,Dr.devan Shah, Cloud Computing Black Book, Dreamtech press, 2015
3. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi S,Mastering in Cloud Computing, McGraw Hill Education, (India) Private Limited, 2013
4. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013
5. http//www.microsoft.com/learning/default.mspx
6. https://www.oreilly.com/library/view/cloud- security-and/9780596806453/ch04.html

22CB017 CLOUD STORAGE TECHNOLOGIES 3 0 0 3

Course Objectives

- Characterize the functionalities of logical and physical components of storage
- Describe various storage networking technologies
- Identify different storage virtualization technologies
- Discuss the different backup and recovery strategies
- Understand common storage management activities and solutions

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values
PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (Cos)

1. Analyze the fundamentals of information storage management and various models of Cloud infrastructure services and deployment.
2. Apply the usage of advanced intelligent storage systems and RAID.
3. Evaluate various storage networking architectures - SAN, including storage subsystems and virtualization.
4. Execute the different roles in providing disaster recovery and remote replication technologies.
5. Implement the security needs and security measures to be employed in information storage management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2	1	3	3							2	
2	3	1	2	3	3								1
3	1	1	3	2	2								2
4	3	2	1	2	2								1
5	1	3	2	1	2								2

UNIT I 8 Hours
STORAGE SYSTEMS
Cloud Storage Fundamentals and Architecture - Cloud Storage Providers and Services - Access methods (RESTful

APIs, SDKs) for cloud object storage - Block storage technologies in cloud environments - File Storage in the Cloud: Network File System (NFS) and Server Message Block (SMB) protocols -Hybrid Cloud Storage - Data Migration - Data Lifecycle Management in the Cloud

UNIT II **9 Hours**

INTELLIGENT STORAGE SYSTEMS AND RAID

Storage Tiering and Caching - Automated Data Placement and Load Balancing: Intelligent Algorithms for Data Placement, Load Balancing Strategies for Distributed Storage Systems, Dynamic Resource Allocation - RAID Technologies in Cloud Storage: RAID Levels - Data Striping, Mirroring, and Parity for Fault Tolerance - RAID Configuration and Performance Optimization

UNIT III **10 Hours**

STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION

Storage Networking in Cloud Environments - Understanding storage protocols - Network-attached storage (NAS) vs. storage area network (SAN) - Storage virtualization techniques and technologies - Network-Attached Storage (NAS) - Storage Area Network (SAN) - iSCSI and Fiber Channel over IP (FCIP) in Cloud Storage - Network Virtualization and Overlay Networks - Storage Virtualization and Abstraction - Network Performance Optimization - Network Security in Cloud Storage

UNIT IV **9 Hours**

BACKUP, ARCHIVE AND REPLICATION

Cloud Backup: Strategies and Architecture, Data Deduplication and Compression, Security - Cloud Archive: Strategies and Architecture, Replication for Data Redundancy: Synchronous and asynchronous replication methods - Disaster Recovery in the Cloud - Hybrid Backup and Archiving in Cloud Environments - Backup and Archive Management in Cloud Environments

UNIT V **9 Hours**

SECURING STORAGE INFRASTRUCTURE

Storage Security Fundamentals: Key Security Principles, Threats and Vulnerabilities in Storage Infrastructure, Access Control and Authentication: Role-based Access Control (RBAC) and Permissions Management, Multi-factor authentication (MFA) for Storage Systems - Storage-level Encryption and Application-level Encryption - Storage infrastructure Management Functions and Processes.

Total: 45 Hours

Reference(s)

1. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice)‖, O'Reilly, 2009.
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.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing‖, Tata Mcgraw Hill, 2013.
4. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security‖, CRC Press, 2017.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach‖, Tata Mcgraw Hill, 2009.

22CB018 CLOUD AUTOMATION TOOLS AND APPLICATION 3 0 0 3

Course Objectives

- To learn the options for running automation tools, and load balancers in the cloud-native applications.
- To learn the configuration management in the cloud.
- To know why cloud automation is important.
- To learn what types of cloud automation tools can be used.
- To learn load balancing and auto scaling in the cloud.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Implement cloud native applications on AWS, Terraform etc.
2. Apply VM provisioning and migration in the cloud.
3. Analyze cloud automation and configuration.
4. Apply balance load and auto scaling in the cloud.
5. Analyze the AWS cloud formation use-case.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2		2	1	3								2
2		2			3								1
3			3	2	3								2
4			2		3							2	
5			2		3								2

UNIT I **7 Hours**

UNDERSTANDING THE CLOUD AUTOMATION

Introduction to Automation & Configuration Tools. Introduction to Terraform. Understanding Terraform Vs CloudFormation. Deploying & Destroying AWS environment with Terraform. Introduction to Packer.

UNIT II **9 Hours**

ABSTRACTION AND VIRTUALIZATION

Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding hypervisors Porting Applications, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Context, Virtualization of CPU, Memory, I/O Devices, Virtual Clusters and Resource management, Virtualization for Data Centre Automation.

UNIT III **9 Hours**

AUTOMATION AND CONFIGURATION MANAGEMENT IN THE CLOUD

Cloud automation at scale, Cloud Configuration Management –unmanaged and managed configuration management, Modification of the capacity of the service, horizontal and vertical scaling, and automatic versus manual scaling. Migrating the business to Cloud. Automating cloud deployments –Balancers.

UNIT IV **9 Hours**

LOAD BALANCING AND AUTO SCALING IN CLOUD

Managed instance groups, Auto scaling and health check, Overview of HTTP(S) load balancing. Example: HTTP load balancer, HTTP(S) load balancing, Configuring an HTTP Load Balancer with Auto scaling, SSL proxy load balancing, TCP proxy load balancing, Network load balancing, Internal load balancing, Configuring an Internal Load Balancer, Choosing a load balancer.

UNIT V **11 Hours**

AWS CLOUD FORMATION USE-CASE

Introduction to AWS CloudFormation, AWS CloudFormation Features and Components, Working of AWS CloudFormation, setting up AWS CloudFormation, building a Pipeline for Test and Production Stacks, AWS CloudFormation Artifacts, Parameter Override Functions with Code Pipeline, Using AWS CLI. AWS CloudFormation, Terraform, VMware vs Center Configuration Manager (VCM), and Puppet.

Total: 45 Hours

Reference(s)

1. Bernd Ruecker, Practical Process Automation: Orchestration and Integration in Micro services and Cloud Native Architectures,O'Reilly Media, First Edition, 2021.
2. Douglas Comer, The Cloud Computing Book: The Future of Computing Explained, Chapman and Hall/CRC, First Edition, 2021.
3. Karen Tovmasyan, Mastering AWS CloudFormation: Plan, develop, and deploy your cloud infrastructure effectively using AWS CloudFormation, Packt Publishing Limited, First Edition, 2020.
4. Mikael Krief, Mitchell Hashimoto, Terraform Cookbook: Efficiently define, launch, and manage Infrastructure as Code across various cloud platforms, Packet Publishing Limited, 2020.
5. Yogesh Raheja, Dennis McCarthy, Automation with Puppet 5.0, Wiley, First Edition, 2018.

22CB019 SOFTWARE DEFINED NETWORKS 2 0 2 3

Course Objectives

- To understand the need for SDN and its data plane operations
- To understand the functions of control plane
- To comprehend the migration of networking functions to SDN environment
- To explore various techniques of network function virtualization
- To comprehend the concepts behind network virtualization

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes(COs)

1. Apply the motivation behind SDN
2. Analyze the functions of the data plane and control plane
3. Evaluate and develop network applications using SDN
4. Execute network services using NFV
5. Implement various use cases of SDN and NFV

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2	3	1	3								
2	2	1	2	2	3							1	
3	2	2	2	3	3								
4	2	2	2	3	1								
5	3	3	1	1	3							2	

UNIT I 6 Hours
SDN: INTRODUCTION

History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes.

UNIT II **6 Hours**

SDN DATA PLANE AND CONTROL PLANE

Data Plane functions and protocols - OpenFLow Protocol - Packet Processing and Performance Optimization – Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, OpenDaylight, ONOS - Distributed Controllers.

UNIT III **6 Hours**

SDN APPLICATIONS

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking – Wide Area Networks (WAN) – Service Provider Networks – Internet Service Providers (ISPs).

UNIT IV **6 Hours**

NETWORK FUNCTION VIRTUALIZATION

Network Virtualization - NFV Architecture – Virtual LANs – OpenFlow VLAN Support – NFV Standards and Frameworks – NFV Concepts – Benefits and Requirements – Reference Architecture.

UNIT V **6 Hours**

NFV FUNCTIONALITY

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use Cases: Virtual Customer Premises Equipment, Virtual Evolved Packet Core, Virtualized Network Monitoring and Traffic Analysis, Network Slicing, Edge Computing and NFV.

5 Hours

EXPERIMENT 1

Setup your own virtual SDN lab

i) Virtualbox/Mininet Environment for SDN - http://mininet.org

ii) https://www.kathara.org

iii) GNS3

6 Hours

EXPERIMENT 2

Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.

6 Hours

EXPERIMENT 3

Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.

6 Hours

EXPERIMENT 4

Create a simple end-to-end network service with two VNFs using vim-emu https://github.com/containernet/vim-emu

6 Hours

EXPERIMENT 5

Install OSM and onboard and orchestrate network service.

Total: 30+30 =60 Hours

Reference(s):

1. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design, 1st Edition, CRC Press, 2014.
2. Ken Gray, Thomas D. Nadeau, Network Function Virtualization, Morgan Kauffman, 2016.
3. Oswald Coker, Siamak Azodolmolky, Software-Defined Networking with OpenFlow, 2nd Edition, O'Reilly Media, 2017.
4. Paul Goransson, Chuck Black Timothy Culver, Software Defined Networks: A Comprehensive Approach, 2nd Edition, Morgan Kaufmann Press, 2016.
5. Thomas D Nadeau, Ken Gray, SDN: Software Defined Networks, O'Reilly Media, 2013.
6. William Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud, Pearson Education, 1st Edition, 2015.

22CB020 SECURITY AND PRIVACY IN CLOUD 3 0 0 3

Course Objectives

- To Introduce Cloud Computing terminology, definition & concepts
- To understand the security design and architectural considerations for Cloud
- To understand the Identity, Access control in Cloud
- To follow best practices for Cloud security using various design patterns
- To be able to monitor and audit cloud applications for security

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand the cloud security concepts and fundamentals.
2. Explain the security challenges in the cloud.
3. Analyze the cloud policy, identity and Access Management.
4. Delivers various risks, audit and monitoring mechanisms in the cloud.
5. Applying the various architectural and design considerations for security in the cloud.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	1	2								
2	1	3	2	3	1								
3	3	2	2	3	2							1	
4	2	1	2	3	3								
5	1	3	3	1	1								3

UNIT I 8 Hours

FUNDAMENTALS OF CLOUD SECURITY CONCEPTS

Overview of Cloud Security- Security Services - Confidentiality, Integrity, Authentication, Non- repudiation, Access Control - Basic of Cryptography - Conventional and Public-key cryptography, Hash Functions, Authentication and Digital Signatures.

UNIT II **11 Hours**

SECURITY DESIGN AND ARCHITECTURE FOR CLOUD

Security Design Principles for Cloud Computing - Comprehensive Data Protection - End-to-end access control - Common Attack Vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III **9 Hours**

ACCESS CONTROL AND IDENTITY MANAGEMENT

Access Control Requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization – Verified and measured boot - Intruder Detection

UNIT IV **8 Hours**

CLOUD SECURITY DESIGN PATTERNS

Introduction to Design Patterns, Cloud Bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT V **9 Hours**

MONITORING, AUDITING AND MANAGEMENT

Proactive Activity Monitoring – Incident Response, Monitoring for Unauthorized Access, Malicious Traffic, Abuse of System Privileges – Events and Alerts – Auditing – Record generation, Reporting and Management, Tamper-Proofing Audit logs, Quality of Services, Secure Management, User Management, Identity Management, Security Information and Event Management

Total: 45 Hours

Reference(s)

1. Dave Shackleford, Virtualization Security, SYBEX a Wiley Brand, 2013
2. Mark C. Chu-Carroll, Code in the Cloud, CRC Press, 2011.
3. Mather, Kumaraswamy and Latif, Cloud Security and Privacy, Oreilly, 2011.
4. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing Foundations and Applications Programming, 2013.
5. Raj Kumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing, Wiley 2013.

22CB021 **MACHINE LEARNING** **3 0 0 3**

Course Objectives

- Define machine learning and problems relevant to machine learning.
- Differentiate supervised, unsupervised and reinforcement learning.
- Apply neural networks, Bayes classifier and k nearest neighbor, for problems appear in machine learning
- Perform statistical analysis of machine learning techniques.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Engineering Knowledge: Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO2.Problem Analysis: Identify, formulate, review research literature, and analyse complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO6. The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PSO1 To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Interpret the machine learning models and relationship between ML and human learning.
2. Identify the problems for machine learning. And select the either supervised, unsupersvised or reinforcement learning.
3. Analyze the various applications of Markov Models and Hidden Markov Models.
4. Apply the various methods using regression techniques
5. Apply the minimum spanning tree clustering and K-nearest neighbors clustering, for problems appear in machine learning.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	2	1								2	
2	1	2	1	2	1	2						1	
3	1	2	1	2	1	2							
4	2	1	1	2									
5	1	2	1	2									

UNIT I **9 Hours**

INTRODUCTION TO MACHINE LEARNING (ML)

Relationship between ML and human learning-A quick survey of major models of how machines learn, Example applications of ML.

UNIT II **9 Hours**

CLASSIFICATION

Supervised Learning-The problem of classification, Feature engineering, Training and testing classifier models, Cross-validation, Model evaluation (precision, recall, F1-mesure, accuracy, area under curve), Statistical decision theory including discriminant functions and decision surfaces, Naive Bayes classification, Bayesian networks, Decision Tree and Random Forests; k-Nearest neighbor classification, Support Vector Machines, Artificial neural networks including backpropagation, Applications of classifications, Ensembles of classifiers including bagging and boosting.

UNIT III **9 Hours**

HIDDEN MARKOV MODELS

Hidden Markov Models (HMM) with forward-backward and Vierbi algorithms, Sequence classification using HMM, Conditional random fields, Applications of sequence classification such as part-of-speech tagging.

UNIT IV **9 Hours**

REGRESSION

Multi-variable regression, Model evaluation, Least squares regression, Regularization, LASSO, Applications of regression, Association rule mining algorithms including apriori, Expectation-Maximization (EM) algorithm for unsupervised learning

UNIT V **9 Hours**

CLUSTERING

average linkage-Wards algorithm, Minimum spanning tree clustering, K-nearest neighbors clustering, BIRCH, CURE, DBSCAN, Anomaly and outlier detection methods.

Total: 45 Hours

Reference(s)

1. R.O. Duda, P.E. Hart, D.G. Stork, Pattern Classification, 2/e, Wiley, 2001.
2. C. Bishop, Pattern Recognition and Machine Learning, Springer, 2007
3. E. Alpaydin, Introduction to Machine Learning, 3/e, Prentice-Hall, 2014.
4. A. Rostamizadeh, A. Talwalkar, M. Mohri, Foundations of Machine Learning, MIT Press.
5. A. Webb, Statistical Pattern Recognition, 3/e, Wiley, 2011.

22CB022 ROBOTIC PROCESS AUTOMATION 3 0 0 3

Course Objectives

- Understand the basic concepts, methodologies and tools in RPA.
- Implement the exception handling and automation techniques using RPA.

Programme Outcomes (POs)

PO1. Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2. Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3. Design/ Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5. Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1. To design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Interpret the basic concepts and methodologies in RPA.
2. Infer the UiPath building blocks in the RPA.
3. Apply the RPA techniques to automate the application.
4. Implement the exception handling and BOT in RPA.
5. Implement the RPA to solve real time problems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2		2								2	
2	2	2	3		3								2	
3	2	2	3		3								3	
4	2	3	3		3								3	
5	2	3	3		3								3	

UNIT I 9 Hours

RPA AND PROCESS METHODOLOGIES

Introduction to RPA Definition importance and benefits of RPA Comparison of RPA with BPO BPM and BPA Understanding RPA Skills On Premise Vs the Cloud Lean and Six Sigma Methodologies for Process Improvement Overview of Agile Methodologies and its importance in RPA

UNIT II 9 Hours

UiPath ESSENTIALS

Introduction to UiPath Installation and activation UiPath Activities Flowcharts Sequences and Data Manipulation UiPath Variables and Data Types-Debugging techniques in UiPath Overview of UiPath Orchestrator BOT Development and Management UiPath Automation Best Practices

UNIT III 9 Hours

ADVANCED RPA TECHNIQUES

Data Manipulation Collections and Data Table Usage File Operations CSV/Excel to data table and vice versa Working with UiExplorer and Desktop Automation Web Automation Basic and Desktop Recording- Advanced Screen Scraping Techniques Data Scraping and Extraction from Websites

UNIT IV **9 Hours**

HANDLING EXCEPTIONS AND USER EVENTS

Exception Handling Techniques: Try-Catch,Re-throwing Exceptions,and Custom Exception Handling- Logging,Debugging, and Error Reporting Techniques- Handling User Events: Assistantbots, System Event Triggers, and Image and Element Triggers-Monitoring Techniques in RPA-Launching an Assistant bot on a Keyboard Event

UNIT V **9 Hours**

DEPLOYMENT AND MAINTENANCE OF BOT

Overview of Orchestration Server and its functionalities Orchestrator to Control Bots and Deploy Bots- Uploading Packages, Managing Packages,and Deleting Packages-Publishing and Managing Updates- Continuous Integration and Continuous Deployment (CI/CD) in RPA

Total: 45 Hours

Reference(s)

1. Tom Taulli, The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems, Monrovia, CA, USA, APress, 2020.
2. Alok Mani Tripathi, Learning Robotic Process Automation, Packt Publishing, 2018.
3. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant.
4. Srikanth Miranda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.
5. Christian Czarnecki, Peter Fettke, Robotic Process Automation: Management, Technology, Applications, 2021.
6. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation, 1st Edition 2015.

22CB023	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2 0 2 3

Course Objectives

- To understand the basics of Blockchain Technology.
- To learn Different protocols and consensus algorithms in Blockchain.
- To learn the Blockchain implementation frameworks.
- To experiment the Hyperledger Fabric, Ethereum networks.
- To understand the Blockchain Applications.

Programme Outcomes (POs)

PO1.Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development

PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required..

PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

Course Outcomes (COs)

1. Understand emerging abstract models for Blockchain Technology.
2. Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
3. Develop conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
4. Apply Hyperledger Fabric and Ethereum platform to implement the Block chain Application.
5. Analyze the real-life applications of Blockchain Technologies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	2	2	1								1	
2	3	3	3	1	2								2	
3	2	2	1	1										
4		2	2		3								2	
5	1	2	3	1	2								1	

UNIT I **7 Hours**

INTRODUCTION TO BLOCKCHAIN

Blockchain- Public Ledgers, Blockchain as Public Ledgers - Block in a Blockchain, Transactions - The Chain and the Longest Chain - Permissioned Model of Blockchain, Cryptographic –Hash Function, Properties of a hash function-Hash pointer and Merkle tree.

UNIT II **6 Hours**
BITCOIN AND CRYPTOCURRENCY
A basic crypto currency, Creation of coins, Payments and double spending, FORTH – the precursor for Bitcoin scripting, Bitcoin Scripts , Bitcoin P2P Network, Transaction in Bitcoin Network, Block Mining, Block propagation and block relay.

UNIT III **6 Hours**
BITCOIN CONSENSUS
Bitcoin Consensus, Proof of Work (PoW)- Hashcash PoW , Bitcoin PoW, Attacks on PoW, monopoly problem- Proof of Stake- Proof of Burn - Proof of Elapsed Time - Bitcoin Miner, Mining Difficulty, Mining Pool-Permissioned model and use cases.

UNIT IV **5 Hours**
HYPERLEDGER FABRIC & ETHEREUM
Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V **6 Hours**
BLOCKCHAIN APPLICATIONS
Smart contracts, Truffle Design and issue- DApps- NFT. Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, etc - Case Study.

EXPERIMENT 1 **5 Hours**
Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.

EXPERIMENT 2 **5 Hours**
Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.

EXPERIMENT 3 **5 Hours**
Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.

EXPERIMENT 4 **5 Hours**
Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.

EXPERIMENT 5 **5 Hours**
Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards.

EXPERIMENT 6 **5 Hours**
Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan.

Total: 30+30 =60 Hours

Text Books

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, “Mastering Bitcoin: Unlocking Digital Cryptocurrencies”, O’Reilly, 2014.

Reference(s)

1. Daniel Drescher, Blockchain Basics, First Edition, Apress, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015
4. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing
5. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

22CB024	COGNITIVE SCIENCE	3 0 0 3

Course Objectives

- Understand the fundamentals of Cognitive Science
- To apply advanced analytics to cognitive science functions
- Explore how cognitive science used in healthcare system.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1. To design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Interpret the underlying theory behind cognition.
2. Connect to the cognition elements computationally.
3. Outline the mathematical functions through WebPPL.
4. Examine applications using cognitive inference model.
5. Outline the applications of cognitive science in healthcare system.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2		3	3							2	
2	2	2		2	2							2	
3	2	2		2	2							2	
4	2	2		2	2							2	
5	2	3		2	2							3	

UNIT I **9 Hours**

INTRODUCTION TO COGNITIVE SCENCE

The mind in cognitive science- Logic and science of the mind – Place of psychology within cognitive science – Cognitive Neuroscience - Perception - Decision – Learning and memory –Language understanding and processing – Mental- Physical relation – From materialism to mental science.

UNIT II **9 Hours**

COGNITIVE INTELLIGENCE

Machines and Cognition - Artificial intelligence – Architectures of Cognition – Knowledge based systems – Logical representation and Reasoning – Logical decision making – Decision making under uncertainty – Learning – Language – Vision – Robotics.

UNIT III **9 Hours**

PROBABILISTIC PROGRAMMING LANGUAGE

WebPPL Language – Syntax – Using Java script libraries – Manipulating probability types and distributions – Finding inference - Exploring random computation - Coroutines: Functions that receive continuations – Enumeration - Other basic computation.

UNIT IV **9 Hours**

INFERENCE MODELS OF COGNITION

Generative Models – Conditioning – Casual and statistical dependence – Conditional dependence – Data analysis - Algorithm for inference.

UNIT V **9 Hours**

LEARNING MODELS OF COGNITION

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models – Occam's razor – Learning (Deep) Continuous function – Mixture Models.

Total: 45 Hours

Reference(s)

1. Vijay V Raghavan, Venkat N.Gudivada, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016
2. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015
3. Robert A. Wilson, Frank C. Keil, the MIT Encyclopedia of the Cognitive Sciences, the MIT Press, 1999.
4. Jose Luis Bermudez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020

22CB025 **PATTERN RECOGNITION** **3 0 0 3**

Course Objectives

- To provide the basic knowledge about the pattern recognition and its applications.

- Implement the supervised and unsupervised algorithms for pattern classification.

Programme Outcomes (POs)

PO1. Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO4. Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5. Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1. To design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Illustrate the basic concepts of pattern recognition.
2. Apply supervised learning models for assigning class label to the input pattern.
3. Implement unsupervised algorithms to group similar patterns into clusters.
4. Apply features election algorithms to select the features.
5. Analyze the various fuzzy techniques used in pattern classification.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	1		1	2							2	
2	3	2		3	3							3	
3	3	3		3	3							3	
4	3	3		2	3							3	
5	2	3		2	3							3	

UNIT I **9 Hours**

INTRODUCTION TO PATTERN RECOGNITION

Importance of Pattern Recognition – Features - Feature Vectors and Classifiers - Supervised, Unsupervised and Semi-supervised learning - Introduction to Bayes Decision Theory - Discriminant Functions and Decision Surfaces-Gaussian PDF and Bayesian Classification for Normal Distributions.

UNIT II **9 Hours**

CLASSIFIERS

Estimation of Unknown Probability Density Functions –Maximum Likelihood Parameter Estimation - Maximum Entropy Estimation - The Naive-Bayes Classifier -Linear Classifiers - Perceptron Algorithm - Least Square Methods - Support Vector Machines for Classification.

UNIT III **9 Hours**

CLUSTERING

Clustering for Unsupervised Learning and Classification-C-means Algorithm-Hierarchical Clustering Procedures - Validity of Clustering Solutions.

UNIT IV **9 Hours**

FEATURE EXTRACTION AND SELECTION

Introduction - Basis Vectors and Images - Entropy Minimization – Karhunen loeve Transformation – Feature Selection through Functions Approximation – Binary Feature Selection – K-NN.

UNIT V **9 Hours**

RECENT ADVANCES

Fuzzy Classification: Fuzzy Set Theory- Fuzzy and Crisp Classification-Elementary Neural Network for Pattern Recognition – Hebbnet – ADALINE - Case Study: Virtual search, Face recognition and Image pattern recognition.

Total: 45 Hours

Reference(s)

1. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Recognition", John Wiley & Sons, 2021.
2. M.NarasimhaMurthy,V.SusheelaDevi,"PatternRecognition",Springer,2011.
3. Pattern Recognition: Sergios Theodoridis, Konstantinos Koutroumbas, Elsevier India Pvt. Ltd (Paper Back), 4th edition.
4. AndrewR.Webb,KeithD.Copsey,"StatisticalPatternRecognition",3rdEdition,Wiley Publication, November 2011.
5. ChristopherM.Bishop,"PatternRecognitionandMachineLearning(InformationScienceand Statistics)" Hardcover, 2010.
6. Pattern Recognition and Image Analysis Earl Gose: Richard Johnsonbaugh, Steve Jost, ePub eBook.

22CB026 **QUANTUM COMPUTING** **3 0 0 3**

Course Objectives

- Understand the background of classical computing and quantum computing.
- Acquire the knowledge about the hardware and mathematical models of quantum computation.

Programme Outcomes (POs)

PO1. Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO4. Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5. Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1. To design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Understand the basics of information processing tasks that can be accomplished using quantum mechanical systems.
2. Understand the background of Quantum Mechanics that allows the calculation of properties of physical systems.
3. Analyze the Quantum algorithms which is used in circuit model.
4. Analyze the computation models used in quantum information theory.
5. Interpret quantum security in order to ensure that any attempt to intercept.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2		3	3							2	
2	2	2		2	2							2	
3	2	2		2	2							2	
4	2	2		2	2							2	
5	2	3		2	2							3	

UNIT I **9 Hours**

QUANTUM COMPUTING BASIC CONCEPTS

Complex Numbers - Matrices and Operators - Quantum Mechanics – Linear Algebra - The Postulatesof Quantum Mechanics - Quantum Bits - Representations of Qubits – Superpositions

UNIT II **9 Hours**

QUANTUM GATES AND CIRCUITS

Quantum Computation - Single qubit gates - Multiple qubit gates – Quantum Circuits – Qubit Copying Circuit - Circuit development - Quantum error correction.

9 Hours

UNIT III

QUANTUM ALGORITHMS

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm: Grover's Algorithm-Quantum search as a quantum simulation - Quantum counting.

UNIT IV **9 Hours**

QUANTUM INFORMATION THEORY

Data compression - Shannon’s noiseless channel coding theorem - Schumacher’s quantum noiseless channel coding theorem – Communication Over Noisy Quantum Channels – Quantum Information Over Noisy Quantum Channels.

UNIT V **9 Hours**

QUANTUM CRYPTOGRAPHY

Principles of Information Security – One-Time Pad - Public key cryptography – RSA Coding Scheme- Quantum Cryptography – Quantum Key Distribution - BB84 - Ekart 91.

Total: 45 Hours

Reference(s)

1. Parag K Lala, " Quantum Computing, A Beginners Introduction", First Edition, Mc Graw Hill Education, 2020.
2. Michael A. Nielsen, Issac L. Chuang, “Quantum Computation and Quantum Information”, Cambridge University Press, tenth Edition, 2010
3. Chris Bernhardt, “Quantum Computing for Everyone”, The MIT Press; Reprint edition (8 September 2020).
4. Scott Aaronson, "Quantum Computing Since Democritus ", Cambridge University Press, 2013.

22CB027	HUMAN RESOURCE MANAGEMENT FOR ENTREPRENEURS	3 0 0 3

Course Objectives

- To enable the students to understand the basics of HRM.
- To gain the knowledge about strategies required to select and manage manpower resources.
- To understand the role of training and development in the organisation.
- To understand job-based compensation scheme and career management.
- To give an insights about performance evaluation and grievance redressal methods.

Programme Outcomes (POs)

PO6. The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO10.Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PSO1 To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2 To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Analysis the various aspects of HRM and its relevance in the organization.
2. Ability to plan, recruits, select and manage the job candidate.
3. Assess the training needs and able to train using various methods of Training.
4. Able to implement Employee benefits and Welfare measures, Employee safety and Health Measures.
5. Evaluate the Performance of the employees and able to devise the strategies to handle the employee issues.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1						3				3		2	2
2						2				3		2	2
3						2				3		2	2
4						2				2		2	2
5						3				2		3	3

UNIT I **9 Hours**

PERSPECTIVES IN HUMAN RESOURCE MANAGEMENT

Evolution of human resource management-The importance of the human capital-Role of human resource manager-Challenges for human resource managers-trends in Human resource-Computer applications in human resource management-Human resource accounting

UNIT II **9 Hours**

HUMAN RESOURCE PLANNING AND RECRUITMENT

Importance of Human Resource Planning-Forecasting human resource requirement-matching supply and demand-- Internal and External sources-Organizational Attraction-Recruitment, Selection, Induction and Socialization- Theories, Methods and Process

UNIT III **9 Hours**

TRAINING AND DEVELOPMENT

Types of training methods-purpose-benefits-resistance. Executive development programme-Common practices-Benefits-Self Development-Knowledge management

UNIT IV **9 Hours**

EMPLOYEE ENGAGEMENT

Compensation plan-Reward-Motivation-Application of theories of motivation -Career management-Mentoring-Development of mentor-Protege relationships- Job Satisfaction, Employee Engagement, Organizational Citizenship Behaviour-Theories, Models

UNIT V **9 Hours**

PERFORMANCE EVALUATION AND CONTROL

Method of performance evaluation-Feedback-Industry practices. Promotion,Demotion,Transfer and Separation-Implication of job change.The control process-Importance-Methods-Requirement of effective control systems grievances-causes-implications-Redressel methods

Total: 45 Hours

Text Book(s)

1. Human Resource Management, 8th Edition, K. Aswathappa, Tata McGraw Hill, 2017

Reference(s)

1. Dessler Human Resource Management, Pearson Education Limited, 14th Edition, 2015.
2. Luis R.Gomez-Mejia, David B.Balkin, Robert L Cardy. Managing Human Resource. PHI Learning. 2012
3. Bernadin , Human Resource Management ,Tata Mcgraw Hill ,8th edition 2012.
4. Wayne Cascio, Managing Human Resource, McGraw Hill, 2007.
5. Ivancevich, Human Resource Management, McGraw Hill 2012.

22CB028 FINANCIAL MANAGEMENT 3 0 0 3

Course Objectives

- Understand basics of Financial Management and the concept of Time Value of Money
- Analyse the Securities Value and its Risk & Return
- Analyse the business risk, financial risk and cost of capital for maximizing the share holder
- Analyse the cash flows to make investment decision
- Discover basic understanding of a company's working capital structure.

Programme Outcomes (POs)

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO10.Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PSO1 To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2 To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Able to perform the basic Financial Functions and apply the concept of Time Value of Money while taking the Financial Decisions
2. Perform the Security Valuation and construct the Portfolio for given level and risk and expected rate of return
3. Manage the risk using Operating and Financial Leverages and calculate the Cost of Capital
4. Able to apply appropriate Capital Budgeting Techniques while taking Investment Decision
5. Ensure the short-term liquidity by appropriately managing the Working Capital

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1		3		1	1					2		1	1
2		2		2	3					3		2	2
3		2		2	3					3		2	2
4		2		3	3					3		2	2
5		2		2	2					3		2	2

UNIT I **9 Hours**

INTRODUCTION

Introduction to Financial Management - Goals of the firm - Financial Environments. VALUE OF MONEY: Simple and Compound Interest Rates, Amortization, Computing more than once a year, Annuity Factor.

UNIT II **9 Hours**

VALUATION OF SECURITIES

Bond Valuation, Preferred Stock Valuation, Common Stock Valuation, Concept of Yield and YTM. RISK AND RETURN: Defining Risk and Return, Using Probability Distributions to Measure Risk, Attitudes Toward Risk, Risk and Return in a Portfolio Context, Diversification, the Capital Asset Pricing Model (CAPM)

UNIT III **9 Hours**

OPERATING AND FINANCIAL LEVERAGE

Operating Leverage, Financial Leverage, Total Leverage, and Indifference Analysis in leverage study. COST OF CAPITAL: Concept , Computation of Specific Cost of Capital for Equity ,Preference-Debt, Weighted Average Cost of Capital, Factors affecting Cost of Capital 4L

UNIT IV **9 Hours**

CAPITAL BUDGETING

The Capital Budgeting Concept & Process - An Overview, Generating Investment Project Proposals, Estimating Project, After Tax Incremental Operating Cash Flows, Capital Budgeting Techniques, Project Evaluation and Selection - Alternative Methods

UNIT V **9 Hours**

WORKING CAPITAL MANAGEMENT

Overview, Working Capital Issues, Financing Current Assets (Short Term and Long Term- Mix), Combining Liability Structures and Current Asset Decisions, Estimation of Working Capital. Cash Management: Motives for holding cash, speeding up Cash Receipts, Slowing down Cash Pay-outs, Electronic Commerce, Outsourcing, Cash Balances to maintain, and Factoring. Accounts Receivable Management: Credit and Collection Policies, Analyzing the Credit Applicant, Credit References, Selecting optimum Credit period

Total: 45 Hours

Reference(s)

1. Prasanna Chandra, "Financial Management- Theory and Practice", New Delhi: Tata McGraw-Hill Publishing Company Ltd, 2017.
2. I. M. Pandey, "Financial Management", New Delhi: Vikas Publishing House Pvt. Ltd., 2016.
3. Van Horne and Wachowicz : Fundamentals of Financial Management, Prentice Hall/ Pearson Education.
4. M. Y. Khan and P. K. Jain, "Financial Management- Text, Problems and Cases", New Delhi: Tata McGraw Hill Publishing Company Ltd, 2018.
5. Brigham and Houston, "Fundamentals of Financial Management", New Delhi: Thomson Learning, 2015.

22CB029 SUPPLY CHAIN MANAGEMENT 3 0 0 3

Course Objectives

- Understand the objectives, importance, and decision phases of supply chain management
- Examine the different supply chain strategies and how to achieve strategic fit.
- Analyze the importance of cross-functional collaboration in supply chain management
- Apply supply chain management concepts to real-world problems.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2. Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3. Design/ Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4. Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5. Modern Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO8. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9. 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.
PO10. Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PSO1 To demonstrate technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2 To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand the key concepts of supply chain management.
2. Develop a supply chain strategy to achieve strategic goals.
3. Plan the supply chain to identify key stakeholders.
4. Implement the supply chain plan.
5. Analyze supply chain performance and develop a supply chain culture.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	3	3	3			2	3	2		2	3
2	3	3	3	3	3			3	2	3		2	2
3	3	3	3	3	3			3	3	2		3	3
4	3	3	3	3	3			2	3	2		2	3
5	3	3	3	3	3			3	2	3		2	3

UNIT I **9 Hours**

SUPPLY CHAIN STRATEGY

Understanding Supply Chain : Objectives, Importance, Decision Phases, Process Views- Supply Chain Strategies: Competitive And Supply Chain Strategies, Achieving Strategic Fit, Expanding Strategic Scope, Challenges-Supply Chain Drivers And Metrics :Financial Measures, Drivers of Supply Chain Performance, Framework For Structuring Drivers

UNIT II **9 Hours**

SUPPLY CHAIN NETWORK DESIGN

Role of Distribution In Supply Chain-Factors Influencing Distribution Network Design-Design Options For Distribution Network-Role Of Network Design In The Supply Chain-Factors Influencing Network Design Decisions-Framework For Network Design Decisions-Models For Facility Location And Capacity Location-Impact Of Globalization On Supply Chain Networks

UNIT III **9 Hours**

DEMAND SUPPLY PLANNING

Demand Forecasting In Supply Chain : Role Of Forecasting In Supply Chain, Characteristics of Forecasts-Forecasting Methods-Role Of IT In Forecasting-Aggregate Planning In The Supply Chain : Role-Characteristics-Aggregate Planning-Role of IT In Aggregate Planning-Sales And Operation Planning-Coordination In Supply Chain

UNIT IV **9 Hours**

INVENTORY MANAGEMENT

Role of cycle inventory-estimating cycle inventory-short term discounting-managing multi echelon cycle inventory-role of safety inventory-impacts on safety inventory-managing safety inventory in multi echelon supply chain- role of it in inventory management-estimating and managing safety inventory-Product Availability-Transportation

UNIT V **9 Hours**

CROSS FUNCTIONAL SCM

Source Decisions: Role-Sourcing-Logistics Providers and Suppliers-Pricing And Revenue Management: Role-Usage-Information Technology In Management : Role-Supply chain IT Framework-Customer/Supplier Relationship management-Sustainability And The Supply Chain : Role-Keymetrics-Sustainability And Supply Chain Drivers-closed loop supply chain

Total: 45 Hours

Reference(s)

1. Supply Chain Management: Strategy, Planning, and Operation, Global Edition, 7th edition, Pearson, 2020.
2. Supply Chain Management Strategy, Planning, and Operation, Global Edition Sunil Chopra,2019
3. Logistics and Supply Chain Management: Systems mechanism within the Globe and Direct Delivery for effective globalization, creatspaceself publisher; 4th edition , 2018
4. Handbook of Research on Global Supply Chain Management

22CB030 **IT PROJECT MANAGEMENT** **3 0 0 3**

Course Objectives

- Understand what is a project management and scheduling
- Analyze the project management features and feasibility studies.
- Understand the purpose of SURUM and DEVOPS in project management.

Programme Outcomes (POs)

PO3. Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO8. Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9.Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PSO1 To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2 To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand the concept of project management.
2. Understand the project management scheduling
3. Analyze the features of project management with respect to AGILE model.
4. Explore the services of SURUM.
5. Understand the concept of Devops in project management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1			1									1	
2			1										2
3			2									2	
4					2								2
5					1			1	1				2

UNIT I **9 Hours**

PROJECT OVERVIEW AND FEASIBILITY STUDIES

Identification - Market and Demand Analysis- Project Cost Estimate, Financial Appraisal

UNIT II **9 Hours**

PROJECT SCHEDULING PROJECT SCHEDULING

Project Scheduling, Introduction to PERT and CPM - Critical Path Calculation - Precedence Relationship - Difference between PERT and CPM - Float Calculation and its importance - Cost reduction by Crashing of activity - Cost Control and Scheduling: Project Cost Control (PERT/Cost - Resource Scheduling & Resource Leveling

UNIT III **9 Hours**

PROJECT MANAGEMENT FEATURES

Risk Analysis-Project Control-Project Audit and Project Termination-Introduction, Agile Principles-Agile methodologies-Relationship between Agile Scrum-Lean-DevOps and IT Service Management (ITIL)

UNIT IV **9 Hours**

SCRUM PROJECT MANAGEMENT

Scrum-Various terminologies used in Scrum-Sprint, product backlog- sprint backlog-sprint review-retro perspective-various roles (Roles in Scrum)-Best practices of Scrum

UNIT V **9 Hours**

DEVOPS

Overview and its Components-Containerization Using Docker-Managing Source Code and Automating Build-Automated Testing and Test Driven Development-Continuous Integration-Configuration Management-Continuous Deployment-Automated Monitoring-Other Agile Methodologies-Introduction to XP FDD-DSDM-Crystal

Total: 45 Hours

Reference(s)

1. Mike Cohn, Succeeding with Agile: Software Development Using Scrum, 2021.
2. Roman Pichler, Agile Product Management with Scrum, 2021.
3. Ken Schwaber, Agile Project Management with Scrum (Microsoft Professional), 2004.

22CB031 INTRODUCTION TO INNOVATION, IP MANAGEMENT AND ENTREPRENEURSHIP 3 0 0 3

Course Objectives

- The successful completion of the course will help students gain knowledge on: How to identify and discover market needs
- How to manage an innovation program
- How to create, protect, assetize and commercialize intellectual property
- Opportunities and challenges for entrepreneurs

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO7.Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
PO8. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PSO1 To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Summarize the life cycle and types of innovation
2. Understand the challenges in the innovation
3. Interpret the needs, benefits and procedure of filing an IPR
4. Examine a business plan to ensure success of a start-up
5. Analyze the requirements of the technology-driven social innovation

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2						2						
2	2	1					2						
3													
4		3			2		1					1	
5		3			1			2					

UNIT I **7 Hours**

INNOVATION

A primer on Innovation, IP Rights and Entrepreneurship, Types of Innovation (incremental, disruptive, etc.), Lifecycle of Innovation (idea, literature survey, PoT, PoC, etc.)

UNIT II **10 Hours**

CHALLENGES IN INNOVATION

Challenges in Innovation (time, cost, data, infrastructure, etc.), co-innovation and open innovation (academia, start-ups and corporates), Technology innovation - case study - jile - A scalable agile devops products, curefit - A platform to stay healthy.

UNIT III **9 Hours**

INTELLECTUAL PROPERTY RIGHT

Types of IPR (patents, copyrights, trademarks, GI, etc.), Lifecycle of IP (creation, protection, assetization, monetization), Balancing IP risks & rewards (Right Access and Right Use of Open Source and 3rd party products, technology transfer & licensing), IP valuation (methods, examples, limitations).

UNIT IV **10 Hours**

ENTREPRENEURSHIP

Opportunity identification in technology entrepreneurship (customer pain points, competitive context), Market research, segmentation & sizing, Product positioning & pricing, go-to-market strategy, Innovation assessment (examples, patentability analysis)

UNIT V **9 Hours**

ENTREPRENEURSHIP - SOCIAL INNOVATION

Startup business models (fund raising, market segments, channels, etc.), Innovation, Incubation & Entrepreneurship in Corporate Context Technology-driven Social Innovation & Entrepreneurship, Manage innovation, IP and Entrepreneurship Programs- Processes, Governance and Tools.

Total: 45 Hours

Reference(s)

1. Joe Tidd, John Bessant. Managing Innovation: Integrating Technological, Market and Organizational Change
2. Richard Razgaitis, Valuation and Dealmaking of Technology-Based Intellectual Property Principles, Methods and Tools, Wiley, 2009
3. Clayton M.Christensen, Innovator"s Dilemma: When New Technologies Cause Great Firms to Fail (Management of Innovation and Change), Harvard Business Review Press, 2013
4. Case Study Materials: To be distributed for class discussion

22CB032 BEHAVIORAL ECONOMICS 3 0 0 3

Course Objectives

- To impart the knowledge on the concepts of behavioral economics
- To introduce the knowledge of biases, beliefs of buyers, self-evaluation, and self-projection
- To provide the knowledge of loss aversion
- To familiarize inter-temporal choice, hyperbolic discounting, and procedural choice
- To introduce the knowledge of game theory and Nash equilibrium.

Programme Outcomes (POs)

PO3. Design/ Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4. Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PSO2 To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Interpret the neoclassical, standard model and behavioral economics
2. Analyze of the statistical decision theory approaches to understanding of the principles of decision making under risk
3. Compare the various theories in the choice under uncertainty
4. Analyze the knowledge of approaches to human decision in time, and the problems related to inconsistency in inter-temporal preferences
5. Apply the behavioural concepts in strategic interaction

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1			2										2
2			2	1									2
3			2										3
4			2	1									2
5			2	2									2

UNIT I **9 Hours**

INTRODUCTION

The neoclassical/standard model and behavioral economics in contrast-historical background-behavioral economics and other social sciences-theory and evidence in the social sciences and in behavioral economics-applications-gains and losses-money illusion-charitable donation.

UNIT II **9 Hours**

BASICS OF CHOICE THEORY

Supervised Learning; The problem of classification-Feature engineering-Training and testing classifier models-Cross-validation-Model evaluation (precision, recall, F1-mesure, accuracy, area under curve)-Statistical decision theory including discriminant functions and decision surfaces-Naive Bayes classification-Bayesian networks-Decision Tree and Random Forests-k-Nearest neighbor classification-Support Vector Machines-Artificial neural networks including backpropagation-Applications of classifications-Ensembles of classifiers including bagging and boostingRevisiting rationality - causal aspects of irrationality-different kinds of biases and beliefs-self-evaluation and self-projection-inconsistent and biased beliefs-probability estimation-trading applications-trade in counterfeit goods-financial trading behavior-trade in memorabilia.

UNIT III **9 Hours**

CHOICE UNDER UNCERTAINTY

Background and expected utility theory-prospect theory and other theories-reference points- loss aversion-marginal utility-decision and probability weighting-applications-ownership and trade-income and consumption-performance in sports.

UNIT IV **9 Hours**

INTERTEMPORAL CHOICE

Geometric discounting-preferences over time-anomalies of inter-temporal decisions- hyperbolic discounting-instantaneous utility-alternative concepts-future projection-mental accounts-heterogeneous selves-procedural choice-policy analysis-mobile calls-credit cards-organization of government-applications-consumption and savings-clubs and membership-consumption planning.

UNIT V **9 Hours**

STRATEGIC CHOICE

Review of game theory and Nash equilibrium-strategies-information-equilibrium in pure and mixed strategies-iterated games-bargaining-signaling-learning-applications-competitive sports- bargaining and negotiation- monopoly and market entry individual preferences- choice anomalies and inconsistencies -social preferences -altruism -fairness-reciprocity-trust-learning-communication-intention-demographic and cultural aspects-social norms-compliance and punishment-inequity aversion-policy analysis-norms and markets-labor markets-market clearing-public goods-applications-logic and knowledge- voluntary contribution-compensation design.

Total: 45 Hours

Reference(s)

1. N. Wilkinson and M. Klaes, An Introduction to Behavioral Economics, 3rd Edition, Palgrave Macmillan,2012

22CB033 **DIGITAL MARKETING** **3 0 0 3**

Course Objectives

- To understand the fundamentals of Digital Marketing
- To analyze various social media marketing
- To understand email and mobile marketing
- To understand the basics of Analytics tools including Google Analytics and Adwords.
- To learn the different types of SEO and SEM.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO6.The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO9.Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Demonstrate the role and importance of digital marketing in today's rapidly changing business environment.
2. Discover the techniques to help organizations to utilize social media for digital marketing.
3. Analyze the key elements and campaign effectiveness of E-Mail marketing and mobile marketing.
4. Evaluate the effectiveness of a digital marketing campaign using Google Analytics.
5. Apply advanced practical skills to plan, predict and manage digital marketing campaign

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	3	2	1		2			2				1
2	2	3	3	3		2			3				1
3	2	3	3	3		2			3				2
4	2	3	3	3		2			3				2
5	2	3	3	3		2			2				1

UNIT I **9 Hours**

BASICS OF DIGITAL MARKETING

Introduction to online digital marketing - Importance of digital marketing - Traditional Vs. Digital Marketing - Types of Digital Marketing - Digital marketing channels- Visitor's engagement- Targeted traffic - Lead generation.

UNIT 2 **9 Hours**

SOCIAL MEDIA MARKETING

Social media analytics, Social media Advertising-Facebook page Optimization-Facebook for business-The basics of Facebook Ads-Instagram Business Profile Creation and Optimization-Twitter Basics and Optimizing Twitter-Twitter Hashtags and Trend analytics.

UNIT 3 **9 Hours**

E- MAIL AND MOBILE MARKETING

E- Mail Marketing – Types of E- Mail Marketing – Email Automation – Integrating Email with Social Media and Mobile- Measuring and maximizing email campaign effectiveness. Mobile Marketing-Mobile Inventory/channels- Location based; Context based; Coupons and offers, Mobile Apps, Mobile Commerce, SMS Campaigns-Profiling and targeting.

UNIT 4 **9 Hours**

DIGITAL MEDIA ANALYTICS

Content Marketing, AdSense, Blogging, and Affiliate Marketing - Influencer Marketing- Video marketing, Google Analytics, Behaviour and acquisition report, Digital media planning and buying-Web remarketing- Design essentials.

UNIT 5 **9 Hours**

SEARCH ENGINE OPTIMIZATION (SEO) AND SEARCH ENGINE MARKETING (SEM)

Search Engine Optimization (SEO): Introduction, On-page SEO, Off-page SEO, Keyword research-Factors affecting the rank of web page. Search Engine Marketing (SEM): Google Ads- Creating campaigns- Search volume - Google Adwords-Site and keyword targeting- Demographic Targeting-Google keyword planner.

Total: 45 Hours

Reference(s)

1. Puneet Singh Bhatia, Fundamentals of Digital Marketing First Edition, Publication Pearson.
2. Vandana Ahuja, Digital Marketing 1st Edition, Publication Oxford
3. Shivani Karwal, "Digital Marketing Handbook: A Guide to search Engine Optimization, Pay Per Click Marketing, Email Marketing and Content Marketing", CreateSpace Independent Publishing Platform, 1st edition.
4. Ian Dodson, The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted and Measurable Online Campaigns, Publication Wiley India Pvt Ltd.
5. Philip Kotler, Hermawan Kartajaya, Iwan Setiawan, Marketing 4.0: Moving from Traditional to Digital, Publication Wiley India Pvt Ltd.
6. Venakataramana Rolla, "Digital Marketing Practice guide for SMB: SEO, SEM and SMM", CreateSpace Independent Publishing Platform, First edition.
7. Enge, E., Spencer, S., Stricchiola, J., & Fishkin, R. (2012). The art of SEO. O'Reilly Media, Inc.

22CB034 CONVERSATIONAL SYSTEMS 3 0 0 3

Course Objectives

- Enable attendees to acquire knowledge on chatbots and its terminologies.
- Work with ML Concepts and different algorithms to build custom ML Model
- Better understand on Conversational experiences and provide better customer experiences

Programme Outcomes (POs)

PO1. Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6.The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

PSO2.To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Classify the fundamentals of conversational systems
2. Outline the basic concepts in chatbots using the Natural Language Processing.
3. Design a chatbot using Conversational Artificial Intelligence Systems.
4. Analyze how conversational systems uses ML technologies.
5. Outline the XR technologies in Conversational Systems.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	3	1	1								1	
2	2	2	1	2	2	2						1	
3	2	2	2	1	3	2							2
4	1	2	1	1								1	
5	1	1	1	2									2

UNIT I 9 Hours

FUNDAMENTALS OF CONVERSATIONAL SYSTEMS

Overview, Case studies, Explanation about different modes of engagement for a human being, History and impact of AI, Underlying technologies-Natural Language Processing, Artificial Intelligence, and Machine Learning, NLG, Speech-To-Text, Text-To-Speech, Computer Vision, etc, Introduction to Top players in Market-Google, MS, Amazon &Market trends Messaging Platforms (Facebook, WhatsApp) and Smart speakers-Alexa, Google Home and other new channels Ethical and Legal Considerations in AI Overview

UNIT II **9 Hours**

FOUNDATIONAL BLOCKS FOR PROGRAMMING AND NATURAL LANGUAGE PROCESSING

Basic Python programming concepts, Node Basics, Coding Best Practices, Evaluation Test(Hands-On)-1HR, Introduction-Brief history, Basic Concepts, Phases of NLP, Application of chatbots, General chatbot architecture, Basic concepts in chatbots-Intents, Entities, Utterances, Variables and Slots, Fulfillment Lexical Knowledge Networks (WordNet, Verbnet, PropBank, etc), Lexical Analysis, Part-of-Speech Tagging, Parsing/Syntactic analysis, Semantic Analysis, Word Sense Disambiguation, Information Extraction, Sentiment Analysis, NLP using Python-Make use of any of the NLP libraries like NLTK, spaCy, StanfordNLP, etc, (Practice session to use an NLP Tool -Hands-on), Affective NLG

UNIT III **9 Hours**

BUILDING A CHATBOT/CONVERSATIONAL AI SYSTEMS

Fundamentals of Conversational Systems (NLU, DM, and NLG), Chatbot framework & Architecture, Conversational Flow & Design, Intent Classification (ML and DL based techniques), Dialogue Management Strategies, Natural Language Generation, UX design, APIs and SDKs, Usage of Conversational Design Tools, Introduction to popular chatbot frameworks-Google Dialog flow, Microsoft Bot Framework, Amazon Lex, RASAChannels-Facebook Messenger, Google Home, Alexa, WhatsApp, Custom Apps, Overview of CE Testing techniques, A/B Testing, Security &Compliance-Data Management, Storage, GDPR, PCI, Building a Voice/ChatBot - Hands-on

UNIT IV **9 Hours**

ROLE OF ML/AI IN CONVERSATIONAL TECHNOLOGIES

Brief Understanding on how Conversational Systems uses ML technologies in ASR, NLP, Advanced Dialog management, Language Translation, Emotion/Sentiment Analysis, Information extraction, etc, to effectively converse.

UNIT V **9 Hours**

CONTACT CENTERS AND OVERVIEW ON CONVERSATIONAL ANALYTICS

Introduction to Contact centers-Impact & Terminologies, Case studies & Trends, how does a Virtual Agent/Assistant fit in here, Conversation Analytics-The need of it, Introduction to Conversational Metrics, Summary

Total: 45 Hours

Reference(s)

1. Mich ael McTear, Conversational AI: Dialogue Systems, Conversational Agents, and Chatbots (Synthesis Lectures on Human Language Technologies), OCT 2020
2. Nitin Indurkhya, Fred J. Damerau, Handbook of Natural Language Processing,2010.
3. Gerardus Blokdyk , Conversational Chatbots for Analytics Third Edition 2018

22CB035 SOCIAL TEXT AND MEDIA ANALYTICS 3 0 0 3

Course Objectives

- Understand the basic ideas of Text mining.
- Analyze the methods and approaches used in analytics.
- Gain knowledge on various types of analytics like web, social network, and social media.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

Course Outcomes (COs)

1. Demonstrate the concepts and applications of text mining.
2. Explain Content analysis and Sentiment analysis.
3. Illustrate web analytics with a suitable model.
4. Illustrate social network analytics with suitable example.
5. Illustrate social media analytics with suitable example.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2		2	2	2							2	
2	2	2		2	2								
3	2		2	2	2							1	
4		2	2	2	2							2	
5		2	2	2									

UNIT I **7 Hours**

TEXT MINING

Introduction- Core text mining operations- Preprocessing techniques- Categorization- Clustering- Information extraction- Probabilistic models for information extraction-Text mining applications.

UNIT II **9 Hours**

METHODS

Content Analysis- Natural Language Processing- Clustering & Topic Detection- Simple Predictive Modeling- Sentiment Analysis; Sentiment Prediction.

UNIT III **9 Hours**

WEB ANALYTICS

Web analytics tools- Clickstream analysis-A/B testing-Online surveys-Web search and retrieval-Search engine optimization-Web crawling and Indexing-Ranking algorithms-Web traffic models.

UNIT IV **10 Hours**

SOCIAL NETWORK ANALYTICS

Social contexts: Affiliation and identity-Social network analysis-Social network and web data and methods. Graphs and Matrices-Basic measures for individuals and networks.

UNIT V **10 Hours**

SOCIAL MEDIA ANALYTICS

Information visualization-Making connections: Link analysis-Random graphs and network evolution.

Total: 45 Hours

Reference(s)

1. Ronen Feldman and James Sanger, The Text Mining Handbook: Advanced Approaches in Analyzing Unstructured Data, Cambridge University Press, 2006.
2. Hansen, Derek, Ben Sheiderman, Marc Smith. Analyzing Social Media Networks with NodeXL: Insights from a Connected World, Morgan Kaufmann, 2011.
3. Avinash Kaushik. Web Analytics 2.0: The Art of Online Accountability, 2009.
4. Hanneman, Robert and Mark Riddle. Introduction to Social Network Method, 2005.
5. Wasserman, S. & Faust, K. Social network analysis: Methods and applications. New York: Cambridge University Press, 1994.
6. Monge, P. R. & Contractor, N. S. Theories of communication networks. New York: Oxford University, 2003.

22CB036 RISK ANALYTICS 3 0 0 3

Course Objectives

- Understand the fundamental principles and concepts of risk analytics.
- Develop skills to identify, measure, and assess different types of risk.
- Apply statistical and quantitative techniques to analyse and model risk.
- Gain practical experience in using risk analytics tools and software.
- Learn how to communicate risk analysis and risk modeling results effectively.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO8.Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO10.Project management and finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PSO1. To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Understand the risk management framework.
2. Analysis the analytical techniques.
3. Analysis the frameworks of risk prioritization and risk assessment.
4. Understand the risk analytics tools and visualization techniques.
5. Apply probability and statistical methods to risk modeling.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2		2										
2		3								2		2	
3		2	1					2					
4	2	3	2									2	
5	2	2	2							2			

UNIT I **9 Hours**

INTRODUCTION TO RISK ANALYTICS

Introduction of risk analytics and types of risk-Risk management frameworks-Role of risk analytics in decision-making-Probability Theory and Statistics-Basic probability concepts-Random variables and probability distributions-Statistical inference and hypothesis testing

UNIT II **9 Hours**

RISK IDENTIFICATION

Preliminary Hazard Analysis (PHA), Hazards and Operability Analysis (HAZOP) - Job Safety Analysis (JSA) - Failure Modes and Effects Analysis (FMEA)- Fault Tree Analysis (FTA), Event Tree Analysis (ETA), Decision Trees- Cause-Consequence Analysis (CCA)

UNIT III **9 Hours**

RISK PRIORITIZATION

Risk Identification and Categorization-Risk registers and risk breakdown structures-Risk taxonomy and classification frameworks-Risk Assessment and Evaluation-Quantitative and qualitative methods for assessing risks-Risk scoring and ranking methodologies.

UNIT IV **9 Hours**

RISK ANALYTICS TOOLS

Introduction to risk analytics software-Data visualization for risk analysis-Case studies using risk analytics tools-Risk Communication and Reporting-Effective communication of risk analysis results-Visualization techniques for risk reporting-Ethical issues in risk assessment and modelling.

UNIT V **9 Hours**

STATISTICAL METHODS FOR RISK MODELING

Probability distributions and their applications in risk modeling-Estimation and inference for risk parameters-Correlation and dependence modeling-Time series analysis for risk forecasting-Insurance Risk Analytics-Underwriting risk assessment-Claims analysis and reserving.

Total: 45 Hours

Reference(s)

1. Mohammad Modarres , Risk Analysis in Engineering Techniques, Tools, and Trends, CRC Press, 2006.
2. Marvin Rausand Stein Haugen , Risk Assessment: Theory, Methods, and Applications, Wiley, 2020.
3. "Risk Analysis and Management for Projects: Techniques and Methods" by Institution of Civil Engineers.
4. "Decision Quality: Value Creation from Better Business Decisions" by Carl Spetzler, Hannah Winter, and Jennifer Meyer.
5. "Data Science for Business: What You Need to Know about Data Mining and Data-Analytic Thinking" by Foster Provost and Tom Fawcett.

22CB037 ENTERPRISE SECURITY 3 0 0 3

Course Objectives

- Apply ethical frameworks to analyze problems and evaluate alternative solutions
- Design appropriate security architecture with an understanding of the technology
- Create and deploy enterprise solutions in support of organizational goals

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2. Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO7. Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
PSO1. To demonstrate technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Outline the basic principles of Security and Networks.
2. Implementing the network concepts in Risk management for IT Security.
3. Examine the Professional code of ethics along with law.
4. Design Software development life cycle with TCP/IP Protocols.
5. Design Security Architecture for real time application.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2										1	
2		3										1	
3	1			2			3					2	
4	1		3	1	2							3	
5			3									3	

UNIT I 9 Hours

INTRODUCTION TO INFORMATION SECURITY AND COMPUTER NETWORKS

CIA triad: Confidentiality, Integrity, Availability - RMIAS model-Information Security knowledge area - Cyber Security industry, certifications and careers - Cryptography - Introduction to Networking Security protocols - Threats-Authentication and Authorization - Access Controls - Security Vulnerabilities - Security Tools -Penetration testing.

UNIT II **9 Hours**

IT SECURITY GOVERNANCE AND RISK MANAGEMENT

Four types of policies - Develop and manage security policies – Perform risk management for IT security - Threat identification and classification - Incident Management - IT security business continuity planning - IT security disaster recovery planning.

UNIT III **9 Hours**

ETHICS AND PHYSICALSECURITY

Types of computer crime - Privacy and the law Computer forensics - Information security professional's code-of ethics – Intellectual property law - Physical security domain - Physical safeguards -The General Data Protection Regulation (GDPR) - The Sarbanes-Oxley Act (SOX) - The Health Insurance Portability and Accountability Act (HIPAA) - Consumer Privacy Act.

UNIT IV **9 Hours**

IT SECURITY ENTERPRISE SOLUTIONS

Software Development Lifecycle (SDLC) - Best practices in software engineering - Network security in context Protecting TCP/IP networks -Virtual Private Networks - IPSec - Data classification - Data Loss Prevention - DLP implementation - Encryption and hashing - Encrypting data in use - Encrypting data in transit – Tokenization - Data masking - Intrusion detection - systems - Identity and access management (IAM) – Firewalls in Enterprise Security.

UNIT V **9 Hours**

NETWORK SECURITYARCHITECTUREAND DESIGN

Defining the trusted computing base - System Security Assurance concepts - Confidentiality and Integrity models - Design Principles and Elements - Design Tools and Techniques - Disaster Recovery and Business Continuity - Business impact analysis - Disaster recovery plan - Business continuity plan.

Total:45 Hours

Reference(s)

1. Enterprise Security: A Data-Centric Approach to Securing the Enterprise, By Aaron Woody,2021
2. Enterprise Security Architecture: A Business-Driven Approach, Nicolas Sherwood, 2005
3. Enterprise Security Risk Management: Concepts and Applications, by BrianJ Allen (Author), Rachelle Loyear (Author), Kristen Noakes-Fry (Editor), 2010.
4. Next-GenerationEnterpriseSecurityandGovernance,byMohiuddinAhmed,Nour Moustafa, Abu Barkat, Paul Haskell-Dowland, 2022.

22CB038 DATA MINING AND ANALYTICS 3 0 0 3

Course Objectives

- Understand the data mining functionalities, technologies and steps in pre-processing the data.
- Analyze the data using data mining algorithms, methods and tools.

Programme Outcomes (POs)

PO1. Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO6. The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PO11. Life-long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.
PSO1. To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand various data mining technologies and applications
2. Analyze data pre-processing techniques with knowledge representation.
3. Apply suitable classification algorithms to perform prediction.
4. Apply regression analysis for prediction and approximation
5. Apply prescriptive analysis on time series data.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3		1		1	2					1		
2	1	2				3					2		
3		3			2						2	2	2
4			2	3	2						2	3	3
5			3	2	3						3	2	3

UNIT I **7 Hours**

INTRODUCTION TO DATA MINING

Data Mining - Related technologies - Machine Learning, DBMS, OLAP, Statistics, Stages of the Data Mining Process, Data Mining Techniques, Knowledge Representation Methods, Applications

UNIT II **9 Hours**

DATA PREPROCESSING AND DATA MINING KNOWLEDGE REPRESENTATION

Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies. Data mining knowledge representation - Task relevant data, Background knowledge, Representing input data and output knowledge, Visualization techniques. Attribute-oriented analysis - Attribute generalization, Attribute relevance, Class comparison, Statistical measures

UNIT III **9 Hours**

DATA MINING ALGORITHMS

Association rules - Motivation and terminology, Basic idea: item sets, Generating item sets and rules efficiently, Correlation analysis. Classification - Basic learning/mining tasks, Inferring rudimentary rules: 1R algorithm, Decision trees, covering rules. Prediction - The prediction task, Statistical (Bayesian) classification, Bayesian networks, Instance-based methods (nearest neighbor), linear models

UNIT IV **10 Hours**

REGRESSION ANALYSIS

Descriptive analysis, Data Modeling, Trend analysis, Simple Linear Regression Analysis. Forecasting model, heuristic methods, predictive modeling and pattern discovery, logistic regression, logit transform, ML estimation, Tests of hypotheses, Wald test, score test, test for overall regression, multiple logistic regression, forward backward method, interpretation of parameters, relation with categorical data analysis. Nonlinear regression (NLS), Linearization transforms, their uses and limitations. Introduction to nonparametric regression methods.

UNIT V **10 Hours**

TIME SERIES AND PERSPECTIVE ANALYSIS

Auto Covariance, Auto-correlation and their properties. Exploratory time series analysis, Test for trend and seasonality, Exponential and moving average smoothing, Holt Winter smoothing, forecasting based on smoothing. Linear time series models- autoregressive, Moving Average, Auto regressive Moving Average and Auto regressive Integrated Moving Average models. Prescriptive analytics, Mathematical optimization, Networks modelling, Multi objective optimization Stochastic modelling, Decision and Risk analysis, Decision trees.

Total: 45 Hours

Reference(s)

1. Jiawei Han and Micheline Kamber, Data Mining: Concepts and Techniques, Morgan Kaufmann Publishers, 3rd ed, 2010.
2. Lior Rokach and Oded Maimon, Data Mining and Knowledge Discovery Handbook, Springer, 2nd edition, 2010
3. Box, G.E.P and Jenkins G.M. Time Series Analysis, Forecasting and Control, Holden-Day,4th ed, 2015.
4. Draper, N. R. and Smith, H. (1998). Applied Regression Analysis (John Wiley) Third Edition
5. Hosmer, D. W. and Lemeshow, S. (2000). Applied Logistic Regression (Wiley).

22CB039	BUSINESS COMMUNICATION AND VALUE SCIENCE - IV	2 0 2 3

Course Objectives

- To understand the importance of Diversity in workplace
- To recognize the importance of Emotional Intelligence, Multiple Intelligences, and Learner Styles
- To develop communicative writing and apply public speaking in real-life scenarios
- To recognize the importance of Corporate Social Responsibility, Corporate Etiquette, Stress Management, Time Management and Conflict Management

Programme Outcomes (POs)

PO1. Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data 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.
PO9.Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PSO1. To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Use tools of structured written communication and hone public speaking skills
2. Apply emotional intelligence and knowledge of multiple intelligences, and learning styles in real-life scenarios
3. Understand the importance of diversity in workplace and corporate social responsibility
4. Identify and practice best time management, stress management practices
5. Recognize and cultivate the attributes needed to function and grow in a corporate environment

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3								2			1	
2		3		2					1			1	
3	2		3						2				
4		2		3					1			2	
5			1						1				

UNIT I **10 Hours**

WORKPLACE ENVIRONMENT AND BUSINESS WRITING

Importance of diversity in workplace, Diversity in corporate environments, Principles of Communicative Writing, Formal and Business letters, best practices for writing business proposals ,using charts and graphs in communicative writing, emotional intelligence, public speaking at workplace and real life scenarios, role plays

UNIT II **5 Hours**

CORPORATE SOCIAL RESPONSIBILITY

Importance of Corporate Social Responsibility (CSR), attributes needed to function and grow in a corporate environment

UNIT III **5 Hours**

FEEDBACK AND EMOTIONAL INTELLIGENCE

Image Management, best practices to share and receive feedback, Applying emotional intelligence in real life scenarios

UNIT IV **5 Hours**

MULTIPLE INTELLIGENCES AND CONFLICT MANAGEMENT

Multiple intelligence and learning styles in interpersonal interactions, impact of conflicts, guidelines to manage conflicts, key features of corporate etiquette, business idioms and corporate terms

UNIT V **5 Hours**

STRESS, TIME MANAGEMENT AND PROJECT WORK

Impact of stress in life and work, managing stress, best practices to manage stress, importance of time management, best time management practices

EXPERIMENT 1 **30 Hours**

Project work: proof of concept for a start-up

Total: 30+30 =60 Hours

Reference(s)

1. Daniel Goleman, Emotional Intelligence: Why it can Matter More than IQ.1996
2. Ryback David, Putting Emotional Intelligence to Work.2012
3. Dale Carnegie, How to Develop Self Confidence and Improve Public Speaking - Time - Tested Methods of Persuasion.
4. TED Talks, The official TED guide to public speaking-Tips and tricks for giving unforgettable speeches and presentations.2016

22CBH01 EXPLORATORY DATA ANALYSIS 2 0 2 3

Course Objectives

- To outline an overview of exploratory data analysis.
- To implement data cleaning and preparation techniques.
- To perform descriptive statistics and data visualization techniques to present insights from the data.
- To apply univariate, bivariate, multivariate, correlation, and time series data exploration and analysis techniques
- To use dimensionality reduction techniques for simplifying complex datasets and visualize high-dimensional data.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2.Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3.Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values

Course Outcomes (COs)

1. Understand the fundamentals of exploratory data analysis.
2. Implement the data cleaning and preparation techniques.
3. Apply advanced data visualization techniques to explore complex relationships and patterns in the data.
4. Analyze and interpret relationships between variables using EDA analysis techniques to gain insights into complex data patterns.
5. Apply dimensionality reduction techniques, such as Principal Component Analysis (PCA), to simplify complex datasets and extract essential features.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	3	3	3							1	
2	2	2	2	3	3							2	
3	2	3	3	2	3							2	
4	2	2	2	2	3							2	
5	2	2	3	2	1							2	

UNIT I
6 Hours
EXPLORATORY DATA ANALYSIS
Overview of Exploratory Data Analysis - importance of EDA - data analysis process: data collection, data cleaning, and data exploration - Introduction to common data types and formats - Introduction to Python - data analysis libraries.

UNIT II **6 Hours**
DATA CLEANING AND PREPARATION
Introduction to data quality issues and common data cleaning techniques - Handling missing data and outliers - Data transformation techniques - Feature engineering and variable creation.

UNIT III **6 Hours**
DESCRIPTIVE STATISTICS AND DATA VISUALIZATION
Descriptive statistics: measures of central tendency, dispersion, and shape - Data visualization principles and best practices - Exploratory data visualization using Matplotlib and Seaborn.

UNIT IV **6 Hours**
EXPLORATORY DATA ANALYSIS TECHNIQUES
Univariate analysis: exploring single variables - Bivariate analysis: exploring relationships between variables - Multivariate analysis: analyzing relationships among multiple variables - Exploring time series data.

UNIT V **6 Hours**
DIMENSIONALITY REDUCTION TECHNIQUES
Introduction to dimensionality reduction - Principal Component Analysis (PCA) and its applications - Distributed Stochastic Neighbour Embedding (t-SNE) for visualization.

EXPERIMENT 1 **6**
Hours
Apply the data preprocessing methods on the given student test performance dataset and visualize the results.

EXPERIMENT 2 **6 Hours**
Perform univariate analysis to analyze the distribution of each variable in students exam results dataset and visualize the results

EXPERIMENT 3 **6**
Hours
Visualize the relationship between the features on students' exam results analysis dataset using bivariate analysis

EXPERIMENT 4 **6**
Hours
Visualize the relationship between the features on students' exam results analysis dataset using multivariate analysis.

EXPERIMENT 5 **6 Hours**

Implement the program to reduce the dimensionality of the MNIST dataset and visualize the reduced data using a scatter plot.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Provost, Foster, and Tom Fawcett.Data Science for Business: What you need to know about data mining and data-analytic thinking Reilly Media, 2013. (Unit 1)
2. McKinney, Wes.Python for Data Analysis.Reilly Media,2022. (Unit 1, 3, 5)
3. Knaflic, Cole Nussbaumer. Storytelling with data A data visualization guide for business professionals.John Wiley Sons, 2015. (Unit 2)
4. Kazil, Jacqueline, and Katharine Jarmul.Data wrangling with python tips and tools to make your life easier. Reilly Media, Inc.2016. (Unit 3)
5. Wickham, Hadley, and Garrett Grolemund. R for data science import, tidy, transform, visualize, and model data.Reilly Media, Inc.2016. (Unit 4, 5)
6. Matthew O. Ward, Georges Grinstein, Daniel Keim, Interactive Data Visualization Foundations, Techniques, and Applications, 2nd Edition, CRC press, 2015.

22CBH02 RECOMMENDER SYSTEMS 3 0 0 3

Course Objectives

- To understand the foundations of the recommender system.
- To learn the significance of machine learning and data mining algorithms for Recommender systems
- To learn about collaborative filtering
- To make students design and implement a recommender system.
- To learn collaborative filtering.

Programme Outcomes (POs)

PO1.Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2. Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3. Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4.Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5.Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand the basic concepts of recommender systems.
2. Implement machine-learning and data-mining algorithms in recommender systems data sets.
3. Implementation of Collaborative Filtering in carrying out performance evaluation of recommender systems based on various metrics.
4. Implement a simple recommender system.
5. Learn about Evaluating Paradigms of recommender systems and its applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2	1	2	1								1
2	1	2	1	1	1								1
3	2	3	1	1	1								2
4	3	2	2	2	1								2
5	2	2	1	2	1								1

UNIT I **9 Hours**

INTRODUCTION

Introduction and basic taxonomy of recommender systems - Traditional and non-personalized Recommender Systems - Overview of data mining methods for recommender systems - similarity measures - Dimensionality reduction - Singular Value Decomposition (SVD).

UNIT II **9 Hours**

CONTENT-BASED RECOMMENDATION SYSTEMS

High-level architecture of content-based systems - Item profiles, Representing item profiles, Methods for learning user profiles, Similarity-based retrieval, and Classification algorithms.

UNIT III **9 Hours**

COLLABORATIVE FILTERING

A systematic approach, Nearest-neighbor collaborative filtering (CF), user-based and item-based CF, components of neighborhood methods (rating normalization, similarity weight computation, and neighborhood selection.

UNIT IV **9 Hours**

ATTACK-RESISTANT RECOMMENDER SYSTEMS

Introduction - Types of Attacks - Detecting attacks on recommender systems - Individual attack- Group attack - Strategies for robust recommender design - Robust recommendation algorithms.

UNIT V **9 Hours**

EVALUATING RECOMMENDER SYSTEMS

Evaluating Paradigms - User Studies - Online and Offline evaluation - Goals of evaluation design- Design Issues - Accuracy metrics - Limitations of Evaluation measures.

Total: 45 Hours

Reference(s)

1. Charu C. Aggarwal, Recommender Systems: The Textbook, Springer, 2016.
2. Dietmar Jannach, Markus Zanker, Alexander Felfernig and Gerhard Friedrich , Recommender Systems: An Introduction, Cambridge University Press (2011), 1st ed.
3. Francesco Ricci , Lior Rokach, Bracha Shapira, Recommender Systems Handbook, 1st ed, Springer (2011),
4. Jure Leskovec, Anand Rajaraman, Jeffrey David Ullman, Mining of massive datasets, 3rd edition, Cambridge University Press, 2020.

22CBH03 **BIG DATA ANALYTICS** **3 0 0 3**

Course Objectives

- Acquire a deep understanding of big data and NoSQL.
- Develop expertise in map reduce analytics using Hadoop and related tools
- Explore the Hadoop related tools for Big Data Analytics.

Programme Outcomes (POs)

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 analyse 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.
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.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Understand the big data and use cases from selected business domains.
2. Understand NoSQL big data management.
3. Utilize map reduce analytics and related tools.
4. Understand the basics of Hadoop.
5. Apply the usage of Hadoop related tools for Big Data Analytics.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	1		1							2	1
2	2	2	3		3							2	2
3	1	3	3		3							2	2
4	2	2	2		3							1	2
5	2	2	1		3							1	3

UNIT I **9 Hours**

UNDERSTANDING BIG DATA

Introduction to big data - Convergence of key trends - Unstructured data - Industry examples of big data Web analytics - Big data applications - Big data technologies - Introduction to Hadoop - Open source technologies - Cloud and big data - Mobile business intelligence - Crowd sourcing analytics- Inter and trans firewall analytics.

UNIT II **9 Hours**

NOSQL DATA MANAGEMENT
Introduction to NoSQL - Aggregate data models - Key-value and document data models - Relationships - Graph databases - Schema less databases - Materialized views - Distribution models - Master slave replication - Consistency - Cassandra - Cassandra data model - Cassandra examples - Cassandra clients

UNIT III **9 Hours**
MAP REDUCE APPLICATIONS
MapReduce workflows - Unit tests with MRUnit - Test data and local tests - Anatomy of MapReduce job run - Classic Map-reduce - YARN - Failures in classic Map-reduce and YARN - Job scheduling - Shuffle and sort - Task execution - MapReduce types - Input formats - Output formats.

UNIT IV **9 Hours**
BASICS OF HADOOP
Data format - Analyzing data with Hadoop - Scaling out - Hadoop streaming - Hadoop pipes - Design of Hadoop distributed file system (HDFS) - HDFS concepts - Java interface - Data flow - Hadoop I/O - Data integrity - Compression - Serialization - Avro - File-based data structures – Cassandra - Hadoop integration.

UNIT V **9 Hours**
HADOOP RELATED TOOLS
Hbase - Data model and implementations - Hbase clients - Hbase examples - Praxis. Pig – Grunt - Pig data model - Pig Latin - Developing and testing Pig Latin scripts. Hive - Data types and file formats - HiveQL data definition - HiveQL data manipulation - HiveQL queries.

Total: 45 Hours

Reference(s)

1. Michael Minelli, Michelle Chambers, and AmbigaDhiraj, Big Data, Big Analytics Emerging Business Intelligence and Analytic Trends for Todays Businesses", Wiley,2013.
2. Eric Sammer, Hadoop Operations,Reilley, 2012.
3. Sadalage, Pramod J. NoSQL distilled, 2013
4. E. Capriolo, D. Wampler, and J. Rutherglen, Programming Hive, Reilley, 2012.
5. Lars George, HBase: The Definitive Guide, Reilley, 2011.
6. Eben Hewitt,Cassandra The Definitive Guide,Reilley, 2010.

22CBH04 NEURAL NETWORKS AND DEEP LEARNING 2 0 2 3

Course Objectives

- To understand the major concepts in deep neural networks.
- To apply Convolutional Neural Network architectures for any real-life applications
- To analyze the key computations underlying deep learning to build and train deep neural networks for various tasks.

Programme Outcomes (POs)

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 analyse 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.
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.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Apply Convolution Neural Network for any suitable applications.
2. Analyze the various categories of associative memory and unsupervised learning networks.
3. Apply Convolutional Neural Networks and its variants for any suitable applications.
4. Analyze the key computations underlying deep learning and use them to build and train deep neural networks for various tasks.
5. Apply autoencoders and generative models for suitable applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		1								2	
2	2	2	3		3								2	
3	1	3	3		3								2	
4	2	2	2		3								2	
5	2	2	1		3								2	

UNIT I **6**
Hours
UNDERSTANDING NEURAL NETWORKS

Neural Networks - Application Scope of Neural Networks - Artificial Neural Network: An Introduction Evolution of Neural Networks - Basic Models of Artificial Neural Network - Important Terminologies of ANNs - Supervised Learning Network.

UNIT II **6 Hours**

ASSOCIATIVE MEMORY AND UNSUPERVISED LEARNING NETWORKS

Training Algorithms for Pattern Association - Autoassociative Memory Network – Heteroassociative Memory Network - Bidirectional Associative Memory (BAM) - Hopfield Networks - Kohonen Self - Organizing Feature Maps - Learning Vector Quantization - Counterpropagation Networks - Adaptive Resonance Theory Network.

UNIT III **6 Hours**

THIRD-GENERATION NEURAL NETWORKS

Spiking Neural Networks - Convolutional Neural Networks - Deep Learning Neural Networks – Extreme Learning Machine Model - Convolutional Neural Networks: The Convolution Operation – Motivation Pooling - Variants of the basic Convolution Function - Computer Vision

UNIT IV **6 Hours**

DEEP FEEDFORWARD NETWORKS

History of Deep Learning - A Probabilistic Theory of Deep Learning - Gradient Learning Chain Ruleand Backpropagation - Regularization Dataset - Augmentation Noise - Robustness Early Stopping - Bagging and Dropout batch normalization -Transposed convolution, object detection, semantic segmentation.

6 Hours

UNIT V

RECURRENT NEURAL NETWORKS

Recurrent Neural Networks - Introduction Recursive Neural Networks - Bidirectional RNNs - DeepRecurrent Networks Applications: Image Generation, Image Compression, Natural LanguageProcessing - Long-short term memory (LSTM) - Complete Auto encoder - Generative adversarial networks – Transfer Learning

EXPERIMENT 1

Implement simple vector addition in TensorFlow. **3 Hours**

EXPERIMENT 2

Implement a regression model in Keras. **3 Hours**

EXPERIMENT 3

Implement a perceptron in TensorFlow/Keras Environment. **3 Hours**

EXPERIMENT 4

Implement a Feed-Forward Network in TensorFlow/Keras. **3 Hours**

EXPERIMENT 5

Implement an Image Classifier using CNN in TensorFlow/Keras. **3 Hours**

EXPERIMENT 6

Improve the Deep learning model by fine tuning hyper parameters. **3 Hours**

EXPERIMENT 7
Implement a Transfer Learning concept in Image Classification. **3 Hours**

EXPERIMENT 8
Using a pre trained model on Keras for Transfer Learning **3 Hours**

EXPERIMENT 9
Perform Sentiment Analysis using RNN **3 Hours**

EXPERIMENT 10
Implement an LSTM based Autoencoder in TensorFlow/Keras. **3 Hours**

Total: 30 + 30 = 60 Hours

Reference(s)

1. S Rajasekaran, G A Vijayalakshmi Pai, Neural Networks, FuzzyLogic and Genetic Algorithm, Synthesis and pplications, PHI Learning, 2017
2. Charu C. Aggarwal, Neural Networks and Deep Learning A Textbook, Springer International Publishing, 1st Edition, 2018.
3. James A Freeman, David M S Kapura, Neural Networks Algorithms, Applications, and Programming Techniques, Addison Wesley, 2003.
4. Magnus Ekman, Addison-Wesley, Learning Deep Learning, 2021.
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, Deep Learning, MIT Press, 2016.
6. Francois Chollet,Deep Learning with Python, Second Edition, Manning Publications, 2021.
7. Deep Learning Projects Using TensorFlow 2, Vinita Silaparasetty, Apress, 2020.

22CBH05 NATURAL LANGUAGE PROCESSING 2 0 2 3

Course Objectives

- To understand the fundamental concepts for natural language processing and automatic speech recognition
- To understand technologies involved in developing speech and language applications.
- To demonstrate the use of deep learning for building applications in speech and natural language processing

Programme Outcomes (POs)

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 analyse 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.
PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Understand basic knowledge, theories and methods in natural language processing.
2. Implement basic and some advanced text processing and feature representation techniques
3. Implement, and evaluate advanced NLP applications, including sentiment classification, named entity recognition, text summarization, machine translation, and modern deep learning models.
4. Apply fundamental principles of speech production and perception and analyze speech signals.
5. Design automatic speech recognition systems and develop applications for speaker recognition.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1	1		3							2	
2	2	2	3		3							2	
3	1	3	3		3							2	
4	2	2	2		3							2	
5	2	2	1		3							2	

UNIT I 6 Hours

INTRODUCTION TO NATURAL LANGUAGE PROCESSING

Overview of NLP - Introduction to Levels of NLP - Morhpology: Derivational &Inflectional Morphology - POS tagging - Parsing: Shallow and Dependency Parsing, Semantics: Word Level Semantics and Thematic roles.

UNIT II 6 Hours

TEXT PROCESSING AND FEATURE REPRESENTATION

Introduction to Corpora - Sentence Segmentation - Stemming: Porter Stemmer, Bag of words and Vector Space Model, Topic Modeling, N-gram Language Model, Smoothing, Word Embeddings: Word2Vec, Glove and Fast text.

UNIT III 6 Hours

APPLICATIONS OF NLP

Sentiment Classification using ML & DL models, Named Entity Recognition - CRF and LSTMs, Text Summarization - Statistical and Deep Learning models - Machine Translation - Encoder & Decoder

Model, Attention Models, Question Answering - Knowledge based Q&A and Deep Learning models for Q&A.

UNIT IV **6 Hours**

SPEECH PROCESSING AND FEATURE REPRESENTATION OF SPEECH SIGNAL

Fundamentals of speech production – Perception of sound – Vocal tract model – Phonetics - Short-Time analysis of the signal – Energy – Zero crossing – Autocorrelation – Short time Fourier analysis - Mel Frequency Cepstral Coefficients, Perceptual linear prediction (PLP), Linear prediction cepstral coefficients (LPCC), Gammatone Frequency Cepstral Coefficients (GFCC), i-vector.

UNIT V **6 Hours**

AUTOMATIC SPEECH AND SPEAKER RECOGNITION

Automatic Speech recognition formulation: Isolated word recognition – Large vocabulary continuous speech recognition - HMM/GMM based speech recognition – DNN/HMM model - CNN based speech recognition - RNN language Models – Evaluation metrics, Speaker - Recognition model – Alexa/Google assistant-based application development.

EXPERIMENT 1

POS Tagging and Parsing using various python packages. **3 Hours**

EXPERIMENT 2

Implementing N-gram language models for next word prediction. **3 Hours**

EXPERIMENT 3

Implementing Word embedding based text classification. **3 Hours**

EXPERIMENT 4

Implementing CNN for sentiment analysis. **3 Hours**

EXPERIMENT 5 **3 Hours**

Implementing RNN for Named Entity recognition.

EXPERIMENT 6

Implementing text summarization using deep learning. **3 Hours**

EXPERIMENT 7

Implementing chatbot using deep learning. **3 Hours**

EXPERIMENT 8

Developing speech recognition system to recognize voice commands **3 Hours**

EXPERIMENT 9

Developing speech recognition system to recognize continuous speech **3 Hours**

EXPERIMENT 10

Implementing CNN based speech recognition using melspectal images **3 Hours**

Total: 30 + 30 = 60 Hours

REFERENCE(S)

1. Dan Jurafsky, James H. Martin "Speech and Language Processing", Draft of 3rd Edition, Prentice Hall 2022.

2. Jacob Benesty, M. M. Sondhi, Yiteng Huang "Springer Handbook of Speech Processing", Springer, 2008.
3. Uday Kamath, John Liu, James Whitaker "Deep Learning for NLP and Speech Recognition" Springer, ,2019.
4. Steven Bird, Ewan Klein, Edward Loper "Natural Language Processing with Python", O'Reilly Media. 2009.
5. Ben Gold, Nelson Morgan, Dan Ellis “Speech and Audio Signal Processing: Processing and Perception of Speech and Music”, John Wiley & Sons, 2011.

22CBH06	COMPUTER VISION	2 0 2 3

Course Objectives

- To understand the fundamental concepts related to Image formation and processing
- To learn feature detection, matching and detection
- To become familiar with feature based alignment, motion estimation and 3D reconstruction
- To understand image based rendering and recognition.
- To learn to detect and analysis objects from motion or scene.

Programme Outcomes (POs)

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 analyse 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.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader indiverse 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 the 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.

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Understand basic knowledge, theories and methods in image processing and computer vision.
2. Implement basic and some advanced image processing techniques in OpenCV.
3. Apply 2D feature-based based image alignment, segmentation, motion estimations and 3D image reconstruction techniques
4. Design and develop innovative image processing and computer vision applications.
5. Apply the concept in understanding the scene and process the background part of the image

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	1	1	1	1			2	1	3	2	2	
2	3	3	3	2	3		1	2	1	2	2	3	
3	3	3	2	2	3			1	1	2	2	3	
4	2	3	3	2	3			2	1	2	3	2	
5	2	3	3	2	2	2		2	1	2	3	3	

UNIT I **6 Hours**

INTRODUCTION TO IMAGE FORMATION AND PROCESSING

Computer Vision - Geometric primitives and transformations - Photometric image formation - The digital camera - Point operators - Linear filtering - More neighborhood operators - Fourier transforms – Pyramids and wavelets - Geometric transformations - Global optimization.

UNIT II **6 Hours**

FEATURE DETECTION, MATCHING AND SEGMENTATION

Points and patches - Edge detection - Edges Lines Segmentation - Region Based Segmentation - Graph Based segmentation - Active contours - Split and merge Mean shift and modefinding - Normalized cuts Graph cuts and energy - Based methods.

UNIT III **6 Hours**

FEATURE-BASED ALIGNMENT AND 3D RECONSTRUCTION

2D and 3D feature-based alignment Pose estimation Geometric intrinsic calibration – Triangulation Two frame structure from motion - Shape from X Active range finding - Surface representations - Point based representations – Volumetric representations - Model based reconstruction.

UNIT IV **6 Hours**

IMAGE-BASED RENDERING AND RECOGNITION

View interpolation Layered depth images Light fields – Video based Rendering - Object detection - Face recognition - Instance recognition - Category recognition Context and scene understanding.

UNIT V **7 Hours**

MOTION ANALYSIS AND SCENE ANALYSIS

Optical Flow – Detection and Correspondence of Interest Points - Detection of MotionPatterns – Video Tracking – Motion Models to aid tracking: Kalman Filters - Stereo mapping - Image fusion - Detection of known objects by linear filters - Detection of unknown objects - Corner detection - Image tagging.

EXPERIMENT 1 **3 Hours**

Perform histogram equalization on the image.

EXPERIMENT 2

Perform the edge detection process and extract edges fromthe input image **3 Hours**

EXPERIMENT 3 **5 Hours**

Perform segmentation, extract and display the segmentedregion.

EXPERIMENT 4 **3 Hours**

Program to detect an object from the input frame.

EXPERIMENT 5

Program to track the object between two frames from image/video. **5 Hours**

EXPERIMENT 6
Program to demonstrate to understand a scene and generate caption. **5 Hours**

EXPERIMENT 7
Program to classify defective object from the correct object. **5 Hours**

Total: 30 + 30 = 60 Hours

REFERENCE(S)

1. Richard Szeliski, Computer Vision Algorithms and Applications, Springer- Texts in Computer Science, Second Edition, 2022.
2. Computer Vision A Modern Approach, D. A. Forsyth, J. Ponce, Pearson Education, Second Edition, 2015.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. Christopher M. Bishop Pattern Recognition and Machine Learning, Springer, 2006.
5. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
6. Jurgen Beyerer, Fernando Puente Leon, Christian Frese," Machine Vision Automated Visual Inspection: Theory, Practice and Applications", 2016, Springer
7. AI Bovik, "The Essential Guide to Image Processing", 2009, Academic Press

22CB701 USABILITY DESIGN OF SOFTWARE APPLICATIONS 3 0 0 3

Course Objectives

- Acquire Knowledge of quantitative user design and evaluating product assignments
- Independently plan, perform and make a report about both an expert evaluation and an evaluation of assignment and research.
- Describe the relation between design review and evaluation of projects, especially the relation between usability and design

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.
PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand the user-cantered design process to evaluate the different Assignments
2. Apply heuristic evaluation techniques to evaluate the website and application
3. Generate ideas for developing and testing innovation through an assignment presentation
4. Understand the UX research techniques for analysing the application
5. Analyse the personal technique for different projects

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	3	2	2	2								2
2	3	2	2	1	1								3
3	2	3	3	3	3							2	3
4	2	1	2	3	2							1	2
5	2	2	1	2	1							2	2

UNIT I **9 Hours**

INTRODUCTION TO USER CENTRED DESIGN

Aspects of User Centred Design - Product Appreciation Assignment - Evaluating the product from user centred design aspects such as functionality - ease of use - ergonomics - aesthetics.

UNIT II **9 Hours**

HEURISTIC EVALUATION

Heuristic Evaluation-10 Heuristic Principles-Examples-Heuristic Evaluation-Group Assignment initiation -Website and App- Evaluation for key tasks of the app or website for heuristic principles- severity - recommendations.

UNIT III **9 Hours**

GROUP ASSIGNMENT PRESENTATIONS AND REVIEWS

Discovery -Define-Design-Implement-Design Prototype -Usability Testing.

UNIT IV **9 Hours**

UX RESEARCH

Understanding users -their goals -context of use-environment of use-Research Techniques-Contextual Enquiry-User Interviews -Competitive Analysis for UX.

UNIT V **9 Hours**

SCENARIOS AND PERSONA TECHNIQUE

Presentation of Personas for the group project-Design Thinking Technique -Discovery and brainstorming-Concept Development-Task flow detailing for the Project-Prototyping Techniques- Paper-Electronic -Prototyping Tools

Total: 45 Hours

Reference(s)

1. Jenny Preece, Helen Sharp and Yvonne Rogers,Interaction Design: Beyond Human-Computer Interaction, 4th Edition, , 2015
2. About Face,4th Edition, Alan Cooper and Robert Reimann,Wiley,2014
3. Elizabeth Goodman, Mike Kuniavsky, Andrea Moed,Observing the User Experience, Second Edition,A Practitioner's Guide to User Research,2012
4. Jesse James Garrett,The Elements of User Experience User-Centered Design for the Web and Beyond,2nd Edition,New Riders2021
5. Jonny Schneider,Understanding Design Thinking, Lean, and Agile, 2017

22CB702 SERVICES SCIENCE AND SERVICE OPERATIONAL MANAGEMENT 3 0 2 4

Course Objectives

- Understand how service performance can be improved by studying services operations management
- Analyse the Service facility design, facility location and Service Quality
- Analyse the role of inventory in services and managing the service supply relationship

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Understand the concept of service operation system
2. Analysis of service development and delivery system
3. Understand the service design and quality
4. Explore the forecasting demand of services
5. Analyse the strategies for managing service supply relationship

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1		1									1	
2	1	2	2									1	
3	1	2	1		2				1				1
4					1								
5								1	1				1

8 Hours

UNIT I

INTRODUCTION

Introduction-Introduction to the course-Introduction to service operations-Role of service in economy and society-Introduction to Indian service sector-Nature of Services and Service Encounters-Differences between services and operations-Service package-characteristics-various frameworks to design service operation system-Kind of service encounter-importance of encounters.

UNIT II **10 Hours**

SERVICE-DOMINANT LOGIC

From Goods-Dominant logic to Service-Dominant Logic-Value Co-creation-Service Strategy and Competitiveness-Development of Strategic Service Vision (SSV) -Data Envelopment Analysis-New Service Development-NSD cycle -Service Blueprinting-Elements of service delivery system.

UNIT III **9 Hours**

SERVICE DESIGN

Customer Journey and Service Design-Design Thinking methods to aid Service Design-Locating facilities and designing their layout-models of facility locations (Huff's retail model) -Role of service-scape in layout design-Service Quality-SERVQUAL-Walk through Audit-Dimensions of Service quality & other quality tools-Service Guarantee & Service Recovery-How to provide Service guarantee-How to recover from Service failure

UNIT IV **9 Hours**

FORECASTING DEMAND FOR SERVICES

A review of different types of forecasting methods for demand forecasting-Managing Capacity and Demand-Strategies for matching capacity and demand-Psychology of waiting-Application of various tools used in managing waiting line in services -Managing Facilitating Goods-Review of inventory models-Role of Inventory in services.

UNIT V **9 Hours**

MANAGING SERVICE SUPPLY RELATIONSHIP

Understanding the supply chain/hub of service-Strategies for managing suppliers of service-Vehicle Routing Problem-Managing after sales service-Understanding services that involve transportation of people and vehicle-Techniques for optimizing vehicle routes-Service Innovation-Services Productivity-Need for Services Innovation.

EXPERIMENT 1 **4 Hours**

Design a new super market in a cosmopolitan city (Identify important attributes, specify attribute levels, experimental design, presentation of alternatives to respondents and estimation of choice model)

EXPERIMENT 2 **4 Hours**

Choose any service organization and present it from the perspective of nature of service, classification of service, blueprint or service design analysis, and service quality

EXPERIMENT 3 **3 Hours**

Prepare a service blueprint for a fast-food outlet.

EXPERIMENT 4 **3 Hours**

Using data, software, user and mashup as services prepare a next gen service-oriented architecture.

EXPERIMENT 5 **4 Hours**

Prepare a review article after analysing 5 relevant papers in services and explain your understanding and feedback on the same.

EXPERIMENT 6 **4 Hours**

Analyse a fortune 500 company in digital media and point out how these technologies could be effectively used in a start up in digital space.

EXPERIMENT 7 **4 Hours**

Analyse the booking policy of an international flight operator, assuming that the average number of no shows is 10 percent, explain why the best overbooking necessary isn't be 10 percent always.

EXPERIMENT 8 **4 Hours**

Prepare a comparative chart analysing any four food delivery agencies and rank them based on reliability, responsiveness, assurance, and empathy.

Total: 45 + 30 = 60 Hours

Reference(s)

1. Fitzsimmons & Fitzsimmons, Service Management: Operations, Strategy, Information Technology, 7th edition, McGraw Hill publications, 2019.
2. Wilson, A., Zeithaml, V. A., Bitner, M. J., &Gremler, D. D. Services marketing: Integrating customer focus across the firm, Seventh Edition, McGraw Hill, 2017.
3. Lovelock, C. Services Marketing, 7/e. Pearson Education India, 2011.
4. Reason, Ben, and Lovlie, Lavrans, Service Design for Business: A Practical Guide to Optimizing the Customer Experience, Pan Macmillan India, 2016.
5. Chesbrough, H. Open services innovation: Rethinking your business to grow and compete in a new era. John Wiley & Sons, 2010.

22CB707 **PROJECT WORK I** **0 0 4 2**

Course Objectives

- To develop knowledge to formulate a real-world problem and project's goals
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Formulate a real-world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2	3	3	1	3	3	3	3	3		3	3
2	2	2	3	3	1	3	3	3	3	3		3	3
3	2	2	3	3	3	3	3	3	3	3	3	3	3
4	2	2	3	3	3	3	3	3	3	3	3	3	3
5	2	2			2	3		3	3	3		3	3

22CB801	**PROJECT WORK II**	**0 0 20 10**

Course Objectives

- To develop knowledge to formulate a real world problem and project's goals
- To identify the various tasks of the project to determine standard procedures.
- To identify and learn new tools, algorithms and techniques.
- To understand the various procedures for validation of the product and analysis the cost effectiveness.
- To understand the guideline to Prepare report for oral demonstrations.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one’s own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

PSO1. To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions.

Course Outcomes (COs)

1. Formulate a real-world problem, identify the requirement and develop the design solutions.
2. Express the technical ideas, strategies and methodologies.
3. Utilize the new tools, algorithms, techniques that contribute to obtain the solution of the project.
4. Test and validate through conformance of the developed prototype and analysis the cost effectiveness.
5. Prepare report and present the oral demonstrations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2	3	3	1	3	3	3	3	3		3	3
2	2	2	3	3	1	3	3	3	3	3		3	3
3	2	2	3	3	3	3	3	3	3	3	3	3	3
4	2	2	3	3	3	3	3	3	3	3	3	3	3
5	2	2			2	3		3	3	3		3	3

22OCE01 ENERGY CONSERVATION AND MANAGEMENT 3 0 0 3

Course Objectives

- To develop an understanding and analyze the energy data of industries
- To carryout energy accounting and balancing
- To conduct energy audit and suggest methodologies for energy savings and
- To utilize the available resources in optimal ways

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Classify and characterize the energy resources.
2. Illustrate the concept of green building.
3. Outline the sustainable construction practices.
4. Understand the hydropower production and conservation of water.
5. Emphasis the significance of energy and resource recovery from waste materials.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1										1		
2	1	2				2					1		1
3	1	2				2					1		1
4	1	2				2					1		1
5	1	2				2					1		1

UNIT I 9 Hours

INTRODUCTION TO ENERGY SCIENCE

Introduction to energy systems and resources; Introduction to Energy, sustainability & the environment. Energy - Past & Present scenario of World; Renewable and Nonrenewable energy resources.

UNIT II 9 Hours

ENERGY CONSERVATION IN BUILDINGS

Principles of Planning of buildings: orientation, energy efficiency, utility. Components of building-classification of buildings. Green building - LEED building assessment standard – LEED certification process - Building rating system - Building energy issues – Building energy design strategies – Energy Auditing.

UNIT III **9 Hours**

SUSTAINABLE CONSTRUCTION

Equipment use in excavations, foundation, concreting. Advanced Techniques in tunneling, under water construction, piling techniques, Innovations & efficiency in Highways, Railways & Harbours - linkages between economic and environmental outcomes

UNIT IV **9 Hours**

WATER CONSERVATION AND SUSTAINABILITY

Types of reservoirs and its functions – Hydropower production – Types of Turbines & selections of turbines & Energy calculations. Water losses from reservoirs and channels – Canal lining & its economic aspects. Water supply systems & Irrigation methods - Rain Water Harvesting methods & benefits.

UNIT V **9 Hours**

ENERGY RECOVERY FROM WASTE

Classification and sources of wastes- Factors affecting MSW generation – Waste management hierarchy - Energy recovery from wastes: Thermochemical methods for energy production - Details of incineration, gasification and pyrolysis & biochemical conversions - Landfill gas recovery system - Principles of fermentation - Concept of MFC - Trans-esterification process - Biofuel processing - Biomass gasification - Organic waste for hydrogen production.

Total: 45 Hours

Reference(s)

1. Boyle, Godfrey, Bob Everett, and Janet Ramage (Eds.) (2004), Energy Systems and Sustainability: Power for a Sustainable Future. Oxford University Press
2. Charles. J. Kibert, Sustainable Construction: Green Building Design and Delivery, John Wiley & Sons, Inc., New Jersey, 2008.
3. H. M. Raghunath, Irrigation Engieering, Wiley India (P) Ltd, 2011
4. E H Thorndike (1976), Energy & Environment: A Primer for Scientists and Engineers, Addison-Wesley Publishing Company
5. M. Datta, Waste Disposal in Engineered Landfills, Narosa Publishing House, ISBN-10: 8173191409,1997.
6. Lal, P.M. Sarma, Priyangshu M, Wealth from Waste: Trends and Technologies, 3rd Edition, The Energy and Resources Institute, New Delhi, ISBN: 9788179934241, 2011.
7. W. McDonough, M. Braungart, Cradle to Cradle: Remaking the Way We Make Things, United States: North Point Press, ISBN-10: 0865475873, 2002.

22OEC01 BASICS OF ANALOG AND DIGITAL ELECTRONICS 3 0 0 3

Course Objectives

- Understand the working of diodes and transistors in electronic circuits.
- Understand the analog operational amplifier and its applications.
- Understand the implementation of combinational and sequential circuits in digital systems.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Apply the diodes and transistors in regulators and amplifiers and analyze their characteristics.
2. Illustrate the working of analog IC with different configurations and its applications.
3. Simplification of Boolean expressions using K-map and implementation of combinational circuits.
4. Analyze the Flip flops and memory configurations in digital circuits.
5. Classify and analyze A/D and D/A converters with its parameters.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1									2	
2		3	1									2	
3			2		1							2	
4			2		3							2	
5			3		2							2	

UNIT I
SEMICONDUCTORS DEVICES

Conductor, Semiconductors & Insulators, Semiconductors: intrinsic & extrinsic, energy band diagram - Mobility - Electrons and holes - The P-N junction diode - Zener diode - Avalanche effect- Rectifier Circuits Half wave, Full wave circuits, Efficiency, PIV, Ripple factor and AC and DC current and voltage in rectifier. PNP and NPN Bipolar junction Transistors - H parameters equivalent circuit - Common emitter amplifier - DC behavior: the load slope and the Q point - AC behavior - Emitter follower amplifier - Field effect transistors: JFET and MOSFET.

UNIT II **9 Hours**

OPERATIONAL AMPLIFIERS: DC PERFORMANCE

The operational amplifier - Input resistance, Output resistance, Open loop gain - Bias currents - Offset currents - Offset voltage - Differential mode gain - Common mode gain - Common mode rejection ratio - Negative feedback - Open loop gain and closed loop gain - Inverter amplifier - Non-inverter amplifier - The voltage follower - Transimpedance amplifier (Current to voltage converter) - Differential amplifier. Adders, Subtractors, Comparator, Integrator and Differentiator.

UNIT III **9 Hours**

DIGITAL TECHNIQUES : COMBINATIONAL CIRCUITS

Numbering systems - Binary, octal and hexadecimal numbers - Boole algebra - Conversion and operations - AND gate- OR gate - Inverter - NAND gate - NOR gate - Exclusive OR gate. Morgans laws. Combinational Circuits: Truth tables, logic expressions, Logic simplification using K- map, , half and full adder/subtractor, multiplexers, demultiplexers, Logic families :TTL and CMOS.

UNIT IV **9 Hours**

DIGITAL TECHNIQUES: SEQUENCIAL CIRCUITS

Gated Latches & Flip Flops- Level triggered and Edge triggered Flip-Flops, Flop (FF) types: RS type. JK FF. JK FF Master slave. D FF. T FF. Flip Flop Conversion. Shift registers, Counters. Memories Structure: address and data bus. ROM, PROM, EPROM and flash RAM. Volatiles Memories: RAM, SRAM, DRAM. Addressing modes.

UNIT V **9 Hours**

DIGITAL TO ANALOG CONVERTERS AND ANALOG TO DIGITAL CONVERTERS

DIGITAL TO ANALOG CONVERTERS : Input latch. Binary Weighted Resistor Network. R-2R Ladder Resistor Network.Pulse Width Modulation . Resolution. Accuracy. Linearity. Zero Offset. Settling Time.Glitches. ANALOG TO DIGITAL CONVERTERS: Sampling. Real time sampling and equivalent time sampling. Sampling frequency. Sampling theorem (Nyquist). Anti-aliasing filtering. Sampling and holding. Conversion.

Total: 45 Hours

Reference(s)

1. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education,2012.
2. J Millman, C. Halkias & Satyabrata Jit, Electronic Devices and Circuits, Tata McGraw- Hill,2010.
3. Ramakant A.Gayakwad, OP-AMP and Linear IC"s , Prentice Hall of India, 2002.
4. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
5. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015.
6. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011.

22OEC02 MICROCONTROLLER PROGRAMMING 3 0 0 3

Course Objectives

- Understand Series of Microcontrollers in terms of architecture, Programming and Interfacing.
- Learn Programming of PIC series of microcontrollers and learn building of hardware circuits using PIC 16F series of Microcontrollers
- Learn the emerging trends in the design of advanced Microcontrollers.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Interpret the components and functionalities of 8051 Microcontrollers.
2. Develop microprocessor applications using the Assembly Language Program
3. Illustrate the working nature of PIC microcontroller on various versions
4. Illustrate the interfacing of different peripherals using PIC Microcontroller
5. Analyze the architecture and instruction set of ARM Microcontroller

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PSO1	PSO2
1	3	2	1									2
2	1	3	1									2
3	1	1	2		1							2
4	1	1	2		3							2
5	1	1	3		2							2

UNIT I 9 Hours

8-BIT MICROCONTROLLER

Introduction-Intel 8051 architecture-Counters and Timers-Serial Interface- Interrupts- Interfacing to external memory and 8255- Instruction set- Address modes.

UNIT II 9 Hours

8051 ALP AND APPLICATIONS

Assembly language program- Timers and Counters programming- DAC- ADC- Sensor- Keyboard and LCD.

UNIT III **9 Hours**

PIC MICROCONTROLLER

PIC Microcontroller features- PIC Architecture, Program Memory, Addressing Modes, Instruction Set, Instruction Format- Byte-oriented Instructions- Bit-oriented Instructions- Literal Instructions- Control Instructions (CALL & GOTO)- Destination Designator. MPLAB overview: Using MPLAB, Toolbars, Select Development Mode and Device type, Project, Text Editor, Assembler, MPLAB operations.

UNIT IV **9 Hours**

PIC HARDWARE

Reset, Clock, Control registers, Register banks, Program Memory Paging, Ports, Interrupts, Timer and Counter, Watchdog Timer, Power up timer, Sleep mode, I2C bus- A/D converter.

UNIT V **9 Hours**

HIGH PERFORMANCE RISC ARCHITECTURE

ARM: The ARM architecture- ARM organization and implementation- The ARM instruction set- The THUMB instruction set- Basic ARM Assembly Language Program- ARM CPU Cores.

Total: 45 Hours

Reference(s)

1. Ayala, Kenneth, "The 8051 Microcontroller", Thomson, 3rd Edition, 2004.
2. Muhammad Ali Mazidi, Janice Gillispie Mazidi, " The 8051 Microcontroller and Embedded Systems", Person Education, 2nd Edition, 2004.
3. John B.Peatman, "Design with Microcontrollers", Person Education", 1st Edition, 2004.
4. Steave Furber, "ARM system-on-chip architecture" Addison Wesley, 2nd Edition, 2000.
5. A.V.Deshmukh, "Microcontrollers: Theory and Applications", Tata Mc Graw Hill, 12th reprint, 2005.

22OEC03 PRINCIPLES OF COMMUNICATION SYSTEMS 3 0 0 3

Course Objectives

- To study the various analog and digital modulation techniques
- To study the various digital communication techniques
- To enumerate the idea of spread spectrum modulation
- To study the design concepts of satellite and optical communication

Programme Outcomes (POs)

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.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Illustrate the process involved in Amplitude, Frequency and phase modulation systems.
2. Analyze the performance of different digital modulation /demodulation techniques.
3. Analyze Pulse Code Modulation scheme for the transmission of analog data in digital format.
4. Apply the concepts of spread spectrum modulation techniques to eradicate interference in wireless communication.
5. Analyze the system design of satellite and optical communication.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2										1
2	3	2											1
3	3	2											1
4	2	2	2										1
5	3	2											1

UNIT I **9 Hours**

FUNDAMENTALS OF ANALOG COMMUNICATION

Principles of amplitude modulation, AM envelope, frequency spectrum and bandwidth, modulation index and percent modulation, AM Voltage distribution, AM power distribution, Angle modulation. FM andPM 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 **9 Hours**

DIGITAL COMMUNICATION

Introduction, Shannon limit for information capacity, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) Minimum Shift Keying (MSK),Phase Shift Keying (PSK), BPSK, QPSK, 8 PSK Quadrature Amplitude Modulation (QAM), Bandwidth Efficiency,Comparison of various Digital Communication System (ASK - FSK - PSK - QAM).

UNIT III **9 Hours**

DIGITAL TRANSMISSION

Introduction, Pulse modulation, PCM , PCM sampling, sampling rate, signal to quantization noise rate,companding, delta modulation, adaptive delta modulation, differential pulse code modulation, pulse transmission, Intersymbol interference, eye patterns.

UNIT IV **9 Hours**

SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES

Introduction, Pseudo-noise sequence, DS spread spectrum with coherent binary PSK, processing gain, FH spread spectrum, multiple access techniques, wireless communication, TDMA and CDMA in wireless communication systems, source coding of speech for wireless communications.

UNIT V **9 Hours**

SATELLITE AND OPTICAL COMMUNICATION

Satellite Communication Systems-Keplers Law,LEO and GEO Orbits, footprint, Link model-OpticalCommunication Systems-Elements of Optical Fiber Transmission link, Types, Losses, Sources and Detectors.

Total: 45 Hours

Reference(s)

1. Wayne Tomasi, Advanced Electronic Communication Systems, 6/e, Pearson Education, 2007.
2. Simon Haykin, Communication Systems, 4th Edition, John Wiley & Sons., 2001.
3. H.Taub,D L Schilling,G Saha ,Principles of Communication,3/e,2007.
4. B.P.Lathi,Modern Analog And Digital Communication systems, 3/e, Oxford University Press, 2007
5. Dennis Roddy, "Satellite Communications", Third Edition, Mc Graw Hill International Editions, 2001.
6. Gerd Keiser, Optical Fiber Communication, McGraw-Hill International, Singapore, 4th edition., 2011.

22OEC04 PRINCIPLES OF COMPUTER COMMUNICATION AND NETWORKS 3 0 0 3

Course Objectives

- To understand the concept of data communication and networking models.
- To study the various networking Components and Networks.
- To explore the routing, addressing and security and management aspects of computer networks.

Programme Outcomes (Pos)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Classify the types of computer networks and analyze the seven layers of OSI model.
2. Analyze the basic operations of Routing Algorithms and Routing devices
3. Analyze the local and wide area networking technologies.
4. Apply the ISDN and ATM interface connections in broadband networks.
5. Analyze the security and management techniques related with networks.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	2	1	1								2	
2	1	2	2	3								2	
3	1	1	2	3								2	
4	1	1	3									2	
5	1	2	3	3								2	

UNIT I 9 Hours

NETWORK FUNDAMENTALS

Types of Computer Networks: by Area, by Topology ; Communication Services: Serial and Parallel, Synchronous and Asynchrounous, Simplex and Duplex, Analog and Digital; Speed and Capacity; Multiplexing and Switching; Network Architecture: OSI Seven-Layer Network model.

UNIT II **9 Hours**

INTERNETWORKING AND COMPONENTS

Routing Concepts: Routing Algorithms, RIP, RIP-2, OSPF and other routing Protocols; Switches and Hubs: Store and Forward Switch, Cut-Through Switch, Hybrid Switch, Performance of Switches ; Repeaters; Repeater Vs Hubs; Bridges: Standards, Bridges Vs Repeaters; Routers and Gateways.

UNIT III **9 Hours**

LOCAL AND WIDE AREA NETWORKING TECHNOLOGIES

LAN Components and Topologies; Access Techniques; Transmission Protocols and Media; Ethernet and IEEE 802.3 Networks: History, 10-MBPS Ethernet, Switched Ethernet, 100-MBPS Ethernet, Gigabit Ethernet.

UNIT IV **9 Hours**

BROADBAND NETWORKS

ISDN: Evolution, ISDN Channel and Interface Structures; Broadband ISDN: Basics, Principles and General Architecture; Asynchronous Transfer Mode(ATM): Introduction, Concepts, Components, Connection Supported by ATM network and Concept of Virtual Channel and Virtual Path, Traffic control and Congestion Control, Operation and Maintenance aspects.

UNIT V **9 Hours**

NETWORK SECURITY AND MANAGEMENT

Security: Need of Security, Security Threats, Vulnerabilities, Methods, tools and Techniques for Attacks; Network Security: Levels of Security, Cryptosystems; Data Encryption Standard (DES), Public Key Cryptography, Firewalls; Network Management: Functions and Elements, Distribution of Management; Simple Network Management Protocol (SNMP), Remote Network Management Services.

Total: 45 Hours

Reference(s)

1. Michael A.Gallo, William M. Hancock, Computer Communications and Networking Technologies, 1 Ed, Thomson Learning, 2002.
2. Kenneth C. Mansfield, Jr.James L. Antonakos, An Introduction to Computer Networking, 1Ed, Prentice Hall of India, 2002
3. A Shanmugam, S Rajeev, Computer Communication Networks, 1Ed, ISTE Learning Materials Centre, 2001
4. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schafer, 3rd edition, 2010, Prentice Hall
5. Digital Signal Processing by SanjitMitra, 4th edition, 2011, McGraw-Hill, New York, NY.

22OEI01 PROGRAMMABLE LOGIC CONTROLLER 3 0 0 3

Course Objectives

- To impart knowledge about automation and architecture of PLC
- To understand the PLC programming using timers, counters and advanced PLC functions
- To familiarize the student with PLC based applications

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Outline the fundamental Concepts of Automation
2. Conclude the architecture, interfacing and communication techniques of PLC
3. Execute the suitable PLC Programming languages
4. Attribute the various functions and instruction sets of PLC
5. Generate a suitable logical programming for given applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1		2	2	3							1	1
2	2	1		2	2	3								1
3	2	1		2	2	3							2	1
4	2	1		2	2	3							2	1
5	2	1		2	2	3							2	1

UNIT I 10 Hours

INTRODUCTION TO AUTOMATION

Evolution of automation -Types of automation - Fixed, flexible and programmable automation - Batch process and continuous process - open loop system and closed loop system - Function of sensors - Proximity sensors: Capacitive and Inductive - Infrared and Laser Push-buttons and toggle switches - Actuators: Solenoid valve - servo motor - electromagnetic relays.

UNIT II **9 Hours**

ARCHITECTURE OF PLC

Components of PLC - sink and source I/O cards - Processor - Memory: Types of memory, Input and Output modules: Discrete, Analog -Scan time of PLC -Interfacing computer and PLC: RS232, RS485, Ethernet - Selection criteria for PLC.

UNIT III **8 Hours**

PLC PROGRAMMING

Programming languages - Ladder logic components: User and bit Instructions, branch instructions, internal relay instruction Boolean logic using ladder logic programming, Latching -Timers: On Delay timer, OFF Delay timer and Retentive timer - Counters: Up Counter and Down Counter.

UNIT IV **10 Hours**

ADVANCED PLC FUNCTIONS

Instructions in PLC: Program Control Instructions, Math Instructions, Data Manipulation Instructions: Data compare operations, Data transfer operations - Sequencer and Shift register instructions- Analog Instructions: PID Controller - Scaling Instructions.

UNIT V **8 Hours**

APPLICATIONS OF PLC

Case Studies: Bottle filling system - Pick and place robot - Car Parking - Traffic light control (4 ways with pedestrian signal) -Elevators - Pneumatic stamping system - alarm annunciator system.

Total: 45 Hours

Reference(s)

1. F.D. Petruzella, Programmable Logic Controllers, Tata Mc-Graw Hill, Third edition, 2015.
2. Benjamin C Kuo, Automatic Control Systems, Prentice Hall of India, New Delhi, 2014.
3. John Park, Steve Mackay, Edwin Wright, Practical data communications for instrumentation and control, Newnes, Elsevier, 2015.
4. K. L.S. Sharma, Overview of Industrial Process Automation, Elsevier, 2014.
5. John W Webb and Ronald A Resis, Programmable Logic Controller, Prentice Hall of India Pvt. Ltd., New Delhi, 2013.

22OEI02 **SENSOR TECHNOLOGY** **3 0 0 3**

Course Objectives

- To impart knowledge about various sensors in multidisciplinary engineering domain
- To familiarize students with different applications and its material handling technology
- To understand the concept of sensing circuits and its static and dynamic characteristics

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Conclude the static and dynamic characteristics of measuring instruments
2. Compare the characteristics and working principles of Resistance, Inductance and Capacitance type sensors
3. Construct the interfacing and signal conditioning circuit for measurement system using different types of sensor
4. Analyze and select the suitable sensor for different industrial applications
5. Combine the modern technologies and smart materials to design various sensors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1										1
2	2	3	2	1	1								1
3	1	2	3	3	1								1
4	2	1	1	3	3								1
5	1	2	1	2	3								1

UNIT I **8 Hours**
SENSORS FUNDAMENTALS AND CHARACTERISTICS
Sensors: Principles of Sensing - Sensor Classification and terminology- Units of Measurements - Measurands-Sensor Characteristics: Static and Dynamic.

8 Hours

UNIT II

PHYSICAL PRINCIPLES OF SENSING

Electric Charges, Fields, and Potentials; Capacitance; Magnetism; Induction; Resistance; Piezoelectric Effect; Hall Effect; Temperature and Thermal Properties of Material; Heat Transfer; Light; Dynamic Models of Sensor Elements.

UNIT III **9 Hours**

INTERFACE ELECTRONIC CIRCUITS

Input Characteristics of Interface Circuits, Amplifiers, Excitation Circuits, Analog to Digital Converters, Direct Digitization and Processing, Bridge Circuits, Data Transmission, Batteries for Low Power Sensors.

UNIT IV **10 Hours**

SENSORS IN DIFFERENT APPLICATION AREA

Occupancy and Motion Detectors; Position, Displacement, and Level; Velocity and Acceleration; Force, Strain, and Tactile Sensors; Pressure Sensors, Temperature Sensors.

UNIT V **10 Hours**

SENSOR MATERIALS AND TECHNOLOGIES

Materials, Surface Processing- MEMS microsystem components- Microfluidics microsystem components - Nano Technology- Smart Materials.

Total: 45 Hours

Reference(s)

1. J. Fraden, Handbook of Modern Sensors: Physical, Designs, and Applications, AIP Press, Springer, 2016.
2. D. Patranabis, Sensors and Transducers, 2nd Edition, Prentice Hall India Pvt. Ltd, New Delhi, 2009.
3. Guozhen Shen, Zhiyong Fan, “Flexible Electronics: From Materials to Devices”, 1st Edition, World Scientific Publishing Co, Singapore, 2015.
4. Horowitz, P., and W. Hill. The Art of Electronics. 2nd ed. Cambridge University Press, 1989.

22OEI03 FUNDAMENTALS OF VIRTUAL INSTRUMENTATION 3 0 0 3

Course Objectives

- Understand the basic components of Virtual Instrumentation system.
- Learn the developing VIs based on Lab VIEW software.
- To learn to develop applications based on Virtual Instrumentation system.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.
PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

Course Outcomes (COs)

1. Outline the concepts of traditional instruments and virtual instruments
2. Conclude the overview of modular programming and the structuring concepts in VI programming
3. Attribute the procedure to install DAQ in various OS and its interfacing methods
4. Implement the VI toolsets for specific applications
5. Generate the applications using Virtual Instrumentation software

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	3	1	1									
2	3	3	2	2	2				2	2	2		
3	2	2	2	1									
4	3	3	3	1	2				1	2	2		
5	3	2	2	1	2				1	2	2		

UNIT I **9 Hours**

INTRODUCTION

Virtual Instrumentation: Historical perspective - advantages - block diagram and architecture of a virtual instrument - Conventional Instruments versus Traditional Instruments - data-flow techniques, graphical programming in data flow, comparison with conventional programming.

UNIT II **9 Hours**

VI PROGRAMMING TECHNIQUES

VIs and sub-VIs, loops and charts, arrays, clusters and graphs, case and sequence structures, formula nodes, local and global variables, State machine, string and file I/O, Instrument Drivers, Publishing measurement data in the web.

UNIT III **9 Hours**

DATA ACQUISITION

Introduction to data acquisition on PC, Sampling fundamentals, Input/output techniques and buses. Latest ADCs, DACs, Digital I/O, counters and timers, DMA, Software and hardware installation, Calibration, Resolution, Data acquisition interface requirements - Issues involved in selection of Data acquisition cards - Data acquisition cards with serial communication - VI Chassis requirements. SCSI, PCI, PXI system controllers, Ethernet control of PXI. Networking basics for office & Industrial applications, VISA and IVI.

UNIT IV **9 Hours**

VI TOOLSETS

Use of Analysis tools, Fourier transforms, power spectrum, correlation methods, windowing and filtering. Application of VI in process control designing of equipments like oscilloscope, Digital multimeter, Design of digital Voltmeters with transducer input Virtual Laboratory, Web based Laboratory.

UNIT V **9 Hours**

APPLICATIONS

Distributed I/O modules- Application of Virtual Instrumentation: Instrument Control, Development of process database management system, Simulation of systems using VI, Development of Control system, Industrial Communication, Image acquisition and processing, Motion control. Development of Virtual Instrument using GUI, Real-time systems, Embedded Controller, OPC, HMI / SCADA software, Active X programming.

Total: 45 Hours

Reference(s)

1. Lisa K. wells & Jeffrey Travis, LabVIEW for everyone, Prentice Hall, New Jersey,1997.
2. Gary Johnson, LabVIEW Graphical Programming, Second edition, McGraw Hill, Newyork, 1997.
3. Kevin James, PC Interfacing and Data Acquisition: Techniques for Measurement, Instrumentation and Control, Newness, 2000.

22OEI04 OPTOELECTRONICS AND LASER INSTRUMENTATION 3 0 0 3

Course Objectives

- To enhance the student knowledge in fiber optics fundamentals and fabrication
- To be recognized with industrial applications of fibers
- To understand the fundamental concepts about lasers
- To identify and describe various fiber optic imaging and optoelectronic sensor applications

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

Course Outcomes (COs)

1. Attribute the properties of optical fibers, their light sources and detectors.
2. Implement the fiber-optic sensor for the measurement of various physical quantities.
3. Conclude the fundamentals of laser, types of laser and its working.
4. Outline the applications of laser for industrial applications.
5. Differentiate the use of laser instruments for various medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	1										
2	3	2	1	2									
3	3	2	1										
4	3	2	2	2									
5	3	2	2	2									

UNIT I 9 Hours

OPTICAL FIBERS AND THEIR PROPERTIES

Introduction to optical fibers - Light guidance - Numerical aperture - Dispersion - Different types of fibers and their properties - Light Sources for fiber optics, Photo detectors, source coupling, splicing and connectors.

UNIT II 9 Hours

INDUSTRIAL APPLICATION OF OPTICAL FIBERS

Fiber optics instrumentation system - optical fiber sensors, Measurement of pressure, temperature, current, voltage and liquid level - fiber optic communication set up - different types of modulators - detectors.

UNIT III **9 Hours**

LASER FUNDAMENTALS

Fundamental characteristics of lasers: laser rate equation - three level system - four level system - properties of laser beams - laser modes - resonator configuration - Q- switching and mode locking - cavity dumping - types of lasers: gas lasers, solid state lasers, liquid lasers and semiconductor lasers.

UNIT IV **9 Hours**

INDUSTRIAL APPLICATION OF LASERS

Lasers for measurement of distance and length, velocity, acceleration, atmospheric effects, sonic boom, pollutants - material processing: laser heating, melting, welding and trimming of materials - removal and vaporization - calculation of power requirements of laser for material processing.

UNIT V **9 Hours**

HOLOGRAM AND MEDICAL APPLICATIONS

Holography: basic principle, methods - holographic interferometry and application, holography for non-destructive - medical applications of lasers, laser and tissue interactive - laser instruments for surgery, removal of tumors of vocal cards, brain surgery, plastic surgery, gynaecology and oncology.

Total: 45 Hours

Reference(s)

1. John M. Senior, Optical Fiber Communications - Principles and Practice, Prentice Hall of India, 2010.
2. John F. Ready, Industrial Applications of Lasers, Academic Press, 2012.
3. Gerd Keiser, Optical Fiber Communication, Mc Graw Hill, New York, 2013.
4. S.C. Gupta, Textbook on Fiber Optics Communications and its application, Prentice Hall of India, 2012.
5. John Wilson and J.F.B. Hawkes, Introduction to Opto Electronics, Prentice Hall of India, 2011.
6. R. P. Khare, Fiber Optics and Optoelectronics, Oxford University Press, 2011.

22OME01 DIGITAL MANUFACTURING 3 0 0 3

Course Objectives

- To understand the process of generating 3D Computer Aided Design (CAD) model by different method.
- To explain the constructional features and develop simple program for CNC lathe and Milling machines.
- To provide an exhaustive knowledge on various generic process and benefits of Additive Manufacturing.
- To familiarize about materials and process parameters of liquid and solid based AM techniques.
- To educate powder based methodology and emerging trends with case studies, applications of AM techniques.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Design a 3D model from the 2D data.
2. Develop a CNC program for simple components.
3. Generate stl file and manipulate parameters of AM machine
4. Select appropriate liquid or solid materials based AM process to the respective application
5. Select appropriate process to fabricate a functional/prototype for aerospace, automotive, electronics, manufacturing and medical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2	2		2							1	1
2	2	2	2		2							1	1
3	2	2	2		2							1	1
4	2	2	2		2								
5	2	2	2		2							1	1

UNIT I **10 Hours**

CAD MODELING

Introduction - Design process - Stages. CAD - Input and Output devices, Modeling methods - Wire frame modelling, Surface modelling, Solid modelling - Constructive Solid Geometry and Boundary Representation Techniques. CAD/CAM data exchange - IGES, STEP. Product Life cycle management (PLM).

UNIT II **10 Hours**

AUTOMATION AND CNC MACHINES

Introduction to Automation - Definition, types, reasons for automating. CNC Machines - Principles, types, features, advantages, applications. CNC Machine structure - Linear motion bearings, Recirculating ball bearings, drive system, and control system. CNC Lathe and Milling programming - Linear and circular interpolation, threading and drilling programs.

UNIT III **7 Hours**

ADDITIVE MANUFACTURING

Introduction - Impact of Additive Manufacturing (AM) and Tooling on Product Development - Distinction between AM and CNC Machining - The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - AM Benefits - Classification of AM process

UNIT IV **8 Hours**

LIQUID AND SOLID MATERIAL BASED SYSTEMS

Stereo lithography Apparatus (SLA), Digital Light Processing (DLP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Process, Materials and Applications

UNIT V **11 Hours**

POWDER BASED PROCESSES AND APPLICATIONS OF ADDITIVE MANUFACTURING

Selective Laser Sintering (SLS), Color Jet Printing (CJP), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - Working Principle, Construction, Process Variables, Materials and Applications. Reverse Engineering using 3D scanner. Application of Additive Manufacturing in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries.

Total: 45 Hours

Reference(s)

1. Ibrahim Zeid, R.Sivasubramania, CAD/CAM Theory and Practice, Tata McGraw Hill, 2010.
2. M. Aditan, B.S. Pabala, CNC Machines, New age International, 2012.
3. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
4. D. T.Pham, S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
5. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015, http://www.springer.com/978-1-4939-2112-6

22OME02 INDUSTRIAL PROCESS ENGINEERING **3 0 0 3**

Course Objectives

- To impart the knowledge on production planning methodologies and layout design
- To learn about production planning and its control methods
- To provide the knowledge of work study, process charts and ergonomic condition
- To impart the knowledge on inventory control and material handling
- To learn about system analysis and different types of maintenance processes

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
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.

Course Outcomes (COs)

1. Select proper plant layout for the required production system
2. Plan the resources required for the production and to perform the control methods
3. Apply work study method, prepare charts to outline the process and develop ergonomic condition suitable for the processes.
4. Analyze the inventory required based on production needs and material handling
5. Perform system analysis and use different types of maintenance process for smooth operations.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	3	1		1								
2	3	3	1		2						2		
3	1	3	3		2								
4	2	3	1		2								
5	2	3	1		2								

UNIT I **10 Hours**

INDUSTRIAL ENGINEERING AND PRODUCTION SYSTEM

Industrial engineering - Concept, History and development, Applications, Roles of Industrial engineer-Production management, Industrial engineering versus production management, operations management. Plant layout, Criteria for good layout, Types of layout - Process layout, Product layout, Combination layout and fixed position layout, Flow (material movement) pattern, Workstation Selection and design.

UNIT II **10 Hours**

PROCESS PLANNING AND PRODUCTION CONTROL

Introduction to Process planning-Definition, Procedure, Process selection, Machine capacity, Process sheet.Process analysis - Group technology, classification and coding system, formation of component family - Production planning, loading, scheduling. Production control -dispatching, routing - Progress control bar, curve, Gantt chart, route and schedule chart.

UNIT III **8 Hours**

WORK STUDY AND ERGONOMICS

Work study - Definition, Need, Advantages, objectives of method study and work measurement, method study procedure, Process chart - symbols, outline process chart, flow process chart, principles of motion economy, ergonomics- applications of ergonomic principles in the shop floor- work benches-seating arrangement, Industrial physiology.

UNIT IV **10 Hours**

INVENTORY MANAGEMENT

Inventory control, classification, management, objectives, functions. Economic order quantity, Economic batch quantity, inventory models,ABC analysis, Material Requirement Planning(MRPI), Manufacturing Resource Planning (MRPII), Operating cycle, lean manufacturing, Supply chain management - Material handling.

UNIT V **8 Hours**

SYSTEM ANALYSIS AND MAINTENANCE

System concept - system analysis, systems engineering, value engineering, value control, types of values. Plant maintenance - objectives, importance. Maintenance engineer - duties, functions and responsibilities. Types - breakdown, scheduled, preventive and predictive - Plant maintenance schedule, Condition monitoring.

Total: 45 Hours

Reference(s)

1. Khanna O.P., Industrial Engineering and management, Dhanpat Rai Publications.,2010
2. Martand T.Telsang, Industrial Engineering and Production Management, S Chand Publishers,2006
3. Panneerselvam R., Production and operations management, Heritage Publishers, 2006
4. Ravi Shankar, Industrial Engineering and Management, Golgotia Publications Pvt. Ltd., New Delhi, 2009

22OME03 MAINTENANCE ENGINEERING 3 0 0 3

Course Objectives

- To understand the principles, objectives and importance of maintenance adopted in industry for successful progress.
- To introduce different maintenance categories, its merits and types of lubrication.
- To expose the idea of condition monitoring, methods and instruments used for allied measurements.
- To learn about failure analysis and repair methods for few mechanical elements.
- To promote computerization in maintenance and inventory management.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment..
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Explain the principles, objectives and importance of maintenance adopted in industry.
2. Select the suitable maintenance category and lubrication type.
3. Apply the appropriate methods and instruments for condition monitoring.
4. Analyze the failures of mechanical systems and select suitable repair methods.
5. Utilize computers in maintenance and inventory management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2											2
2	2	2											2
3					2	2							2
4	1	2	1		2	2							2
5	2	2	2		1	1							2

UNIT I **9 Hours**

PRINCIPLES OF MAINTENANCE PLANNING

Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.

UNIT II **9 Hours**

MAINTENANCE CATEGORIES AND LUBRICATION

Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.

UNIT III **9 Hours**

CONDITION MONITORING

Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.

UNIT IV **9 Hours**

FAILURE ANALYSIS AND REPAIR METHODS

Failure analysis - Failures and their development - Role of Non Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.

UNIT V **9 Hours**

COMPUTER AIDED MAINTENANCE MANAGEMENT

Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.

Total: 45 Hours

Reference(s)

1. Srivastava S.K, Maintenance Engineering, S Chand and Company, 2010.
2. Mishra R.C, Pathak K, Maintenance Engineering and Management, Second edition, Prentice Hall India Learning Pvt. Ltd., 2012.
3. Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, Maintenance Engineering Handbook, Seventh edition, McGraw-Hill Professional, 2008.
4. Davies A, Handbook of Condition Monitoring: Techniques and Methodology, Springer, 2012.
5. Otegui Jose Luis, Failure Analysis, Fundamentals and Applications in Mechanical Components, Nineteenth edition, Springer, 2014.

22OME04 SAFETY ENGINEERING 3 0 0 3

Course Objectives

- To study the principles of safety management system.
- To introduce the provisions contained in the industrial laws.
- To provide knowledge on safety requirements for engineering industry.
- To learn safety requirement for chemical industry.
- To study the various safety measures adopted in construction industries.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

Course Outcomes (COs)

1. Explain safety management system of an industry.
2. Implement the provisions of acts and rules in industries.
3. Implement and review the safety performance followed in various industries
4. Evaluate safety appraisal in chemical industries.
5. Generate safety reports on construction industries.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1					2	1		1					
2					1			3					
3	2										3		
4	2	3							2				
5					2								

UNIT I **8 Hours**

SAFETY MANAGEMENT

Concepts - Evolution, International Labour Organization (ILO), National Safety Council, Techniques - Job Safety Analysis (JSA), Safety survey, Safety inspection, Safety Sampling, Accident Reporting and Investigation - Concept of an accident, Accident causation models, cost of accident, investigation, Safety Performance Monitoring - Safety indices.

UNIT II **10 Hours**

SAFETY AND LAW

Factory Act 1948-Safety and Health chapters, Tamil Nadu Factories Rules- Safety and Health chapters, Environment and Pollution Laws, ,Building and other construction works act 1996, Electricity Rules.

UNIT III **10 Hours**

SAFETY IN ENGINEERING INDUSTRIES

Safety in machine shop,- Principles of machine guarding - Personal protective equipment- Safety in handling industrial gases - Safety in cold forming and hot working of metals- Safety in finishing, inspection and testing, heat treatment, electro plating, leak test, radiography.

UNIT IV **9 Hours**

SAFETY IN CHEMICAL INDUSTRIES

Safety in process design, unit operations, pressure vessel, heat exchanger, safety valves -Plant commissioning and inspection, pressure vessel, Plant maintenance and emergency planning, management of maintenance HAZOP study.

UNIT V **8 Hours**

SAFETY IN CONSTRUCTION INDUSTRY

Construction regulations, contractual clauses, permit to work, - Education and training-Hazards of construction and prevention- excavation, scaffolding, dismantling, road works, construction of high rise buildings - Working at heights,-Working on fragile roofs, work permit systems-Construction machinery, cranes, chain pulley blocks, earth moving equipment, conveyors- Manual handling, Safety in demolition work, - Safety in confined spaces

Total: 45 Hours

Reference(s)

1. Blake R.B., Industrial Safety, Prentice Hall, Incorporated, New Jersey,1973.
2. National Safety Council, Accident Prevention Manual for Industrial Operations, Chicago, 1988
3. Subramanian V., The Factories Act, 1948, with Tamil Nadu Factories Rules , 1950, Madras
4. Environmental Pollution Control Act, 1986
5. BOCW Act,1996, Madras Book agency, Chennai-1
6. Explosive Act, 1884, Eastern Book Company, Lucknow -266 001.

22OBT01 BIOFUELS 3 0 0 3

Course Objectives

- To understand and explore the scope of biofuels the most efficient renewable source of energy.
- To develop the expertise in the technology pertaining to their generation and employment in order to surrogate the existing conventional fuels and hence strives towards sustainabledevelopment
- To give way to the bolster green technology and incline towards more ecofriendly options.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

Course Outcomes (COs)

1. Apply the bio-resources that can be used for the production of biofuels.
2. Analyze the physical and chemical properties of the biodiesel.
3. Analyze the mechanisms of improvising the quality and performance of engines using biofuels
4. Analyze the bio-fuel conversion technologies and their environmental attributes
5. Evaluate the designing aspects of major unit processes/operations of an integrated bio-refinery

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	1	2										
2	2	1		3									
3	1	2		2									
4	2	3				2							
5	1	2				2							

UNIT I **9 Hours**

CLASSIFICATION AND RESOURCES

Introduction, biofuel as a renewable energy, classification of biofuels - First, second, third and fourth generation biofuels, different plant sources as biofuel feed stocks, Biogases, physical and chemical characteristics of vegetable oils - iodine number, hydroxyl, acid values, rancidity, hydrogenolysis and hydrolysis, Food vs energy.

UNIT II **9 Hours**

BIODIESEL

Definition, basics and chemistry of biodiesel, vegetable oils in biodiesel production, Trans esterification: Chemical methods, enzymatic methods and types of catalysts, separation and purification, physical properties and characterization of biodiesel - Cloud point, pour point, cold filter plugging point, flash point, viscosity and cetane number.

UNIT III **9 Hours**

QUALITY BIODIESEL AND ENVIRONMENT

Producing Quality Biodiesel, quality control, test methods, ASTM specifications. Oxidative andthermal stability, estimation of mono, di, triglycerides and free glycerol, engine performance test, blending of ethanol with biodiesel, blending of biodiesel with high speed diesel (HSD) and their combustion properties.

UNIT IV **9 Hours**

BIOETHANOL AND BIOGASES

Ethanol as a fuel, microbial and enzymatic production of ethanol from biomass - lignocellulose, sugarcane, sugar beet, corn, wheat starch, purification - wet and dry milling processes, saccharification-chemical and enzymatic. Production of bio methane and bio hydrogen.

UNIT V **9 Hours**

BIOREFINERIES

Definition and types of biorefineries, co-products of biorefineries-oil cake and glycerol, purificationof glycerol obtained in biodiesel plant; anaerobic and thermal gasification of biomass, economics of biorefineries.

Total: 45 Hours

Reference(s)

1. Caye Drapcho, John Nghiem and Terry Walker, Biofuels Engineering process technology,McGraw Hill Professional, 2008.
2. Mousdale, Biofuels, CRC Press, 2008
3. Ahindra Nag, Biofuels Refining and Performance, McGraw-Hill Professional, 2007.
4. Lisbeth Olsson, Biofuels (Advances in Biochemical Engineering/ Biotechnology), Springer,2007

22OFD01 **TRADITIONAL FOODS** **3 0 0 3**

Course Objectives

- Understand the importance of traditional foods and food habits
- Know the traditional processing of snack, sweet and dairy food products
- Infer the wide diversity and common features of traditional Indian foods and meal patterns.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required..
PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

Course Outcomes (COs)

1. Justify the processing methods of traditional foods in terms of its health benefits
2. Assess the production methods of traditional sweets, snacks and dairy products
3. Differentiate Traditional fermented foods products based on its raw material
4. Implement a large scale production of tradition foods for its increased consumption
5. Compare the health aspects of traditional foods with modern foods

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1												
2		1											
3	2	1	1										
4							2						
5							2						

UNIT I **9 Hours**

TRADITIONAL METHODS OF FOOD PROCESSING

Introduction - food culture -geographical features and food. Traditional methods of milling grains - rice, wheat and corn - equipment and processes as compared to modern methods. Equipment and processes for edible oil extraction- comparison of traditional and modern methods. Energy costs, efficiency, yield, shelf life and nutrient content comparisons. Traditional methods of food preservation - sun-drying, osmotic drying, brining, pickling and smoking.

UNIT II **9 Hours**

TRADITIONAL SWEETS, SNACKS AND DAIRY PRODUCTS

Production, formulation, preparation and processing of Indian traditional sweet and snack food products:- Rasgolla, Gulab jamun; formulation and preparation of namkeen, potato chips, banana chips. Acid coagulated and fermented dairy products- paneer, dahi, shrikhand, lassi - processing conditions, defects etc. Fat rich products- Butter, ghee and its processing.

UNIT III **9 Hours**

TRADITIONAL FERMENTED FOOD PRODUCTS

Idli, Soya sauce, fish pickle, dry fish, meat and vegetable fermented products. Various alcohol based products. Ways to increase nutritional quality of food such as enrichment, fortification, fermentation and mutual supplementation. Best cooking and processing methods to retain nutrients

UNIT IV **10 Hours**

COMMERCIAL PRODUCTION OF TRADITIONAL FOODS

Commercial production of traditional breads, snacks, ready-to-eat foods and instant mixes, frozen foods -types marketed, turnover; role of SHGs, SMES industries, national and multinational companies; commercial production and packaging of traditional beverages such as tender coconut water, neera, lassi, buttermilk, dahi. Commercial production of intermediate foods - ginger and garlic pastes, tamarind pastes, masalas (spice mixes), idli and dosa batters

UNIT V **8 Hours**

HEALTH ASPECTS OF TRADIONAL FOODS

Comparison of traditional foods with typical fast foods / junk foods - cost, food safety, nutrient composition, bioactive components; energy and environmental costs of traditional foods; traditional foods used for specific ailments /illnesses.

Total: 45 Hours

Reference(s)

1. Sen and Colleen Taylor, Food Culture in India, Greenwood Press, 2005.
2. Davidar, Ruth N. "Indian Food Science: A Health and Nutrition Guide to Traditional Recipes:" East West Books, 2001.
3. Steinkrus.K.H. Handbook of Indigenous Fermented Foods, CRC press, 1995.
4. Aneja. R.P, Mathur.BN, R.C. Chandan,and Banerjee.A.K. Technology of Indian Milk Products. Dairy India Year Book, 2009.

22OFD02 FOOD LAWS AND REGULATIONS 3 0 0 3

Course Objectives

- Introduce the concept of food hygiene, importance of safe food and laws governing it
- Learn common causes of food borne illness - viz. physical, chemical and biological and identification through food analysis
- Understand food inspection procedures employed in maintaining food quality

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

Course Outcomes (COs)

1. Analyse the food safety strategies and nutritional quality of the food
2. Check the food regulatory mechanism and mandatory laws for food products
3. Determine the national and international regulatory agencies
4. Understand and apply the voluntary regulatory standards
5. Assess the implementation of food safety for a food processing industry

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	1	2	1											
2		1				1	2							
3		1												
4	1	2												
5	1	2												

UNIT I **10 Hours**

INTRODUCTION

Introduction, concept of food safety and standards, food safety strategies. Food hazards and contaminations - biological (bacteria, viruses and parasites), chemical (toxic constituents / hazardous materials) pesticides residues / environmental pollution / chemicals) and physical hazards. Preventive food safety systems - monitoring of safety, wholesomeness and nutritional quality of food. Prevention and control of physical, chemical and microbiological hazards. Principles of food safety - Establishment: design and facilities - emergency preparedness - Maintenance cleaning and sanitation - personal hygiene - packaging and labelling - transportation - traceability - recall procedure - visitor policy. Adulteration: Intentional and unintentional -

Preservatives - antioxidants, sweeteners, flavours, colours, vitamins, stabilizers - indirect additives - organic resides - inorganic residues and contaminants.

UNIT II **10 Hours**

FOOD LAWS

Indian and Food Regulatory Regime (Existing and new), PFA Act and Rules, Food Safety and Quality Requirements, Additives, Contaminants and Pesticide Residue. Food Safety and Standards Act, 2006, FSSAI roles and responsibilities, Essential Commodities Act, 1955, Global Scenario, Codex Alimentarius, WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR) WHO/FAO Expert Bodies (JECFA/ JEMRA/JMPR). Food safety inspection services (FSIS) and their utilization.

UNIT III **10 Hours**

REGULATIONS

Introduction to OIE & IPPC, Other International Food Standards (e.g. European Commission, USFDA etc). WTO: Introduction to WTO Agreements: SPS and TBT Agreement, Export & Import Laws and Regulations, Export (Quality Control and Inspection) Act, 1963. Role of Agricultural and Processed Food Products Export Development Authority (APEDA), Customs Act and Import Control Regulations, Other Voluntary and mandatory product specific regulations, Other Voluntary National Food Standards: BIS Other product specific standards; AGMARK. Nutritional Labelling, Health claims.

UNIT IV **10 Hours**

STANDARDS

Voluntary Quality Standards and Certification GMP, GHP, HACCP, GAP, Good Animal Husbandry Practices, Good Aquaculture Practices ISO 9000, ISO 22000, ISO 14000, ISO 17025, PAS 22000, FSSC 22000, BRC, BRCIOP, IFS, SQF 1000, SQF 2000. Role of NABL, CFLS.

UNIT V **5 Hours**

IMPLEMENTATION AND RISK ASSESSMENT

Implementation of food safety for a desired food processing industry. Risk assessment studies: Risk management, risk characterization and communication.

Total: 45 Hours

Reference(s)

1. Singal RS (1997). Handbook of indices of food quality and authenticity. Woodhead Publ. Cambridge, UK.
2. Shapton DA (1994). Principles and practices of safe processing of foods. Butterworth Publication, London. Winton AL (1999) Techniques of food analysis, Allied Science Publications New Delhi.
3. Pomeranze Y (2004). Food analysis - Theory and Practice CBS Publications, New Delhi.
4. Jacob MB (1999). The chemical analysis of foods and food products. CBS Publ. New Delhi.

22OFD03 POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES 3 0 0 3

Course Objectives

- To understand the importance and different methods of post harvest handling and storage of fruits and vegetables.
- To gain knowledge on different preservation methods of fruits and vegetables
- To familiarize with the value added products from fruits and vegetables

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions..
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

Course Outcomes (COs)

1. Implement the different post harvest handling practices for the storage of fruits and vegetables
2. Analyze the suitable preservation method (sugar, salt or dehydration) to produce value added products from fruits and vegetables
3. Evaluate the requirement of low temperature and irradiation methods to preserve specific fruits and vegetables
4. Apply the concentration and fermentation methods to preserve fruits and vegetables
5. Implement the canning method to preserve fruits and vegetables

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	1	2	1		1							
2	1	1											
3	1	2											
4	1		1										
5	2	1	1										

UNIT I **9 Hours**

POST HARVEST PRACTICES AND PROCESSING

Maturity indices for harvesting; pathological spoilage's during storage, ripening and control measures, Post-harvest handling, sorting & grading, packaging, storage, transportation, Methods of pre-cooling, post-harvest treatments to hasten and delay ripening; Methods of storage at farm level - cold storage, controlled/modified atmosphere storage, Quality management, export requirements, Nutritive value, nutraceutical properties

UNIT II **9 Hours**

PRESERVATION AND VALUE ADDITION

General principles and methods of fruit and vegetable preservation. Preservation using sugar: Principle and Preparation of jam, jelly, marmalade, squash, RTS, carbonated beverages, crush, nectar, cordial, fruit bar, preserves, candies and carbonated fruit beverages. Processing using salt: Principle - Brining - Preparation of pickles, chutney and sauces, ketchup.

UNIT III **9 Hours**

PRESERVATION BY LOW TEMPERATURE AND IRRADIATION

Preservation by low temperature: definition, principle, methods - Refrigeration, freezing. Methods of freezing-changes during freezing. Preparation of frozen foods. Minimal Processing of Fruits and Vegetables - techniques involved - Preservation by irradiation: definition- principle, application, irradiation unit.

UNIT IV **9 Hours**

PRESERVATION BY DRYING

Machineries involved in processing of fruits and vegetables products. Drying and dehydration: definition, principle, Types of driers: Solar, cabinet, spray drier, drum drier, fluidized bed drier. Preparation of product for dehydration. Dehydration principles and equipment. Preparation of fruits - powder production. Problems related to storage of dehydrated products.

UNIT V **9 Hours**

PRESERVATION BY CANNING

Canning: principles, Types of cans, packing of canned products-preparation of canned products - general considerations in establishing a commercial fruit and vegetable cannery, machineries involved in canning and bottling unit- spoilage of canned foods. Bottling of fruit and vegetable. Precautions in canning operations.

Total: 45 Hours

Reference(s)

1. S.Ranganna, HandBook of Analysis and Quality Control for Fruit and Vegetable Products, McGraw Hill Education (India) Private Limited, Chennai, 2017
2. N.W. Desrosier, the Technology of Food Preservation, CBS Publisher & Distributions, New Delhi, 1987.
3. R.P. Srivastava and S. Kumar, Fruit and Vegetable Preservation: Principles and Practices, Second Edition, International Book Distribution Co., Lucknow, 1998.
4. G. Lal, G. Siddappa and G.L. Tondon, Preservation of Fruits and Vegetables, Indian Council of Agricultural Research, New Delhi, 1986.
5. Chakraverty, A.S. Mujumdar, G.S.V. Raghavan and H.S. Ramaswamy, Handbook of Post-harvest Technology, Marcel Dekker Press, USA, 2001.
6. D.K. Salunkhe, and S.S. Kadam, Handbook of Fruit Science and Technology: Production, Composition and Processing, Marcel Dekker, New York, 1995.

22OFD04 CEREAL, PULSES AND OILSEED TECHNOLOGY 3 0 0 3

Course Objectives

- Understand the application of scientific principles in the processing technologies specific to the materials
- Understand the storage methods and handling techniques followed for cereals, pulses and oil seeds
- Develop the knowledge in the area of Cereals, pulses and oil seed processing and technology

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Identify the specific processing technologies employed for cereals
2. Analyse the composition of millets and their nutritional importance
3. Relate the compositional changes and processing methods of pulses and legumes
4. Create the competence in processing of oilseeds technology
5. Relate the storage processing of food grains with quality aspects

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2		2		2							
2	1	2		2		1							
3	2	2		1		2							
4	2	3		2		2							2
5	2	2		2		3							

UNIT I 9 Hours

CEREALS

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products - Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice-Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products - Corn flakes, Corn starch, canned corn products, puffed product; Oats-Milling, Oat Products - Steel cut,rolled oats, quick cooking; Traditional and Fermented cereal products.

UNIT II **9 Hours**

OTHER CEREALS AND MILLETS

Sorghum, Pearl Millet, Finger millet, Foxtail Kodo Millet - Basic agricultural millet, aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

UNIT III **9 Hours**

PULSES AND LEGUMES

Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting, dhal milling, products - puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

UNIT IV **9 Hours**

OILSEEDS AND NUTS

Basic agricultural aspects structure, composition, Storage, Insect control; processing: traditional and modern methods of oil extraction, refining, bleaching, deodorizing, hydrogenation; oil blends; applications of different oils and fats in food processing & products.

UNIT V **9 Hours**

STORAGE AND HANDLING

Bag Storage - Advantages and Disadvantages, Cover Plinth Storage Structures, CAP storage (Cover and Plinth Storage). Protection against Rodents, Fungi, Pests and Mites. Fumigation Processes for bag storage piles. Bulk Storage in silos and large Bins. Conveyors and Elevators for feeding and discharging.

Total: 45 Hours

Reference(s)

1. Chakraverty, A.: Post Harvest Technology of Cereals, Pulses and Oilseeds. Oxford and IBH Publishing Co, Calcutta, 1995.
2. Delcour, Jan A. and R. Carl Hoseney., Principles of Cereal Science and Technology, 3rd Edition, American Association of Cereal Chemists, 2010.
3. Karl Kulp, Handbook of Cereal Science and Technology, 2nd Rev. Edition, CRC Press, 2000.
4. N.L.Kent and A.D.Evans, Technology of Cereals (4th Edition) Elsevier Science (Pergaman),Oxford, UK, 1994.
5. Matz, Samuel A., The Chemistry and Technology of Cereals as Food and Feed, 2nd Edition,CBS, 1996.
6. Morris, Peter C. and J.H. Bryce., Cereal Biotechnology, CRC/Wood head publishing, 2004.

22OFT01 FASHION CRAFTSMANSHIP 3 0 0 3

Course Objectives

- To impart theoretical and practical knowledge about various handi-craft techniques
- To enhance innovative skills on hand crafts.
- To build confidence on doing handicrafts.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.
PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences
PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change..
PSO1: Demonstrate the knowledge and technical skills in software development.

Course Outcomes (COs)

1. Outline the classification, techniques and criteria for selecting raw materials for making various handicraft materials and produce textile based handicrafts. Produce various decorative and appealing products
2. Design and construct various wall hangings and fashion accessories.
3. Design and construct toys and accessories
4. Design and construct head accessories, home furnishings and paintings
5. Design and construct various decorative and appealing products for interiors

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	1	3			2		2	2		2	2	
2	3	2	3			1		2	3		2	2	
3	3	2	3			2		2	3		2	2	
4	3	2	3			2		2	3		2	2	
5	3	2	3			2		2	3		2	2	

UNIT I **9 Hours**

TECHNIQUES OF HANDICRAFT MATERIALS

Definition of Handicraft, Classification: Reusable, Non reusable, Raw materials used in various craft materials: printed, embroidered, stitched and handmade, Criteria for selection of raw materials: material types and end uses.

UNIT II **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - INTERIORS

Designing and Construction procedures for following various decorative and appealing products: Wall hangings - String Art on plywood, Pressed Flower Art frames.

UNIT III **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ACCESSORIES

Designing and Construction procedures for following various decorative and appealing products: Handbags, Hats, footwear.

UNIT IV **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - ORNAMENTS

Designing and Construction procedures for following various decorative and appealing products: Stone necklace using Macrame Technique, Tribal Jewellery using woollen threads, Floral Jewellery using Resin Technique, Fabric Jewellery using Tie and Dye Technique.

UNIT V **9 Hours**

DECORATIVE AND APPEALING PRODUCTS - FANCY ITEMS

Designing and Construction procedures for following various decorative and appealing products: Jewellery Box, Utility Holder, Gift items. Lampshade decors from cardboard, Driftwood Frames for pictures and Mirrors.

Total: 45 Hours

Reference(s)

1. Handmade in India: A Geographic Encyclopaedia of India Handicrafts. Abbeville press; 1 edition (October 20,2009)
2. Encyclopaedia of Card making Techniques (Crafts), Search Press Ltd, illustrated edition, 2007
3. All about Techniques in Illustration, Barron Educational Series, 2001
4. Printing by Hand: A Modern Guide to printing with Handmade stamps, Stencils and Silk Screens, STC Craft/A Melanie Falick Book, 2008
5. Materials & Techniques in the Decorative Arts: An Illustrated Dictionary, University of Chicago Press, 2000
6. https://www.marthastewart.com/274411/fashion-crafts

22OFT02 INTERIOR DESIGN IN FASHION 3 0 0 3

Course Objectives

- To impart knowledge on interior design.
- To improve the design skills, sustainable with socially-conscious designs

Programme Outcomes (POs)

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.
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.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO1. Ability to demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

Course Outcomes (COs)

1. Interpret the elements of interior design concepts and resolve the personality requirements
2. Develop graphical representations of interior design concepts
3. Resolve the space planning requirements of residential home as per CPWD guidelines
4. Determine the aesthetic requirements of interior design components.
5. Appraise the roles and responsibilities of interior designer.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	3		-	1						2	
2	3	2	3		2	3		2				3	
3	3	3	3		2	2		2				2	
4	3	3	3		2	3		2				2	
5	3	2			2			3				3	

UNIT I **9 Hours**

INTRODUCTION

Interior designing - definition, importance, requirements and types - Structural design, Decorative Design - Designing interiors, Good taste; Design themes, types and application. Personality of the Home - Art elements - Line: types, characteristics and importance; form: size and shape, characteristics; Colour - sources, qualities, emotional effects, colour wheel and schemes.

UNIT II **9 Hours**

GRAPHICAL PRESENTATIONS

3D composition; Isometric and Axonometric- Still life- Furniture Sketching- Object Drawing with color rendering - Interior elements, Lighting, plants. Perspective, Axonometric Isometric drawing. Orthographic Projection - Lifts and escalators.

UNIT III **9 Hours**

SPACE PLANNING

Space planning concepts- interiors, circulation. Definition, application of ergonomic principals in interiors. Residential house space planning case study- CPWD guidelines. Lighting for different locations and activities, measurement, ventilation and indoor air quality, noise control methods.

UNIT IV **9 Hours**

INTERIOR COMPONENTS

Application of colour in interiors; Texture - types and significance; Pattern: types and effects; Light - importance. Importance of Furniture Design for Interiors- Ancient Age / Middle Age / Contemporary. Doors, Windows, Staircase designs, False Ceiling, Partitions, Wall Panelling, Comics, Mosaic, Cladding- Flooring and Wall Cladding

UNIT V **9 Hours**

ROLES AND RESPONSIBILITIES OF INTERIOR DESIGNER

Role of an Interior Designer- Responsibility towards society and need of an Interior Designer to better the environment- Ethics and Code of Conduct- Responsibility towards client, contractor and supplier, Estimation. Professional Fees- Work of an Interior Designer- Making of portfolio, JD Annual Design Awards.

Total: 45 Hours

Reference(s)

1. Joanna Gaines, Homebody: A guide to creating spaces you never want to leave, Harper design, 2018.
2. Erin gates, Elements of Style: Designing a Home and a life, Simon and Schuster, 2014.
3. Simon Dodsworth, The Fundamentals of Interior Design, AVA publishing, 2009.
4. V. Mary. Knackstedt, The Interior Design Business Handbook: A Complete Guide to Profitability, Wiley, New Jersey; 2006.
5. M. G. Shah, C. M. Kale, and S.Y. Patki, Building Drawing with an Integrated Approach to Build Environment, Tata McGraw Hill, 2002.
6. Https://eclectictrends.com

22OFT03 SURFACE ORNAMENTATION 3 0 0 3

Course Objectives

- To familiarize the students about the various techniques of surface embellishment with relevance to garment embellishments.
- To aware of various types of embroidery and methods of producing it.
- To make the students confident about doing surface embellishment work

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Analyze the raw material requirements for surface ornamentation and its application
2. Implement hand embroidery stitches on fabric and show the stitch development procedure in diagrammatic representations
3. Apply the machine and computerized embroidery stitches
4. Analyze the surface embellishment techniques and its application
5. Assess the quality maintenance parameters of all embroidered products and analyze the 6 traditional embroidery techniques

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	3	2					1					
2	2	3	2						2			2	2
3	2	3	2		3							2	2
4	2	2	2						2			2	2
5	2	2	2						2				2

UNIT I **9 Hours**

INTRODUCTION TO SURFACE ORNAMENTATION

Introduction, Definition, Need, Types, Raw materials, Importance of surface ornamentation, Selection of needle, thread and fabric for hand embroidery and machine embroidery. various methods of surface embellishment- embroidery and surface ornamentation.

UNIT II **9 Hours**

HAND EMBROIDERY

General rules for hand embroidery. Types of hand embroidery stitches-Running, Couching, Button hole, Satin, Long & Short, Wheat, Chain, Stem, Herringbone, Cross stitch, Knotted stitches, Fish bone, Fly stitch, Braids, Back, Hem, Seed, Needle weaving, Whip stitches.

UNIT III **9 Hours**

MACHINE EMBROIDERY

General rules for machine embroidery. Types of frames and methods of transferring the designs. Attachments to sewing machines for embroidery, Types of machine embroidery stitches- Eyelet work, Cut work, patch work, Mirror work, Applique, Shaded embroidery, Shadow work, Bead and Sequins work, Vermicelli, Zigzag, Granite stitch. Computerized embroidery machine- Concept of design and development, software used in embroidery machines, process of designing, method and types of stitch application, punching and digitizing.

UNIT IV **9 Hours**

EMBELLISHMENT TECHNIQUES

Materials used and Applications. Types of embellishment techniques- fabric painting-hand, Stencil-dabbing and Spraying. Dyeing and printing-advanced tie and dye techniques, batik and block printing. Trimmings and decorations-Laces, Pompons, Fringes, Tassels, Tucks, Show buttons, Crocheting.

UNIT V **9 Hours**

TRADITIONAL EMBROIDERIES OF INDIA AND CARE

Care and maintenance of embroidered articles-care and maintenance methods for embroidered apparel, pressing. Traditional Embroideries of India-Phulkari, Kasuti, Kashmiri embroidery, Kutch work, Chikkankari, Kantha.

Total: 45 Hours

Reference(s)

1. Ruth Chandler, Modern Hand Stitching-Dozens of stitches with creative free-form variations,2014
2. Sophie Long, Mastering the Art of Embroidery: Traditional Techniques and Contemporary Applications for Hand and Machine Embroidery, Heritage Publishers, London, 2013
3. Christen Brown ,Embroidered & Embellished, C&T Publishing, 2013
4. Sheila Paine, Embroidered Textiles, Thames and Hudson Publisher, UK, 1990.
5. Gail Lawther, Inspirational Ideas for Embroidery on Clothes & Accessories, Search Press Ltd, UK, 1993.
6. http://www.needlenthread.com/tag/hand-embroidery-stitches.

22OPH01 **NANOMATERIALS SCIENCE** **3 0 0 3**

Course Objectives
- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Programme Outcomes (POs)
PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

Course Outcomes (COs)
1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	1	1						1		
2	3	2	2	1	1						1		
3	3	2	2	1	1						1		
4	3	2	2	1	1						1		
5	3	2	2	1	1						1		

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future -classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top down processes - mechanical milling, nanolithography and types based on radiations - Bottom up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nanosystems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes- structure, synthesis and electrical properties -applications- quantum well laser- quantum efficiency of semiconductor nanomaterials

UNIT V **9 Hours**

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- single electron transistor - - organic photovoltaic cells- spintronics

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

22OPH02 SEMICONDUCTOR PHYSICS AND DEVICES 3 0 0 3

Course Objectives

- Impart knowledge in physical properties of semiconducting materials
- Analyze the factors affecting the operation of semiconductor devices
- Apply the physics of semiconductors to develop semiconductor devices

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

PSO2 Develop practical competencies in Software and Hardware Design.

Course Outcomes (COs)

1. Exemplify the band gap, drift and diffusion current densities due to carrier transport in semiconductors
2. Analyze the energy band diagram in thermal equilibrium and space charge width of PN junction
3. Illustrate the operation of Bipolar Junction transistor at different modes and different configurations
4. Illustrate the operation of metal oxide field effect transistor and their memory devices
5. Represent the working mechanism of opto-electronic devices

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2	1	1						1		1
2	3	2	2	1	1						1		1
3	3	2	2	1	1						1		1
4	3	2	2	1	1						1		1
5	3	2	2	1	1						1		1

UNIT I **9 Hours**

ENERGY BANDS AND CARRIER TRANSPORT PROPERTIES

Energy Bands: Formation of energy bands - doping effects - energy levels - electron and hole concept in semiconductor. Carrier transport: Carrier drift-drift current density - conductivity- diffusion current density - total current density

UNIT II **9 Hours**

P-N JUNCTION

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

UNIT III **9 Hours**

BIPOLAR JUNCTION TRANSISTOR

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor.

UNIT IV **9 Hours**

MOSFET

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

UNIT V **9 Hours**

PHOTONIC DEVICES

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

Total: 45 Hours

Reference(s)

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee , "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

22OPH03 APPLIED LASER SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on laser science
- Explore different strategies for producing lasers
- Create expertise on the applications of lasers in various fields

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.
PO11: Life-Long Learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

Course Outcomes (COs)

1. Illustrate the transition mechanisms and the components of a laser system
2. Compare the different types of lasers based on pumping method, active medium and energy levels
3. Compute the rotation of earth, velocity and distance using lasers and apply the same for day today applications
4. Analyze the role of lasers in surgical and endoscopy applications
5. Apply the laser techniques in industrial applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	2	2		1						1		
2	3	2	2		1						1		
3	3	2	2		1						1		
4	3	2	2		1						1		
5	3	2	2		1						1		

UNIT I **9 Hours**

LASER FUNDAMENTALS

Introduction - principle - absorption and emission of light - thermal equilibrium - Einstein's prediction - Einstein's relations - A and B coefficients - condition for large stimulated emission - spontaneous and stimulated emission in optical region - light amplification - condition for light amplification - population inversion- Components of lasers - pumping methods - pumping mechanisms - optical resonator

UNIT II **9 Hours**

LASER BEAM CHARACTERISTICS AND TYPES

Characteristics of laser - Classification of lasers - principle, construction, working, energy level diagram and applications of molecular gas laser (CO2 laser) - liquid laser (dye laser) - excimer laser - Solid state laser (Nd:YAG laser) - semiconductor laser (homojunction laser).

UNIT III **9 Hours**

LASERS IN SCIENCE

Introduction - Harmonic generation (SHG) - Stimulated Raman emission - lasers in chemistry - laser in nuclear energy - lasers and gravitational waves - rotation of the earth - measurement of distance - Light detection And Ranging (LIDER) - velocity measurement – holography

UNIT IV **9 Hours**

LASERS IN MEDICINE AND SURGERY

Light induced biological hazards: Eye and skin - Eye laser surgery - photocoagulations - homeostasis - dentistry - laser angioplasty - different laser therapies - advantages & disadvantages - laser endoscopy.

UNIT V **9 Hours**

LASERS IN INDUSTRY

Applications in material processing: laser welding - hole drilling - laser cutting - Lasers in electronics industry: information storage - bar code scanner- Lasers in defence: laser based military weapons - laser walls.

Total: 45 Hours

Reference(s)

1. K. Thiyagarajan and A. K. Ghatak, "LASERS: Fundamentals and Applications", Springer, USA, 2015
2. M. N. Avadhanulu, "An Introduction to Lasers Theory and Applications", S. Chand Publisher, 2013
3. W. Koechner, M. Bass, "Solid State Lasers: a graduate text", Springer Verlag, New York, 2006
4. K. P. R. Nair, "Atoms, Molecules and Lasers", Narosa Publishing House, 2009
5. K. R. Nambiar, "Lasers: Principles Types and Applications", New Age International Publications, 2006
6. A. Sennaroglu, "Solid-State Lasers and Applications", CRC Press, 2006

22OPH04 **BIOPHOTONICS** **3 0 0 3**

Course Objective:

- To understand the light-matter interaction in biological cells or tissues by using the principles of optics and lasers.
- To apply the properties of biological cells or tissues in biomedical applications by various optical imaging, sensing and activation techniques.
- To analyze the concepts of Modern optical measurement techniques and devices in early detection of disease and cure them.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

Course Outcomes (COs)

1. Infer the laws of optics and lasers to interpret the biological cells and tissues.
2. Identify the properties of different optical instruments in biological systems to represent their behavior in structure and design of detection engineering instruments.
3. Use laser tweezers techniques to infer the activities of cells (tissues) and explain the single molecule detection processes in medical diagnosis.
4. Outline the properties of ultra short laser pulses and tissue engineering to rectify the affecting factors in biological cells.
5. Compare the various types of bio-imaging methods to detect the infected cells and molecules in biological science.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	3	2	2	1								
2	2	3	2	2	1								
3	3	3	2	2	1								
4	4	3	2	2	1								
5	5	3	2	2	1								

UNIT I **9 Hours**

INTRODUCTION TO BIOPHOTONICS

Light as Photon Particles – Coherence of light - lasers – classification of lasers – Mechanisms of Non-linear Optics (NLO) processes associated with Biophotonics - Light scattering mechanisms: Rayleigh scattering, Miescattering, Brillouin Scattering, Raman Scattering -Different light sources – Quantitative description of light: Radiometry.

UNIT II **9 Hours**

PHOTOBIOLOGY

Interaction of light with cells and tissues – Light – Tissue Interaction Variables – Light –Tissue Interaction Theory: Radiative Transport Theory – Photo process in biopolymers – In Vivo Photoexcitation – photo-induced physical, chemical, thermal and mechanical effects in biological systems – Optical biopsy – Single molecule detection

UNIT III **9 Hours**

BIONANO PHOTONICS

Laser Microtools, Semiconductor quantum dots for bioimaging, Metallic nanoparticles and nanorods for biosensing – Optical biosensors: Fibre-Optic, evanescent wave, surface Plasmon resonance (SPR) based biosensors – biomaterials for photonics – Principle and design of laser tweezers – laser trapping and dissection for biological manipulation.

UNIT IV **9 Hours**

TISSUE ENGINEERING WITH LIGHT

Basics of tissue optics: Light absorption and scattering in tissues, Wavelength effects and spectra– the therapeutic window, Light penetration in tissues – Absorbing agents in tissues and blood –Skinoptics, response to the UV radiation, Optical parameters of tissues – tissue welding – tissue contouring – tissue regeneration – Femto laser surgery – low level light therapy and photo dynamic therapy

UNIT V **9 Hours**

BIO-IMAGING TECHNIQUES AND ITS APPLICATIONS

An overview of optical imaging – Fluorescence Microscopy – Scanning Microscopy – In vivo Confocal Microscopy – Multi photon Microscopy – Optical Coherence Tomography (OCT) – Fluorescence Resonance Energy Transfer (FRET) imaging – fluorescence lifetime imaging Microscopy (FLIM) – Nonlinear optical imaging – Coherent Anti-stokes Raman Scattering –Bioimaging Applications.

Total: 45 Hours

Reference(s)

1. Introduction to Biophotonics, ParasN.Prasad, WileyInter-science, AJohnWiley & Sons, Inc., Publication (Class notes are developed mainly based on this book.)
2. Introduction to Biomedical Imaging, Andrew G.Webb, 2002, IEEE Press.
3. Biomedical Optics: Principles and Imaging, Lihong.V.Wang, Hsin.-I.Wu, 2007, Wiley Interscience 2007. & "An Introduction to Biomedical Optics", R.Splinterand B.A.Hooper, Taylor & Francis
4. Bioimaging Current Concepts in Light and Electron Microscopy, DouglasE.Chandler & Robert W.Roberson, Jones and Bartlett publishers.
5. Optical Imaging and Microscopy : Techniques and Advanced Systems, Peter Török and Fu-JenKao, 2004, Springer.

22OPH05 PHYSICS OF SOFT MATTER 3 0 0 3

Course Objectives

- To recognize the properties of soft matter and hard matter
- To understand the fundamental interactions of colloids and gels
- To explain the structure and phase behavior of liquid crystals and supramolecules
- To summarize the soft matter proprties of structures and components of life

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development

Course Outcomes (COs)

1. Identify the salient features of soft matter and hard matter
2. Exemplify the fundamental interactions and stability of colloids and gels
3. Illustrate the structure and properties of liquid crystals
4. Outline the aggregation and phase behavior of surfactants, polymers, copolymers and block copolymers
5. Analyze the soft matter behavior of nucleic acids, proteins, polysaccharides and membranes

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1											
2	2	1											
3	2	2											
4	2	2											
5	2	2											

UNIT I **9 Hours**

CONDENSED MATTER

Intermolecular forces-Condensation and freezing-mechanical response: Hookean solid-Newtonian liquid-viscoelasticity. Glasses: relaxation time-viscosity- glass forming liquids. Soft matter: length scales-fluctuations and Brownian motion.

UNIT II **9 Hours**

COLLOIDAL DISPERSIONS AND GELS

Forces between colloidal particles: vander Waals forces-electrostatic double layer forces-steric hindrance-depletion interactions. Stability and phase behaviour: Crystallisation-strong colloids-weak colloids.Physical and chemical gels-classical theory of gelation-elasticity of gels.

UNIT III **9 Hours**

LIQUID CRYSTALS

Liquid crystal phases-distortions and topological defects-electrical and magnetic properties-polymer liquid crystals-Fredricks transition and liquid crystal displays

UNIT IV **9 Hours**

SUPRAMOLECULAR SELF ASSEMBLY

Aggragation and phase separation-types of micelles- bilayers and vesicles. Phase behaviour of concentrated surfactant solutions-phase separation in polymers, copolymers and block copolymers

UNIT V **9 Hours**

SOFT MATTER IN NATURE

Components and structures of life-Nucleic acids-proteins-interaction between proteins-polysaccharides-membranes

Total: 45 Hours

REFERENCES

1. Richard A L Jones, Soft Condensed Matter, Oxford University Press, UK, 2002
2. Masao Doi, Soft Matter Physics, Oxford University Press, UK, 2013.
3. Ian W. Hamley, Introduction to Soft Matter, John Wiley & Sons, 2007
4. A. Fernandez-Nieves, A M Puertas, Fluids, Colloids and Soft materials: An Introduction to Soft Matter Physics, John Wiley & Sons, 2016
5. Maurice Kleman, Oleg D. Lavrentovich, Soft Matter Physics: An Introduction, Springer-Verlag, New York, 2003.

22OCH01 CORROSION SCIENCE AND ENGINEERING 3 0 0 3

Course Objectives

- Analyse the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1											
2	2						1						
3	1	3											
4	2	2											
5	3	3					1						

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing - Ultrasonic monitoring, and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection(sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.

22OCH02 **POLYMER SCIENCE** **3 0 0 3**

Course Objectives

- Explain the properties of different polymers with its mechanism
- Select the appropriate polymerization techniques to synthesize the polymers
- Identify suitable polymers for various industrial applications

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

Course Outcomes (COs)

1. Illustrate the types of mechanism of polymerization reactions and analyze the natural and synthetic polymers
2. Identify the suitable polymerization techniques to synthesize the high quality polymers
3. Identify the structure, thermal, and mechanical properties of polymers for different applications
4. Apply the polymer processing methods to design polymer products
5. Analyze the polymers used in electronic and biomedical applications.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	1											
2	1	2											
3	2	2											
4	1	1	2										
5	1	3	2										

UNIT I **10 Hours**

POLYMERS AND ELASTOMERS

Classification of polymers - Mechanism: Addition polymerization - free radical, cationic, anionic and co-ordination (Ziegler-Natta) polymerization - copolymerization - condensation polymerization (nylon-6,6) -ring opening polymerization (nylon-6). Elastomers: Natural rubber and synthetic rubber: styrene -butadiene rubber (SBR), butyl, neoprene, thiocol rubbers. High performance polymers: polyethers, polyether ether ketone (PEEK), polysulphones and polyimides

UNIT II **8 Hours**

POLYMERIZATION TECHNIQUES

Homogeneous and heterogeneous polymerization - bulk polymerization (PMMA, PVC) - solution polymerization - polyacrylic acid, suspension polymerization (ion-exchange resins) - emulsion polymerization (SBR) - advantages and disadvantages of bulk and emulsion polymerization. Melt solution and interfacial poly-condensation

UNIT III **8 Hours**

CHARACTERIZATION AND TESTING

Characterization of polymers by Infrared Spectroscopy (IR) and Nuclear Magnetic Spectroscopy (NMR) - Thermal properties: TGA and DSC - Testing tensile strength - Izod impact - Compressive strength - Rockwell hardness - Vicot softening point - water absorption

UNIT IV **9 Hours**

POLYMER PROCESSING

Moulding: Compression - injection - extrusion and blow mouldings. Film casting - calendering. Thermoforming and vacuum formed polystyrene - foamed polyurethanes. Fibre spinning: melt, dry and wet spinning. Fibre reinforced plastics fabrication: hand-layup - filament winding and pultrusion

UNIT V **10 Hours**

SPECIALITY POLYMERS

Preparation and properties of heat resistant and flame retardant polymers. Polymers for electronic applications: liquid crystalline, conducting and photosensitive polymers – E waste management. Polymer for biomedical applications: artificial organs, controlled drug delivery, Scaffolds in tissue Engineering –waste management.

Total: 45 Hours

Reference(s)

1. V. R. Gowarikar, N. V. Viswanathan and Jayadev Sreedhar, "Polymer Science", New Age International (P) Ltd., New Delhi, 2021
2. Joel R. Fried, "Polymer Science and Technology", Prentice Hall of India (P). Ltd., 2014
3. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011
4. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2008
5. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
6. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004

22OCH03 **ENERGY STORING DEVICES** **3 0 0 3**

Course Objectives

- Compare the energy density of commercialized primary and secondary batteries.
- Classify the fuel cells and compare their efficiency in different environmental conditions.
- Demonstrate the various energy storage devices and fuel cells.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

Course Outcomes (COs)

1. Find the parameters required for operation of a cell to evaluate the capacity of energy storage devices.
2. Identify the electrodes, electrolyte and cell reactions of different types of primary, secondary batteries and infer the selection criteria for commercial battery systems with respect to commercial applications.
3. Differentiate fuel cells based on its construction, production of current and applications.
4. Compare different methods of storing hydrogen fuel and its environmental applications.
5. Classify the solar cell based on the materials used in it.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	3	1											
2	2	3				1							
3	3	1											
4	2	2				1							
5	3	3				1							

UNIT I **6 Hours**

BASICS OF CELLS AND BATTERIES

Components - classification - operation of a cell - theoretical cell voltage - capacity - specific energy - energy density of lithium and lead acid battery - charge efficiency- charge rate - charge retention - closed circuit voltage - open circuit voltage current density - cycle life - discharge rate-over charge-over discharge

UNIT II **10 Hours**

BATTERIES FOR PORTABLE DEVICES AND ELECTRIC VEHICLES

Primary batteries: zinc-carbon - magnesium,and mercuric oxide - recycling/safe disposal of used cells. Secondary batteries: lead acid - nickel-cadmium - lithium ion batteries - rechargeable zinc alkaline battery.

Reserve batteries: Zinc-silver oxide - lithium anode cell - photogalvanic cells. Battery specifications for cars and automobiles. Extraction of metals from battery materials.

UNIT III **10 Hours**

TYPES OF FUEL CELLS

Importance and classification of fuel cells: Description, working principle, components, applications and environmental aspects of the following types of fuel cells: alkaline fuel cells - phosphoric acid - solid oxide - molten carbonate and direct methanol fuel cells

UNIT IV **10 Hours**

HYDROGEN AS A FUEL

Sources and production of hydrogen: Electrolysis and photocatalytic water splitting. Methods of hydrogen storage: High pressurized gas - liquid hydrogen type - metal hydride. Hydrogen as engine fuel - features, application of hydrogen technologies in the future – limitations.

UNIT V **9 Hours**

ENERGY AND ENVIRONMENT

Future prospects of renewable energy and efficiency of renewable fuels - economy of hydrogen energy. Solar Cells: First, second, third and fourth generation solar cell - photobiochemical conversion cell.

Total: 45 Hours

Reference(s)

1. S.P. Jiang, Q. Li, Introduction to Fuel Cells, Springer, 2021.
2. M.M. Eboch, The Future of Energy, From Solar Cells to Flying Wind Farms, Capstone, 2020.
3. N. Eliaz, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
4. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018
5. A. Iulianelli, A. Basile, Advances in Hydrogen Production, Storage and Distribution, Elsevier, 2016.

22OMA01 GRAPH THEORY AND COMBINATORICS 3 0 0 3

Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science & Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory based computing and network security studies in Computer Science.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization to develop to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development..

Course Outcomes (COs)

1. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2	PSO3
1	1	2												
2	1	3												
3	2	3												
4	2	3												
5	3	3												

UNIT I 9 Hours

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II 9 Hours

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - Non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. NarsinghDeo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics And Its Applications, McGraw Hil, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

22OGE02 **ENTREPRENEURSHIP DEVELOPMENT I** **3 0 0 3**

Course Objectives

- Learn the basics and scope of the Entrepreneurship
- Understand the generation of ideas of the Entrepreneurship
- Evolve the legal aspects of the business
- Learn to analyze the various business finance
- Learn the basics of the Operations Management

Programme Outcomes (POs)

PO6:The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO9: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PSO1.To demonstrate the technical knowledge in Computer Science with equal appreciation of humanities, management sciences and human values.

PSO2. To create, select, and apply appropriate techniques, resources, modern engineering and business tools including prediction and data analytics to complex engineering activities and business solutions

Course Outcomes (COs)

1. Analyze the role of entrepreneurship in economic development.
2. Explain the types of ideas that to be used for entrepreneurship development.
3. Examine the legal aspects of business and its association.
4. Examine the sources of business and its analysis.
5. Analyse the different modes of operation management.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1						1			2			1	1
2						1			2			1	1
3						1			2			1	1
4						1			2			1	1
5						1			2			1	1

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

22OGE03 ENTREPRENEURSHIP DEVELOPMENT II 3 0 0 3

Course Objectives

- Evolve the marketing mix for promotion the product / services
- Handle the human resources and taxation
- Learn to analyze the taxation
- Understand the Government industrial policies and supports
- Preparation of a business plan

Programme Outcomes (POs)

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO8: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PSO1: Demonstrate the knowledge and technical skills in software development.

PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Examine the strategies and plans in marketing management.
2. Analyse the cases involved in human resource management.
3. Classify the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Examine the various steps involved in preparing the business plan.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1						1	2	2					1	1
2						1	2	2					1	1
3						1	2	2					1	1
4						1	2	2					1	1
5						1	2	2					1	1

UNIT I **9 Hours**

MARKETING MANAGEMENT

Marketing environment, Segmentation, Targeting and positioning, Formulating marketing strategies, Marketing research, marketing plan, marketing mix (cases)

UNIT II **9 Hours**

HUMAN RESOURCE MANAGEMENT

Human Resource Planning (Cases), Recruitment, Selection, Training and Development, HRIS, FactoriesAct 1948 (an over view)

UNIT III **9 Hours**

BUSINESS TAXATION

Direct taxation, Income tax, Corporate tax, MAT, Tax holidays, Wealth tax, Professional taxCases). Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases)

UNIT IV **9 Hours**

GOVERNMENT SUPPORT

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State LevelInstitutions-TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Marketsurvey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill:2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. http://niesbud.nic.in/agencies.html

22OGE04 | **NATION BUILDING, LEADERSHIP AND SOCIAL RESPONSIBILITY** | **3 0 0 3**

Course Objectives

- To understand the importance of National Integration, Patriotism and Communal Harmony
- To outline the basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality
- To analyze the different types of responsibility role of play for the improvement of society

Programme Outcomes (POs)

PO1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO11: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Understand religo-cultural diversity of the country and its impact on the lives of the people and their beliefs
2. Acquire a sense of responsibility, smartness in appearance and improve self confidence
3. Develop the sense of self-less social service for better social & community life
4. Apply the importance of Physical and Mental health and structure of communication organization and various mode of communication
5. Acquire awareness about the various types of weapon systems in the Armed Forces.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2		1				1				3		
2	2		2				2				2		
3	2		1				1				2		
4	2		3				3				3		
5	2		1				1				2		

UNIT I **9 Hours**

NATIONAL INTEGRATION

Importance & Necessity, Factors Affecting National Integration, Unity in Diversity. Threats to National Security. Water Conservation and Rain Harvesting, Waste Management and Energy Conservation. Leadership Capsule-Traits-Indicators-Motivation-Moral Values-Honor Code-Case Studies: Shivaji, Jhansiki Rani, Case Studies–APJ Abdul kalam, Deepa Malik, Maharana Pratap, N Narayan Murthy Ratan Tata Rabindra Nath Tagore, role of NCC cadets in 1965 war.

UNIT II **9 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

Intra & Interpersonal skills - Self-Awareness- &Analysis, Empathy, Critical & creative thinking, Decision making and problem solving, Communication skills, Group Discussion – copping with stress and emotions, changing mindset, Public Speaking, Time Management, Social skills, Career counseling, SSB procedure and Interview skills.

UNIT III **9 Hours**

SOCIAL SERVICE, COMMUNITY DEVELOPMENT AND ENVIRONMENTAL AWARENESS

Basics of social service and its need, Types of social service activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare, contribution of youth and NCC in Social welfare. Protection of children & women safety, Road/ Rail Travel Safety, New initiatives, Cyber and mobile security awareness. Disaster management Capsule-Organization-Types of Disasters-Essential Services-Assistance-Civil Defence Organization

UNIT IV **9 Hours**

HEALTH, HYGIENE AND COMMUNICATION

Sanitation, First Aid in Common Medical Emergencies. Health, Treatment and Care of Wounds. Yoga-Introduction, Definition, Purpose, Benefits. Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasanaetc. Obstacle Training Contact: Obstacle training - Intro, Safety measures, Benefits, Straight balance, Clear Jump, Gate Vault, ZigZagBalance, High Wall etc. COMMUNICATION: Basic Radio Telephony (RT) Procedure-Introduction, Advantages, Disadvantages, Need for standard- Procedures-Types of Radio Telephony Communication-Radio telephony procedure, Documentation.

UNIT V **9 Hours**

ARMED FORCES AND NCC GENERAL

Army, navy, Air force and Central armed policed forces- Modes of entry into army, police and CAPF-Naval expeditions & campaigns. History, Geography of Border / Coastal areas. EEZ maritime security & ICG. Modes of Entries in armed forces. Security challenges & role of cadets in Border management. Aims, Objectives and org of NCC- Incentives- Duties of NCC cadets- NCC Camps: types and conduct.

Total: 45 Hours

Reference(s)

1. Lt. Dr S Rajan and Capt. Dr R Latha, NCC Master, Dream Book Publishing, 2024.
2. R. Gupta, NCC National Cadet Corps A, B & C-Certificate Examination Book, 22nd edition, Ramesh Publishing House, 2022.
3. Singh and Neeraj, A Hand Book of NCC, Kanti Prakashan Publishing, 5th edition, 2021.
4. https://nccorissa.org/old/Doc/Ncc-CadetHandbook.pdf

22OBM01 OCCUPATIONAL SAFETY AND HEALTH IN PUBLIC HEALTH EMERGENCIES 3 0 0 3

Course Objectives

- Students will be able to know about Occupational safety and health (OSH)
- Students will be able to discuss about risks faced by emergency responders during disease outbreaks and other emergencies
- Students will be able to create awareness on necessary strategies for managing OSH in emergency situations

Programme Outcomes (POs)

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.

PO7: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO11: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

1. Practice the occupational safety measures by the scientific knowledge to overcome the risks faced by emergency responders
2. Apply appropriate strategies and tools in Occupational safety and healthcare
3. Analyse common risks for safety and health in emergencies
4. Adapt appropriate occupational safety practices in chemical accidents
5. Guide Occupational safety measures in radiation incidents

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1		3	2	1			1				2		
2		2	2	2			1				2		
3		3	2	2			1				2		
4		2	2	2			1				2		
5		3	2	2			1				2		

UNIT I **9 Hours**

MANAGEMENT ASPECTS

Management system approach to occupational safety and health hazards and risks – rights, duties and responsibilities of employers and workers during outbreaks and emergencies – Emergency responders health monitoring and surveillance

UNIT II **9 Hours**

STRATEGIES AND TOOLS

International Health Regulations, 2005 – Incident command system for managing outbreaks and emergencies – Occupational safety and health controls – Strategies for infection prevention and control

UNIT III **9 Hours**

COMMON RISKS FOR SAFETY AND HEALTH IN EMERGENCIES

Vector-borne diseases, water and food-borne diseases, Vaccine-preventable diseases – Heat stress - Slips, trips and falls - Road traffic injuries – Ergonomic hazards - Violence – Psychological stress during outbreaks and injuries

UNIT IV **9 Hours**

OCCUPATIONAL SAFETY AND HEALTH IN CHEMICAL INCIDENTS

Emergencies caused by chemical incidents – occupational safety and health hazards and risks of chemicals – Personal Protective Equipment – Decontamination of emergency response personnel – medical surveillance of emergency responders

UNIT V **9 Hours**

OCCUPATIONAL SAFETY AND HEALTH IN RADIATION INCIDENTS

Sources and scenarios of radiation incidents – guidance for protection of emergency responders - Occupational health surveillance of persons occupationally exposed to radiation in emergencies

Total: 45 Hours

Reference(s)

1. Emergency responder health monitoring and surveillance. National Response Team technical assistance document. Atlanta (GA): National Institute for Occupational Safety andHealth; 2012.
2. Emergency response framework (ERF). Geneva: World Health Organization; 2013
3. Guidelines on occupational safety and health management systems, second edition.Geneva: International Labour Organization; 2009.
4. OSH management system: a tool for continual improvement. Geneva: International Labour Organization; 2011
5. OECD Environmental Outlook to 2050: the consequences of inaction. Paris: Organization for Economic Co-operation and Development; 2012.

22OBM02 **AMBULANCE AND EMERGENCY MEDICAL SERVICE MANAGEMENT** **3 0 0 3**

Course Objectives

- Understand the ambulance & transport management and allied services.
- Compare the ambulance design and equipment, transportation and corporate Profit.
- Carry-out various acts governing transport management.

Programme Outcomes (POs)

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

Course Outcomes (COs)

1. Identify ambulance services, types and allied services
2. Formulate minimum ambulance rescue equipment and developing a transportation Strategy.
3. Understand the Emergency response team, Transportation interfaces, Transportation Service Characteristics& regulatory reforms involved.
4. Identify ambulance services, types and allied services
5. Formulate minimum ambulance rescue equipment and developing a transportation Strategy.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2	2											
2	2												
3		2											
4	2	2											
5	2												

UNIT I **9 Hours**
INTRODUCTION
Introduction-transportation ambulance types-Advanced Life Support Ambulance-Basic Life Support Ambulance-Patient Transport Ambulance-Emergency services-Ambulances-Allied services-telephone management

UNIT II **9 Hours**
AMBULANCE DESIGN AND EQUIPMENT
Design and Equipment of Ambulances -Minimum Ambulance Rescue Equipment-Emergency drugs medicines Recruitment validation Training to handle in house Ambulance emergency procedures Checklist measures Roles of paramedics, midwives, community nurses, hospice workers in emergency handling via ambulance.

UNIT III **9 Hours**

TRANSPORTATION REGULATION FOR EMERGENCY MEDICAL SERVICE

Crisis Management-Anxiety & Stress Management-the Emergency response team-police assistance- Information handling & processing-Establishing customer service levels - Developing and Reporting customer service standards - Impediments to an Effective customer Service strategy - Improving customer Service Performance Transportation

UNIT IV **9 Hours**

AMBULANCE PREVENTIVE MAINTENANCE

Legal obligations Switch Console Front, Main Electrical, Patient Compartment Climate Oxygen system On board Suction system 110/12 VOLT system, Modular Body, Medical Equipment - Cot & Stretcher, safety belts-driver(s), passenger, Patients-child restraint device-incubator

UNIT V **9 Hours**

THE MOTOR VEHICLE ACT

The Motor Vehicle Act, 1988- Rules of the road Regulations 1989- Overall Dimensions of Motor Vehicles (Prescription of conditions for exemption) Rules 1991-Use of Red light on the top front of the vehicle

Total: 45 Hours

Reference(s)

1. Fawcett,"Supply Chain Management", Pearson Education India, 01-Sep-2008 - 600 pages.
2. B. Feroz, A. Mehmood, H. Maryam, S. Zeadally, C. Maple and M. A. Shah, "Vehicle-Life Interaction in Fog-Enabled Smart Connected and Autonomous Vehicles," in IEEE Access, vol. 9, pp. 7402-7420, 2021, doi: 10.1109/ACCESS.2020.3049110.
3. R. Jin, T. Xia, X. Liu, T. Murata and K. -S. Kim, "Predicting Emergency Medical Service Demand With Bipartite Graph Convolutional Networks," in IEEE Access, vol. 9, pp. 9903-9915, 2021, doi: 10.1109/ACCESS.2021.3050607.
4. Les Pringle,"Call the Ambulance",Transworld Publishers, 2010.
5. Edward J. Bardi, John Joseph Coyle, Robert A. Novack"Management of Transportation", Thomson/South-Western, 2006

22OBM03 HOSPITAL AUTOMATION 3 0 0 3

Course Objectives

- Introduce the concepts of hospital systems and need for central monitoring
- Exemplify the power generation, utility and protection systems.
- Apply the distributed and central monitoring functions in hospital environment

Programme Outcomes (POs)

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.

Course Outcomes (COs)

1. Identify the factors in central power generating and monitoring systems
2. Analyze the sensors and actuators for the automation systems
3. Classify the equipment types and its applications.
4. Apply software tools and digital computer for monitoring of parameters and medical data handling
5. Design central monitoring station for hospitals for control and surveillance applications

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2												
2		2											
3		2											
4		2											
5	3												

UNIT I 9 Hours

AUTOMATION IN HEALTHCARE

Introduction to automation Role of automation in healthcare Remote Patient Monitoring Maximizing resources on patient care Reducing variability, Automating clinician and patient interactions through products.

UNIT II 9 Hours

POWER GENERATION AND MEDICAL GAS PRODUCTION

Power generator, Battery : Maintenance and troubleshooting, energy conservation and monitoring system - Automation in dryer, compressor, air conditioning, lighting, heating systems.

UNIT III 9 Hours

AUTOMATION IN PIPING

Monitoring of flow and pressure of medical gas System components Vacuum control units Automatic changeover system - Types of Outlets - Leakage test- Prevention and safety automation.

UNIT IV
INSTRUMENTATION SYSTEMS **9 Hours**
Optical sensors , Pressure Sensors - Ultrasonic Sensors - Tactile Sensors - Thermal sensors -Biosensor - Linear Actuators, Central monitoring station - Alarm system - Regulation and standards.

UNIT V
APPLICATIONS **9 Hours**
Business intelligence & executive dashboards - Radio-Frequency Identification (RFID)- based patient and asset tracking solutions - Tablet-based applications for bed side access to doctors/nurses - Healthcare CRM for patient relationship management - Patient kiosk, tele-health – HIS integration.

Total: 45 Hours

Reference(s)

1. Khandpur RS, Handbook of Biomedical Instrumentation, Prentice Hall of India, New Delhi, 3 rd edition, 2014.
2. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education India, Delhi, 4 th edition 2008
3. Curtis Johnson D Process Control Instrumentation Technology, Prentice Hall of India, 8th edition 2006
4. John V. Grimaldi and Rollin H. Simonds., Safety Management, All India Travelers Book seller, New Delhi, 1989
5. N.V. Krishnan, Safety in Industry, Jaico Publisher House, 1996.

22OAG01 RAINWATER HARVESTING TECHNIQUES 3 0 0 3

Course Objectives

- To enhance the awareness about water resources management and conservation.
- To acquire knowledge about water harvesting techniques and their implementation. To practice the design aspects of sustainable rainwater harvesting solutions for communities.

Programme Outcomes (POs)

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.

PO7: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

Course Outcomes (COs)

1. Assess the sources, availability and challenges in water resources management
2. Assess various water harvesting systems in practice
3. Execute design considerations for comparing surface runoff harvesting methods
4. Compare the characteristics and impacts of flood water harvesting techniques
5. Evaluate various rainwater harvesting methods for groundwater recharging

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1						3						
2	2	1											
3	1	1	3				2						
4	1	2	3				2						
5	1	1	3				2						

UNIT I 8 Hours

WATER RESOURCES

Global water distribution – primary and secondary sources of water – technical, social and cultural aspects; Global challenges in water and climate – water scarcity – water pollution – Indian scenario; Water resources management – public participation – integrated approach; Water governance – water sharing plans – policy, schemes and concerns

UNIT II 10 Hours

WATER CONSERVATION CHALLENGES

Principles of water harvesting for rural and urban – collection at micro and macro levels, flow control, storage and uses; Rainwater harvesting systems – traditional and contemporary – groundwater recharge; Water resources inventory – site analysis – database collection – water allocation principles based on demand and supply; Traditional water harvesting systems – practices in India – references in old texts – reasons for their deterioration – way forward; Watershed-based approach – project planning at micro and macro levels – community participation – rain centres.

UNIT III **9 Hours**

SURFACE RUNOFF HARVESTING

Short-term and micro-level harvesting techniques for runoff – terracing and bunding – rock and ground catchments; Long-term and macro-level harvesting techniques for runoff – farm ponds – percolation ponds and nala bunds; Design considerations – site selection – selection of runoff coefficients – computation of rainwater runoff volume – hydrograph analysis – cost estimation; Design of storage structures – storage capacity – selection of component – methods of construction

UNIT IV **9 Hours**

FLOOD WATER HARVESTING

Floods – causes of urban floods and droughts – characteristics of water spread – impacts; Flood water harvesting – permeable rock dams – water spreading bunds – flood control reservoir; Design considerations – computation of flood water quantity; Trenching and Diversion Structures – types – site selection – design criteria – most economic section – design consideration of ditch system

UNIT V **9 Hours**

GROUNDWATER HARVESTING

Rooftop rainwater harvesting – recharge pit – recharge trench – tube well – recharge well; artificial recharge – gully plug – dug well – percolation tank – nala bunds – recharge shaft; Groundwater harvesting – aquifer characteristics – subsurface techniques – infiltration wells – recharge wells – groundwater dams; Design of drainage system – types – design criteria – filter design – causes of failures

Total: 45 Hours

Reference(s)

1. Theib YO, Dieter P, Ahmed YH, Rainwater Harvesting for Agriculture in the Dry Areas, CRC Press, Taylor and Francis Group, London, 2012.
2. Lancaster, Brad. Rainwater Harvesting for Drylands and Beyond, Volume 1, 3rd edition, Rainsource Press. 2019.
3. Das M, Open Channel Flow, Prentice Hall of India Pvt. Ltd., New Delhi, 2008.
4. Michael AM, Ojha TP, Principles of Agricultural Engineering, Volume II, 4th Edition, Jain Brothers, New Delhi, 2003.
5. Suresh R, Soil and Water Conservation Engineering, Standard Publisher Distributors, New Delhi, 2014.
6. Singh G, Venkataramanan C, Sastry G, Joshi BP, Manual of Soil and Water Conservation Practices, CSWCR&TI, Dehradun, 1990

22OEE01 VALUE ENGINEERING 3 0 0 3

Course Objectives

- To understand the concept of value engineering in order to reduce cost of product or process or service.
- To implement creative and innovative techniques using FAST diagram.
- To study benefits of Value Engineering for various industries.

Programme Outcomes (POs)

PO9: 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.
PO10: 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.
PO11: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Demonstrate the knowledge and technical skills in software development.
PSO2: Develop practical competencies in Software and Hardware Design

Course Outcomes (COs)

1. Apply the concepts of value and value engineering to prepare a job plan.
2. Analyze the cost and worth of a product/service using the principles of economics.
3. Evaluate the value of a product/service to take managerial decisions.
4. Apply the soft skills in understanding team building, team work and report writing.
5. Asses the functions and values of product/services in industries using case studies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1										3	1	1	1
2									1	3	1	1	1
3										3	1	1	1
4									1	3	2	1	1
5									2	3	1	1	1

UNIT I 8 Hours
INTRODUCTION TO VALUE ENGINEERING

Historical perspective of Value Engineering, Aims and objectives of Value Engineering, Concept of Value, Value Engineering concerned with Economic Value, Value Engineering Job plan.

UNIT II 9 Hours
FUNCTIONAL ANALYSIS

Function-Cost-Worth analysis: Function Analysis System Technique (FAST); Review of principles of engineering economics

UNIT III **10 Hours**

EVALUATION OF VALUE ENGINEERING

Evaluation of function, Problem setting system, problem solving system, setting and solving management - decision - type and services problem, evaluation of value

UNIT IV **9 Hours**

HUMAN ASPECTS IN VALUE ENGINEERING

Team building; Life cycle costing; Managing Value Engineering Study; Value Engineering Report writing; Presentation Skill - Individual and Team Presentations; Implementation and follow-up.

UNIT V **9 Hours**

BENEFITS OF VALUE ENGINEERING

Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe Value Engineering Case studies in the Industries like Manufacturing; Construction; Health Care; Process.

Total: 45 Hours

Reference(s)

1. Anil Kumar Mukhopadhyaya, Value Engineering Mastermind - From Concepts to Certification, Response. Business Books from SAGE, Los Angeles / London / New Delhi / Singapore / Washington DC, 2014.
2. Anil Kumar Mukhopadhyaya, Value Engineering -Concepts, Techniques and Applications, Response Books, A Division of SAGE Publications, New Delhi / Thousand Oaks / London, 2003
3. R. D. Miles, Techniques of Value analysis & Engineering, McGraw Hill, 2000.
4. E. Midge Arthur, Value Engineering -A Systematic Approach, McGraw Hill Book Co., New York, 2000.
5. Zimmerman, Value Engineering - A Practical Approach, CBS Publishers & Distributors, New Delhi, 2000.

22OEE02 ELECTRICAL SAFETY 3 0 0 3

Course Objectives

- To provide knowledge on basics of electrical fire and statutory requirements for electrical safety
- To understand the causes of accidents due to electrical hazards
- To know the various protection systems in Industries from electrical hazards
- To know the importance of earthing
- To distinguish the various hazardous zones and applicable fire proof electrical devices

Programme Outcomes (POs)

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.
PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.
PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.
PO8: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

Course Outcomes (COs)

1. Analyze the basic concepts in electrical circuit and hazards involved in it.
2. Analyze the electrical hazards in the workplace and its impacts.
3. Examine the operation of various protection systems from electrical hazards.
4. Analyze the various safety procedures involved in the industries.
5. Explore the different hazardous zones in Industries and their safety measures.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	1	1				2	1						
2	1	1				1	2	2					
3	1	1				2		2					
4	1	1				2	1						
5	1	1				2	1	2					

UNIT I **9 Hours**
INTRODUCTION
Objectives of safety and security measures - Hazards associated with electric current and voltage - principles of electrical safety - working principles of major electrical equipment - Typical supply situation - Indian electricity act and rules - statutory requirements from electrical inspectorate-International standards on electrical safety.

UNIT II **9 Hours**
ELECTRICAL HAZARDS
Primary and secondary hazards-shocks, burns, scalds, falls-human safety in the use of electricity- Energy leakage-clearances and insulation-classes of insulation-voltage classifications-excess energy- current surges- over current and short circuit current-heating effects of current- Lightning, hazards, lightning arrestor, - national electrical safety code ANSI.

UNIT III **9 Hours**
ELECTRICAL SAFETY EQUIPMENT
Fuse, circuit breakers and overload relays - safe distance from lines - capacity and protection of conductor joints and connections, overload and short circuit protection - earth fault protection. FRLS insulation - insulation and continuity test - system grounding - equipment grounding - earth leakage circuit breaker (ELCB) - ground fault circuit interrupter - electrical guards - Personal protective equipment.

UNIT IV **9 Hours**

ELECTRICAL SAFETY OPERATION AND MAINTENANCE

Role of environment in selection - protection and interlock - discharge rod and earthing devices - safety in the use of portable tools - preventive maintenance - installation – earthing, specifications, earth resistance, earth pit maintenance - Fire Extinguishers - CO2 and Dry Powder schemes.

UNIT V **9 Hours**
HAZARDOUS AREAS
Classification of hazardous zones-intrinsically safe and explosion proof electrical apparatus-increase safe equipment-their selection for different zones-temperature classification-grouping of gases-use of barriers and isolators-equipment certifying agencies – electrical safety standards. (IS, API and OSHA standards)

Total: 45 Hours

Reference(s)

1. Fordham Cooper, W., “Electrical Safety Engineering, Butterworth and Company”, London, Third Edition, 2013.
2. “Indian Electricity Act and Rules”, Government of India.
3. “Power Engineers”, Handbook of TNEB, Chennai, 2010.
4. “Accident prevention manual for industrial operations”, N.S.C., Chicago, 1982.
5. John Cadick, P.E., Mary Capelli-Schellpfeffer, Dennis K. Neitzel, Al Winfield, “Electrical Safety Handbook”, Fourth Edition, Tata Mcgraw Hill, 2014.