B.E. (Computer Science and Engineering)

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
SATHYAMANGALAM - 638401 ERODE DISTRICT TAMILNADU INDIA
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Stay Ahead

CONTENTS

VISION OF THE DEPARTMENT

To excel in the field of Computer Science and Engineering, to meet the emerging needsof the industry, society, and beyond.

MISSION OF THE DEPARTMENT

1. To impart need based education to meet the requirements of the industry and society.
2. To equip students for emerging technologies with global standards and ethics that aid insocietal sustainability.
3. To build technologically competent individuals for industry and entrepreneurialventures by providing infrastructure and human resources.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs)

I. Graduates will apply computer science and engineering principles and practices to solvereal-world problems with their technical competence.

II. Graduates will have the domain knowledge to pursue higher education and apply cuttingedge research to develop solutions for socially relevant problems.

III. Graduates will communicate effectively and practice their profession with ethics,integrity, leadership, teamwork, and social responsibility, and pursue lifelong learning throughout their careers.

PROGRAM OUTCOMES (POs)

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

b) 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.

c) 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 public health and safety, and the cultural, societal, and environmental considerations.

d) 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.

e) 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.

f) 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

g) 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.

h) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

i) Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

j) 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.

k) 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.

l) 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.

PROGRAMME SPECIFIC OUTCOMES (PSOs)

m) Apply suitable algorithmic thinking and data management practices to design develop, and evaluate effective solutions for real-life and research problems.

n) Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

MAPPING OF PEOs AND POs

PEOs	Program Outcomes(s)													
	a	b	c	d	e	f	g	h	i	j	k	l	m	n
I	X	X	X	X	X	X	X						X	X
II	X	X	X	X	X	X	X					X		
III								X	X	X	X	X	X	X

(Candidates admitted during the Academic Year 2022-2026)

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

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
22PH102	ENGINEERING PHYSICS	2	0	2	3	4	50	50	100	BS
22CH103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
22GE001	FUNDAMENTALS OF COMPUTING	3	0	0	3	3	40	60	100	ES
22HS001	FOUNDATIONAL ENGLISH	1	0	2	2	3	100	0	100	HSS
22GE004	BASICS OF ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
22HS002	STARTUP MANAGEMENT	1	0	2	2	3	100	0	100	EEC
22CS108	COMPREHENSIVE WORK	0	0	2	1	2	100	0	100	EEC
Total		**14**	**1**	**12**	**21**	**27**	**-**	**-**	**-**	**-**

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
22PH202	ELECTROMAGNETISM AND MODERN PHYSICS	2	0	2	3	4	50	50	100	BS
22CH203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
22GE002	COMPUTATIONAL PROBLEM SOLVING	3	0	0	3	3	40	60	100	ES
22GE003	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
22CS206	DIGITAL COMPUTER ELECTRONICS	3	0	2	4	5	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
22HS003*	தமிழர் மரபு HERITAGE OF TAMILS	1	0	0	1	1	100	0	100	HSS
Total		**17**	**1**	**10**	**23**	**28**	**-**	**-**	**-**	**-**

*The Lateral entry students have to complete this course during IV semester

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS301	PROBABILITY, STATISTICS AND QUEUING	3	1	0	4	4	40	60	100	BS
22CS302	DATA STRUCTURES I	3	0	2	4	5	50	50	100	PC
22CS303	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	3	3	40	60	100	ES
22CS304	PRINCIPLES OF PROGRAMMING LANGUAGES	3	0	2	4	5	50	50	100	PC
22CS305	SOFTWARE ENGINEERING	3	0	0	3	3	40	60	100	PC
22HS004	HUMAN VALUES AND ETHICS	2	0	0	2	2	100	0	100	HSS
22HS005	SOFT SKILLS AND EFFECTIVE COMMUNICATION	0	0	2	1	2	100	0	100	HSS
22HS006	தமிழரும் தொழில்நுட்பமும் Tamils and Technology	1	0	0	1	1	100	0	100	HSS
Total		**18**	**1**	**6**	**22**	**25**	**-**	**-**	**-**	**-**

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS401	DISCRETE MATHEMATICS	3	1	0	4	4	40	60	100	ES
22CS402	DATA STRUCTURES II	3	0	2	4	5	50	50	100	PC
22CS403	OPERATING SYSTEMS	3	1	0	4	4	40	60	100	PC
22CS404	WEB TECHNOLOGY AND FRAMEWORKS	2	0	2	3	4	50	50	100	PC
22CS405	DATABASE MANAGEMENT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	-	-	-	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	100	0	100	HSS
Total		**-**	**-**	**-**	**23**	**-**	**-**	**-**	**-**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS501	THEORY OF COMPUTATION	3	1	0	4	4	40	60	100	ES
22CS502	COMPUTER NETWORKS	3	0	2	4	5	50	50	100	PC
22CS503	MACHINE LEARNING ESSENTIALS	3	0	2	4	5	50	50	100	PC
22CS504	FREE OPEN SOURCE SOFTWARE	2	0	2	3	4	50	50	100	PC
	PROFESSIONAL ELECTIVE II	-	-	-	3	-	-	-	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22CS507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**22**	**-**	**-**	**-**	**-**	**-**

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS601	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	3	3	40	60	100	PC
22CS602	PRINCIPLES OF COMPILER DESIGN	3	1	0	4	4	40	60	100	PC
22CS603	CLOUD COMPUTING	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE III	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IV	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE V	-	-	-	3	-	-	-	100	PE
22CS607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**21**	**14**	**-**	**-**	**-**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS701	DISTRIBUTED AND PARALLEL COMPUTING	3	0	0	3	3	40	60	100	PC
22CS702	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE VI	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE VII	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE VIII	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IX	-	-	-	3	-	-	-	100	PE
22CS707	PROJECT WORK I	0	0	4	2	4	60	40	100	EEC
TOTAL		-	-	-	**21**	-	-	-	-	-

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	-	-	-	-

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks			Category
							CIA	SEE	Total	
ELECTIVES										
22HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
22HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
22HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
22HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
22HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
VERTICAL I - DATA SCIENCE										
22CS001	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22CS002	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CS003	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CS004	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CS005	NATURAL LANGUAGE PROCESSING	2	0	2	3	4	50	50	100	PE
22CS006	COMPUTER VISION	2	0	2	3	4	50	50	100	PE
VERTICAL II - FULL STACK DEVELOPMENT										
22CS007	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22CS008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CS009	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
22CS010	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22CS011	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
22CS012	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL III - CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
22CS013	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
22CS014	CLOUD SERVICES AND DATA MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CS015	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
22CS016	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
22CS017	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
22CS018	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE

VERTICAL IV - CYBER SECURITY AND DATA PRIVACY										
22CS019	CYBER SECURITY	3	0	0	3	3	40	60	100	PE
22CS020	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE
22CS021	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
22CS022	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
22CS023	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22CS024	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
VERTICAL V - CREATIVE MEDIA										
22CS025	MULTIMEDIA AND ANIMATION	2	0	2	3	4	50	50	100	PE
22CS008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CS026	AUGMENTED REALITY AND VIRTUAL REALITY	2	0	2	3	4	50	50	100	PE
22CS027	GAME DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22CS028	VIDEO CREATION AND EDITING	2	0	2	3	4	50	50	100	PE
22CS029	DIGITAL MARKETING	3	0	0	3	3	40	60	100	PE
VERTICAL VI- ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING										
22CS030	KNOWLEDGE ENGINEERING	3	0	0	3	3	40	60	100	PE
22CS031	SOFT COMPUTING	3	0	0	3	3	40	60	100	PE
22CS004	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CS032	TEXT AND SPEECH ANALYSIS	3	0	0	3	3	40	60	100	PE
22CS033	OPTIMIZATION TECHNIQUES	3	0	0	3	3	40	60	100	PE
22CS034	ETHICS AND AI	3	0	0	3	3	40	60	100	PE
VERTICAL VII- DIVERSE COURSES										
22CS035	SOFTWARE QUALITY ASSURANCE	3	0	0	3	3	40	60	100	PE
22CS036	XML AND WEB SERVICES	3	0	0	3	3	40	60	100	PE
22CS037	INFORMATION STORAGE MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CS038	MOBILE APPLICATION DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22CS039	INTERNET OF THINGS	3	0	0	3	3	40	60	100	PE
22CS040	BUSINESS ANALYTICS	3	0	0	3	3	40	60	100	PE

HONOUR VERTICAL										
VERTICAL I - DATA SCIENCE										
22CSH01	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22CSH02	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CSH03	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CSH04	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CSH05	NATURAL LANGUAGE PROCESSING	2	0	2	3	4	50	50	100	PE
22CSH06	COMPUTER VISION	2	0	2	3	4	50	50	100	PE
MINOR VERTICAL										
VERTICAL I - DATA SCIENCE										
22CSM01	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22CSM02	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CSM03	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CSM04	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CSM05	NATURAL LANGUAGE PROCESSING	2	0	2	3	4	50	50	100	PE
22CSM06	COMPUTER VISION	2	0	2	3	4	50	50	100	PE
OPEN ELECTIVE COURSES										
2OCE01	ENERGY CONSERVATION AND MANAGEMENT	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
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
22OGE01	PRINCIPLES OF MANAGEMENT	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	RAIN WATER 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
22OCB01	INTERNATIONAL BUSINESS MANAGEMENT	3	0	0	3	3	40	60	100	OE
ONE CREDIT COURSES										
22CS0XA	EDGE AI FOR DATA SCIENCE	1	0	0	1	-	100	0	100	EEC
22CS0XB	GENERATIVE ADVERSARIAL NETWORKS FOR DATA SCIENCE	1	0	0	1	-	100	0	100	EEC
22CS0XC	AutoML FOR DATA SCIENCE	1	0	0	1	-	100	0	100	EEC
22CS0XD	FULL STACK WEB DEVELOPMENT	1	0	0	1	-	100	0	100	EEC
22CS0XE	GENERATIVE AI	1	0	0	1	-	100	0	100	EEC

22CS0XF	3D ANIMATIONS	1	0	0	1	-	100	0	100	EEC
22CS0XG	CLOUD DEPLOYMENT	1	0	0	1	-	100	0	100	EEC
22CS0XH	EXTENDED REALITY	1	0	0	1	-	100	0	100	EEC
22CS0XI	AWS SAGE MAKER MACHINE LEARNING ENGINEERING	1	0	0	1	-	100	0	100	EEC
22CS0XJ	REAL-TIME AI PROGRAMMING USING MOJO	1	0	0	1	-	100	0	100	EEC
22CS0XK	MODELLING TIME SERIES AND SEQUENTIAL DATA	1	0	0	1	-	100	0	100	EEC
22CS0XL	BUSINESS INTELLIGENCE USING POWER BI	1	0	0	1	-	100	0	100	EEC
22CS0XM	SYSTEM SECURITY - AN INDUSTRY PERSPECTIVE	1	0	0	1	-	100	0	100	EEC

CS – Department Code

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	10	10	4						24	15	15%	20%
2	ES	6	10	4	4	4				27	17	15%	20%
3	HSS	3	3	3						9	6	5%	10%
4	PC			11	15	11	11	7		55	34	30%	40%
5	PE				3	6	9	12		30	18	15%	20%
6	EEC	2			1	1	1	2	10	18	10	5%	10%
Total		21	23	22	23	22	21	21	10	163	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course

(Candidates admitted during the Academic Year 2023-2027)

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

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
22PH102	ENGINEERING PHYSICS	2	0	2	3	4	50	50	100	BS
22CH103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
22GE001	FUNDAMENTALS OF COMPUTING	3	0	0	3	3	40	60	100	ES
22HS001	FOUNDATIONAL ENGLISH	1	0	2	2	3	100	0	100	HSS
22GE004	BASICS OF ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
22HS002	STARTUP MANAGEMENT	1	0	2	2	3	100	0	100	EEC
22CS108	COMPREHENSIVE WORK	0	0	2	1	2	100	0	100	EEC
Total		**14**	**1**	**12**	**21**	**27**	-	-	-	-

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
22PH202	ELECTROMAGNETISM AND MODERN PHYSICS	2	0	2	3	4	50	50	100	BS
22CH203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
22GE002	COMPUTATIONAL PROBLEM SOLVING	3	0	0	3	3	40	60	100	ES
22GE003	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
22CS206	DIGITAL COMPUTER ELECTRONICS	3	0	2	4	5	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
22HS003*	தமிழர் மரபு HERITAGE OF TAMILS	1	0	0	1	1	100	0	100	HSS
Total		**17**	**1**	**10**	**23**	**28**	-	-	-	-

*The Lateral entry students have to complete this course during IV semester

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS301	PROBABILITY, STATISTICS AND QUEUING	3	1	0	4	4	40	60	100	BS
22CS302	DATA STRUCTURES I	3	0	2	4	5	50	50	100	PC
22CS303	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	3	3	40	60	100	ES
22CS304	PRINCIPLES OF PROGRAMMING LANGUAGES	3	0	2	4	5	50	50	100	PC
22CS305	SOFTWARE ENGINEERING	3	0	0	3	3	40	60	100	PC
22HS004	HUMAN VALUES AND ETHICS	2	0	0	2	2	100	0	100	HSS
22HS005	SOFT SKILLS AND EFFECTIVE COMMUNICATION	0	0	2	1	2	100	0	100	HSS
22HS006	தமிழரும் தொழில்நுட்பமும் Tamils and Technology	1	0	0	1	1	100	0	100	HSS
Total		**18**	**1**	**6**	**22**	**25**	**-**	**-**	**-**	**-**

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS401	DISCRETE MATHEMATICS	3	1	0	4	4	40	60	100	ES
22CS402	DATA STRUCTURES II	3	0	2	4	5	50	50	100	PC
22CS403	OPERATING SYSTEMS	3	1	0	4	4	40	60	100	PC
22CS404	WEB TECHNOLOGY AND FRAMEWORKS	2	0	2	3	4	50	50	100	PC
22CS405	DATABASE MANAGEMENT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	-	-	-	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	100	0	100	HSS
Total		**-**	**-**	**-**	**23**	**-**	**-**	**-**	**-**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS501	THEORY OF COMPUTATION	3	1	0	4	4	40	60	100	PC
22CS502	COMPUTER NETWORKS	3	0	2	4	5	50	50	100	PC
22CS503	MACHINE LEARNING ESSENTIALS	3	0	2	4	5	50	50	100	PC
22CS504	FREE OPEN SOURCE SOFTWARE	2	0	2	3	4	50	50	100	PC
	PROFESSIONAL ELECTIVE II	-	-	-	3	-	-	-	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22CS507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**22**	**-**	**-**	**-**	**-**	**-**

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS601	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	3	3	40	60	100	PC
22CS602	PRINCIPLES OF COMPILER DESIGN	3	1	0	4	4	40	60	100	PC
22CS603	CLOUD COMPUTING	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE III	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IV	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE V	-	-	-	3	-	-	-	100	PE
22CS607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**21**	**14**	**-**	**-**	**-**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS701	DISTRIBUTED AND PARALLEL COMPUTING	3	0	0	3	3	40	60	100	PC
22CS702	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE VI	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE VII	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE VIII	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IX	-	-	-	3	-	-	-	100	PE
22CS707	PROJECT WORK I	0	0	4	2	4	60	40	100	EEC
TOTAL		-	-	-	**21**	-	-	-	-	-

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	-	-	-	-

Code No.	Course	L	T	P	C	Hours / Week	Maximum Marks			Category
							CIA	SEE	Total	
ELECTIVES										
22HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
22HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
22HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
22HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
22HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
VERTICAL I - DATA SCIENCE										
22CS001	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22CS002	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CS003	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CS004	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CS005	NATURAL LANGUAGE PROCESSING	2	0	2	3	4	50	50	100	PE
22CS006	COMPUTER VISION	2	0	2	3	4	50	50	100	PE
VERTICAL II - FULL STACK DEVELOPMENT										
22CS007	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22CS008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CS009	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
22CS010	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22CS011	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
22CS012	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL III - CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
22CS013	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
22CS014	CLOUD SERVICES AND DATA MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CS015	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
22CS016	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
22CS017	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
22CS018	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE

VERTICAL IV - CYBER SECURITY AND DATA PRIVACY										
22CS019	CYBER SECURITY	3	0	0	3	3	40	60	100	PE
22CS020	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE
22CS021	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
22CS022	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
22CS023	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22CS024	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
VERTICAL V - CREATIVE MEDIA										
22CS025	MULTIMEDIA AND ANIMATION	2	0	2	3	4	50	50	100	PE
22CS008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CS026	AUGMENTED REALITY AND VIRTUAL REALITY	2	0	2	3	4	50	50	100	PE
22CS027	GAME DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22CS028	VIDEO CREATION AND EDITING	2	0	2	3	4	50	50	100	PE
22CS029	DIGITAL MARKETING	3	0	0	3	3	40	60	100	PE
VERTICAL VI- ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING										
22CS030	KNOWLEDGE ENGINEERING	3	0	0	3	3	40	60	100	PE
22CS031	SOFT COMPUTING	3	0	0	3	3	40	60	100	PE
22CS004	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CS032	TEXT AND SPEECH ANALYSIS	3	0	0	3	3	40	60	100	PE
22CS033	OPTIMIZATION TECHNIQUES	3	0	0	3	3	40	60	100	PE
22CS034	ETHICS AND AI	3	0	0	3	3	40	60	100	PE
VERTICAL VII- DIVERSE COURSES										
22CS035	SOFTWARE QUALITY ASSURANCE	3	0	0	3	3	40	60	100	PE
22CS036	XML AND WEB SERVICES	3	0	0	3	3	40	60	100	PE
22CS037	INFORMATION STORAGE MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CS038	MOBILE APPLICATION DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22CS039	INTERNET OF THINGS	3	0	0	3	3	40	60	100	PE
22CS040	BUSINESS ANALYTICS	3	0	0	3	3	40	60	100	PE
HONOUR VERTICAL										
VERTICAL I - DATA SCIENCE										
22CSH01	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE

22CSH02	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CSH03	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CSH04	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CSH05	NATURAL LANGUAGE PROCESSING	2	0	2	3	4	50	50	100	PE
22CSH06	COMPUTER VISION	2	0	2	3	4	50	50	100	PE
OPEN ELECTIVE COURSES										
2OCE01	ENERGY CONSERVATION AND MANAGEMENT	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
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
22OGE01	PRINCIPLES OF MANAGEMENT	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	RAIN WATER 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
22OCB01	INTERNATIONAL BUSINESS MANAGEMENT	3	0	0	3	3	40	60	100	OE
ONE CREDIT COURSES										
22CS0XA	EDGE AI FOR DATA SCIENCE	1	0	0	1	-	100	0	100	EEC
22CS0XB	GENERATIVE ADVERSARIAL NETWORKS FOR DATA SCIENCE	1	0	0	1	-	100	0	100	EEC
22CS0XC	AutoML FOR DATA SCIENCE	1	0	0	1	-	100	0	100	EEC
22CS0XD	FULL STACK WEB DEVELOPMENT	1	0	0	1	-	100	0	100	EEC
22CS0XE	GENERATIVE AI	1	0	0	1	-	100	0	100	EEC
22CS0XF	3D ANIMATIONS	1	0	0	1	-	100	0	100	EEC
22CS0XG	CLOUD DEPLOYMENT	1	0	0	1	-	100	0	100	EEC
22CS0XH	EXTENDED REALITY	1	0	0	1	-	100	0	100	EEC
22CS0XI	AWS SAGE MAKER MACHINE LEARNING ENGINEERING	1	0	0	1	-	100	0	100	EEC
22CS0XJ	REAL-TIME AI PROGRAMMING USING MOJO	1	0	0	1	-	100	0	100	EEC
22CS0XK	MODELLING TIME SERIES AND SEQUENTIAL DATA	1	0	0	1	-	100	0	100	EEC
22CS0XL	BUSINESS INTELLIGENCE USING POWER BI	1	0	0	1	-	100	0	100	EEC
22CS0XM	SYSTEM SECURITY - AN INDUSTRY PERSPECTIVE	1	0	0	1	-	100	0	100	EEC

CS – Department Code

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	10	10	4						24	15	15%	20%
2	ES	6	10	3	4	4				27	17	15%	20%
3	HSS	2	3	4						9	6	5%	10%
4	PC			11	15	11	11	7		55	34	30%	40%
5	PE				3	6	9	12		30	18	15%	20%
6	EEC	3			1	1	1	2	10	18	11	5%	10%
Total		21	23	22	23	22	21	21	10	163	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course

(Candidates admitted during the Academic Year 2024-2028)

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

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
22PH102	ENGINEERING PHYSICS	2	0	2	3	4	50	50	100	BS
22CH103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
22GE001	FUNDAMENTALS OF COMPUTING	3	0	0	3	3	40	60	100	ES
22HS001	FOUNDATIONAL ENGLISH	1	0	2	2	3	50	50	100	HSS
22GE004	BASICS OF ELECTRONICS ENGINEERING	2	0	2	3	4	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	40	60	100	HSS
Total		**15**	**1**	**10**	**21**	**26**	-	-	-	-

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22MA201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
22PH202	ELECTROMAGNETISM AND MODERN	2	0	2	3	4	50	50	100	BS
22CH203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
22GE002	COMPUTATIONAL PROBLEM SOLVING	3	0	0	3	3	40	60	100	ES
22GE003	BASICS OF ELECTRICAL ENGINEERING	2	0	2	3	4	50	50	100	ES
22CS206	DIGITAL COMPUTER ELECTRONICS	3	0	2	4	5	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	50	50	100	HSS
22HS006*	தமிழரும் தொழில்நுட்பமும் TAMILS AND TECHNOLOGY	1	0	0	1	1	40	60	100	HSS
22HS009	COCURRICULAR OR EXTRACURRICULAR ACTIVITY	-	-	-	NC	2	100	-	100	HSS
Total		**17**	**1**	**12**	**23**	**30**	-	-	-	-

* 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**	
22CS301	PROBABILITY, STATISTICS AND QUEUING THEORY	3	1	0	4	4	40	60	100	BS
22CS302	DATA STRUCTURES I	3	0	2	4	5	50	50	100	PC
22CS303	COMPUTER ORGANIZATION AND ARCHITECTURE	3	1	0	4	4	40	60	100	ES
22CS304	PRINCIPLES OF PROGRAMMING LANGUAGES	3	0	2	4	5	50	50	100	PC
22CS305	SOFTWARE ENGINEERING	3	0	0	3	3	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	HSS
Total		**17**	**2**	**6**	**22**	**25**	**-**	**-**	**-**	**-**

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS401	DISCRETE MATHEMATICS	3	1	0	4	4	40	60	100	ES
22CS402	DATA STRUCTURES II	3	0	2	4	5	50	50	100	PC
22CS403	OPERATING SYSTEMS	3	1	0	4	4	40	60	100	PC
22CS404	WEB TECHNOLOGY AND FRAMEWORKS	2	0	2	3	4	50	50	100	PC
22CS405	DATABASE MANAGEMENT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	-	-	-	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	-	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL	0	0	2	1	2	60	40	100	HSS
22HS010	SOCIALLY RELEVANT PROJECT	-	-	-	NC	2	100	-	100	HSS
Total		**-**	**-**	**-**	**21**	**-**	**-**	**-**	**-**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS501	THEORY OF COMPUTATION	3	1	0	4	4	40	60	100	ES
22CS502	COMPUTER NETWORKS	3	0	2	4	5	50	50	100	PC
22CS503	MACHINE LEARNING ESSENTIALS	3	0	2	4	5	50	50	100	PC
22CS504	FREE OPEN SOURCE SOFTWARE	3	0	0	3	3	50	50	100	PC
	PROFESSIONAL ELECTIVE II	-	-	-	3	-	-	-	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22CS507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**22**	**-**	**-**	**-**	**-**	**-**

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS601	CRYPTOGRAPHY AND NETWORK SECURITY	3	0	0	3	3	40	60	100	PC
22CS602	PRINCIPLES OF COMPILER DESIGN	3	1	0	4	4	40	60	100	PC
22CS603	CLOUD COMPUTING	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE III	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IV	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE V	-	-	-	3	-	-	-	100	PE
22CS607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**21**	**-**	**-**	**-**	**-**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS701	DISTRIBUTED AND PARALLEL COMPUTING	3	0	0	3	3	40	60	100	PC
22CS702	ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE VI	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE VII	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE VIII	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IX	-	-	-	3	-	-	-	100	PE
22CS707	PROJECT WORK I	0	0	4	2	4	60	40	100	EEC
Total		**-**	**-**	**-**	**21**	**-**	**-**	**-**	**-**	**-**

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22CS801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	**-**	**-**	**-**	**-**

Code No.	Course	L	T	P	C	Hours /Week	Maximum Marks			Category
							CIA	SEE	Total	
ELECTIVES										
22HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	50	50	100	HSS
22HSH01	HINDI	1	0	2	2	3	50	50	100	HSS
22HSG01	GERMAN	1	0	2	2	3	50	50	100	HSS
22HSJ01	JAPANESE	1	0	2	2	3	50	50	100	HSS
22HSF01	FRENCH	1	0	2	2	3	50	50	100	HSS
VERTICAL 1 - DATA SCIENCE										
22CS001	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22CS002	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22CS003	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22CS004	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CS005	NATURAL LANGUAGE PROCESSING	3	0	0	3	3	40	60	100	PE
22CS006	COMPUTER VISION	3	0	0	3	3	40	60	100	PE
VERTICAL II - FULL STACK DEVELOPMENT										
22CS007	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22CS008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CS009	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
22CS010	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22CS011	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
22CS012	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL III - CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
22CS013	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
22CS014	CLOUD SERVICES AND DATA MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CS015	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
22CS016	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
22CS017	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
22CS018	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE

VERTICAL IV - CYBER SECURITY AND DATA PRIVACY										
22CS019	CYBER SECURITY	3	0	0	3	3	40	60	100	PE
22CS020	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE
22CS021	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
22CS022	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
22CS023	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22CS024	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
VERTICAL V - CREATIVE MEDIA										
22CS025	MULTIMEDIA AND ANIMATION	2	0	2	3	4	50	50	100	PE
22CS008	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22CS026	AUGMENTED REALITY AND VIRTUAL REALITY	2	0	2	3	4	50	50	100	PE
22CS027	GAME DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22CS028	VIDEO CREATION AND EDITING	2	0	2	3	4	50	50	100	PE
22CS029	DIGITAL MARKETING	3	0	0	3	3	40	60	100	PE
VERTICAL VI- ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING										
22CS030	KNOWLEDGE ENGINEERING	3	0	0	3	3	40	60	100	PE
22CS031	SOFT COMPUTING	3	0	0	3	3	40	60	100	PE
22CS004	NEURAL NETWORKS AND DEEP LEARNING	2	0	2	3	4	50	50	100	PE
22CS032	TEXT AND SPEECH ANALYSIS	3	0	0	3	3	40	60	100	PE
22CS033	OPTIMIZATION TECHNIQUES	3	0	0	3	3	40	60	100	PE
22CS034	ETHICS AND AI	3	0	0	3	3	40	60	100	PE
VERTICAL VII- DIVERSE COURSES										
22CS035	SOFTWARE QUALITY ASSURANCE	3	0	0	3	3	40	60	100	PE
22CS036	XML AND WEB SERVICES	3	0	0	3	3	40	60	100	PE
22CS037	INFORMATION STORAGE MANAGEMENT	3	0	0	3	3	40	60	100	PE
22CS038	MOBILE APPLICATION DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22CS039	INTERNET OF THINGS	3	0	0	3	3	40	60	100	PE
22CS040	BUSINESS ANALYTICS	3	0	0	3	3	40	60	100	PE
OPEN ELECTIVE COURSES										
22OCE01	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	3	40	60	100	OE

22OEC02	MICROCONTROLLER PROGRAMMING	3 3	0	0	3	3	40	60	100	OE
22OEC03	PRINCIPLES OF COMMUNICATION SYSTEMS	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
22OGE01	PRINCIPLES OF MANAGEMENT	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

ONE CREDIT COURSES										
22CS0XA	EDGE AI FOR DATA SCIENCE	1	0	0	1	-	100	0	100	EEC
22CS0XB	GENERATIVE ADVERSARIAL NETWORKS FOR DATA SCIENCE	1	0	0	1	-	100	0	100	EEC
22CS0XC	AUTOML FOR DATA SCIENCE	1	0	0	1	-	100	0	100	EEC
22CS0XD	FULL STACK WEB DEVELOPMENT	1	0	0	1	-	100	0	100	EEC
22CS0XE	GENERATIVE AI	1	0	0	1	-	100	0	100	EEC
22CS0XF	3D ANIMATIONS	1	0	0	1	-	100	0	100	EEC
22CS0XG	CLOUD DEPLOYMENT	1	0	0	1	-	100	0	100	EEC
22CS0XH	EXTENDED REALITY	1	0	0	1	-	100	0	100	EEC
22CS0XI	AWS SAGE MAKER MACHINE LEARNING ENGINEERING	1	0	0	1	-	100	0	100	EEC
22CS0XJ	REAL-TIME AI PROGRAMMING USING MOJO	1	0	0	1	-	100	0	100	EEC
22CS0XK	MODELLING TIME SERIES AND SEQUENTIAL DATA	1	0	0	1	-	100	0	100	EEC
22CS0XL	BUSINESS INTELLIGENCE USING POWER BI	1	0	0	1	-	100	0	100	EEC
22CS0XM	SYSTEM SECURITY - AN INDUSTRY PERSPECTIVE	1	0	0	1	-	100	0	100	EEC

CS – Department Code

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	10	10	4						24	15	15%	20%
2	ES	6	10	3	4	4				27	17	15%	20%
3	HSS	3	3	2						8	5	5%	10%
4	PC			15	15	11	11	7		59	36	30%	40%
5	PE				3	6	9	12		30	18	15%	20%
6	EEC	2		1	1	1	1	2	10	18	11	5%	10%
Total		21	23	22	23	22	21	21	10	163	100	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course

22MA101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- To impart mathematical modeling to describe and explore real-world phenomena and data.
- To provide basic understanding on Linear, quadratic, power and polynomial, exponential, and multi variable models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of polynomial equations

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. Implement the concepts of mathematical modeling based on linear functions in Engineering.
2. Formulate the real-world problems as a quadratic function model
3. Demonstrate the real-world phenomena and data into Power and Polynomial functions
4. Apply the concept of mathematical modeling of exponential functions in Engineering
5. Develop the identification of multivariable functions in the physical dynamical problems

Articulation Matrix

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

UNIT I **9 Hours**

MATHEMATICS MODELING OF LINEAR FUNCTIONS

The geometry of linear equations - Formation of linear equations: Method of least squares and method of regression - Vector spaces: Basic concepts with examples - Linear combination - Eigen values and vectors.

UNIT II **9 Hours**

MATHEMATICAL MODELING OF QUADRATIC FUNCTIONS

General form of a quadratic function - Basic relationships between the equation and graph of a quadratic function - Sum of squares error and the quadratic function of best fit - Quadratic forms: Matrix form - Orthogonality - Canonical form and its nature.

UNIT III **9 Hours**

MATHEMATICAL MODELING OF POWER AND POLYNOMIAL FUNCTIONS

Characteristics of the graphs of power and polynomial functions - Fitting of power and polynomial functions using the method of least squares - Local maxima and local minima of power and polynomial functions - Power series of functions with real variables, Taylors series, Radius and interval of convergence - Tests of convergence for series of positive terms - Comparison test, ratio test.

UNIT IV **9 Hours**

MATHEMATICAL MODELING OF EXPONENTIAL FUNCTIONS

Concept of exponential growth - Graphs of exponential functions - Relationship between the growth factor and exponential growth or decline - Exponential equations have a variable as an exponent and take the form y = abx through least square approximation - Calculus of exponential functions - Exponential series – Characteristics.

UNIT V **9 Hours**

MATHEMATICAL MODELING OF MULTIVARIABLE FUNCTIONS

Graphing of functions of two variables - Partial derivatives - Total derivatives - Jacobians - Optimization of multivariable functions with constraints - Optimization of multivariable functions without constraints.

Total: 45 + 15 = 60 Hours

Reference(s)

1. Erwin Kreyszig, Advanced Engineering Mathematics, Tenth Edition, Wiley India Private Limited, New Delhi 2016
2. B. S. Grewal, Numerical Methods in Engineering & Science: With Programs in C, C++ & MATLAB, Khanna, 2014
3. S.C. Gupta, V.K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons2020
4. Thomas and Finney, Calculus and analytic Geometry, Fourteenth Edition, By Pearson Paperback, 2018

22PH102 ENGINEERING PHYSICS 2 0 2 3

Course Objectives

- Understand the concept and principle of energy possessed by mechanical system
- Exemplify the propagation and exchange of energy
- Identify the properties of materials based on the energy possession

Programme Outcomes (POs)

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

PO2. 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 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. 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.

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO12. 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. Illustrate the concept and principles of energy to understand mechanical systems
2. Exemplify the types of mechanical oscillations based on vibrational energy
3. Infer the concept of propagation of energy as transverse and longitudinal waves
4. Analyze the exchange of energy and work between the systems using thermodynamic principles
5. Apply the concept of energy and entropy to understand the mechanical properties of materials

Articulation Matrix

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

UNIT I **6 Hours**

CONSERVATION OF ENERGY

Concept of energy - types of energy - conservation of energy Mechanical energy: - translation - rotation - vibration - Kinetic and potential energies - conservation - work and energy - laws of motion - minimization of potential energy - equilibrium - dissipative systems - friction

UNIT II **5 Hours**

VIBRATIONAL ENERGY

Periodic Motion - Simple Harmonic Motion - Energy of the SHM - Pendulum types - Damped oscillations - forced oscillations - natural frequency – resonance

UNIT III **6 Hours**
PROPAGATION OF ENERGY
Transfer of energy - material medium - Transverse wave - Longitudinal wave - standing wave - interference - Doppler effect. Sound waves and its types - characteristics - human voice - reflection - refraction - beats

UNIT IV **7 Hours**
EXCHANGE OF ENERGY
Energy in transit - heat - Temperature - measurement - specific heat capacity and water - thermal expansion - Heat transfer processes. Thermodynamics: Thermodynamic systems and processes - Laws of thermodynamics - Entropy - entropy on a microscopic scale - maximization of entropy

UNIT V **6 Hours**
ENERGY IN MATERIALS
Elastic energy - Structure and bonding - Stress - strain - Tension and compression - elastic limit - Elastic Modulus - Stress - strain diagram - ductility - brittleness - rubber elasticity and entropy

EXPERIMENT 1 **5 Hours**
Assess the physical parameters of different materials for engineering applications like radius, thickness and diameter to design the electrical wires, bridges and clothes

EXPERIMENT 2 **5 Hours**
Evaluate the elastic nature of different solid materials for modern industrial applications like shock absorbers of vehicles

EXPERIMENT 3 **5 Hours**
Analyze the photonic behavior of thin materials for advanced optoelectronic applications like adjusting a patients head, chest and neck positions as a medical tool

EXPERIMENT 4 **5 Hours**
Investigate the phonon behavior of poor conductors for thermionic applications like polymer materials and textile materials

EXPERIMENT 5 **5 Hours**
Assess the elongation of different solid materials for industrial applications like buildings, bridges and vehicles

EXPERIMENT 6 **5 Hours**
Measure the compressibility of different liquids for modern industrial applications like navigation, medicine and imaging

Total: 30 + 30 = 60 Hours

Reference(s)

1. C J Fischer, The energy of Physics Part I: Classical Mechanics and Thermodynamics, Cognella Academic Publishing, 2019
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

22CH103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Understand the origin of elements from the universe
- Outline the properties of elements in the periodic table
- Analyse the different types of bond formed during chemical reactions and its reaction thermodynamics
- Summarize different states of matter based on atomic arrangement

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Understand nuclear transmutation reactions that lead to the formation of elements in the universe
2. Illustrate atomic structure of elements in the periodic table and interpret the periodic trends in properties of elements with its anomaly
3. Apply the conditions for the formation of different types of chemical bonds and predict the minimum energy required for a reaction to occur
4. Analyse endothermic and exothermic processes and exchange of energy during chemical reactions
5. Analyse whether the given matter is a solid, liquid, gas, or plasma and interpret the arrangement of atoms

Articulation Matrix

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

UNIT I **6 Hours**

ORIGIN OF ELEMENTS

Hydrogen - Elements and Sun - Fusion - Hypernova - Supernova - Dying stars - Man-made elements.

UNIT II **6 Hours**

ATOMIC STRUCTURE AND PERIODICITY

Atomic Structure - Electronic configuration - Periodic Table - Periodic trends in properties of elements - Anomalous behaviour in periodicity.

UNIT III **6 Hours**

CHEMICAL BONDING

Octet rule & its limitations - Types of chemical bonds - Bond energy - Bond cleavage - Activation energy of reactions.

UNIT IV **6 Hours**

REACTION THERMODYNAMICS

Conservation of energy - Endothermic reactions & exothermic reactions - Exchange of energy involved in chemical reactions.

UNIT V **6 Hours**

STATES OF MATTER

Solid - Liquid - Gas - Plasma - Quantum dots - Arrangement of atoms/ions/molecules in different phases.

EXPERIMENT 1 **4 Hours**

Evaluate the dissolved oxygen (DO) levels in effluent samples collected from sewage treatment plant in BIT. Ensure the suitability of outlet water for the growth of aquatic animals (fishes).

EXPERIMENT 2 **4 Hours**

Investigate the amount of Iron (Fe^{2+}) in a mild steel alloy sample using a spectrophotometer.

EXPERIMENT 3 **4 Hours**

Estimate the amount of chromium present in industry effluent samples and bottled beverages.

EXPERIMENT 4 **4 Hours**

Ensure the suitability of drinking water in the RO water supply in BIT based on the presence of chloride ions.

EXPERIMENT 5 **4 Hours**

Assess the acidic nature of effluent water from industries using the conductometric titration method.

EXPERIMENT 6 **4 Hours**

Measure the stain removal efficiency of the prepared soaps from stained clothes.

EXPERIMENT 7 **4 Hours**

Assess the purity of commercially available active pharmaceutical ingredients (aspirin) as per the government-prescribed standards.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Peter Atkins, Physical Chemistry, Oxford university press, 2019
2. Rose Marie Gallagher and Author Paul Ingram, Complete Chemistry Cambridge IGCSE, Oxford university press, 2020
3. P L Soni, Text book of inorganic chemistry, Chand publishers, New Delhi, 2017
4. J.D. Lee, Concise inorganic chemistry, Blackman Science Ltd, France, Wiley-India, 5th edition (Reprint), 2016
5. Gareth Price, Thermodynamics of chemical processes, Oxford university press, 2019
6. D Tabor, Gases, liquids and solids and other states of matter, Oxford University press, 2018

22GE001 FUNDAMENTALS OF COMPUTING 3 0 0 3

Course Objectives

- Understand the fundamental digital logics behind computations of computer systems.
- Develop simple assembly language programs with respect to arithmetic operations.
- Understand the program execution process and basics of software development methodologies.

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.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Infer the hidden languages and inner structures of computer hardware and software through codes and combinations.
2. Interpret the organizational and architectural issues of a digital computer with concepts of various data transfer techniques in digital computers and the I/O interfaces.
3. Analyze programming problems and apply assembly instructions to solve simple problems.
4. Infer the fundamentals of operating system and System programs basics.
5. Apply the software development methodologies to various real life scenarios.

Articulation Matrix

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

UNIT I **8 Hours**

CODES AND COMBINATIONS

Communication using Mores and Braille binary codes - Digitizing letters, numbers and objects using binary codes - Performing simple operations: addition through binary codes.

UNIT II **9 Hours**

COMPUTATION USING COMPUTER

Communication to computing devices through various input sources - Computational operation - flow, functions and controls - Communication to output devices - Basic communication protocol.

UNIT III **11 Hours**

ASSEMBLY LANGUAGE PROGRAMMING

Little Man Computing (LMC) Model - Instruction Set - Labels - Calculation -Branching - Input - Output - Loops - Simple programs.

UNIT IV **9 Hours**

OPERATING SYSTEM AND APPLICATION GENERATION

BIOS - Device Drivers - Resources - Scheduler - Applications Generation and Creation - Stages of Compilation - Linkers, Loaders and Libraries.

UNIT V **8 Hours**

SOFTWARE DEVELOPMENT

Phases of application life cycle management - Software Development Methodologies - Web Page development.

Total: 45 Hours

Reference(s)

1. Charles Petzold, "Code: The Hidden Language of Computer Hardware and Software", Microsoft Press books, 2009.
2. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
3. Andrew Eliaz, "Little Man Computer Programming: For The Perplexed from the Ground Up", The Internet Technical Bookshop; 1st edition, 2016.
4. Abraham Silberschatz, "Peter Baer Galvin and Greg Gagne, Operating System Concepts", 9th Edition, John Wiley & Sons Pvt. Ltd, 2015.
5. Roger S. Pressman, "Software Engineering: A Practitioner's Approach", McGraw Hill International edition, Seventh edition, 2010

22HS001 **FOUNDATIONAL ENGLISH** **1 0 2 2**

Course Objectives

- Heighten awareness of grammar in oral and written expression
- Improve speaking potential and reading fluency in formal and informal contexts
- Prowess and develop abilities as critical readers and writers in interpreting complex texts.

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.

PO12: 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. Express themselves in a professional manner using error-free language
2. Express in both descriptive and narrative formats
3. Understand and make effective use of the English Language in Business contexts
4. Actively read and comprehend authentic text
5. Express opinions and communicate experiences.

Articulation Matrix

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

UNIT I **15 Hours**

SELF-EXPRESSION

Self-Introduction-Recreating Interview Scenarios (with a focus on verbal communication)-Subject Verb Concord - Tenses - Common Errors in verbal communication Be-verbs Self-Introduction- Recreating interview scenarios-Haptics-Gestures-Proxemics-Facial expressions-Paralinguistic / Vocalic- Body Language- Appearance-Eye Contact-Artefacts Self-Introduction-Powerful openings and closings at the interview-Effective stock phrases -Modified for spontaneity and individuality-Question tags, framing questions including WH-questions- Prepositions-Listening to Ted talks-Listening for specific information

UNIT II **15 Hours**

CREATIVE EXPRESSION

Descriptive Expression-Picture Description and Blog Writing -Vocabulary-One-word substitution- Adjectives-Similes, Metaphors, Imagery & Idioms -Link words - Inclusive language Narrative Expression- Travelogue and Minutes of Meeting -Verbal Analogy-Sequence & Time order words - Jumbled paragraph, sentences, Sequencing-Text & Paragraph Completion-Past tense -Using quotation marks

UNIT III **15 Hours**

FORMAL EXPRESSION

Formal Letters and Emails-Writing: E-mails and Letters of apology, Requisition and Explanation, and Letters to newspapers-Speaking: Tendering verbal apologies, and explanations, persuading a listener/ audience-Hierarchy in Business correspondence- Subject of a mail, Header, Body (Salutation) and Footer of a mail- Conjunctional clause Punctuation-Formal Idioms-Phrases-Articles - Definite & Indefinite-Types of sentences-Modal verbs Precision in comprehension, Summary writing, Selective summary-Reading: Active reading-short paragraphs, excerpts, articles and editorials-Skimming and Scanning Reading comprehension & analysis- Tenses, QP/ PQ approach. Identifying the central themes/ crux-Interpreting tone - formal/informal/semi-formal-Note-taking-Listening: Listening for data, for specific information, for opinion-Active and passive Listening-Transcription-Paraphrasing and summarizing information-Agreeing & disagreeing-Note-taking-Writing: Summary writing, selective summary, paraphrasing, note-making, opinion pieces-Finding synonyms in the context Paraphrasing- Sentence Transformation - simple, compound, complex. Sentence Substitution-Sentence completion- Interpreting paragraphs

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking Foundation Books, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book forIntermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010
4. Reynolds, John. Cambridge IGCSEA, First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervisionand Curriculum Development, 2008.

22HS001 FOUNDATIONAL ENGLISH 1 0 2 2

Course Objectives

- Heighten awareness of grammar in oral and written expression
- Improve speaking potential and reading fluency in formal and informal contexts
- Prowess and develop abilities as critical readers and writers in interpreting complex texts.

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.
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1. Express themselves in a professional manner using error-free language
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Articulation Matrix

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

UNIT I **15 Hours**

SELF-EXPRESSION

Self-Introduction-Recreating Interview Scenarios (with a focus on verbal communication)-Subject Verb Concord - Tenses - Common Errors in verbal communication Be-verbs Self-Introduction - Recreating interview scenarios – Haptics – Gestures – Proxemics - Facial expressions - Paralinguistic / Vocalic - Body Language – Appearance - Eye Contact - Artefacts Self-Introduction - Powerful openings and closings at the interview - Effective stock phrases - Modified for spontaneity and individuality - Question tags, framing questions including WH-questions – Prepositions - Listening to Ted talks - Listening for specific information.

UNIT II **15 Hours**

CREATIVE EXPRESSION

Descriptive Expression - Picture Description and Blog Writing – Vocabulary - One-word substitution – Adjectives - Similes, Metaphors, Imagery & Idioms - Link words - Inclusive language Narrative Expression - Travelogue and Minutes of Meeting - Verbal Analogy - Sequence & Time order words - Jumbled paragraph, sentences, Sequencing - Text & Paragraph Completion - Past tense - Using quotation marks.

UNIT III **15 Hours**

FORMAL EXPRESSION

Formal Letters and Emails - Writing: E-mails and Letters of apology, Requisition and Explanation, and Letters to newspapers - Speaking: Tendering verbal apologies, and explanations, persuading a listener/ audience - Hierarchy in Business correspondence - Subject of a mail, Header, Body (Salutation) and Footer of a mail - Conjunctional clause Punctuation - Formal Idioms – Phrases - Articles - Definite & Indefinite - Types of sentences - Modal verbs Precision in comprehension, Summary writing, Selective summary - Reading: Active reading - Short paragraphs, excerpts, articles and editorials - Skimming and Scanning Reading comprehension & analysis - Tenses, QP/ PQ approach - Identifying the central themes/ crux-Interpreting tone - formal/informal/semi-formal - Note-taking - Listening: Listening for data, for specific information, for opinion-Active and passive Listening – Transcription - Paraphrasing and summarizing information - Agreeing & disagreeing – Note – Taking - Writing: Summary writing, selective summary, paraphrasing, note-making, opinion pieces - Finding synonyms in the context Paraphrasing - Sentence Transformation - Simple, compound, complex. Sentence Substitution - Sentence completion - Interpreting paragraphs.

Total: 45 Hours

Reference(s)

1. Sasikumar, V, et.al. A Course in Listening & Speaking Foundation Books, 2005.
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. Prasad, Hari Mohan. A Handbook of Spotting Errors. Mcgraw Hill Education, 2010
4. Reynolds, John. Cambridge IGCSEÃ‚Â® First Language English. 2018th ed., Hodder Education, 2018.
5. Wiggins, Grant P., and Jay McTighe. Understanding by Design. Association for Supervision and Curriculum Development, 2008.

22GE004 BASICS OF ELECTRONICS ENGINEERING

2 0 2 3

Course Objectives

- To understand the concept of energy transmission through mechanical, electrical and electromagnetic form.
- To analyze the use of PN Junction Diode and BJT for signal conditioning.
- To apply the working principle of PN Junction Diode and BJT for the design of basic Digital Logic.
- To analyze the working and characteristics of Special Purpose Semiconductor Electronic 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 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.

PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Understand the need for electrical and electromagnetic signal transmission.
2. Analyze the working principle and characteristics of PN junction diode.
3. Analyze the working principle and characteristics of Bipolar Junction Transistor.
4. Apply the working principle of PN Junction diode and BJT for designing basic Digital Logic functions.
5. Analyze the energy conversion needs and working principle of Special purpose electronic devices.

Articulation Matrix

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

UNIT I **6 Hours**

ENERGY TRANSFER AND SIGNALS

Energy Transmission through Mechanical - Electrical and Electromagnetic means - Signal as Energy Transmission - Complexity in signal transmission (Volume of Information - Distance and Time taken) - Limitations of Mechanical Energy Transmission - Electrical and Electromagnetic Signal Transmission - Need for Conversion between Electrical and Mechanical Signals.

UNIT II **8 Hours**

SIGNAL CONDITIONING USING DIODE

Need for Vacuum Tubes in the Evolution of Electronics - Overview of Vacuum Tubes - Diode and Triode - Limitations of Vacuum Tubes - Semiconductor Group in Periodic Table - Overview of Semiconductor Materials - Flow of electrical energy through PN Junction Diode - Signal Clipping - Signal Clamping and Signal Multiplication using PN Junction Diode - Limitations of PN Junction Diode.

UNIT III **6 Hours**

SIGNAL CONDITIONING USING TRANSISTOR

Need for controlling electrical signals - Principle of Bipolar Junction Transistor operation - Signal Switching and Amplification using BJT - Limitations of BJT - Principle of Field Effect Transistor operation.

UNIT IV **6 Hours**

LOGIC SYNTHESIS USING DIODE AND TRANSISTORS

Overview of Logic Gates - PN Junction and BJT as electronic switches - Digital Logic Synthesis using Diode and Transistor: Diode Logic - Resistor Transistor Logic - Diode Transistor Logic - Transistor Logic.

UNIT V **4 Hours**

DEVICES FOR SPECIAL REQUIREMENTS

Voltage Regulation using Zener Diode - Variable Capacitance using Varactor Diode - Electrical Energy to Light Energy conversion using Light Emitting Diode - Light to Energy to Electrical Energy conversion using Solar Cell.

EXPERIMENT 1 **6 Hours**

Design a voltage multiplier to convert the low voltage from the mains power supply to the high voltage to operate the microwave oven.

EXPERIMENT 2 **6 Hours**

Design and construct regulated DC power supply for Mobile phone charger

EXPERIMENT 3 **6 Hours**

Design and construct an audio amplifier circuit to play the mobile music in a huge speaker.

EXPERIMENT 4 **6 Hours**

Design and construct Switching circuit for the Pump to control over flow and drain condition for overhead tank using PN junction diode.

EXPERIMENT 5 **6 Hours**

Design and construct BJT based circuit to implement two-way connection for stair case light application.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Thomas L. Floyd, Electronic Devices: Electron Flow Version, Ninth Edition, Prentice Hall, 2012.
2. J Millman, C. Halkias & Satyabrata JIT, Electronic Devices and Circuits, Tata McGraw-Hill, 2007.
3. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education 2006.
4. David A. Bell, Electronic Devices and Circuits, Prentice Hall of India, 2003.
5. Adel S. Sedra & Kenneth C. Smith, Micro Electronic Circuits Theory and Applications, Sixth Edition, Oxford University Press, 2013.
6. Behzad Razavi, Microelectronics, Wiley India Pvt. Ltd.; 2nd edition (2018)

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. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. Project Management and Finance: Demonstrate 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.

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	PO12	PSO1	PSO2
1							1	2	1		1			
2							2	2	1	1	2			
3							3	3	1	2	2			
4							1	3	1	2	2			
5								2	3	2	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 **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.

22HS003 HERITAGE OF TAMILS 1 0 0 1

Course Objectives

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

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.

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	PO11	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,
4. International Institute of Tamil Studies.
5. Dr.M.Valarmathi, The Contributions of the Tamils to Indian Culture, International Institute of Tamil Studies.
6. Keeladi, Sangam City Civilization on the banks of river Vaigai, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
7. Dr.K.K.Pillay, Studies in the History of India with Special Reference to Tamil Nadu.
8. Porunai Civilization, Department of Archaeology & Tamil Nadu Text Book and Educational Services Corporation, Tamil Nadu
9. R.Balakrishnan, Journey of Civilization Indus to Vaigai, RMRL.

22MA201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- To impart and analyze the concepts of differential equations to describe in real-world phenomena
- To provide basic understanding on differential equation models and vector field models
- Summarize and apply the methodologies involved in framing the real world problems related to fundamental principles of complex functions

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. Interpret the concept of differential equations through mathematical modeling and analyze its applications in engineering
2. Formulate the real world problems as second order linear differential equations and give solutions for the same
3. Demonstrate the real-world phenomena with magnitude and direction in the form of vector functions
4. Apply the concept of vector fields and line integrals through mathematical modeling in engineering
5. Determine complex functions and apply them to formulate problems arising in engineering

Articulation Matrix

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

UNIT I **9 Hours**

FIRST ORDER LINEAR DIFFERENTIAL EQUATIONS

Formation of differential equations - Solutions of first order linear ODE: Leibnitzs and method of separation of variables - Cooling/Heating of an object - A falling object - Modeling of electric circuits: RL and RC circuits - Modeling of population dynamics: Exponential growth and decay - Logistic growth model.

UNIT II **9 Hours**

SECOND ORDER LINEAR DIFFERENTIAL EQUATIONS

Methods of solving second order linear ordinary differential equations - Models for linear oscillators: Simple harmonic motion - Mechanical vibrations with and without damping - Electric circuit system: RLC circuits.

UNIT III **9 Hours**

VECTOR DIFFERENTIAL CALCULUS

Vector and scalar functions - Fields - Derivative of a vector function and geometrical interpretation - Velocity and acceleration - Gradient and its properties - Tangent and normal vectors - Directional derivative - Divergence of a vector field - Curl of a vector field - Projectile motion.

UNIT IV **9 Hours**

VECTOR INTEGRAL CALCULUS

Line integrals of vector point functions - Surface integral of vector point functions - Applications of line and surface integrals - Greens theorem in a plane - Stokes theorem - Gauss divergence theorem.

UNIT V **9 Hours**

COMPLEX FUNCTIONS

Basic concepts of Complex numbers Geometrical representation of complex number - Analytic functions and its properties - Construction of Analytic functions: Fluid flow Electric flow - Mapping of complex functions.

Total: 45 + 15 = 60 Hours

Reference(s)

1. Richard E. Williamson, Introduction to Differential Equations and Dynamical Systems, McGraw Hill Companies. Inc, 1997
2. Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3. George B. Thomas, Maurice D. Weir and Joel Hass Thomas Calculus, 13/e, Pearson Publishers, 2013
4. Erwin Kreyszig, Advanced Engineering Mathematics Wiley, 10th editi5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017on ,2015
5. J. Stewart, Essential Calculus, Cengage, 2nd edition, 2017

22PH202 ELECTROMAGNETISM AND MODERN PHYSICS

2 0 2 3

Course Objectives

- Understand the principles and mechanisms of electricity and magnetism
- Infer the classification of electromagnetic waves
- Analyze the theory of relativity and energy bands

Programme Outcomes (POs)

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

PO2. 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 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. 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.

PO9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO12. 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 the principles and mechanism of electrostatics and current
2. Illustrate the principles and mechanism of magneto statics
3. Classify electromagnetic waves and infer the characteristics of visible light
4. Outline the importance of theory of relativity and analyze the wave nature of particles
5. Exemplify the electrical properties of semiconductor based on the band theory

Articulation Matrix

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

UNIT I **6 Hours**

ELECTRICITY

Electric monopoles - Electric field - Electric flux - Electric potential - Electrical energy – Capacitor - Conductors and Insulators - Electric dipole and polarization - Electric current - Voltage sources – Resistance.

UNIT II **6 Hours**

MAGNETISM

Sources of magnetism - Monopoles - Magnetic field and force - Magnetic field and current distribution - Magnetic dipole - Magnetic potential energy - Inductor - Electric and magnetic field comparison.

UNIT III **6 Hours**

ELECTROMAGNETIC WAVES AND LIGHT

Electromagnetism: Basic laws - Electromagnetic energy - Radiation. Electromagnetic waves: Origin, nature and spectrum - Visible light. Principle of least time - Geometrical optics - Human eye - Diffraction - Interference - Polarization – LASER.

UNIT IV **6 Hours**

MODERN PHYSICS

Special theory of relativity - Simultaneity and time dilation - Length contraction - Relativistic mass variation - Matter waves - De-Broglie hypothesis - Wave nature of particles.

UNIT V **6 Hours**

ENERGY BANDS IN SOLIDS

Band theory of solids - Classification of materials - Semiconductors - Direct and indirect semiconductor - Fermi energy - Intrinsic and extrinsic semiconductor - Carrier concentration - Electrical conductivity.

EXPERIMENT 1 **5 Hours**

Analysis a I-V characteristics of a solar cell for domestic applications

EXPERIMENT 2 **5 Hours**

Determine the carrier concentration of charge carriers in semiconductors for automotive applications

EXPERIMENT 3 **5 Hours**

Investigate the photonic behavior of laser source for photo copier device

EXPERIMENT 4 **5 Hours**

Implement the principle of stimulated emission of laser for grain size distribution in sediment samples

EXPERIMENT 5 **5 Hours**

Assess the variation of refractive index of glass and water for optical communication

EXPERIMENT 6 **5 Hours**

Evaluate the band gap energy of semiconducting materials for display device applications.

Total: 3 0 + 3 0 = 60 Hours

Reference(s)

1. C J Fischer, The energy of Physics Part II: Electricity and Magnetism, Cognella Academic Publishing, 2019
2. P G Hewitt, Conceptual Physics, Pearson education, 2017
3. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2019
4. J Walker, D Halliday and R Resnick, Principles of Physics, John Wiley and Sons, Inc, 2018
5. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017

22CH203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Understand the concept of electrochemistry for determination of electrode potential, pH and applications as energy storage devices
- Outline the chemistry of metal corrosion and analyze the methods of corrosion control
- Understand the role of catalyst in the rate of reaction
- Summarize the variation in properties and reactivity of isotopes.

Programme Outcomes (POs)

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

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

PO7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

Course Outcomes (COs)

1. Apply the electrochemical concepts to determine the electrode potential of a metal
2. Analyze the working of batteries for the energy storage devices
3. Understand the mechanism of corrosion and suggest a method to control the corrosion
4. Illustrate reaction mechanisms and assess the role of catalyst in a chemical reaction
5. Analyze various types of nuclear transmutation including decay reactions

Articulation Matrix

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

UNIT I **6 Hours**

ELECTROCHEMISTRY

Origin of potential - Electromotive force - Electrical double layer - Transport of charge within the cell - Cell description - Prediction of cell potentials.

UNIT II **6 Hours**

ENERGY STORING DEVICES

Relation between electrical energy and energy content of a cell - Reversible and irreversible cell - Charging and discharging reactions in a reversible cell - Current challenges in energy storage technologies.

UNIT III **6 Hours**

METAL CORROSION AND ITS PREVENTION

Oxidation of metals: Electrochemical origin of corrosion - Electromigration - Electron transfer in the presence and absence of moisture - Galvanic series - Strategies for corrosion control: Galvanic anode and impressed current.

UNIT IV **6 Hours**

CATALYSIS

Energy profile diagram for a chemical reaction - Activation energy - Role of catalyst - Homogeneous and heterogeneous catalysis – Types.

UNIT V **6 Hours**

NUCLEAR REACTIONS

Radioactive and stable isotopes - Variation in properties between isotopes - Radioactive decay (alpha, beta and gamma) - Half-life period - Nuclear reactions - Radiocarbon dating.

EXPERIMENT 1 **4 Hours**

Measure industrial effluent water pH and assess water quality against allowed standards

EXPERIMENT 2 **4 Hours**

Iron (Fe^{2+}) in Bhavani River water: Potentiometric Analysis

EXPERIMENT 3 **4 Hours**

Construct a Zn-Cu electrochemical cell and validate the output by connecting the LED light

EXPERIMENT 4 **5 Hours**

Evaluate the corrosion percentage in concrete TMT bars

EXPERIMENT 5 **4 Hours**

Determination of the percentage of corrosion inhibition in plain-carbon steel using natural inhibitors

EXPERIMENT 6 **4 Hours**

Electroplating of copper metal on iron vessels for domestic application

EXPERIMENT 7 **5 Hours**

Determination of acid-catalyzed hydrolysis kinetics in locally sourced fruit extracts

Total: 60 Hours

Reference(s)

1. Jain and Jain, Engineering Chemistry, 16th Edition, Dhanpat Rai Publishing Company, New Delhi, 2013.
2. P.H. Rieger, Electrochemistry, Second Edition (Reprint), Springer, Netherland, 2012
3. E. McCafferty, Introduction to Corrosion Science, Springer; 2010 Edition, January 2010
4. S. Vairam, Engineering Chemistry, John Wiley & Sons, 2014
5. H.J. Arnikar, Essentials of Nuclear Chemistry, 4th edition, (revised) New Age International Publishers, 2011
6. U. Hanefeld, L. Lefferts, Catalysis: An Integrated Textbook for Students, Wiley- VCH, 2017

22GE002 COMPUTATIONAL PROBLEM SOLVING 3 0 0 3

Course Objectives

- Analyze the algorithm design techniques and development principles in solving the real life problems.
- Illustrate the different ways of organizing and storing the data in computing systems.
- Understand the basic network configuration and setup connections among different device systems.

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.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Analyze a problem and formulate algorithms, pseudocodes and flowcharts.
2. Develop algorithmic solutions to simple computational problems and explore algorithmic approaches to problem solving.
3. Design and apply appropriate data structures for solving computing problems.
4. Compare the various storage devices used in a computer system.
5. Analyze the requirements for a given organizational structure and establish the connection between two or more computers to form a network.

Articulation Matrix

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

UNIT I **6 Hours**
VISUAL PROCESS MODELING
Scenario decomposition - Logical sequencing - Drawing flowchart - Preparation of visual process model.

UNIT II **12 Hours**

ALGORITHMIC DESIGN THINKING

Analysis - Verification - Brute force - Divide and conquer - Greedy - Backtracking.

UNIT III **12 Hours**

DATA ORGANIZATION

Elementary Data Organization - Abstract Data Types - Fundamentals of Linear and Non Linear Data Structures.

UNIT IV **7 Hours**

DATA STORAGE

Flat File and Relational database - Data Read & Write in Local Storage - Server Storage and Cloud storage - Database Query Methods.

UNIT V **8 Hours**

NETWORKING ESSENTIALS

Networking Components and Services - IP Addressing - Configuring and Managing the Campus Network - Network Security - Firewalls.

Total: 45 Hours

Reference(s)

1. David D. Riley, Kennya. Hunt, "Computational thinking for the modern problem Solver", CRC Press Taylor & Francis Group, 2014.
2. Anany Levitin, "Introduction to the Design and Analysis of Algorithms", Third Edition, Pearson Education Asia, 2011.
3. Mark Allen Weiss, "Data Structures and Algorithm Analysis in C", 2nd Edition, Pearson Education,2016.
4. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, "Database System Concepts", McGraw Hill, 2015.
5. Behrouz A.Forouzan, "Data Communication and Networking", 5th Edition, Tata McGraw-Hill, 2014.

22GE003 BASICS OF ELECTRICAL ENGINEERING 2 0 2 3

Course Objectives

- To understand the basic concepts of electrical charge and its properties
- To interpret the formation of electric field due to electric charges
- To illustrate the concept of magnetic fields due to revolving electron
- To illustrate the force on moving charges in electric and magnetic field
- To understand the energy transfer in electro mechanical conversion

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.

Course Outcomes (COs)

1. Interpret the behavior of electric charges in different medium using coulombs law.
2. Analyse the electric field due to different charge distributions.
3. Analyse the magnetic field intensity due to long conductor, solenoid, toroid and magnetic dipoles.
4. Analyze the force on conductors due to the moving charges.
5. Interpret the energy conversion concepts in electromagnetic fields.

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	2											
4	2	2												
5	2	2												

UNIT I **5 Hours**
ELECTRIC CHARGE
Properties of charge - Additivity of charges - Quantization of charge - Conservation of charge - Forces between multiple charges - Electric charge in conductor - Drift of Electrons - Charges in Clouds.

UNIT II **7 Hours**

ELECTRIC FIELD

Electric field due to system of charges - Significance of Electric field line - Electric Dipole and its significance - Continuous charge distribution - Field in infinite long uniform straight conductors - Field in uniform charged uniform infinite plane sheet - Field due to uniform thin spherical sheet.

UNIT III **7 Hours**

MAGNETIC FIELDS

Concept of magnetic field - Magnetic fields in infinitely long straight wire - Straight and toroidal solenoids - Magnetic dipole moment of a revolving electron - Magnetic field intensity due to a magnetic dipole (bar magnet) along its axis and perpendicular to axis - Induced Electric field due to changing Magnetic Field.

UNIT IV **6 Hours**

FORCE ON CHARGES

Force on a moving charge in uniform magnetic and electric fields - Force on a current carrying conductor in a uniform magnetic field - Force between two parallel current carrying conductors.

UNIT V **5 Hours**

ELECTRO MECHANICAL ENERGY CONVERSION

Energy transfer in electromagnetic fields - Energy storage in magnetic field - Electromagnetic induction - induced emf - Eddy currents - Self and mutual inductance Linear Momentum and Angular Momentum carried by Electromagnetic Fields.

EXPERIMENT 1 **7 Hours**

Analysis the behavior of a Fixed Resistor in An Electric Heater.

EXPERIMENT 2 **8 Hours**

Construct An Electrical Wiring Layout for a Basic Household Applications.

EXPERIMENT 3 **8 Hours**

Analysis The Self and Mutual Induction in a Domestic Fan.

EXPERIMENT 4 **8 Hours**

Design a Transistor-Based Electronic Switch.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Mathew N. O. Sadiku, Principles of Electromagnetics, 6th Edition, Oxford University 2020
2. William H. Hayt and John A. Buck, Engineering Electromagnetics, McGraw Hill 2020
3. Kraus and Fleisch, Electromagnetics with Applications, McGraw Hill International Editions, 2017
4. S.P.Ghosh, Lipika Datta, Electromagnetic Field Theory, First Edition, McGraw Hill Education(India) Private Limited 2017

22CS206 DIGITAL COMPUTER ELECTRONICS 3 0 2 4

Course Objectives

- Understand the operation of Arithmetic Logic unit in Microprocessors
- Interpret Data retrieval from Memory by Microprocessors
- Analyze the role of Control Unit in Microprocessors
- Analyze Instruction execution in Microprocessors

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.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Analyze the Design of Arithmetic and Logic Unit in Microprocessors.
2. Analyze the Data Storage and Retrieval from Random Access Memory
3. Analyze the working mechanism of Control Unit in Microprocessors
4. Analyze the execution of Arithmetic and Logical Instructions
5. Analyze the execution of Jump and Memory related Instructions

Articulation Matrix

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

UNIT I **9 Hours**

BINARY SYSTEM AND DESIGN OF ALU

Conversion of Decimal – Hexadecimal - Octal and Binary Numbers - Representation of Negative Numbers in Binary - Design of Binary Arithmetic Logic Modules - Magnitude Comparator - Encoder - Decoder - Multiplexer - Demultiplexer - Design of Arithmetic and Logic Unit (ALU).

UNIT II **9 Hours**

SYNCHRONOUS CIRCUIT AND DESIGN OF RAM

Latches and Flip Flops - Clock - Registers - Counters - Shift Registers - Storage and Retrieval of Binary Numbers from Registers - Design of Random Access Memory (RAM) - Encoding and Decoding of Memory address locations.

UNIT III **9 Hours**

DESIGN OF CONTROL UNIT

Design of Control Unit - Mechanism of Instruction Read, Data Read, Instruction Decode - Instruction Execute and Data Write.

UNIT IV **9 Hours**

BASIC INSTRUCTION EXECUTION

Arithmetic Instructions - Increments, Decrements and Rotate Instructions - Logic Instructions - Arithmetic and Logic instructions.

UNIT V **9 Hours**

ADVANCED INSTRUCTION EXECUTION

Memory Reference instructions - Register Instructions - Jump and Call Instructions - Concept of Flag - Extended Register Instructions - Indirect Instructions - Stack instructions.

EXPERIMENT 1 **5 Hours**

Buzzer Alarm System: Logic Circuit for Intruder Detection

EXPERIMENT 2 **5 Hours**

Binary Calculator: Design and Simulation of a Basic Arithmetic Unit.

EXPERIMENT 3 **5 Hours**

Binary Comparator: Designing a Circuit to Compare Binary Numbers

EXPERIMENT 4 **5 Hours**

Digital Lock System: With the combination of Flip-Flops and Logic Gates.

EXPERIMENT 5 **5 Hours**

Digital Alarm Clock: Timekeeping with Counters and Decoders

EXPERIMENT 6 **5 Hours**

Elevator Control System: Implementing Logic for Floor Selection

Total: 45 + 30 = 75 Hours

Reference(s)

1. Morris Mano, "Digital Logic & Computer Design", Pearson Education India, 2019.
2. Albert Paul Malvino and Jerald A Brown, "Digital Computer Electronics,(3rd Edition)", McGraw Hill Education India, 2001.
3. David Money Harris and Sarah L Harris, "Digital Design and Computer Architecture", Elsevier, 2007
4. John C Schott, "But How do it Know? The Basic Principles of Computers for Everyone", John C Scott Publishers, 2009.
5. Petzold Charles, "Code: The Hidden Language of Computer Hardware and Software (2nd Edition)", Microsoft Press, 2022.
6. Thomas C Bartee, "Digital Computer Fundamentals (6th Edition)",Tata Mcgraw Hill Education, 2011.

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 <u>உற்பத்தித் தொழில் நுட்பம்</u>: **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 <u>வேளாண்மை மற்றும் நீர்ப்பாசனத் தொழில் நுட்பம்</u>: **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 <u>அறிவியல் தமிழ் மற்றும் கணித்தமிழ்</u>: **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.

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.

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.

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	PO12	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 and 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

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.

22CS301 PROBABILITY, STATISTICS AND QUEUING THEORY **3 1 0 4**

Course Objectives

- The students will be able to understand the basic concepts of probability and the distributions with characteristics and also two dimensional random variables
- Summarize and apply the methodologies of the statistics and queuing theory.
- 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 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.

PSO1: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Demonstrate and apply the basic probability axioms and concepts in the core areas.
2. Apply the concepts of probability distributions in an appropriate place of computers and Engineering.
3. Implement basic statistical inference techniques engineering problems.
4. Design an experiment using ANOVA technique and summarize the measurements for statistical quality control.
5. Identify and apply the queuing methodologies to optimize the result of the waiting line.

Articulation Matrix

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

UNIT I **9 Hours**

PROBABILITY AND RANDOM VARIABLE

Axioms of probability - Conditional probability - Total probability - Bayes theorem - Random variable - Probability mass function - Probability density functions – Properties - Moments - Moment generating functions and their properties.

UNIT II **9 Hours**

STANDARD DISTRIBUTIONS

Discrete distributions: Binomial - Poisson - Negative Binomial - Continuous distributions: Uniform - Exponential - Gamma - Normal distributions and their properties.

UNIT III **9 Hours**

TESTING OF HYPOTHESIS

Sampling distributions - Estimation of parameters - Statistical hypothesis - Large sample test based on normal distribution for single mean and difference of means - Small sample tests: t-test for mean -F- test - Chi-square test for Goodness of fit and Independence of attributes.

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS AND CONTROL CHART

One way and two way classifications - Completely Randomized Design - Randomized Block Design - Latin Square Design - Control charts for measurements (X and R charts) - Control charts for attributes (p, c and np charts).

UNIT V **9 Hours**

QUEUING THEORY

Pure Birth and Death Process - Characteristics of Queuing models - Kendalls notation - Single and multi server Markovian queuing models - M/M/1 and M/M/C (Finite and infinite capacity) – Pollaczek - Khinchine formula.

Total: 45 + 15 = 60 Hours

Reference(s)

1. Richard A Johnson, Miller & Freund's Probability and Statistics for Engineers, PHL Publisher, 1996.
2. Kishore S Trivedi, Probability and Statistics with Reliability Queuing and Computer Science Applications, John Wiley and Sons, Second Edition, 2012.
3. Arnold O Allen, Probability Statistics and Queuing Theory with Computer Applications, New Age International, 2003.
4. Jay L Devore, Probability and Statistics for Engineering and The Sciences, Thomson Learning, Seventh Edition, 2002.
5. Sheldon M Ross, Introduction to Probability and Statistics for Engineers and Scientists,

22CS302 DATA STRUCTURES I **3 0 2 4**

Course Objectives

- Implement array and hash data structure for real world applications.
- Apply the different linear and non-linear data structures to problem solutions.
- Critically analyze the performance of various data structures using asymptotic notations.

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.
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.
PO12: 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: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Implement the array data structure and its types for searching and sorting operations.
2. Outline the algorithm efficiency with different asymptotic notations for optimizing the code.
3. Implement the linear node-based data structure for real world applications.
4. Evaluate the performance of Hash over arrays and list in memory access.
5. Analyze the tree traversal algorithms for various non-linear data structures.

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	1
2	2	2	2	2	2						2	2	1	
3	2	3	3	2	2						2	2	2	1
4	3	3	3	3	2						3	3	3	
5	3	2	3	3	3						3	3	2	2

UNIT I **10 Hours**

FOUNDATIONAL DATA STRUCTURES

Algorithms and Data Structures - Data Structures hierarchy - Types of Data - Singular Data and Plural Data - Position indexing : Array - Sets - Ordered Arrays - Searching over Arrays and Ordered Arrays.

UNIT II **7 Hours**

ALGORITHM EFFICIENCY

Algorithm efficiency using Asymptotic Notations - Optimizing code with and without Big O Notation - Optimizing for optimistic scenarios - Trade- offs between Time and Space.

UNIT III **10 Hours**

ADT AND NODE BASED DATA STRUCTURES

ADT : Stacks - Queues - Recursion - Recursive Algorithms for Speed - Node Based Data Structures : Linked list - Need of Linked List - Arrays vs Linked List - Types of Linked List and its operations - Skip Lists.

UNIT IV **8 Hours**

FAST LOOKUP WITH HASH

Hash Table - Hash functions - Internal implementation of Hash - Iteration over Hash - Hash operations - Hash of Hash - Array of Hash - Hash of Array.

UNIT V **10 Hours**

TREES

Tree - Binary Tree - Binary Search Tree - Tree traversal - AVL Tree - Red Black Tree - B Tree - B+ Tree - Heap.

EXPERIMENT 1 **8 Hours**

Implement a python program for the supermarket application using Stack and Queue for basket storage and checkout respectively.

EXPERIMENT 2 **4 Hours**

Implement a python program for using a singly linked list. managing a train station and need to keep track of passengers on a particular train

EXPERIMENT 3 **4 Hours**

Create a python program that allows users to search for a person's phone number quickly in the phone directory.

EXPERIMENT 4 **2 Hours**

Implement a Python program to sort the student grades for the quiz competition.

EXPERIMENT 5 **2 Hours**

Implement a digital signature generator and verifier using hash functions and public-key cryptography. Users can sign documents and verify the authenticity of signed documents.

EXPERIMENT 6

10 Hours

Implement a python program to give a direction for a Stranger. Landmark will be considered as a node and the path between the two landmark is the link

Total: 45 + 30 = 75 Hours

Reference(s)

1. Michael T. Goodrich, Roberto Tamassia, Michael H. Goldwasser, Data Structures & Algorithms in Python, Wiley, 2013.
2. Larry Wall, Tom Christiansen & Randal L. Schwartz, Progrmaming Perl, O"Reilly, 3rd edition, 2000.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education, 2016.
4. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011.
5. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education Asia, 2011.
6. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, PHI Pvt. Ltd., 2009.

22CS303 COMPUTER ORGANIZATION AND ARCHITECTURE 3 1 0 4

Course Objectives

- Understand the computer architecture concepts related to design of processors, memory management and I/O system.
- Explore the GPU computing architecture and develop an environment for creating high performance GPU-accelerated applications using CUDA programming.
- Gain knowledge on modern processor architecture to design the best processor/computing system.

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.
PO12: 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: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Analyze the processor architecture and instruction sets of x86/x64 and ARM architecture.
2. Design a data path for a simple processor and compare the various techniques related to simultaneous execution of multiple instructions from a program.
3. Organize the computer memory to speed up the performance and facilitate the transfer of data between the computer’s central processing unit and the external devices.
4. Analyze the GPU computing architecture and develop applications to run on NVIDIA GPUs using the CUDA programming environment.
5. Analyze the modern processor architectures and instruction sets and implement a RISC-V processor in a low-cost FPGA board.

Articulation Matrix

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

UNIT I **9 Hours**

UNDERSTANDING PROCESSOR ARCHITECTURE AND INSTRUCTION SETS

Basic Computer Organization and Design - Instruction Set principles - x86 and x64 architecture & instruction sets - 32 bit and 64 bit ARM architecture & instruction sets.

UNIT II **9 Hours**

PROCESSOR DESIGN

Designing a Data path for a Simple Processor - DLX Pipeline - Super Pipelining - Super scalar processor - Instruction level parallelism (ILP) - Speculative Execution - Side channel attack (Spectre and Meltdown).

UNIT III **9 Hours**

MEMORY UNIT AND I/O ORGANIZATION

Memory Hierarchy - Cache Architectures - Levels in Cache - Improving Cache Performance - Memory Prefetch - Tera MTA - Connecting I/O Devices to the Processor.

UNIT IV **8 Hours**

EXPLORING GPU ARCHITECTURE

GPU Vs CPU architecture - GPU Architecture Basics - NVIDIA"s CUDA Toolkit - CUDA Programming.

UNIT V **10 Hours**

MODERN COMPUTER ARCHITECTURE

Domain-Specific Computer Architectures - Sony PlayStation design PS3/PS5, MAC M1 chip, Xbox, Cerebas - Wafer Scale Computing, Accelerators (FPGA, ASIC) - RISC-V Architecture and Instruction Set - Implementing RISC-V in a field - Programmable gate array (FPGA).

Total: 45+15=60 Hours

Reference(s)

1. Carl Hamacher, Zvonko Vranesic and Safwat Zaky, Computer Organization, McGraw-Hill,Third Reprint, 2015.
2. David A, Patterson and John L, Hennessy, Computer Organization and Design: The hardware/ software interface, MorganKaufmann,4th edition, 2014.
3. Jim Ledin, Modern Computer Architecture and Organization - Learn x86, ARM, and RISC-V architectures and the design of smartphones, PCs, and cloud servers - Second Edition,2022.

22CS304 PRINCIPLES OF PROGRAMMING LANGUAGES 3 0 2 4

Course Objectives

- Understand the history and evolution of programming language.
- Gain knowledge about the different data types and control flow statements.
- Impart knowledge about the subprograms, functions, debugging and error handling mechanisms.

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.
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.
PO12: 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: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Outline the programming paradigms and the basic structure of programming language.
2. Assess the implementation of different types of data, variable and types system.
3. Analyze suitable conditional statements and control structures for real world applications.
4. Develop programs using subprograms and explore their types for problem solving.
5. Determine the tools for error handling and event handling in Programming.

Articulation Matrix

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

UNIT I **8 Hours**

UNDERSTANDING PROGRAMMING PARADIGMS

Natural Vs Artificial language - Common Programming Paradigms - Syntax and semantics - Language Evaluation Criteria - Programming Language Grammar.

UNIT II **10 Hours**

VARIABLES AND DATA TYPES

Variable Declarations - Guidelines for Initializing Variables - Power of Variable names - Fundamental Data types - Type Systems - Type Inference and Polymorphism.

UNIT III **10 Hours**

STATEMENTS

Expressions and Assignment statements - Organizing straight-line code - Using conditionals - Controlling loops - Unusual control structures - General control issues.

UNIT IV **9 Hours**

SUBPROGRAMS

Fundamentals of Subprograms - Design issues - Parameter passing methods - Overloaded subprograms - Generic subprograms - Implementing subprograms.

UNIT V **8 Hours**

DEBUGGING AND ERROR HANDLING

Debugging - Debugging Strategies - Debugging Tools - Error Messages - Documentation - Test cases - Debugging with print statements - Debugging with comments and questions - Exception handling and Event handling

EXPERIMENT 1 6 Hours

Online shopping cart: Develop an application to implement online shopping cart and generate bill for the purchased products.

EXPERIMENT 2 3 Hours

Pocket Bazaar: Develop an application to manage an inventory of products for grocery stores.

EXPERIMENT 3 3 Hours

Vacation Destination Decision Maker: Create an application program that helps a user decide on their next vacation destination based on their preferences.

EXPERIMENT 4 3 Hours

Temperature monitor: Develop an application for temperature monitoring system and provide an alert message.

EXPERIMENT 5 3 Hours

Develop an access control system that simulates the granting access to authorized personnel based on their credentials, such as ID cards and PIN codes.

EXPERIMENT 6 **6 Hours**

Math Quiz Generator: Design a math quiz generator that generates questions of various difficulty levels and arithmetic operations.

EXPERIMENT 7 **6 Hours**

Build a maze solver application that finds a path from the entrance to the exit of a maze.

Total:45 + 30 = 75 Hours

Reference(s)

1. Steve McConnell, Code Complete, Microsoft Press, 2004.
2. Robert. W. Sebesta, Concepts of Programming Languages 10/E, Pearson Education.
3. D. A. Watt, Wiley Dreamtech, Programming Language Design Concepts, 2007.
4. A.B. Tucker, R. E. Noonan, Programming Languages, 2nd Edition, TMH.
5. K. C. Louden, Programming Languages, 2nd Edition, Thomson, 2003

22CS305 SOFTWARE ENGINEERING 3 0 0 3

Course Objectives

- Understand the systematic approach related to the design, development and maintenance of a software system
- Analyze the limitations of manual testing process and provide a succinct summary of those limitations with the help of automated testing tools.
- Understand the Enterprise Architecture (EA) framework that provides the building blocks for successful digital business transformation.

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.
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 in diverse teams, and in multidisciplinary settings.
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.
PO12: 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: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Apply the software development methodologies to various real life scenarios.
2. Apply modern tools and techniques to develop scalable, maintainable, and reliable software systems.
3. Analyze the coding strategies and techniques to write well-structured, efficient, and error-free code.
4. Apply specific modern testing tools to ensure the quality and reliability of software products.
5. Analyze the elements, structure, and positioning of an Enterprise Architecture framework used for successful digital business transformation.

Articulation Matrix

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

UNIT I **9 Hours**

SOFTWARE DEVELOPMENT PROCESS

Phases in Software Development - Traditional Software Development Models - Agile Methodologies - Agile Scaling Frameworks - Lean Software Development - Software Requirements Specification(SRS) - Project Scheduling and Estimation.

UNIT II **10 Hours**

TOOLS AND TECHNIQUES FOR SOFTWARE DEVELOPMENT

DevOps - Version control with Git - Containerization Using Docker and Kubernetes- Application Performance Monitoring (APM) - Continuous Integration Continuous deployment (CICD) - Clean Room build.

UNIT III **9 Hours**

CODE QUALITY

Software Metaphors - Upstream Prerequisites - Key Construction Decisions - Defensive Programming - Code Tuning Strategies and Techniques.

UNIT IV **9 Hours**

TESTING

Writing good test cases - Test driven development - Test Automation - Testing using Selenium tool - Continuous Testing - Exploratory Testing - Testing in Agile and DevOps Environments.

UNIT V **8 Hours**

ENTERPRISE ARCHITECTURE AND MODELING

Enterprise Architecture (EA) in Digital Transformation - Agility in Digital Business - Measuring EA: Metrics, KPIs and Risks.

Total: 45 Hours

Reference(s)

1. Roger S.Pressman, Software Engineering: A Practitioners Approach, McGraw Hill International edition, Seventh edition, 2020.
2. Steve Mc Connell, Code Complete - A practical handbook of software construction, Second Edition, 2004.
3. Tushar K Hazra, Bhuvan Unhelker, Enterprise Architecture for Digital Business -Integrated Transformation Strategies- Integrated Transformation strategies, First edition, 2021.
4. Gene Kim, Kevin Behr, and George Spafford, The Phoenix Project: A Novel About IT, DevOps, and Helping Your Business Win, IT Revolution Press, 2018.

22HS004 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: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	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: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	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 1 **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. Norman Lewis, Word Power Made Easy, W. R. Goyal Pub. & Distributors, 2009.
2. Sasikumar, V, 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. Barun K. Mitra,Personality Development & Soft Skills, Oxford University Press, 2012
6. Ken Taylor, Business English Orient Blackswan, 2011

22CS401 **DISCRETE MATHEMATICS** **3 1 0 4**

Course Objectives

- Implement the definitions of relevant vocabulary from graph theory and combinatorics and be able to perform related calculations
- Understand and use the terms Cardinality, finite, countably infinite and uncountably infinite, and determine which of these characteristics is associated with a given set
- 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 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.
PSO1: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Understand and apply the concepts of Boolean algebra and characteristics in computers.
2. Apply formalized arguments to classify and assess real-world arguments.
3. Represent the characteristics of predicate logic in computer engineering.
4. Apply different properties of injection, surjection, bijection, composition and inverse functions in software engineering.
5. Interpret the concepts of Permutations, Combinations and Mathematical induction in the phenomena of real world.

Articulation Matrix

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

PROPOSITIONAL CALCULUS

Propositions- Logical connectives-Compound propositions-Conditional and biconditional propositions-Truth tables - Tautologies and Contradictions - Logical and equivalences and implications-DeMorgans Laws-Normal forms-Principal conjunctive and disjunctive normal forms -Rules of inference-Arguments-Validity of arguments.

UNIT III **9 Hours**

PREDICATE CALCULUS

Predicates-Statement Function - Variables-free and bound variables- Quantifiers-Universe of discourse-Logical equivalences and implications for quantified statements- Theory of inference- The rules of universal specification and generalization-Validity of arguments.

UNIT IV **9 Hours**

SET THEORY AND FUNCTIONS

Set Operations-properties-Power set-Relations-Graph and matrix of a relation- Partial Ordering-Equivalence relations-Partitions- Functions -Types of Functions- composition of relation and functions-inverse functions.

UNIT V **9 Hours**

COMBINATORICS

Basics of Counting - Counting arguments- Pigeonhole Principle- Permutations and Combinations-Recursion and recurrence relations-Generating Functions- Mathematical Induction- Inclusion -Exclusion

Total: 45 + 15 = 60 Hours

Reference(s)

1. Trembly J P and Manohar R, Discrete Mathematical Structures with Applications to computer Science, Tata McGraw Hill Publications Co. Ltd., New Delhi 30th Re-print 2007.
2. Alan Doerr and Kenneth Levasseur, Applied Discrete Structures for Computer Science, Galgotia Publications Pvt. Ltd. Delhi. 2010.
3. Ralph P Girmaldi and Ramana B.V. Discrete and Combinatorial Mathematics: An Applied Introduction, Fifth Edition, Pearson Education Asia, Delhi, 2007.
4. Kolman Busby Ross, Discrete Mathematical Structures, Prentice-Hall India, New Delhi, Fifth Edition, 2007.
5. Rosen K.H Discrete Mathematics and its Applications, Tata McGraw Hill Publications, New Delhi. 7th Edition, 2011.

22CS402 DATA STRUCTURES II 3 0 2 4

Course Objectives

- Understand and use the various major modern data structures like Trie, Rope, Segment tree and Octree.
- Apply the graph data structure and tree traversal algorithms for solving real time problems.
- Analyze the performance of algorithm design techniques with different data structures.

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.
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.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Implement the Trie data structure and its basic search operations.
2. Outline the traversal algorithm and its types with graph data structure.
3. Implement Minimum Spanning tree algorithms and analyze their performance.
4. Design and implement different problems using the backtracking and branch and bound techniques and analyze the time complexities of them.
5. Implement modern data structures like Segment tree, Quadtree and Octree for real world applications.

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	2
2	2	2	2	2	2						2	2	2	2
3	2	3	3	2	2						2	2	2	2
4	3	3	3	3	2						3	3	3	3
5	3	2	3	3	3						3	3	3	3

UNIT I
TRIE DATA STRUCTURES **9 Hours**
Trie Structure - Types - Prefix-Based Search - Space Efficiency - Time Complexity - Compact Tries - Applications - Suffix Array and Suffix Tree - Rope.

UNIT II
GRAPH **9 Hours**
Graph representation - Breadth-first traversal - Depth-first traversal - Shortest Path Algorithms: Unweighted Shortest Paths - Dijkstra's Algorithm - Travelling Salesman Problem - Analysis of shortest path algorithms.

UNIT III
GRAPH MST **9 Hours**
Minimum Spanning Tree: Prim's Algorithm - Kruskal's Algorithm- Disjoint-Set Union (Union-Find) - A* algorithm - Flood filling algorithm - Analysis of MST algorithms.

UNIT IV
ALGORITHM DESIGN TECHNIQUES **9 Hours**
NP Complete problems- Backtracking: N-Queens Problem and Subset-Sum problem - Branch and bound: Knapsack problem - Approximation algorithms for NP hard problems: Traveling salesman - P, NP, NP-Complete and NP-Hard Problems.

UNIT V
MODERN DATA STRUCTURES **9 Hours**
Segment Tree - Interval Tree - Fenwick Tree - K-D Tree - Quadtree and Octree - Circular Buffer (Ring Buffer) - Marshaling / Unmarshalling - JSON - benefits - Schema - limitations - Protobuf.

4 Hours

EXPERIMENT 1
Implement a trie data structure to efficiently support autocomplete suggestions based on user input in google docs.

4 Hours

EXPERIMENT 2
Implement an Algorithm to find the shortest route and travel time between two locations within a city's transportation network.

10 Hours

EXPERIMENT 3
Design a cost-efficient telecommunication network to connect multiple cities using Kruskal's algorithm

4 Hours

EXPERIMENT 4
Implement a chess game application using backtracking.

4 Hours

EXPERIMENT 5
Implementing Segment Tree for Range Sum Query in a Real-time Data Analytics Platform for student management system.

4 Hours

EXPERIMENT 6
Implement a geographic information system (GIS) for locating a city as node using quadtree

Total: 45+30=75 Hours

Reference(s)

1. Michael H. Goldwasser, Data Structures and Algorithms in Python, Wiley publications, 2013.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, 2nd Edition, Pearson Education,2016.
3. Richard F. Gilberg, and Behrouz A. Forouzan, Data Structures - A Pseudocode Approach with C, Thomson 2011.
4. Aho, J.E.Hopcroft and J.D.Ullman, Data Structures and Algorithms, Pearson education, Asia, 2010.
5. Reema Thareja, Data Structures Using C, Second Edition , Oxford University Press, 2011

22CS403 OPERATING SYSTEMS 3 1 0 4

Course Objectives

- Establish a solid foundation in the introductory concepts of operating systems and gain insights into the structures, services, and roles of operating systems in computing environments.
- To apply process scheduling algorithms in a multi-programming environment and implement the various deadlock strategies effectively to prevent each other from accessing the computer resources
- To gain knowledge on the operations of memory management and File 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.
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.
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 in diverse teams, and in multidisciplinary settings.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Analyze the basic structure and architectural components of the operating system and interpret how application programs interact with the operating system through APIs.
2. Apply the various scheduling algorithms and synchronization techniques to achieve better performance of a computer system.
3. Analyze memory allocation and deallocation mechanisms involved in memory management for a specific system.
4. Apply the various file handling strategies to manage files on a secondary storage structure and in a distributed environment.
5. Analyze the virtualization technologies and their types to simulate hardware functionality and create a virtual computer system.

Articulation Matrix

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

UNIT I **8 Hours**
INTRODUCTION TO OPERATING SYSTEMS
Basic Operating System Concepts - Operating System Structure and Components - Operating System Services and Interfaces - Role of the Kernel and User Space - System calls and System Programs - Open Source and Closed source operating systems.

UNIT II **12 Hours**
PROCESS MANAGEMENT
Processes and Threads - Process Scheduling and CPU Scheduling Algorithms - Process Synchronization and Concurrency Control - Deadlocks and Handling Strategies - Inter-Process Communication (IPC) - Multi-Core and Multi-Processor Management

UNIT III **9 Hours**
MEMORY MANAGEMENT
Memory Hierarchy - Address Spaces and Memory Allocation - Paging and Segmentation - Page Replacement Algorithms - NUMA (Non-Uniform Memory Access) - Memory Compression - Memory Tiering.

UNIT IV **8 Hours**
FILE SYSTEM DESIGN AND IMPROVEMENTS
File System Structures - Storage Technologies - SSD and Flash Storage Optimization - Copy-on-Write (CoW) File Systems - File System Journaling - Distributed File Systems and Cloud Storage - File System Monitoring and Analytics.

UNIT V **8 Hours**
VIRTUALIZATION AND RECENT DEVELOPMENTS
Virtualization Principles and Types (Hardware, Software, Network, Storage) - Hypervisors and Virtual Machine Monitors - Microkernels and Exokernels - Security and Integrity in Virtualized Environments - Security in Operating Systems - Operating Systems for Quantum Computers - Cross-Platform Compatibility.

Total: 45+15=60 Hours

Reference(s)

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, 9th Edition, John Wiley & Sons Pvt. Ltd, 2015
2. Andrew S. Tanenbaum, Modern Operating Systems, Fourth Edition, Prentice Hall of India Pvt. Ltd, 2014
3. William Stallings, Operating System, Seventh Edition Prentice Hall of India, 2012
4. Harvey M. DeitelM, Operating Systems, Pearson Education Pvt. Ltd, 2007.
5. Distributed file system for cloud: A Clear and Concise Reference Kindle Edition by Gerardus Blokdyk
6. https://www.redhat.com/en/topics/virtualization

22CS404 WEB TECHNOLOGY AND FRAMEWORKS 2 0 2 3

Course Objectives

- Understand the Web Application Architectures and trace the evolution of the web and introduce concepts like Web 3.0 and Decentralized Web.
- Familiar with the different Web development Frameworks and Full stack development.
- Explore the emerging web technologies and implement best practices for making web applications accessible to all users

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.
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.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Analyze the architecture of various web applications and develop simple use cases for the real time web applications
2. Implement web applications using client-side scripting language and server-side scripting languages.
3. Integrate the web applications with databases using Web frameworks.
4. Develop a complete, functional web application that incorporates both front-end and back-end components.
5. Implement the emerging web technologies in web application development projects.

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
2	2	2	2	2	2						2	2		2
3	2	3	3	2	2						2	2		2
4	3	3	3	3	2						3	3		3
5	3	2	3	3	3						3	3		3

UNIT I **5 Hours**
INTRODUCTION TO WEB APPLICATIONS
Evolution of the web - Understanding Web Application Architectures: Server Side Rendered Applications- Single Page Application (SPA) - Mobile Application Development – Comparison of Monolithic and Microservice architectures - Serverless computing - HTTP Protocol and Methods - Web Browsers and Rendering Engines - Use cases of various web applications, including Flipkart, BIT Discourse, BIP, Wiki and Moodle.

UNIT II **7 Hours**
SCRIPTING LANGUAGES
Client-side Scripting vs Server-Side Scripting - Client-side Scripting: Execution Location - Languages: JavaScript Fundamentals - Document Object Model (DOM).
Server-Side Scripting: Execution Location - Language(s) - PHP Programming fundamentals.

UNIT III **6 Hours**
WEB DEVELOPMENT FRAMEWORKS
Introduction to Web Development Frameworks - MVC Architecture - Building APIs with a Framework - RESTful APIs and API Design - Building a RESTful API - Database Integration with ORM/ODM - Building a Basic Front-End Application.

UNIT IV **6 Hours**
FULL STACK DEVELOPMENT
Full-Stack Development - Combining Front-End and Back-End Technologies - Building a Full-Stack Web Application- 12 factor application model - Deployment and Hosting Options - Continuous Integration and Continuous Deployment (CI/CD) - Performance Optimization and Scalability.

UNIT V **6 Hours**
EMERGING WEB TECHNOLOGIES
Emerging Web Technologies: Progressive Web Apps (PWAs) - WebAssembly and WebRTC - Web Security Best Practices – Open Web Application Security Project (OWASP) - Web Accessibility and Inclusive Design - Web Performance Optimization.

EXPERIMENT 1 **6 Hours**

Create a Multipage Website that serves as a personal portfolio using the browser's developer tools and CSS to enhance the web page.

EXPERIMENT 2 **3 Hours**

Implement an animated web application for Rock, Paper, Scissors game to handle input validation ensuring that the user's choice is one of Rock, Paper, or Scissors.

EXPERIMENT 3 **3 Hours**

Create a simple inventory management system to generate QR code for each product thereby allowing user validation using PHP.

EXPERIMENT 4 **3 Hours**

Develop a secure online banking system using a server-side framework like Flask, Django, or Ruby to avoid risk to financial systems.

EXPERIMENT 5 **7 Hours**

Develop a Full Stack Web Application for task management system in a Corporate Environment for tracking project progress and streamlining work assignments.

EXPERIMENT 6 **4 Hours**

Create a RESTful API for an online store used to manage different products using Node.js or Express.

EXPERIMENT 7 **4 Hours**

Develop a real-time chat application with a continuous integration and continuous deployment (CI/CD) pipeline and set up monitoring to ensure optimal performance

Total: 30+30=60 Hours

Reference(s)

1. P.J. Deitel and H.M. Deitel, Internet and World Wide Web - How to Program, Pearson Education,2009.
2. James Gillies and Robert Cailliau, How the Web Was Born: The Story of the World Wide Web, 2000
3. D Crockford , JavaScript: The Good Parts, O Reilly , 2009
4. Mark Masse , REST API Design Book,O Reilly,2011
5. Matti Luukkainen and Jarkko Moilanen , Fullstack Open: Deep Dive Into Modern Web Development"
6. Michal Zalewski , The Tangled Web: A Guide to Securing Modern Web Applications" 2011
7. https://www.theodinproject.com/lessons/foundations.

22CS405 DATABASE MANAGEMENT SYSTEM 3 0 2 4

Course Objectives

- Analyze the data models, conceptualize, and design a database system using E-R diagrams.
- Gain knowledge on the design principles of relational and modern database systems like SQL, NoSQL and NewSQL.
- Impart knowledge in transaction processing, concurrency control and recovery techniques.

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.
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.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO1: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Analyze the data models and the types of data used in databases.
2. Implement SQL queries for creating databases and performing the relational operations.
3. Apply the normalization theory in relational databases for removing anomalies.
4. Analyze the basic issues of transaction processing, concurrency control, deadlock and its recovery schemes.
5. Analyze the performance of NoSQL and NewSQL databases related to design.

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	
2	2	2	2	2	2						2	2	2	
3	2	3	3	2	2						2	2	2	
4	3	3	3	3	2						3	3	3	
5	3	2	3	3	3						3	3	3	

UNIT I **8 Hours**

INTRODUCTION TO DATABASES AND DBMS

Understanding Data and Information - Database vs DBMS - Modern Databases - DBMS Architecture and Components - Data Models - Relational Model - Codd's 12 Rules - Object-Relational Mapping (ORM).

UNIT II **10 Hours**

STRUCTURED QUERY LANGUAGE (SQL)

SQL Basic Commands - Constraints - Database Objects - SQL Functions - Subqueries- Correlated Subqueries- Nested subqueries - Recursive queries - Common Table Expressions (CTEs) - Triggers and Stored procedures.

UNIT III **9 Hours**

DATABASE DESIGN AND NORMALIZATION

Database Design fundamentals - Entity-Relationship Diagrams (ERD) - ERD to tables - Functional Dependencies and Normal Forms: 1NF, 2 NF, 3 NF, BCNF, 4 NF, 5NF and 6 NF - Domain-Key Normal Form (DKNF) - Nested Normal Form (NNF) - Denormalization and Trade-offs - Emerging trends in Database Design - Dealing with real-world complexities in Database Design- CASE Tools for Database Design.

UNIT IV **9 Hours**

QUERY OPTIMIZATION AND TRANSACTION MANAGEMENT

Query Optimization and Execution Plans -Optimization Visualization Tool - DB Sharding - Vitess – Vitess vs MySQL- Table partitioning - Transaction Management and ACID Properties - Concurrency Control: Lock based protocols -Deadlock handling – Multi version concurrency control (MVCC) - Transaction isolation.

UNIT V **9 Hours**

NOSQL AND NEWSQL DATABASES

NoSQL Vs NewSQL- NoSQLDatabases: MongoDB and Cassandra - NewSQL databases: Redis and NuoDB -Selection of NoSQL or NewSQL over RDBMS - CAP Theorem and BASE Properties - HeidiSQL - In-Memory Databases and Caching - Database Security and Encryption - Database Performance Tuning

EXPERIMENT 1 **4 Hours**

Create a relational database with tables for storing employee details and perform CRUD operations.

EXPERIMENT 2 **6 Hours**

Create a relational database for e-commerce applications and add primary key, foreign key, check constraints and triggers.

EXPERIMENT 3 **6 Hours**

Create an ER diagram for the library management system and implement the database schema in RDBMS.

EXPERIMENT 4 **3 Hours**

Create a MongoDB database for an event management system.

EXPERIMENT 5 **4 Hours**

Design a distributed database for an e-commerce platform to handle order processing.

EXPERIMENT 6 **4 Hours**

Develop an in-memory caching solution using Redis for a content publishing platform (Blog).

EXPERIMENT 7 **3 Hours**

Develop a secure RDBMS solution for a banking financial transactions system.

Total: 45+30=75 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw - Hill, Sixth Edition, 2018
2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems,Pearson Education, Seventh Edition, 2016
3. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management, Thompson Learning Course Technology, Ninth edition, 2011
4. Guy Harrison , Next Generation Databases: NoSQLand Big Data, Apress.

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

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 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.
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.

Course Outcomes (COs)

1. Examine 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. Impact 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	PO12	PSO1	PSO2
1	1	2												
2	1	1												
3	2	2					1							
4	1													
5	2													

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 - 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: 30 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

22HS008 **ADVANCED ENGLISH AND TECHNICAL EXPRESSION** **0 0 2 1**

Course Objectives

- To enable students to achieve proficiency in academic writing
- Effectively use the language to persuade others
- Appreciate the nuances of the language and engage an audience
- Use advanced tools of language to improve communicative competence
- Prepare for professional demands at the workplace
- Give concrete expression to the plans and goals

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: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2: Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet global requirements.

Course Outcomes (COs)

1. Understand the clarity in articulating the objectives and aims and improved proficiency in using the English language
2. Communicate effectively and with good interpersonal skills; speak in public, engage the audience, and lead a group discussion
3. Critically evaluate the ethics of persuasive appeals and confidence to influence opinion
4. Analyse a specific piece of information; take in what is read, and use good writing techniques with proper grammar and syntax in all formal situations
5. Create awareness and empathy to emotional signals in communication

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	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 CREATIVE EXPRESSION **15 Hours**

Proposals & Grant applications, Argumentative essays & editorials, Sales Pitches, Campaigning, Commercials/advertisements, effectively answering the famous interview question: 'Why should we hire you?' Sentence and paragraph formation - Rhetorical questions - Emphasis & effective repetition - Empathetic expression, knowing the audience, capturing attention - Creating Memes, Comic Strips, Stand-up comedy, Caption writing, and Limericks, Vocabulary and slang words for comedy - Similes & Metaphors - Homophones, homonyms, alliteration, wordplay

UNIT II FORMAL EXPRESSION **15 Hours**

Writing: Action plans, Cover letters, Mind-Mapping, Paragraph writing Logical reasoning SVA - Advanced level - Style: Clarity, Concision, Coherence, Evocativeness, Efficacious Vocabulary - Conditional Clause - Be verbs- Tenses- advanced - Opening and closing sentences - Action plans, Anecdotal references, order of communication/ narration, complete communication- Wh-questions - Effective beginning and closing - Rhetorical questions - Appraising target audience - Pronunciation, Enunciation, Tone, Pace and Volume. - Writing: SOPs, Research Objectives, Thesis Statement, Indexing, Scholarly Articles, Academic Writing, Executive Summary, Survey Questionnaires, Citations and Bibliography - Reading: Quantitative & qualitative analysis, Analysis and paraphrasing of reference materials Speaking: Commentate live events, give instructions to operate machines/ conduct experiments Listening: Informational listening, Reflective listening, - Discriminative listening - Connective words - Prefixes and Suffixes - Quoting and paraphrasing Proofreading - Directed writing and writing formats - Note taking - Active verbs

Total: 30 Hours

Reference(s)

1. Sangeeta Sharma et.al. Communication Skills for Engineers and Scientists, PHI Learning Pvt. Ltd, 2011
2. Murphy, Raymond. English Grammar in Use: A Self-Study Reference and Practice Book for Intermediate Students: with Answers. Cambridge: Cambridge University Press, 1985.
3. R.C. Sharma & Krishna Mohan, Business Correspondence and Report Writing, Tata McGraw Hill & Co. Ltd., 2001
4. Harold R. Wallace and L.Ann Masters, Personality Development, Cengage Learning, New Delhi
5. Krishna Mohan, Meera Bannerji, Developing Communication Skills Macmillan India Ltd. 1990, Delhi
6. N.K.Agrawal and F.T.Wood, English Grammar, Composition and Usage Macmillan India Ltd., New Delhi

22HS010 SOCIALLY RELEVANT PROJECT

Course Objectives

- To develop Problem-Solving Skills
- To enhance Research and Analytical Abilities
- To promote Social Responsibility and Ethical Awareness

Program Outcomes

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

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.Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

PO8.Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO11. Project Management and Finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes:

1. Interact with society conduct a field surveys and identify societal issues.
2. Analyze societal problems using engineering principles.
3. Develop plan and provide optimal solutions for social issues using their engineering knowledge and skills.
4. Prepare comprehensive reports on their findings and proposed solutions.
5. Enhance the social responsibility and ethical considerations in engineering.
6. Develop community interaction and managerial skills

Articulation Matrix

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

Students have to interact with society, conduct a field survey and identify the issues / problems available in the society. Analyze the issues using engineering knowledge, skills and attitude and provide the optimal solutions to solve the social issues and submit the report.

`Total: 40 Hours

22HS009 COCURRICULAR / EXTRACURRICULAR ACTIVITIES

Course Objectives

- To develop Interpersonal and Leadership Skills
- To Foster Personal Growth and Time Management
- To enhance Community Engagement and Social Responsibility

Program Outcomes

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 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.
PO12. 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: Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes:

1. Build leadership skills and teamwork capabilities by engaging in group activities through organization and participation of events
2. Demonstrate the technical, creative, and interpersonal skills through active participation in technical events.
3. Exhibit balanced academics with diverse cultural, sports, and literary activities, showcasing improved time management and organizational skills.
4. Enhance the social responsibility and community engagement by participating in outreach and extension activities.
5. Gain practical experience and industry insights through field visits, industrial training, and internships.

Articulation Matrix

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

Every student shall be required to undergo a minimum of 40 hours of Co-curricular / Extracurricular activitiesorganized through society chapters, technical and non-technical Club activities during the II semester, failing which he/she shall not be permitted to appear for the VIII Semester examination. Such students are permitted to appear for the SemesterEnd examinations only after completing the requirements. The attendance of the courses / events shall be maintained on the regular basis by the concerned Co-coordinators and made available in the Office of the Controller of Examinations before the commencement of Semester end examinations of Semester II.

The following co-curricular and extra-curricular activities are conducted on a regular basis and is compulsory for all students. The students' performances are assessed on the basis of their participation and organization of events in voluntary services, performance in technical and nontechnical events, games and sports, performance in literary activities, performance in cultural activities and their participation in District/Regional/State/National and International level events.

Co-Curricular activity

Technical events organized through departments, Special labs, Clubs, Society and Chapters etc. includes but not limited to Workshop, Seminar, Conference, Symposium Technical Contest Competition, Field visit, Industrial Training, and Internships.

Extracurricular activity

Non-Technical Events Organized through departments, Special labs, Clubs, Society and Chapters etc. includes but not limited to NSS Camp, NCC Camp, YRC activity, Yoga, Sports and games, Cultural events, Outreach activity and Extension activity.

Total: 40 Hours

22CS501 THEORY OF COMPUTATION **3 1 0 4**

Course Objectives

- Understand the mathematical models of computation and formal language
- Understand the capability of Turing machines and to design TM for a given language.
- Understand the decidability and intractability of computational 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.

PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Design the Finite Automata for computable problems
2. Formulate / Design regular expression for pattern recognition
3. Develop pushdown automata for language recognition
4. Analyse the Turing machine for language acceptance.
5. Analyse the undecidability of languages

Articulation Matrix

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

UNIT I **9 Hours**

FINITE AUTOMATA

Introduction- Basic Mathematical Notation and techniques - Finite State systems - Basic Definitions - Finite Automaton - DFA & NFA - Regular Languages - Regular Expression - Equivalence of NFA and DFA - Equivalence of finite Automaton and regular expressions - Minimization of DFA - Pumping Lemma for Regular sets.

UNIT II **9 Hours**

CONTEXT FREE GRAMMAR

Grammar Introduction - Types of Grammar - Context Free Grammars (CFG) and Languages - Derivations and Languages - Ambiguity - Relationship between derivation and derivation trees - Simplification of CFG - Greibach Normal form - Chomsky normal form.

UNIT III **9 Hours**

PUSHDOWN AUTOMATA

Pushdown Automata - Definitions - Moves - Instantaneous descriptions - Deterministic pushdown automata - Equivalence of Pushdown automata and CFL - pumping lemma for CFL

UNIT IV **9 Hours**

TURING MACHINES

Definitions of Turing machines - Models - Computable languages and functions - Techniques for Turing machine construction - Multi head and Multi tape Turing Machines - The Halting problem.

UNIT V **9 Hours**

UNSOLVABLE PROBLEMS AND COMPUTABLE FUNCTIONS

Unsolvable Problems and Computable Functions - Recursive and recursively enumerable languages - Universal Turing machine. Measuring and Classifying Complexity: - P and NP completeness - Polynomial time reductions

Total: 45 + 15 = 60 Hours

Reference(s)

1. Hopcroft J.E, Motwani R, and Ullman J D, Introduction to Automata Theory, Language and Computations, 3rd Edition, Pearson Education (ISBN 1292039051), 2014.
2. Martin J, Introduction to Languages and the Theory of Computation, 3rd Edition, TMH, 2007.
3. Kamala Krithivasan and Rama R, Introduction to Formal Languages, Automata Theory and Computation, Pearson Education 2009.
4. Peter Linz , An Introduction to Formal Languages and Automata, Fifth edition, 2012.
5. Harry R Lewis and Christos H Papadimitriou, Elements of the Theory of Computation, Second Edition, Prentice Hall of India, Pearson Education, New Delhi, 2003
6. Mishra K L P and Chandrasekaran N, Theory of Computer Science Automata, Languages and Computation, Third Edition, Prentice Hall of India, 2004.

22CS502 COMPUTER NETWORKS 3 0 2 4

Course Objectives

- To understand the division of network functionality into layers and to familiarize the functions and protocols of each layer of TCP/IP protocol suite.
- To understand the components required to build different types of network and to learn concepts related to network addressing.
- To understand the flow of information from one node to another node in the network and to learn the application layer utilities

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Compare OSI model with TCP/IP protocol suite and design a network based on four different topologies.
2. Design and analyze error and flow control algorithms for communication between adjacent nodes in a network.
3. Identify and apply the suitable routing algorithms for the given network.
4. Develop a client/server application using TCP/UDP and design algorithms for end-end communication
5. Analyze the capabilities of application layer utilities and replicate the same for new applications.

Articulation Matrix

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

UNIT I **9 Hours**

DATA COMMUNICATIONS

Introduction: Data Communications, Networks, Network Types, Protocol Layering, TCP/IP Protocol Suite, OSI Model - Physical Layer: Introduction to Physical Layer - Transmission Media: Guided Media, Unguided Media.

UNIT II **9 Hours**

DATA LINK LAYER

Introduction to Data Link Layer: Link Layer Addressing - Error Detection and Correction: Block Coding, Cyclic Codes, Checksum, Forward Error Correction - Data Link Control: DLC services, Data-Link Layer Protocols, HDLC, Point-to-Point Protocol - Media Access Control: Random Access and Controlled Access.

UNIT III **9 Hours**

NETWORK LAYER

Network Layer Services - Packet Switching - IPV4 Addresses - Forwarding of IP Packets - Network Layer Protocols: IP, ICMPv4 - Routing Algorithms - Unicast Routing Protocols - Next Generation IP: IPv6 Addressing, IPv6 Protocol.

UNIT IV **9 Hours**

TRANSPORT LAYER

Introduction to Transport Layer: Simple Protocol - Stop-and-Wait Protocol - Go-Back-N Protocol - Selective Repeat Protocol - Bidirectional Protocols: Piggybacking - User Datagram Protocol - Transmission Control Protocol - Congestion Control.

UNIT V **9 Hours**

APPLICATION LAYER

Client Server Programming - WWW - HTTP - FTP - DNS – SNMP - DHCP.

EXPERIMENT 1 **5 Hours**

Design a Local area network for organization of 5 laboratories with interdepartmental connectivity and show the simulated output.

EXPERIMENT 2 **5 Hours**

Implement Cyclic Redundancy Check and Checksum algorithms to detect and correct errors while transferring files (.jpeg, .txt, .csv) over unreliable networks.

EXPERIMENT 3 **5 Hours**

Configure routers and switches to manage and optimize network traffic, ensuring reliable internet connectivity and efficient data flow for home or office networks and show the simulated output.

EXPERIMENT 4 **5 Hours**

Configure the network address using Address Resolution Protocol (ARP) to map IP addresses to MAC addresses in a college network, and Reverse ARP (RARP) to obtain their IP addresses from an available server and show the simulated output.

EXPERIMENT 5 **5 Hours**

Implement Distance Vector and Link State Routing algorithms to determine the most efficient path for data transmission across large corporate networks.

EXPERIMENT 6 **5 Hours**

Develop a real-time chat application that uses Transmission Control Protocol (TCP) for reliable, ordered communication and User Datagram Protocol (UDP) for faster, connectionless messaging.

Total: 45 + 30 = 75 Hours

Reference(s)

1. Behrouz A. Forouzan, Data Communication and Networking, Fifth Edition, McGraw Hill Education (India) Private Limited, 2017.
2. Andrew S Tanenbaum and David J Wetherall, Computer Networks, Fifth Edition, Pearson Education, 2011.
3. William Stallings, Data and Computer Communications, Tenth Edition, Prentice Hall, 2013.
4. Larry L Peterson and Bruce S Davie, Computer Networks: A Systems Approach, Fifth Edition, Elsevier, 2011.
5. James F Kurose and Keith W Ross, Computer Networking: A Top-Down Approach Featuring the Internet, Sixth Edition, Addison-Wesley, 2013.

22CS503 MACHINE LEARNING ESSENTIALS 3 0 2 4

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 algorithms in machine learning.
- Perform statistical analysis of machine learning techniques.

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.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Understand the need for Machine learning and apply concept learning to find maximally consistent hypothesis.
2. Apply supervised learning algorithms to solve classification and regression problems.
3. Analyze unsupervised and reinforcement learning algorithms with real time applications.
4. Analyze the representation and algorithms involved in Neural Networks.
5. Apply the advanced machine learning algorithms to design predictive

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Need for Machine Learning - Machine Learning Process - Types of Machine Learning - Concept Learning: Find - Salgorithm, Version space, Candidate Elimination algorithm, Inductive Bias.

UNIT II **9 Hours**

SUPERVISED LEARNING

Classification Algorithms: Support Vector Machines - Logistic Regression - K-Nearest Neighbors - Naive Bayes Classifier - Decision Trees - Random Forests - Regression Algorithms: Simple Linear Regression - Multiple Linear Regression.

UNIT III **9 Hours**

UNSUPERVISED LEARNING AND REINFORCEMENT LEARNING

Clustering algorithm: k-means clustering - Fuzzy c-means clustering - Hierarchical clustering - Gaussian (EM) clustering - Density-based clustering - Reinforcement Learning: Examples - Challenges - Q - Learning Algorithm.

UNIT IV **9 Hours**

NEURAL NETWORKS

Neural Network Basics: Multilayer Perceptron - Feed Forward Neural Networks - Back Propagation - Hyperparameter Tuning. Convolutional Neural Networks: Image Classification. Recurrent Neural Networks: Long Short - Term Memory.

UNIT V **9 Hours**

ADVANCED MODELS

Generative Models - Autoencoders - Recommendation System: Collaborative Filtering Recommendation System - Content Based Recommendation System - Hybrid Recommendation System.

EXPERIMENT 1 **5 Hours**

Implement Find S / Candidate Elimination algorithm that analyses customer purchase history and suggest the most specific product a customer might buy.

EXPERIMENT 2 **5 Hours**

Implement a Support Vector Machine (SVM) to classify healthy versus diseased plants based on image features.

EXPERIMENT 3 **5 Hours**

Implement and compare K-Means and EM algorithms to cluster patients based on medical records to identify personalized treatment plans.

EXPERIMENT 4 **5 Hours**

Apply an Artificial Neural Network by implementing the Back propagation algorithm to classify handwritten digits and evaluate the model's performance in accuracy.

EXPERIMENT 5 **5 Hours**

Develop a program for real-time sign language recognition system using a Convolutional Neural Network (CNN) and evaluate the performance metrics.

EXPERIMENT 6 **5 Hours**

Develop a Recommendation System using Content based / Collaborative Filtering for movie / Book recommendations.

Total: 45 + 30 = 75 Hours

Reference(s)

1. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.
2. Trevor Hastie, Robert Tibshirani, Jerome Friedman, The Elements of Statistical Learning, 2nd edition, Springer Series in Statistics.
3. Ethem Alpaydin, Introduction to Machine Learning, Second edition, MIT press.

22CS504 FREE OPEN SOURCE SOFTWARE 2 0 2 3

Course Objectives

- Impart the knowledge to build dynamic front-end development using Vue.js and to provide back-end services with Express.js.
- Implement Database solutions using Redis and API design with GraphQL API.
- Automate deployment processes using Ansible tool by ensuring efficient and reliable software delivery.

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.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Implement Vue CSS binding, computed properties and watchers to develop interactive and responsive web applications.
2. Create dynamic web applications using ExpressJS that serve static files and templates, manage sessions, and utilize JWT authentication.
3. Implement publish/subscribe mechanisms and transaction to design optimized data storage solutions.
4. Apply GraphQL architecture and its application components to develop efficient and flexible APIs that meet diverse data retrieval and manipulation needs.
5. Create and manage playbooks and roles to effectively automate and streamline IT infrastructure management.

Articulation Matrix

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

UNIT I **6 Hours**

FRONT-END DEVELOPMENT USING VUE.JS

Introduction to Vue - Directives – Methods – Event Modifiers – Forms – Vue CSS Binding – Vue Computed Properties – Watchers.

UNIT II **6 Hours**

BACK-END DEVELOPMENT WITH EXPRESSJS

Setting up ExpressJS Environment – Routing – URL Binding – Middleware and Templating – Static Files – Sessions – JWT Authentication.

UNIT III **6 Hours**

DATABASE MANAGEMENT USING REDIS

Overview of Redis – Data types – Commands – Keys – Strings – Hashes – Lists – Set – Sorted Sets – HyperLogLog – Publish Subscribe – Transactions.

UNIT IV **6 Hours**

GRAPHQL API

Introduction to GraphQL – Architecture – Application Components – Type System – Schema – Resolver – Query – Mutation – Validation.

UNIT V **6 Hours**

DEPLOYMENT AND HOSTING USING ANSIBLE

Introduction to Ansible – YAML Basics – Ad hoc Commands – Playbooks – Roles – Variables – Advanced Execution – Troubleshooting.

EXPERIMENT 1 **6 Hours**

Create a dynamic, responsive and interactive image gallery with Vue.js that incorporates components, computed properties and event handlers.

EXPERIMENT 2 **6 Hours**

Develop a Blog platform backend with Express.JS and implement routing and URL Binding along with JWT Authentication for API Route.

EXPERIMENT 3 **6 Hours**

Implement a Redis-Powered Real-Time Notification System for a Social Media Application.

EXPERIMENT 4 **6 Hours**

Deploy a GraphQL API using Node.Js with Express.JS to perform a CRUD operation for task management application.

EXPERIMENT 5 **6 Hours**

Create a GraphQL API for Task Management Application and deploy it using Ansible.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Olga Filipova, “Vue.js 2 and Bootstrap 4 Web development”, First edition, Packt publishers, 2017.
2. Evan M. Hahn, “Express in Action: Writing, building, and testing Node.js applications”, Manning Publications.
3. Maxwell Dayvson Da Silva and Hugo Lopes Tavares, “Redis Essentials”, First Edition, Packt Publishers, 2015.
4. Eve Porcello and Alex Banks, “Learning GraphQL: Declarative Data Fetching for Modern Web Apps, First Edition, 2018.
5. Jeff Geerling, "Ansible for DevOps: Server and Configuration Management for Humans", LeanPub publishers, Second Edition, 2023.

22CS507 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 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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project Management and Finance: Demonstrate 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	PSO1	PSO2
1	1	2	1	1	2			2	2	2			1	1
2	1	2	1	1	2			2	2	2			1	1
3	1	2	1	1	2			2	2	2	2		1	1
4	1	2	1	1	2			2	2	2	2		1	1
5	1	2			2			2	2	2			1	1

22CS601 CRYPTOGRAPHY AND NETWORK SECURITY 3 0 0 3

Course Objectives

- To understand Cryptography Theories, Algorithms and Systems.
- To understand necessary Approaches and Techniques to build protection mechanisms in order to secure computer networks.

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Analyze the fundamentals of networks security, security architecture, threats and vulnerabilities.
2. Apply the different cryptographic operations of symmetric cryptographic algorithms.
3. Apply the different cryptographic operations of public key cryptography.
4. Apply the various Authentication schemes to simulate different applications.
5. Understand various Security practices and System security standards.

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	3	3	3		3								2	
4	3	3	2		2								2	
5	3	3	3		3								2	

UNIT I **9 Hours**

INTRODUCTION

Introduction - Motivating examples - Basic concepts: confidentiality, integrity, availability, security policies, security mechanisms, assurance - Basic Cryptography Historical Background Transposition/Substitution - Caesar Cipher Introduction to Symmetric crypto primitives - Asymmetric crypto primitives.

UNIT II **9 Hours**

SYMMETRIC KEY CRYPTOGRAPHY

Traditional Symmetric ciphers - Substitution Ciphers - Transposition ciphers - Stream and block ciphers - Modern Symmetric Key Ciphers - Congruence and matrices - Groups, Rings, Fields - Finite fields - Data Encryption Standard - DES Analysis – Structure - Multiple DES - Advanced Data Encryption Standard – Transformation - Key Expansion, Key distribution and Analysis – RC4 - Modern Block Ciphers - Stream Ciphers - Other Issues.

UNIT III **9 Hours**

ASYMMETRIC KEY CRYPTOGRAPHY

Mathematics of cryptography - Primality testing-factorization – Euler‘s totient function, Fermat‘s and Euler‘s Theorem – Chinese Remainder Theorem – Exponentiation and logarithm - RSA crypto system – Key distribution – Key management – Diffie-Hellman key exchange -ElGamal cryptosystem – Elliptic curve Arithmetic - Elliptic curve cryptography.

UNIT IV **9 Hours**

MESSAGE INTEGRITY AND MESSAGE AUTHENTICATION

Authentication requirement – Authentication function – MAC – Cryptographic hash Functions - Security of hash function and MAC – SHA - Digital signature - Key management – private and public -distribution – Entity Authentication: Biometrics, Passwords, Challenge Response protocols- Authentication applications – Kerberos - X.509.

UNIT V **9 Hours**

SYSTEM SECURITY AND ADVANCED NETWORK SECURITY

Electronic Mail security – PGP, S/MIME – IP security – Web Security – Intruders – Malicious software – viruses – Firewalls - Wireless Application protocol (WAP) security - Security in GSM - Security in 3G - Security in java - .Net - Operating Systems - Case studies – Single Sign on (SSO) - Denial of service (DOS) - Cross site scripting vulnerability CSSV.

Total: 45 Hours

Reference(s)

1. William Stallings, “Cryptography and Network security”, Pearson Education, New Delhi 2007
2. Network Security: The Complete Reference by Roberta Bragg, Mark Phodes-Ousley, Keith Strassberg Tata McGraw-Hill, 2008.
3. Charlie Kaufman, Radia Perlman, and Mike Speciner, “Network Security:PRIVATE Communication in a PUBLIC World “, Prentice Hall. 2007

22CS602 PRINCIPLES OF COMPILER DESIGN 3 1 0 4

Course Objectives

- Understand the principles, algorithms, and data structures involved in the design and construction of compilers
- Acquire knowledge in construction of scanners, parsers and in intermediate code generation
- Familiar with the code generation schemes and optimization methods.

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.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Analyze the role of each phase of a compiler and the compiler construction tools.
2. Construct Finite automata to recognize regular language.
3. Construct Parser to recognize Context Free Grammar.
4. Generate intermediate code for programming constructs.
5. Apply optimization techniques in code generation and analyze the issues in code generation.

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION TO FORMAL LANGUAGES AND COMPILERS

Formal Language - Elements of Language - Formal Grammar - Chomsky Classification. Compilers: Language Processors - Structure of a Compiler - Grouping of Phases into Passes - Compiler Construction Tools.

UNIT II **9 Hours**

LEXICAL ANALYSIS

Lexical Analysis: Role of Lexical Analyzer - Input Buffering - Specification of tokens - Recognition of Tokens - Finite automata - Regular expression to finite automata - Optimization of DFA based Pattern Matches - Lexical Analyzer Generator Lex.

UNIT III **11 Hours**

SYNTAX ANALYSIS

Introduction - Role of the parser - Context-Free Grammars - Writing a Grammar - Top Down parsing - LL(1) Grammars - Non-recursive Predictive Parsing - Bottom-up parsing - Shift Reduce Parsing -LR Parsers: Simple LR Parser - Canonical LR Parser - LALR Parser - Parser Generator YACC.

UNIT IV **8 Hours**

INTERMEDIATE CODE GENERATION

Variants of Syntax Trees – Three-Address Code - Types and Declarations - Translation of Expressions - Control Flow - Switch-Statements – Backpatching.

UNIT V **9 Hours**

CODE OPTIMIZATON

Issues in the Design of a Code Generator - The Target Language - Basic Blocks and Flow Graphs - Optimization of Basic Blocks - A Simple Code Generator - Principal Sources of Optimization.

Total: 45 + 15 = 60 Hours

Reference(s)

1. Alfred V. Aho, Ravi Sethi and Jeffrey D. Ullman Compilers: Principles, Techniques and Tools, 2nd Edition, Pearson, 2012.
2. Torbengidius Mogensen, Basics of Compiler Design, Springer, 2011.
3. Charles N, Ron K Cytron, Richard J LeBlanc Jr., Crafting a Complier, Pearson Education, 2010
4. D. Grune, H.E. Bal, C.J.H. Jacobs, K.G. Langendoen, Modern Compiler Design, Wiley, 2008
5. Kennath C. Louden, Compiler Construction Principles and Practice. New Delhi: Vikas publishing House, 2006.
6. Allen I. Holub, Compiler Design in C, Prentice Hall of India, 2007.

22CS603 CLOUD COMPUTING` 3 0 2 4

Course Objectives

- Provide the ideal solution to manage enterprise resources effectively and efficiently by cloud computing.
- Identify the security and privacy issues in cloud computing.
- Develop the ability to understand and use the architecture of compute and storage cloud, service and delivery models.

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Analyze the concept of virtualization in Cloud Computing.
2. Deploy applications over different Cloud computing infrastructures
3. Implement Cloud Dockers to automate the deployment of applications.
4. Analyze the security and privacy issues in cloud computing.
5. Implement the cloud applications to solve real time problems.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to Cloud Computing - Characteristics and Benefits of Cloud Computing - Hardware and software - Evolution of cloud computing - Server virtualization: parallel and vector processing.

UNIT II **9 Hours**

CLOUD SERVICE MODELS

Software as a Service (SaaS) - Infrastructure as a Service (IaaS) - Platform as a Service (PaaS) - Cloud Data Center - Service Oriented Architecture (SoA) - Basic approach to a Data center Based SoA.

UNIT III **9 Hours**

CLOUD DOCKER

Introduction - Docker Architecture -Docker Engine - Docker Containers - Docker Objects - Docker Run - Pipeline - Automation Scripts.

UNIT IV **9 Hours**

CLOUD SECURITY

Securing cloud boundary - Service boundary - Security mapping - Brokered cloud storage access - Storage location and tenancy - Encryption - Establishing the Identity and Presence.

UNIT V **9 Hours**

CLOUD STORAGE AND APPLICATIONS

Applications in the cloud - Functionality mapping - Applications attributes - Cloud APIs-Cloud storage definition - Managed and Unmanaged cloud storage - Exploring cloud backup solutions - Cloud storage interoperability.

EXPERIMENT 1 **4 Hours**

Install Virtualbox/VMware Workstation with different flavours of linux or windows OS on top of windows

EXPERIMENT 2 **4 Hours**

Install a C compiler in the virtual machine created using virtual box and execute Simple Programs

EXPERIMENT 3 **4 Hours**

Implement the procedure to transfer the files from one virtual machine to another virtual machine for reliable data access with the help of any open stack virtual machine.

EXPERIMENT 4 **4 Hours**

Install the single node private cloud environment to resource allocation

EXPERIMENT 5 **4 Hours**

Implement the procedure to create and deploy a simple web application in public cloud environment

EXPERIMENT 6 **4 Hours**

Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim

EXPERIMENT 7 **3 Hours**

Create and Deploy applications on Microsoft Windows Azure

EXPERIMENT 8 **3 Hours**

Install Hadoop single node cluster and run simple applications like word count.

Total: 45 + 30 = 75 Hours

Reference(s)

1. Rittinghouse, John W., and James F. Ransome, Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
2. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2014.
3. Adrian Mouat - Using Docker: Developing and Deploying software with containers, O Reilly Media, 2016.
4. George Reese, Cloud Application Architectures Building Applications and Infrastructure in the Cloud Transactional Systems for EC2 and Beyond (Theory in Practice), O Reilly, 2009., CRC Press, 2017
5. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, - Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
6. IBM Cloud Computing http://www.ibm.com/cloud-computing/us/en/

22CS607 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 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.

PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project Management and Finance: Demonstrate 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	PSO1	PSO2
1	1	2	1	1	2			2	2	2			1	1
2	1	2	1	1	2			2	2	2			1	1
3	1	2	1	1	2			2	2	2	2		1	1
4	1	2	1	1	2			2	2	2	2		1	1
5	1	2			2			2	2	2			1	1

22CS701 DISTRIBUTED AND PARALLEL COMPUTING 3 0 0 3

Course Objectives

- Understanding the concepts of parallel computing and architecture of parallel system.
- Analyse the process scheduling in the multiprocessor system in parallel execution.
- Understanding the concepts of distributed computing in distributed environments.
- Compare the performance of the parallel and distributed computing.

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 modelling to complex engineering activities with an understanding of the limitations.
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 in diverse teams, and in multidisciplinary settings.
PO12. 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

- Apply knowledge of parallel and distributed computing techniques and methodologies
- Analyze the requirements for programming parallel systems and how they can be used to facilitate the programming of concurrent systems.
- Analyze the various design principles of parallel algorithms.
- Compare the different architectural models of distributed computing.
- Analyze the various Communication design principles in distributed computing

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO DISTRIBUTED SYSTEMS

Goals of the Distributed Systems - Relation to parallel systems - Synchronous versus asynchronous execution - Design issues and challenges - Types of Distributed Systems - Distributed System Models - Hardware and software concepts related to distributed systems - Middleware models.

UNIT II **9 Hours**

DISTRIBUTED COMPUTING AND COMMUNICATION DESIGN PRINCIPLES

A Model of distributed executions - Models of communication networks - Global state of distributed system - Models of process communication - Communication and Coordination: Shared Memory, Consistency, Atomicity, Message-Passing, Consensus, Conditional Actions, Critical Paths, Scalability and Cache coherence in multiprocessor systems - Synchronization mechanism.

UNIT III **7 Hours**

INTRODUCTION TO PARALLEL COMPUTING

The Idea of Parallelism - Power and potential of parallelism - Examining sequential and parallel programs - Scope and issues of parallel and distributed computing - Goals of parallelism - Parallelism and concurrency using multiple instructions streams.

UNIT IV **10 Hours**

PARALLEL ARCHITECTURE AND CLASSIFICATION MODEL

Pipeline architecture - Array processor - Multi processor architecture - Systolic architecture - Dataflow architecture - Architectural classification schemes - Memory access classification - Memory Issues : Shared vs distributed - Symmetric multiprocessing (SMP) – SIMD - Vector processing - GPU co-processing - Flynn's Taxonomy - Instruction Level support for parallel programming - Multiprocessor caches and Cache Coherence - Non-Uniform Memory Access (NUMA).

UNIT V **10 Hours**

PARALLEL ALGORITHM DESIGN PRINCIPLES AND PROGRAMMING

Need for communication and coordination/synchronization - Scheduling and contention - Independence and partitioning - Task-Based Decomposition - Data Parallel Decomposition - Characteristics of task and interaction - Load balancing - Data Management - Parallel algorithm models - Sources of overhead in parallel programs - Performance metrics for parallel algorithm implementations - Parallel algorithmic patterns like divide and conquer - Map and Reduce - Specific algorithms like parallel Merge Sort - Parallel graph Algorithms.

Total: 45 Hours

Reference(s)

1. Introduction to Parallel Computing (2nd Edition), AnanthGrama, Anshul Gupta, and George Karypis, Vipin Kumar, Addition Wesley
2. Parallel and Distributed Systems 2nd Edition, Arun Kulkarni, NupurPrasasdGiri, Nikhilesh Joshi, BhushanJadhav, Wiley
3. Introduction To Parallel Programming, Steven Brawer, Academic Press
4. Dieter Gollmann, Computer Security, John Wiley & Sons Ltd., 2011. Introduction To Parallel Processing, M.Sasikumar, Dinesh Shikhare and P. Ravi Prakash, Randy Chow, T. Johnson, Distributed Operating Systems and Algorithms, Addison Wesley
5. Distributed Operating Systems, A.S. Tanenbaum, Prentice Hall
6. Ian Foster: Designing and Building Parallel Programs – Concepts and tools for Parallel Software Engineering, Pearson Publisher, 1st Edition, 2019.
7. Parallel Programming in C with MPI and OpenMP Michael J.Quinn, McGrawHill Higher Education

22CS702 **ARTIFICIAL INTELLIGENCE AND EXPERT SYSTEM** **3 0 2 4**

Course Objectives

- To impart artificial intelligence principles, techniques and its history
- To assess the applicability, strengths, and weaknesses of the basic knowledge representation, problem solving, and learning methods in solving engineering problems
- To develop intelligent systems by assembling solutions to concrete computational 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.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Evaluate Artificial Intelligence (AI) methods and describe their foundations.
2. Apply basic principles of AI in solutions that require problem solving, inference, perception, knowledge representation and learning.
3. Demonstrate knowledge of reasoning and knowledge representation for solving real world problems
4. Analyze and illustrate how learning algorithms play vital role in problem solving
5. Illustrate the construction of learning and expert system.

Articulation Matrix

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

UNIT I **9 Hours**

ARTIFICIAL INTELLIGENCE AND ITS ISSUES

Definitions - Importance of AI, Evolution of AI - Applications of AI, Classification of AI systems with respect to environment, Knowledge Inferring systems and Planning, Uncertainty and towards Learning Systems.

UNIT II **9 Hours**

OVERVIEW TO PROBLEM SOLVING AND HEURISTIC APPROACH

Problem solving by Search - Problem space - State space - Performance Measurement - Game playing mini-max algorithm, Alpha-Beta Pruning - Search Algorithms - Breadth-first search - Depth-first search, A* search - The effect of heuristic accuracy on performance - Generating heuristics from relaxed problems - Local Search and Optimization Problem - Hill-climbing search - Constraint Satisfaction Problem - Variations on the CSP formalism.

UNIT III **9 Hours**

KNOWLEDGE REPRESENTATION, UNCERTAINTY AND KNOWLEDGE REASONING

Logical systems Knowledge Based systems - Propositional Logic Constraints - Predicate Logic First Order Logic - Inference in First Order Logic - Ontological Representations and applications -Overview Definition of uncertainty - Bayes Rule Inference - Belief Network - Decision Network.

UNIT IV **9 Hours**

LEARNING SYSTEMS

Knowledge in learning: Explanation based learning - Forms of Learning Types - Supervised, Unsupervised, Learning Decision Trees - Statistical learning methods: Instance based learning - Neural Network - Reinforcement learning: Passive and active communication: Formal grammar - Augmented Grammars - Future of AI.

UNIT V **9 Hours**

EXPERT SYSTEMS AND GAMES

Expert Systems - Stages in the development of an Expert System - Probability based Expert Systems - Expert System Tools - Difficulties in Developing Expert Systems - Applications of Expert Systems - Game theory, classification of games, game playing strategies, prisoner s Dilemma, Game playing techniques.

EXPERIMENT 1 **5 Hours**

Data pre-processing, annotation and creation of datasets using various AI tools

EXPERIMENT 2 **5 Hours**

Implementation of Breadth First and Depth First searching techniques

EXPERIMENT 3 **5 Hours**

Implementation of Hill Climbing algorithm and A* algorithm

EXPERIMENT 4 **5 Hours**

Designing a chat-bot application

EXPERIMENT 5 **5 Hours**

Implementation of Inference system

EXPERIMENT 6 **5 Hours**

Implementation of n-Queens problem where n>=1 to n<=9

Total: 45 + 30 = 75 Hours

Reference(s)

1. Russell, S. and Norvig, P, Artificial Intelligence - A Modern Approach, 3rd edition, Prentice Hall,2015.
2. Poole, D. and Mackworth, A, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press,2010
3. Ric, E., Knight, K and Shankar, B, Artificial Intelligence, 3rd edition, Tata McGraw Hill,2009
4. Luger, G.F, Artificial Intelligence -Structures and Strategies for Complex Problem Solving, 6th edition, Pearson,2008.
5. Padhy, N.P, Artificial Intelligence and Intelligent Systems, Oxford University Press,2009.
6. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010

22CS707 PROJECT WORK I **0 0 4 2**

Course Objectives

- To develop knowledge to formulate a real world problem and projects 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 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.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. Project Management and Finance: Demonstrate 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.
PO12. 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	PSO1	PSO2
1	2	2	3	3	1	3	3	3	3	3		2	3	3
2	2	2	3	3	1	3	3	3	3	3		2	3	3
3	2	2	3	3	3	3	3	3	3	3	2	2	3	3
4	2	2	3	3	3	3	3	3	3	3	2	2	3	3
5	2	2			2			3	3	3		2	3	3

22CS801 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 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.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11. Project Management and Finance: Demonstrate 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.
PO12. 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	PSO1	PSO2
1	2	2	3	3	1	3	3	3	3	3		2	3	3
2	2	2	3	3	1	3	3	3	3	3		2	3	3
3	2	2	3	3	3	3	3	3	3	3	2	2	3	3
4	2	2	3	3	3	3	3	3	3	3	2	2	3	3
5	2	2			2			3	3	3		2	3	3

22HSH01 HINDI **1 0 2 2**

Course Objectives

- To help students acquire the basics of Hindi
- To teach them how to converse in Hindi on simple day- to -day situations
- To help students understand a simple technical text in Hindi

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.

Course Outcomes (COs)

1. Construct simple sentences and use vocabulary required for day- to -day conversation.
2. Distinguish and understand the basic sounds of Hindi language.
3. Apply appropriate grammar to write and speak in Hindi language
4. Comprehend the conversation and give correct meaning
5. Take up Hindi examinations conducted by Dakshin Bharat Hindi Prachar Sabha

Articulation Matrix

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

UNIT I **9 Hours**

VOWELS AND CONSONANTS

Hindi Alphabet: Introduction (Self introduction) - Vowels - Consonants - Plosives - Fricatives - Nasal sounds - Vowel Signs - Chandra Bindu & Visarg -Table of Alphabet -Vocabulary.

UNIT II **9 Hours**

NOUNS

Nouns: Genders -Masculine & Feminine -Reading Exercises.

UNIT III **9 Hours**

PRONOUNS AND TENSES

Pronouns and Tenses - Categories of Pronouns - Personal Pronouns - Second person (you & honorific) - Definite & Indefinite pronouns - Relative pronouns - Present tense - Past tense - Future tense - Assertive & Negative Sentences - Interrogative Sentences.

UNIT IV **9 Hours**

CLASSIFIED VOCABULARY

Classified Vocabulary: Parts of body -Relatives Spices Eatables - Fruit & Vegetables - Clothes -Directions - Seasons Professions.

UNIT V **9 Hours**

CONVERSATIONS

Speaking -Telling the times -Saying the Numbers from 1 to 50 Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

1. B.R. Kishore, Self Hindi Teacher for Non-Hindi Speaking People, Vee Kumar Publications (P) Ltd., New Delhi, 2009.
2. Hindi Prachar Vahini - 1
3. Videos, Stories, Rhymes and Songs.

22HSG01 GERMAN **1 0 2 2**

Course Objectives

- To help students appear for the A1 level Examination
- To teach them how to converse fluently in German in day-to-day scenarios

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.

Course Outcomes (COs)

1. Listen and identify individual sounds of German
2. use basic phonemes and words while speaking
3. read and understand short passages on familiar topics
4. use basic sentence structures while writing
5. understand basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to the German language-Alphabets-Numbers Greetings -Days and Seasons-Working with Dictionary.

UNIT II **9 Hours**

LANGUAGE AND ITS COMMON USE

Nouns – Articles - Speaking about oneself - Listening to CD supplied with books - Paying special attention to pronunciation.

UNIT III **9 Hours**

TECHNICAL DEUTSCHE

Regular &Irregular verbs - Personal pronouns – Family - Introduction to types of sentences.

UNIT IV **9 Hours**

INTERROGATION

Question words - Types of Questions - Nominative case - Verb Conjugation - country – Nationalities.

UNIT V **9 Hours**

IMPLEMENTATION

Verbs to be & to have - Conjugation - Hobbies - Framing basic Questions and answers

Total: 45 Hours

Reference(s)

1. Kursbuch and Arbeitsbuch, NETZWERK A1 DEUTSCH ALS FREMDSPRACHE, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2015.
2. Langenscheidt Eurodictionary, German English / English German, Goyal Publishers & Distributers Pvt. Ltd., New Delhi, 2009.
3. Grundkurs, DEUTSCH Lehrbuch Hueber Munichen, 2007.

22HSJ01 JAPANESE 1 0 2 2

Course Objectives

- To train students for N5 Level Examination
- To teach them use basic Japanese sentences in day-to-day conversation
- To make students familiar with the Japanese cultural facets and social etiquette

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.

Course Outcomes (COs)

1. Recognize and write Japanese alphabet
2. Speak using basic sounds of the Japanese language
3. Apply appropriate vocabulary needed for simple conversation in Japanese language
4. Apply appropriate grammar to write and speak in Japanese language
5. Comprehend the conversation and give correct meaning

Articulation Matrix

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

UNIT I **9 Hours**

SELF INTRODUCTION / DEMONSTRATIVES / NOUN MODIFIERS

Introduction to Japanese Japanese script - Pronunciation of Japanese(Hiragana (Katakana) Long vowels - Pronunciation of in,tsu,ga -Letters combined with ya,yu,yo - Daily Greetings and Expressions -Numerals. Speaking: Self Introduction - Listening: Listening to Greetings, Listening to specific information: Numbers, Time.

UNIT II **9 Hours**

TIME EXPRESSION / VERBS - PAST

Introduction to time - Introduction of verbs - Listening to specific information.

UNIT III **9 Hours**

- ADJECTIVES - II ADJECTIVE

Word Sentence - Introduction to Adjectives - Technical Japanese Vocabulary - Pair Activity Day to day situational conversation Listening to Japanese Alphabet Pronunciation - Simple Conversation.

UNIT IV **9 Hours**

CONJUGATION OF II ADJECTIVE

Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - Houga adjective desu - Technical Japanese Vocabulary - Individual Activity - Listening to conversation with related particles

UNIT V **9 Hours**

CONJUGATION OF VERBS - TE FORM / TA FORM / NAI FORM / PLAIN FORM

N gahoshidesu - V masu form tai desu - Verb te form - Technical Japanese Vocabulary - Listening to different Counters, simple conversations with verbs and adjectives.

Total: 45 Hours

Reference(s)

1. Minna no Nihongo Japanese for Everyone Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.
2. Minna no Nihongo Japanese for Everyone Elementary Main Textbook 1-2 Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

22HSF01 FRENCH **1 0 2 2**

Course Objectives

- To prepare the students for DELF A1 Examination
- To teach them to converse fluently in French in day-to-day scenarios

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.

Course Outcomes (COs)

1. Help students acquire familiarity in the French alphabet & basic vocabulary
2. Listen and identify individual sounds of French
3. Use basic sounds and words while speaking
4. Read and understand short passages on familiar topics
5. Understand and use basic grammar and appropriate vocabulary in completing language tasks

Articulation Matrix

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

UNIT I **9 Hours**

ENTRER EN CONTACT

La langue franÃƒÂ§aise, alphabets, les numÃƒÂ©ros, les jours, les mois. Grammaire Les verbes s appeler, etre, avoir, les articles definis, indefinis Communication Saluer, s informer sur quelqu un, demander de se presenter Lexique L alphabet, les nationalites, l age, les pays, les couleurs, les jours de la semaine, les mois de l annee, les professions

UNIT II **9 Hours**

PARTAGER SON LIEU DE VIE

Les francais et leur habitat, des habitations insolites -Grammaire Verbes Conjugaison Present (Avoir / Etre / ER, IR, RE Regulier et Irregulier) Adjectifs les propositions de lieu Communication Chercher un logement, decrire son voisin, s informer sur un logement - Lexique L habitat, les pieces, l equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN LES LOISIRS DES FRANCAIS, LES GOUTS DES AUTRES, LES ACTIVITES QUOTIDIENNES

Grammaire Articles contractes, verbes vouloir, pouvoir, devoir, adjectifs interrogatifs, future proche Communication Exprimer ses gouts, parler de ses loisirs, justifier un choix, exprimer une envie - Lexique le temps libre et les loisirs, les saisons, les activites quotidiennes, le temps (le matin, le soir, la nuit)

UNIT IV **9 Hours**

COMPRENDRE SON ENVIRONNEMENT SOUVRIR A LA CULTURE

Grammaire Verbes Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait Communication Propose a quelqu un de faire quelque chose, raconter une sortie au passe, parler d un film Lexique Les sorties, la famille, l art, les vetements et les accessoires

UNIT V **9 Hours**

GOUTER A LA CAMPAGNE

Grammaire La forme negative, les verbes acheter, manger, payer, articles partitifs, le pronom en de quantite Communication Accepter et refuser une invitation, donner des instructions, commander au restaurant Lexique Les services et les commerces, les aliments, les ustensiles, l argent

Total: 45 Hours

Reference(s)

1. Grammaire Progressive du Francais, CLE International, 2010
2. Saison1, Marie Noelle Cocton et al, Didier, 2014.
3. Preparation a l examen du DELF A1 Hachette
4. Reussir le DELF A1 Bruno Girardeau
5. Website: Francais Linguaphone Linguaphone Institute Ltd., London, 2000.
6. Francais Harrisonburg : The Rosetta Stone : Fairfield Language Technologies, 2001

22CS001 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 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

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	PO12	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 Neighbor 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.

22CS002 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 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.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	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.

22CS003 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Analyze the basics of big data and use cases from selected business domains.
2. Analyze the NoSQL databases and its related concepts.
3. Apply Map reduce workflows for web applications.
4. Analyze the basic concepts 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	PO12	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.

22CS004 NEURAL NETWORKS AND DEEP LEARNING

2 0 2 3

Course Objectives

- Understand the major concepts in deep neural networks.
- Apply Convolutional Neural Network architectures for any real-life applications
- 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems

Course Outcomes (COs)

1. Apply the basic concepts of neural networks.
2. Analyze the categories of associative memory and unsupervised learning networks.
3. Apply Convolutional Neural Networks and its variants for web and mobile applications.
4. Build and train the deep learning neural network models.
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.

22CS005 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 engineeringproblems 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 designsystem components or processes that meet the specified needs with appropriate consideration for thepublic health and safety, and the cultural, societal, and environmental considerations.
PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with anunderstanding of the limitations.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, andevaluate effective solutions for real-life and research problems.

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	PO12	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 DependencyParsing, 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 – Shorttime Fourier analysis - Mel Frequency Cepstral Coeffecients, Perceptual linear prediction (PLP), Linear predictioncepstral 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 vocabularycontinuous speech recognition - HMM/GMM based speech recognition – DNN/HMMmodel - 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 voicecommands **3 Hours**

EXPERIMENT 9
Developing speech recognition system to recognizecontinuous 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.

22CS006 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 engineeringproblems 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 designsystem components or processes that meet the specified needs with appropriate consideration for thepublic health and safety, and the cultural, societal, and environmental considerations.
PO4. Conduct Investigations of Complex Problems: Use research-based knowledge and researchmethods including design of experiments, analysis and interpretation of data, and synthesis of theinformation to provide valid conclusions.
PO5. Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modernengineering and IT tools including prediction and modeling to complex engineering activities with anunderstanding of the limitations.
PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assesssocietal, health, safety, legal and cultural issues and the consequent responsibilities relevant to theprofessional engineering practice.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions insocietal and environmental contexts, and demonstrate the knowledge of, and need for sustainabledevelopment.
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 engineeringcommunity and with society at large, such as, being able to comprehend and write effective reportsand design documentation, make effective presentations, and give and receive clear instructions.
PO11. Project Management and Finance: Demonstrate the knowledge and understanding of theengineering and management principles and apply these to one's own work, as a member and leader ina team, to manage projects and in multidisciplinary environments.
PO12. Life-long Learning: Recognize the need for, and have the preparation and ability to engage inindependent and life-long learning in the broadest context of technological change.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, andevaluate effective solutions for real-life and research problems.

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	PO12	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

22CS007 AGILE SOFTWARE DEVELOPMENT 3 0 0 3

Course Objectives

- To provide students with a theoretical as well as practical understanding of agile software development practices.
- To understand the Agile Scrum framework and development practices.
- To apply software design principles and refactoring techniques to achieve agility.
- To understand Agile requirements and perform testing activities within an agile project.
- To understand the benefits and pitfalls of working in an Agile team in terms of quality assurance.

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Understand genesis of Agile and driving forces for choosing Agile techniques.
2. Apply the Agile Scrum framework and development practices.
3. Apply iterative software development processes by planning and executing them.
4. Analyze the impact of the success of social aspects behind the software testing.
5. Analyze techniques and tools for improving team collaboration and management.

Articulation Matrix

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

UNIT I **9 Hours**

AGILE METHODOLOGY

Theories for Agile management - Agile software development - Traditional model vs. Agile model - classification of Agile methods - Agile manifesto and principles - Agile project management - Agile team interactions - Ethics in Agile teams - Agility in design, testing - Agile documentations - Agile drivers, capabilities and values.

UNIT II **9 Hours**

AGILE PROCESSES

Extreme Programming: Method overview - Lifecycle - Work products, roles and practices - Lean production SCRUM, Crystal, Feature Driven Development, Adaptive Software Development, Kanban model.

UNIT III **9 Hours**

AGILITY AND KNOWLEDGE MANAGEMENT

Agile information systems - Agile decision making - Earls schools of KM - Institutional knowledge evolution cycle - Development, acquisition, refinement, distribution, deployment, leveraging - KM in software engineering - Managing software knowledge - Challenges of migrating to Agile methodologies - Agile knowledge sharing role of story cards Story card Maturity Model SMM.

UNIT IV **9 Hours**

AGILITY AND REQUIREMENTS ENGINEERING

Impact of Agile processes in RE - Current Agile practices variance - Overview of RE using Agile - Managing unstable requirements - Requirements elicitation - Agile requirements abstraction model - Requirements management in Agile environment, Agile requirements prioritization - Agile requirements modeling and generation - Concurrency in Agile requirements generation.

UNIT V **9 Hours**

AGILITY AND QUALITY ASSURANCE

Agile Interaction Design - Agile product development - Agile Metrics - Feature Driven Development FDD - Financial and Production Metrics in FDD - Agile approach to Quality Assurance - Test Driven Development - Pair programming: Issues and Challenges - Agile approach to Global Software Development.

Total: 45 Hours

Reference(s)

1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede Eds. Agile Software Development, Current Research and Future Directions, Springer Verlag Berlin Heidelberg, 2010
2. David J. Anderson Eli Schragenheim, Agile Management for Software Engineering Applying the Theory of Constraints for Business Results, Prentice Hall, 2003
3. Hazza Dubinsky, Agile Software Engineering, Series Undergraduate Topics in Computer Science, Springer, VIII edition, 2009
4. Craig Larman, Agile and Iterative Development: A managers Guide, Addison-Wesley, 2004
5. Kevin C. Desouza, Agile information systems conceptualization, construction, and management, Butterworth-Heinemann, 2007.

22CS008 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	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.

22CS009 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

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	PO12	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

22CS010 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

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	PO12	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 dialer 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 TextFields, Label, Toolbar, Statusbar, 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.

22CS011 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Analyze 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	PO12	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.

22CS012 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

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	PO12	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.

22CS013 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 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.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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										1	2
2		1	3	2									1	2
3		2	1	3									1	2
4	1	2	1	3									1	2
5	1	3		2									1	2

UNIT I **9 Hours**

UNDERSTANDING VIRTUALIZATION

Describing Virtualization - Microsoft Windows Drives Server Growth - Explaining Moore s Law - Understanding the Importance of Virtualization - Examining Todays 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 Todays Hypervisors - VMware ESX - Citrix Xen - Microsoft Hyper-V - Other Solutions.

UNIT III **9 Hours**

VIRTUAL MACHINES

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

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

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.

22CS014 CLOUD SERVICES AND DATA MANAGEMENT

3 0 0 3

Course Objectives

- Analyze the basic concepts of Cloud and capabilities across the various Cloud service models.
- Analyze virtualization technology to derive the best practice model for deploying cloud-based applications.
- Create an application by utilizing cloud platforms such as Google App Engine, Microsoft Azure and Open Stack.
- Identify strategies to reduce risk and eliminate issues associated with adoption of cloud services.
- Select appropriate structures for designing, deploying and running cloud-based services in a business 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 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.

PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. (IBM ICE), Cloud Computing Architecture, IBM Global Technology Services Thought Leadership White Paper, April 2011.
2. Analyze the different forms of cloud service models
3. Apply the characteristics and architecture of IaaS using various real-world applications.
4. Evaluate PaaS concepts and architectures with real-world examples.
5. Analyze, and synthesize concepts related to the SaaS delivery model.

Articulation Matrix

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

UNIT I **9 Hours**

CLOUD COMPUTING REFERENCE ARCHITECTURE (CCRA)

Introduction to Cloud Computing Reference Architecture (CCRA), Benefits of CCRA, Architecture Overview, Versions and Application of CCRA for Developing Clouds

UNIT II **9 Hours**

INTRODUCTION OF DELIVERY MODELS IN CLOUD COMPUTING

Introduction to Cloud Delivery Models, List Various Cloud Delivery Models, Advantages of Delivery Models in Cloud, Trade-off in Cost to Install Versus Flexibility, Cloud Service Model Architecture.

UNIT III **9 Hours**

INFRASTRUCTURE AS A SERVICE (IAAS)

Introduction to Infrastructure as a Service Delivery Model, Characteristics of IaaS, Architecture, Examples of IaaS, Applicability of IaaS in the Industry.

UNIT IV **9 Hours**

PLATFORM AS A SERVICE (PAAS)

Introduction to Platform as a Service Delivery Model, Characteristics of PaaS, Patterns, Architecture and Examples of PaaS, Applicability of PaaS in the Industry.

UNIT V **9 Hours**

SOFTWARE AS A SERVICE (SAAS)

Introduction to Software as a Service Delivery Model, Characteristics of SaaS, Architecture, Examples of SaaS, Applicability of SaaS in the Industry.

Total: 45 Hours

Reference(s)

1. (IBM ICE), Cloud Computing Architecture, IBM Global Technology Services Thought Leadership White Paper, April 2011.
2. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013.
3. Cloud Computing: A Practical Approach, Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Tata McGraw Hill, 2011.
4. Enterprise Cloud Computing, Gautam Shroff, Cambridge University Press, 2010.
5. Cloud Application Architectures Building Applications and Infrastructure in the Cloud,George Reese, Oreilly, SPD, 2011.

22CS015 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 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.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	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 **9 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 **9 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

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**

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,CloudComputing Implementation, Management and Security, CRC Press, 2017.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, quotCloud Computing - A Practical Approach, Tata Mcgraw Hill, 2009.

22CS016 CLOUD AUTOMATION TOOLS AND APPLICATIONS

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 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	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 **9 Hours**

UNDERSTANDING THE CLOUD

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 - 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 **9 Hours**

AWS CLOUDFORMATION USE-CASE

Introduction to AWS Cloud Formation - 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.

22CS017 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 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.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	PSO1	PSO2
1	1	2	3											2
2		1	3	2										2
3		2	1	3										2
4	1	2	1	2										2
5	1	3		2										2

UNIT I **6 Hours**

SDN DATA PLANE AND CONTROL PLANE

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, Open Daylight, ONOS - Distributed Controllers.

UNIT III **6 Hours**

VIRTUALMACHINES 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.

EXPERIMENT 1 12 Hours

Design, and Test the LAN connection for an organization to create a risk-free virtual environment using GNS3 network simulation tool.

EXPERIMENT 2 6 Hours

Design a Mininet topology with a single SDN controller and two hosts connected to a switch, and use Wireshark to capture for an institution.

EXPERIMENT 3 6 Hours

Design and implement an SDN-based network infrastructure for a smart campus that uses the Northbound API to program flow table rules on the switch for various use cases.

EXPERIMENT 4 6 Hours

Install a network topology using the OSM GUI or CLI, connecting the necessary VNFs to form service chains or network service graphs for an organization.

Total: 30 + 30 = 60 Hours

Reference(s)

1. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design, 1 st 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,2 nd Edition, OReilly Media, 2017.
4. Paul Goransson, Chuck Black Timothy Culver, Software Defined Networks A Comprehensive Approach, 2 nd 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, 1 st Edition, 2015.

22CS018 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 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

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	PO12	PSO1	PSO2
1	3	3	3	1	2								2	
2	1	3	2	3	1									2
3	3	2	2	3	2								2	
4	2	1	2	3	3									2
5	1	3	3	1	1									2

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.

22CS019 CYBER SECURITY 3 0 0 3

Course Objectives

- To learn cybercrime and cyber law.
- To understand the cyber-attacks and tools for mitigating them.
- To understand information gathering.
- To learn how to detect a cyber-attack.
- To learn how to prevent a cyber-attack.

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Understand the basics of cyber security, cybercrime and cyber law.
2. Classify various types of attacks and learn the tools to launch the attacks.
3. Apply various tools to perform information gathering for data security and integrity.
4. Apply intrusion techniques to detect intrusion and to observe network traffic for malicious transactions in the network.
5. Apply intrusion prevention techniques to prevent intrusion and to protect against known and unknown threats.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Cyber Security - History of Internet - Impact of Internet - CIA Triad; Reason for Cyber Crime - Need for Cyber Security - History of Cyber Crime; Cybercriminals - A Global Perspective on Cyber Crimes - Classification of Cybercrimes.

UNIT II **9 Hours**

ATTACKS AND COUNTER MEASURES

OSWAP; Malicious Attack Threats and Vulnerabilities: Scope of Cyber-Attacks - Security Breach Types of Malicious Attacks - Malicious Software - Common Attack Vectors - Social engineering Attack - Wireless Network Attack - Web Application Attack - Attack Tools - Countermeasures.

UNIT III **9 Hours**

RECONNAISSANCE

Harvester - Who is - Netcraft - Host - Extracting Information from DNS - Extracting Information from E-mail Servers - Social Engineering Reconnaissance; Scanning - Port Scanning - Network Scanning and Vulnerability Scanning - Scanning Methodology - Ping Sweer Techniques - Nmap Command Switches - SYN - Stealth - XMAS - NULL - IDLE - FIN Scans - Banner Grabbing and OS Fingerprinting Techniques.

UNIT IV **9 Hours**

INTRUSION DETECTION

Host-Based Intrusion Detection - Network-Based Intrusion Detection - Distributed or Hybrid Intrusion Detection - Intrusion Detection Exchange Format - Honeypots - Example System Snort - Cyber Laws - The Indian IT Act - Cyber Crime and Punishment.

UNIT V **9 Hours**

INTRUSION PREVENTION

Firewalls and Intrusion Prevention Systems: Need for Firewalls - Firewall Characteristics and Access Policy - Types of Firewalls - Firewall Basing - Firewall Location and Configurations - Intrusion Prevention Systems - Example Unified Threat Management Products.

Total: 45 Hours

Reference(s)

1. Anand Shinde, Introduction to Cyber Security Guide to the World of Cyber Security, Notion Press, 2021
2. Nina Godbole, Sunit Belapure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley Publishers, 2011
3. https://owasp.org/www-project-top-ten/David Kim, Michael G. Solomon, Fundamentals of Information Systems Security, Jones & Bartlett Learning Publishers, 2013.
4. Patrick Engebretson, The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing Made easy, Elsevier, 2011.
5. Kimberly Graves, CEH Official Certified Ethical hacker Review Guide, Wiley Publishers, 2007.

22CS020 MODERN CRYPTOGRAPHY 3 0 0 3

Course Objectives

- To learn about the basics of modern cryptography.
- To focus on how cryptographic algorithms and protocols work and how to use them.
- To build a Pseudorandom permutation.
- To construct the basics of cryptanalytic techniques for ensuring data integrity.
- To provide instruction on how to use the concepts of block ciphers and message authentication codes.

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Interpret the basic principles of cryptography and general cryptanalysis.
2. Determine the concepts of symmetric encryption and authentication.
3. Identify the use of public key encryption, digital signatures, and key establishment.
4. Apply the cryptographic algorithms to compose, build and analyze simple cryptographic solutions.
5. Demonstrate the use of Message Authentication Codes to authenticate information transmitted between the users.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Basics of Symmetric Key Cryptography - Basics of Asymmetric Key Cryptography - Hardness of Functions - Notions of Semantic Security (SS) and Message Indistinguishability (MI): Proof of Equivalence of SS and MI - Hard Core Predicate - Trap-door permutation - Goldwasser-Micali Encryption - Goldreich-Levin Theorem: Relation between Hardcore Predicates and Trap-door permutations.

UNIT II **9 Hours**

FORMAL NOTIONS OF ATTACKS

Attacks under Message Indistinguishability: Chosen Plaintext Attack (IND-CPA) - Chosen Ciphertext Attacks (IND-CCA1 and IND-CCA2) - Attacks under Message Non-malleability: NM-CPA and NMCCA2 - Inter-relations among the attack model.

UNIT III **9 Hours**

RANDOM ORACLES

Provable Security and asymmetric cryptography - Hash functions - One-way functions: Weak and Strong one-way functions - Pseudo-random Generators (PRG): Blum-Micali-Yao Construction - Construction of more powerful PRG - Relation between One-way functions and PRG - Pseudorandom Functions (PRF).

UNIT IV **9 Hours**

BUILDING A PSEUDORANDOM PERMUTATION

The LubyRackoff Construction: Formal Definition - Application of the LubyRackoff Construction to the construction of Block Ciphers - The DES in the light of LubyRackoff Construction.

UNIT V **9 Hours**

MESSAGE AUTHENTICATION CODES

Left or Right Security (LOR) - Formal Definition of Weak and Strong MACs - Using a PRF as a MAC - Variable length MAC - Public Key Signature Schemes: Formal Definitions - Signing and Verification - Formal Proofs of Security of Full Domain Hashing - Assumptions for Public Key Signature Schemes: One-way functions Imply Secure One-time Signatures - Shamir's Secret Sharing Scheme - Formally Analyzing Cryptographic Protocols - Zero Knowledge Proofs and Protocols.

Total: 45 Hours

Reference(s)

1. William Stallings, "Cryptography and Network Security: Principles and Practice quot, PHI 7th Edition, 2017.
2. OdedGoldreich, Foundations of Cryptography, CRC Press (Low Priced Edition Available), 2009.
3. Hans Delfs and Helmut Knebl, Introduction to Cryptography: Principles and Applications, Springer Verlag, 2007.
4. Wenbo Mao, Modern Cryptography, Theory and Practice, Pearson Education (Low Priced Edition), 2004.

22CS021 CYBER FORENSICS 3 0 0 3

Course Objectives

- To understand the principles and concepts of computer forensics.
- To learn to utilize forensic tools for network-based attacks.
- To identify and apply appropriate methodologies for forensics data.
- To identify and analyze the vulnerabilities in the network.

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.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. To understand the basics of computer forensics, legal and ethical considerations, and the importance of maintaining the integrity of digital evidence.
2. Apply different types of computer forensic tools to preserve the integrity of data in the network.
3. Analyze and validate forensics data from the communicating devices to detect intruders.
4. Apply the various firewall techniques to detect the vulnerabilities in the networks.
5. Implement real-world hacking techniques to test system security and to ensure the system safety from hackers.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO COMPUTER FORENSICS

Introduction to Traditional Computer Crime - Traditional problems associated with Computer Crime - Introduction to Identity Theft amp Identity Fraud - Types of CF techniques - Incident and incident response methodology - Forensic duplication and investigation - Preparation for IR: Creating response tool kit and IR team - Forensics Technology and Systems - Understanding Computer Investigation - Data Acquisition.

UNIT II **9 Hours**

EVIDENCE COLLECTION AND FORENSICS TOOLS

Processing Crime and Incident Scenes - Working with Windows and DOS Systems - Current Computer Forensics Tools: Software/ Hardware Tools.

UNIT III **9 Hours**

ANALYSIS AND VALIDATION

Validating Forensics Data - Data Hiding Techniques - Performing Remote Acquisition - Network Forensics - Email Investigations - Cell Phone and Mobile Devices Forensics.

UNIT IV **9 Hours**

E-MAIL SECURITY

PGP - S/MIME - Internet Firewalls for Trusted System: Roles of Firewalls - Firewall related terminology - Types of Firewalls - Firewall designs - SET for E-Commerce Transactions.

UNIT V **9 Hours**

ETHICAL HACKING IN WEB

Social Engineering - Denial of Service - Session Hijacking - Hacking Web servers - Hacking Web Applications - SQL Injection - Hacking Wireless Networks - Hacking Mobile Platforms.

Total: 45 Hours

Reference(s)

1. Bill Nelson, Amelia Phillips, Frank Enfinger, Christopher Steuart, Computer Forensics and Investigations, Cengage Learning, India Edition, 2016.
2. CEH official Certified Ethical Hacking Review Guide, Wiley India Edition, 2015.
3. MarjieT.Britz, Computer Forensics and Cyber Crime: An Introduction, 3rd Edition, Prentice Hall, 2013.
4. John R. Vacca, Computer Forensics: Computer Crime Scene Investigation, Cengage Learning, 2nd Edition, 2005.
5. Man Young Rhee, Internet Security: Cryptographic Principles, Algorithms and Protocols, Wiley Publications, 2003.

22CS022 ETHICAL HACKING 3 0 0 3

Course Objectives

- To learn about the importance of information security.
- To learn different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To understand the different phases in penetration testing

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Enumerate the numerous assaults carried out during ethical hacking and penetration testing.
2. Apply the hacking techniques and understand the tools to be used for hacking.
3. Understand the various vulnerabilities of Windows and Linux OS.
4. Apply the techniques to hack web servers and tools for it.
5. Determine the characteristics of the firewall, the intruder detection mechanisms, and the malicious software to protect the system.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Ethical Hacking Overview - Role of Security and Penetration Testers – Penetration-Testing Methodologies - Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer

- The Internet Layer - IP Addressing - Network and Computer Attacks - Malware - Protecting Against Malware Attacks - Intruder Attacks - Addressing Physical Security.

UNIT II **9 Hours**

SCANNING AND ENUMERATION

Introduction to Scanning - Objectives - Scanning Methodology - Tools - Introduction to Enumeration - Enumeration Techniques - Enumeration Procedure – Tools.

UNIT III **9 Hours**

SYSTEM HACKING

Introduction - Cracking Passwords - Password Cracking Websites - Password Guessing - Password Cracking Tools - Password Cracking Countermeasures - Escalating Privileges - Executing Applications - Keyloggers and Spyware.

UNIT IV **9 Hours**

PROGRAMMING FOR SECURITY PROFESSIONALS

Programming Fundamentals - C language - HTML - Perl - Windows OS Vulnerabilities - Tools for Identifying Vulnerabilities - Countermeasures - Linux OS Vulnerabilities - Tools for Identifying Vulnerabilities - Countermeasures.

UNIT V **9 Hours**

NETWORK PROTECTION SYSTEMS

Access Control Lists - Cisco Adaptive Security Appliance Firewall - Configuration and Risk Analysis Tools for Firewalls and Routers - Intrusion Detection and Prevention Systems - Network-Based and Host-Based IDSs and IPSs - Web Filtering - Security Incident Response Teams - Honeypots.

Total: 45 Hours

Reference(s)

1. EC-Council, Ethical Hacking and Countermeasures: Attack Phases, Cengage Learning, 2010.
2. Jon Erickson, Hacking, 2nd Edition: The Art of Exploitation, No Starch Press Inc., 2008.
3. Michael T. Simpson, Kent Backman, James E. Corley, Hands-On Ethical Hacking and Network Defense, Cengage Learning, 2013.
4. Patrick Engebretson,The Basics of Hacking and Penetration Testing Ethical Hacking and Penetration Testing Made Easy Second Edition0 Elsevier2013.
5. RafayBoloch, Ethical Hacking and Penetration Testing Guide, CRC Press, 2014.

22CS023 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 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

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

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

Reference(s)

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.
3. Daniel Drescher, Blockchain Basics, First Edition, Apress, 2017.
4. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Gold feder. Bitcoin and cryptocurrency technologies a comprehensive introduction. Princeton University Press, 2016.
5. Melanie Swan, Blockchain Blueprint for a New Economy, OReilly, 2015
6. Ritesh Modi, Solidity Programming Essentials A Beginners Guide to Build Smart Contracts for Ethereum and Blockchain, Packt Publishing

22CS024 MALWARE ANALYSIS 3 0 0 3

Course Objectives

- Understand the fundamentals of malware, types and its effects.
- Identify and analyze various malware types by static and dynamic analysis.
- To deal with detection, analysis, understanding, controlling, and eradication of malware.

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Understand the various concepts of malware analysis and their technologies used.
2. Possess the skills necessary to carry out independent analysis of modern malware samples using both static and dynamic analysis techniques.
3. Understand the methods and techniques used by professional malware analysts.
4. To be able to safely analyze, debug, and disassemble any malicious software by malware analysis.
5. Understand the concept of Android malware analysis their architecture, and App development.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION AND BASIC ANALYSIS

Introduction to Malware - Malware threats - Malware types: Viruses, Worms, Rootkits, Trojans, Bots, Spyware, Adware, Logic Bombs - Goals of Malware Analysis - AV Scanning - Hashing - Finding Strings - Packing and Obfuscation - PE file format – Static - Linked Libraries and Functions - Static Analysis tools Virtual Machines and their usage in Malware analysis - Sandboxing - Basic dynamic analysis - Malware execution - Process Monitoring - Viewing processes - Registry snapshots.

UNIT II **10 Hours**

ADVANCED STATIC ANALYSIS

The Stack – Conditionals - Branching - Rep Instructions - Disassembly - Global and local variables - Arithmetic operations - Loops - Function Call Conventions - C Main Method and Offsets. Portable Executable File Format - The PE File Headers and Sections - IDA Pro - Function analysis – Graphing - The Structure of a Virtual Machine - Analyzing Windows programs - Anti-static analysis techniques – Obfuscation – Packing - Metamorphism - Polymorphism.

UNIT III **10 Hours**

ADVANCED DYNAMIC ANALYSIS

Live malware analysis - Dead malware analysis - Analyzing traces of malware - System calls - API calls - Registries - Network activities - Anti-dynamic analysis techniques - VM detection techniques - Evasion techniques - Malware Sandbox - Monitoring with Process Monitor - Packet Sniffing with Wireshark - Kernel vs. User-mode Debugging - OllyDbg - Breakpoints - Tracing - Exception Handling – Patching.

UNIT IV **8 Hours**

MALWARE FUNCTIONALITY

Downloaders and Launchers - Backdoors - Credential Stealers - Persistence Mechanisms – Handles - Mutexes - Privilege Escalation - Covert malware launching Launchers - Process Injection - Process Replacement - Hook Injection - Detours - APC injection.

UNIT V **8 Hours**

ANDROID MALWARE ANALYSIS

Android Malware Analysis: Android architecture - App development cycle – APK tool - APK inspector - Dex2Jar-JD-GUI - Static and Dynamic Analysis - Case Study: Smartphone Apps Security.

Total: 45 Hours

Reference(s)

1. Michael Sikorski and Andrew Honig, Practical Malware Analysis by No Starch Press, 2012, ISBN 9781593272906
2. Bill Blunden, The Rootkit Arsenal Escape and Evasion in the Dark Corners of the System, Second Edition, Jones amp Bartlett Publishers, 2009.
3. Jamie Butler and Greg Hoglund, Rootkits Subverting the Windows Kernel by 2005, Addison-Wesley Professional.
4. Bruce Dang, Alexandre Gazet, Elias Bachaalany, bastienJosse, " Practical Reverse Engineering x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.
5. Victor Marak, quot Windows Malware Analysis Essentials quot Packt Publishing, O Reilly, 2015.

22CS025 MULTIMEDIA AND ANIMATION 2 0 2 3

Course Objectives

- Understand the basic knowledge of multimedia Systems and related technologies.
- Learn about multimedia elements in a comprehensive way.
- Understand the basics of digital 2D animation to create story and multimedia production
- Design the technical and artistic skills to produce 3D animations.

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Apply the multimedia elements, image processing and animation.
2. Analyze the encode and decode the multimedia elements
3. Apply the author 2D and 3D creative and interactive presentations for different target multimedia applications.
4. Apply the author 2D and 3D creative and interactive presentations for different target multimedia applications.
5. Create and animate the 3D models using software tools.

Articulation Matrix

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

UNIT I **6 Hours**

INTRODUCTION TO MULTIMEDIA ELEMENTS

Multimedia - Medium - Properties of a multimedia system - Traditional data stream characteristics - Text - Basic sound concepts - Speech. Image - Computer image processing.

UNIT II **6 Hours**

MULTIMEDIA COMPRESSION

Storage space - Coding requirements - Hybrid coding – JPEG: Image preparation, Lossy mode, lossless mode, Hierarchical mode - H.261 MPEG: Video encoding, Data stream, MPEG 3, MPEG 7, MPEG 21.

UNIT III **6 Hours**

MULTIMEDIA AUTHORING

Authoring metaphors - Tools features and types: card and page based tools - Icon and object based tools - Time based tools - 3D Modeling and animation tools - Image editing tools - Audio editing tools - Digital movie tools - Creating interactive presentations - Virtual learning - Simulations.

UNIT IV **6 Hours**

2D ANIMATION

Introduction to 2D Animation - Colour theory& amp basics - Layout & Designing Basic of sketching - Composition of basic elements - Graphics and advertising Creating Digital Layout - Professional image editing - Story Boarding, stop motion animation - Production / Post-Production Background composition - 2D animation and techniques.

UNIT V **6 Hours**

3D ANIMATION

3D Modeling - Modeling techniques - Types of modelling - 3D Shading - Use of material - Shader and texture editing - Introduction to 3D Animation - 3D Animation and Rigging - Setting up controllers for joints - Simple skeleton structure with proper joint orientation - 3D Lighting and rendering.

EXPERIMENT 1 **3 Hours**

Image Editing and Manipulation.

EXPERIMENT 2 **3 Hours**

Implementation of audio and Video Editing techniques

EXPERIMENT 3 **3 Hours**

Sketching of cartoon characters

EXPERIMENT 4

Design 2D Logo using the image editing tool. **3 Hours**

EXPERIMENT 5 **3 Hours**

Creating gif animated images in 2D Animation

EXPERIMENT 6 **3 Hours**

Exploring the Interface of 3D application

EXPERIMENT 7 **3 Hours**
Create different types of Materials and Shading

EXPERIMENT 8 **3 Hours**
Create a simple walk cycle using the character Rigs

EXPERIMENT 9 **3 Hours**
Create a 3-point Light Setup

EXPERIMENT 10 **3 Hours**
Create particle Simulation

Total: 30 + 30 = 60 Hours

Reference(s)

1. Ze-Nian Li, Mark S. Drew, Jiangchuan Liu, Fundamentals of Multimedia, Third Edition, Springer Texts in Computer Science, 2021.
2. Andleigh, P. K and Kiran Thakrar, Multimedia Systems and Design, PHI, 2003.
3. Multimedia: Making It Work, Tay Vaughan, 9th Edition,
4. The Illusion of Life Disney Animation Frank Thomas and Ollie Johnston
5. Maraffi, Chris, Maya Character Creation Modeling and Animation Controls. New Riders, 2008.
6. John M Blain, The Complete Guide to Blender Graphics Computer Modeling & Animation, CRC press, 3rd Edition, 2016.

22CS026 AUGMENTED REALITY AND VIRTUAL REALITY — 2 0 2 3

Course Objectives

- To impart the fundamental aspects and principles of AR/VR technologies.
- To learn about the graphical processing units and their architectures.
- To gain knowledge about AR/VR application development.
- To gain knowledge about AR/VR application development.

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.
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.
PO12. 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Analyze the tools and technologies related to AR/VR.
2. Design various models using modeling techniques.
3. Apply programming concepts and techniques specific to VR development, including 3D graphics.
4. Develop AR/VR applications in different domains.
5. Apply the technologies related to AR to build AR-enabled devices.

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		2	2	2
2	2	3	3	3	3			2	2	2		2	3	3
3	2	2	2	2	2			2	2	2		2	3	3
4	3	3	3	3	3			2	2	2		2	3	3
5	3	3	3	3	3			2	2	2		2	3	3

UNIT I **6 Hours**

INTRODUCTION

Introduction to Virtual Reality and Augmented Reality - Definition - Introduction to Trajectories and Hybrid Space - Three Is of Virtual Reality - Virtual Reality Vs 3D Computer Graphics - Benefits of Virtual Reality - Components of VR System - Introduction to AR-AR Technologies - Input Devices - Types of Trackers - Human Visual System - Personal Graphics Displays - Human Auditory System.

UNIT II **6 Hours**

VR MODELING

Modelling - Geometric modelling - Virtual object shape - Object visual appearance - Kinematics modelling - Transformation matrices - Object position - Transformation invariants - Object hierarchies - Physical modelling - Behavior modelling - Model management.

UNIT III **6 Hours**

VR PROGRAMMING

VR Programming - Toolkits and Scene Graphs - World ToolKit - Java 3D - Comparison of World ToolKit and Java 3D.

UNIT IV **6 Hours**

APPLICATIONS

Human Factors in VR - Methodology and Terminology - VR Health and Safety Issues - VR and Society - Medical Applications of VR – Education - Arts and Entertainment - Military VR Applications - Emerging Applications of VR.

UNIT V **6 Hours**

AUGMENTED REALITY

Introduction to Augmented Reality - Computer vision for AR - Interaction - Modelling and Annotation Navigation -Wearable devices.

EXPERIMENT 1 **10 Hours**

Develop an AR business card application using Marker based AR.

EXPERIMENT 2 **10 Hours**

Develop an mobile VR application that allows users to explore and interact with buildings.

EXPERIMENT 3 **10 Hours**

Create a Markerless augmented reality museum application.

Total: 30 + 30 = 60 Hours

Reference(s)

1. 1. Charles Palmer, John Williamson, Virtual Reality Blueprints Create compelling VR experiences for mobile, Packt Publisher, 2018.
2. 2. Dieter Schmalstieg, Tobias Hollerer, Augmented Reality: Principles & Practice, Addison Wesley, 2016.
3. 3. John Vince, Introduction to Virtual Reality, Springer-Verlag, 2004.
4. 4. William R. Sherman, Alan B. Craig: Understanding Virtual Reality Interface, Application, Design, Morgan Kaufmann, 2003.

22CS027 GAME DEVELOPMENT 2 0 2 3

Course Objectives

- To know the basics of 2D and 3D graphics for game development.
- To know the stages of game development.
- To understand the basics of a game engine.
- To survey the gaming development environment and tool kits.
- To learn and develop simple games using Pygame 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 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Understand the foundations of 2D and 3d Graphics
2. Design game design documents
3. Implementation of gaming engines.
4. Survey gaming environments and frameworks.
5. Develop and construct a simple game in Pygame.

Articulation Matrix

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

UNIT I **6 Hours**

3D GRAPHICS FOR GAME DESIGN

Genres of Games, Basics of 2D and 3D Graphics for Game Avatar, Game Components - 2D and 3D Transformations - Projections - Color Models - Illumination and Shader Models - Animation - Controller Based Animation.

UNIT II **6 Hours**

GAME DESIGN PRINCIPLES

Character Development, Storyboard Development for Gaming - Script Design - Script Narration, Game Balancing, Core Mechanics, Principles of Level Design - Proposals - Writing for Preproduction, Production and Post - Production.

UNIT III **6 Hours**

GAME ENGINE DESIGN

Rendering Concept - Software Rendering - Hardware Rendering - Spatial Sorting Algorithms - Algorithms for Game Engine- Collision Detection - Game Logic - Game AI - Pathfinding.

UNIT IV **6 Hours**

OVERVIEW OF GAMING PLATFORMS AND FRAMEWORKS

Pygame Game development - Unity - Unity Scripts - Mobile Gaming, Game Studio, Unity Single player and Multi-Player games.

UNIT V **6 Hours**

GAME DEVELOPMENT USING PYGAME

Developing 2D and 3D interactive games using Pygame - Avatar Creation - 2D and 3D Graphics Programming - Incorporating music and sound - Asset Creations - Game Physics Algorithms Development - Device Handling in Pygame - Overview of Isometric and Tile Based Arcade Games - Puzzle Games.

EXPERIMENT 1 **3 Hours**

Installation of a game engine, e.g., Unity, Unreal Engine, familiarization of the GUI. Conceptualize the theme for a 2D game

EXPERIMENT 2 **3 Hours**

Character design, sprites, movement and character control

EXPERIMENT 3 **3 Hours**

Level design: design of the world in the form of tiles along with interactive and collectible objects

EXPERIMENT 4 **4 Hours**

Design of interaction between the player and the world, optionally using the physics engine.

EXPERIMENT 5 **4 Hours**

Developing a 2D interactive using Pygame

EXPERIMENT 6 **4 Hours**

Developing a Puzzle game

EXPERIMENT 7 **3 Hours**

Design of menus and user interaction in mobile platforms.

EXPERIMENT 8 **3 Hours**

Developing a 3D Game using Unreal

EXPERIMENT 9 **3 Hours**

Developing a Multiplayer game using unity

Total: 30 + 30 = 60 Hours

Reference(s)

1. Sanjay Madhav, Game Programming Algorithms and Techniques: A Platform Agnostic Approach, Addison Wesley,2013.
2. Will McGugan, Beginning Game Development with Python and Pygame: From Novice to Professional, Apress,2007.
3. Paul Craven, Python Arcade games, Apress Publishers,2016.
4. David H. Eberly, 3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics, Second Edition, CRC Press,2006.
5. Jung Hyun Han, 3D Graphics for Game Programming, Chapman and Hall/CRC, 2011.

22CS028 VIDEO CREATION AND EDITING 2 0 2 3

Course Objectives

- To introduce the broad perspective of linear and nonlinear editing concepts.
- To understand the concept of Storytelling styles.
- To be familiar with audio and video recording. To apply different media tools.
- To learn and understand the concepts of AVID XPRESS DV 4.

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.

PO9. Individual and Team Work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. Project Management and Finance: Demonstrate 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.

PO12. 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Compare the strengths and limitations of Nonlinear editing.
2. Identify the infrastructure and significance of storytelling.
3. Apply suitable methods for recording to CDs and VCDs.
4. Address the core issues of advanced editing and training techniques
5. Design and develop projects using AVID XPRESS DV 4.

Articulation Matrix

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

UNIT I **6 Hours**

FUNDAMENTALS

Evolution of filmmaking - Linear editing - Non-linear digital video - Economy of Expression - Risks associated with altering reality through editing.

UNIT II **6 Hours**

STORYTELLING

Storytelling styles in a digital world through jump cuts, L-cuts, match cuts, cutaways, dissolves, split edits Consumer and pro NLE systems - digitizing images - managing resolutions - Understanding video color - Color correcting basics - Color enhancement effects mechanics of digital editing - pointer files - Media management.

UNIT III **6 Hours**

USING AUDIO AND VIDEO

Audio: Timeline Audio Tracks - Editing Audio - Gaining, Fading and Balancing Audio - Video: Capturing digital and analog video - importing audio on putting video - exporting digital video to tape - recording to CDs and VCDs.

UNIT IV **6 Hours**

WORKING WITH FINAL CUT PRO

Working with clips and the viewer - Working with sequences, the timeline, and the canvas - Basic editing adding and editing testing effects - Advanced editing and training techniques - Working with Audio using media tools - Viewing and setting preferences.

UNIT V **6 Hours**

WORKING WITH AVID XPRESS DV 4

Starting projects and working with project window - Using basic tools and logging - Preparing to record and recording - Importing files - Organizing with bins - Viewing and making footage - Using timeline and working in trim mode - Working with audio - Output options.

EXPERIMENT 1 **3 Hours**

Write a Movie Synopsis (Individual/Team Writing)

EXPERIMENT 2 **3 Hours**

Present team stories in class

EXPERIMENT 3 **4 Hours**
Script/Storyboard Writing (Individual Assignment)

EXPERIMENT 4 **4 Hours**
Pre-Production: Personnel, budgeting, scheduling, location scouting, casting, contracts

EXPERIMENT 5 **4 Hours**
Production: Single camera production personnel

EXPERIMENT 6 **3 Hours**
Writing the Final Proposal: Overview, Media Treatments, Summary, Pitching

EXPERIMENT 7 **4 Hours**
Write Documentary

EXPERIMENT 8 **5 Hours**
Post-production: Editing, Sound design, Finishing

Total: 30 + 30 = 60 Hours

Reference(s)

1. Avid Xpress DV 4 User Guide, 2007.
2. Final Cut Pro 6 User Manual, 2004.
3. Keith Underdahl, Digital Video for Dummies, Third Edition, Dummy Series, 2001.
4. Robert M. Goodman and Partick McGarth, Editing Digital Video: The Complete Creative and Technical Guide, Digital Video and Audio, McGraw - Hill 2003.

22CS029 DIGITAL MARKETING 3 0 0 3

Course Objectives

- Understand the overview of Digital Marketing.
- Examine the role and importance of digital marketing in the business environment.
- Determine the focuses on digital marketing and its measure

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Identify some of the latest digital marketing trends and skills sets needed for today's Marketer.
2. Compare the strengths and limitations of search engine optimization.
3. Apply the suitable techniques for E-Mail Marketing.
4. Discover the hottest techniques to help to successfully plan, predict, and manage your digital Marketing campaigns.
5. Evaluate the importance of your digital marketing assets, which ones actually matter the most to your business.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO ONLINE MARKET

Online market space - Digital marketing strategy - Components - Opportunities for building brand website - Planning and creation - Content marketing.

UNIT II **9 Hours**

SEARCH ENGINE OPTIMISATION

Search Engine optimisation - Keyword Strategy- SEO Strategy - SEO success factors -On-Page Techniques - Off-Page Techniques. Search Engine Marketing- How Search Engine works- SEM components- PPC advertising -Display Advertisement.

UNIT III **9 Hours**

E- MAIL MARKETING

E- Mail Marketing - Types of E- Mail Marketing - Email Automation - Lead Generation - 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 IV **9 Hours**

SOCIAL MEDIA MARKETING

Social Media Marketing - Social Media Channels- Leveraging Social media for brand conversations and buzz. Successful /benchmark Social media campaigns. Engagement Marketing- Building Customer relationships - Creating Loyalty drivers - Influencer Marketing

UNIT V **9 Hours**

DIGITAL TRANSFORMATION

Digital Transformation & Channel Attribution- Analytics- Ad-words, Email, Mobile, social media, Web Analytics - Changing your strategy based on analysis- Recent trends in Digital marketing.

Total: 45 Hours

Reference(s)

1. Fundamentals of Digital Marketing by Puneet Singh Bhatia; Publisher: Pearson Education; First Edition (July 2017);ISBN-10: 933258737X;ISBN-13: 978-9332587373
2. Digital Marketing by Vandana Ahuja; Publisher: Oxford University Press (April 2015). ISBN-10: 0199455449
3. Marketing 4.0: Moving from Traditional to Digital by Philip Kotler;Publisher: Wiley; first edition(April 2017); ISBN10: 9788126566938;ISBN 13: 9788126566938;ASIN: 8126566930.
4. Michael Millerth, B2B Digital Marketing: Using the Web to Market Directly to Businesses, first edition, Que Biz-Tech series2012.
5. Dave Chaffey, Fiona Ellis Chadwick, Digital Marketing: Strategy, Implementation & Practice, Paperback - Import, 2012.

22CS030 KNOWLEDGE ENGINEERING 3 0 0 3

Course Objectives

- To understand the basics of Knowledge Engineering.
- To discuss the knowledge representation and reasoning methods.
- To apply reasoning and uncertainty for intelligent systems.
- To design and develop ontologies.
- To understand learning and rule learning.

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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Understand the basics of Knowledge Engineering.
2. Interpret the knowledge representation and reasoning methods.
3. Apply reasoning and uncertainty for intelligent systems.
4. Design and develop ontologies.
5. Understand learning and rule learning.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO KNOWLEDGE ENGINEERING

Introduction - Data, Information and Knowledge - Skills of Knowledge Engineer - Knowledge based systems - Types of Knowledge based systems - Expert Systems - Neural Networks - Case Based Reasoning - Genetic Algorithms - Intelligent Systems - Data Mining

UNIT II **9 Hours**

KNOWLEDGE REPRESENTATION AND REASONING

Knowledge Acquisition - Knowledge Representation and Reasoning - Using Knowledge - Logic, Rules and Representation - Developing Rule based Systems - Semantic Networks – Frames.

UNIT III **9 Hours**

REASONING UNDER UNCERTAINTY

Introduction - Abductive reasoning - Probabilistic reasoning: Enumerative Probabilities - Subjective Bayesian view - Belief Functions - Baconian Probability - Fuzzy Probability - Uncertainty methods – Evidence-based reasoning - Intelligent Agent – Mixed-Initiative Reasoning - Knowledge Engineering.

UNIT IV **9 Hours**

ONTOLOGIES DESIGN AND DEVELOPMENT

Concepts and Instances - Generalization Hierarchies - Object Features - Defining Features -Representation - Transitivity - Inheritance - Concepts as Feature Values - Ontology Matching Design and Development Methodologies - Steps in Ontology Development.

UNIT V **9 Hours**

LEARNING AND RULE LEARNING

Machine Learning - Concepts - Generalization and Specialization Rules - Types of Generalization and Specialization - Formal definition of Generalization. Modelling, Learning and Problem Solving.

Total: 45 Hours

Reference(s)

1. Ela Kumar, Knowledge Engineering, I K International Publisher House, 2018.
2. Gheorghe Tecuci, Dorin Marcu, Mihai Boicu, David A. Schum, Knowledge Engineering Building Cognitive Assistants for Evidence-based Reasoning, Cambridge University Press, First Edition, 2016.
3. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
4. John F. Sowa: Knowledge Representation Logical, Philosophical, and Computational Foundations, Brooks Cole, Thomson Learning, 2000.
5. King, Knowledge Management and Organizational Learning, Springer, 2009.
6. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition, 2001.

22CS031 SOFT COMPUTING 3 0 0 3

Course Objectives

- Apply suitable soft computing techniques for various applications
- Integrate various soft computing techniques for complex 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.

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.

PO12. 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Analyze the basic concepts of soft computing
2. Classify the architecture and working principles of specialized neural networks
3. Apply the concept of fuzzification and defuzzification in fuzzy systems
4. Analyze the fundamental concepts of genetic algorithm and classify its types
5. Apply hybrid soft computing techniques to solve real time problem

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					3	3	
2	2	2	3	2		2	2					3	3	
3	2	3	3	2		2	2					3	3	
4	3	3	3	3		3	2					3	3	
5	3	3	3	3		3	2					3	3	

UNIT I **10 Hours**

INTRODUCTION TO SOFT COMPUTING

Introduction - Artificial Intelligence - Artificial Neural Networks - Fuzzy Systems - Genetic Algorithm and Evolutionary Programming - Swarm Intelligent Systems - Classification of ANNs -McCulloch and Pitts Neuron Model - Learning Rules: Hebbian and Delta - Perceptron Network -Adaline Network - Madaline Network.

UNIT II **10 Hours**

ARTIFICIAL NEURAL NETWORKS

Back propagation Neural Networks - Kohonen Neural Network - Learning Vector Quantization -Hamming Neural Network - Hopfield Neural Network - Bi-directional Associative Memory -Adaptive Resonance Theory Neural Networks - Support Vector Machines - Spike Neuron Models.

UNIT III **9 Hours**

FUZZY SYSTEMS

Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets - Classical Relations and Fuzzy Relations - Membership Functions – Defuzzification - Fuzzy Arithmetic and Fuzzy Measures - Fuzzy Rule Base and Approximate Reasoning - Introduction to Fuzzy Decision Making

UNIT IV **8 Hours**

GENETIC ALGORITHMS

Basic Concepts - Working Principles - Encoding- Fitness Function - Reproduction -Inheritance Operators-Cross Over - Inversion and Deletion - Mutation Operator- Bit-wise Operators -Convergence of Genetic Algorithm.

UNIT V **8 Hours**

HYBRID OF SYSTEMS

Hybrid Systems - Neural Networks, Fuzzy Logic and Genetic - GA Based Weight Determination - LR-Type Fuzzy Numbers - Fuzzy Neuron - Fuzzy BP Architecture - Learning in Fuzzy BP- Inference by Fuzzy BP - Fuzzy ArtMap: A Brief Introduction - Soft Computing Tools - GA in Fuzzy Logic Controller Design - Fuzzy Logic Controller

Total: 45 Hours

Reference(s)

1. N.P.Padhy, S.P.Simon, "Soft Computing with MATLAB Programming", Oxford University Press, 2015.
2. S.N.Sivanandam , S.N.Deepa, "Principles of Soft Computing", Wiley India Pvt. Ltd., 3rd Edition, 2018.
3. Kwang H.Lee, "First course on Fuzzy Theory and Applications, Springer, 2005.
4. James A. Freeman and David M. Skapura, "Neural Networks Algorithms, Applications, and programming Techniques, Addison Wesley, 2003.

22CS032 TEXT AND SPEECH ANALYSIS 3 0 0 3

Course Objectives

- Acquire a deep understanding of natural language processing (NLP) techniques.
- Develop expertise in text analysis through practical implementation of advanced techniques
- Explore the fundamentals of speech 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 modeling to complex engineering activities with an understanding of the limitations.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Understand the foundations of natural language processing and speech analysis
2. Apply classification algorithms to text documents
3. Build question-answering and dialogue systems
4. Develop speech recognition and speech synthesis systems
5. Develop and construct a robust text classification model by exploring advanced techniques in text and speech analysis

Articulation Matrix

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

NATURAL LANGUAGE PROCESSING BASICS

Introduction to Natural Language Processing - Language syntax and structure - Text pre-processing and wrangling - Text tokenization - Stemming and lemmatization - Stop-word removal - Feature engineering for text representation-Bag-of-Words model-Bag-of-N-Grams model-TF-IDF model.

UNIT II **9 Hours**

TEXT CLASSIFICATION AND SENTIMENT ANALYSIS

Vector semantics and word embeddings - Word2Vec model-GloVe model-FastText model-Deep learning models for text classification - Recurrent Neural - Networks (RNN) – Transformers - Text summarization techniques - Topic modelling.

UNIT III **9 Hours**

QUESTION ANSWERING AND DIALOGUE SYSTEMS

Information retrieval techniques-IR-based question Answering - Knowledge-based question Answering - Language models for question Answering - Classic-question answering Models -Introduction to Chabots and dialogue Systems - Designing Dialogue Systems - Evaluating dialogue systems.

UNIT IV **9 Hours**

SPEECH RECOGNITION AND SYNTHESIS

Introduction to speech Processing - Speech signal analysis and pre-Processing - Acoustic modelling for speech Recognition - Hidden Markov Models (HMM) - Deep learning-based speech Recognition - Automatic Speech Recognition (ASR) Systems - Text normalization and letter-to-sound Conversion - Speech Synthesis Techniques - Concatenative and parametric Approaches - Wave Net and other neural TTS systems.

UNIT V **12 Hours**

TEXT AND SPEECH ANALYSIS MODELLING

Named Entity Recognition (NER) - Coreference resolution - Text coherence and cohesion - Advanced sentiment analysis - Advanced language modelling - Machine translation - Multi-modal analysis (text and speech) - Ethical considerations in text and speech analysis.

Total: 45 Hours

Reference(s)

1. Natural Language Processing with Python: Analyzing Text with the Natural Language Toolkit" by Steven Bird, Ewan Klein, and Edward Loper.
2. Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition" by Daniel Jurafsky and James H. Martin.
3. Text Mining: Classification, Clustering, and Applications" by Ashok N. Srivastava and Mehran Sahami.
4. Deep Learning for Natural Language Processing: Creating Neural Networks with Python" by Palash Goyal, Sumit Pandey, and Karan Jain.
5. Speech and Language Processing for Human-Machine Communications" by Joseph Mariani, rard Chollet, and Jacques.
6. Text Analytics with Python: A Practical Real-World Approach to Gaining Actionable Insights from Your Data" by Dipanjan Sarkar

22CS033 OPTIMIZATION TECHNIQUES 3 0 0 3

Course Objectives

- Formulate and solve linear programming problems (LPP), Integer Programming Problems and Transportation Problems
- Solve the dynamic programming and its simulation and obtain a solution to network problems using CPM and PERT techniques.
- Able to optimize the function subject to the constraints and solve problems under Markovian queuing models.

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.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Formulate and solve linear programming problems (LPP).
2. Evaluate Integer Programming Problems and Transportation Problems.
3. Solve dynamic programming and its simulation.
4. Obtain a solution to network problems using CPM and PERT techniques.
5. Optimize the function subject to the constraints and solve problems under Markovian queuing models.

Articulation Matrix

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

UNIT I **9 Hours**

LINEAR MODELS

Introduction of Operations Research: Development – Definition - Characteristics and phases - Types of operation research models - Applications; Linear Programming: mathematical formulation of LPP - Graphical Methods to solve LPP - Simplex Method- Two-Phase method.

UNIT II **9 Hours**

INTEGER PROGRAMMING AND TRANSPORTATION PROBLEMS

Integer programming: Integer Programming Formulations - The Cutting-plane Algorithm - Branch and bound method - Zero-One Implicit Enumeration Algorithm - Transportation problem - Types of Transportation Problem - Methods to Solve Transportation Problem - Transshipment Model - Modelling the Transportation Problem with Quantity Discounts.

UNIT III **9 Hours**

DYNAMIC PROGRAMMING AND SIMULATION

Dynamic Programming: Introduction - Terminology - Bellmans principle of optimality - Applications of dynamic programming - Shortest path problem - linear programming problem - Simulation: Introduction - Definition - Types of simulation models - steps involved in the simulation process - Advantages and Disadvantages - Application of Simulation to queuing and inventory.

UNIT IV **9 Hours**

PROJECT SCHEDULING

Introduction - Phases of project management - Guidelines for network construction - Critical path method (CPM) - Gantt Chart - PERT- Crashing of project network - Project Scheduling with Constrained Resources -Cost considerations in PERT and CPM.

UNIT V **9 Hours**

CLASSICAL OPTIMIZATION THEORY

Unconstrained problems - Necessary and sufficient conditions - Newton-Raphson method, Constrained problems - Equality constraints - Inequality constraints - Kuhn-Tucker conditions.

Total: 45 Hours

Reference(s)

1. Hamdy A Taha, Operations Research: An Introduction, Pearson, 10th Edition, 2017.
2. ND Vohra, Quantitative Techniques in Management, Tata McGraw Hill, 4th Edition, 2011.
3. J. K. Sharma, Operations Research Theory and Applications, Macmillan, 5th Edition, 2012.
4. Hiller F.S, Liberman G.J, Introduction to Operations Research, 10th Edition McGraw Hill, 2017.
5. Jit. S. Chandran, Mahendran P. Kawatra, KiHoKim, Essentials of Linear Programming, Vikas Publishing House Pvt.Ltd. New Delhi, 1994.
6. Ravindran A., Philip D.T., and Solberg J.J., Operations Research, John Wiley, 2nd Edition, 2007.

22CS034 ETHICS AND AI 3 0 0 3

Course Objectives

- Understand the fundamental concepts of morality and ethics in AI.
- Explore the AI standards and Regulations in the field of AI.
- Determine the problems to solve societal issues using ethics and artificial intelligence.

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.

PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Analyze the morality and ethics in AI
2. Acquire knowledge in application ethics, issues, and its challenges
3. Design Autonomous and semi-Autonomous System based on AI standards and Regulations.
4. Develop the concepts of Robo ethics and Morality with professional responsibilities.
5. Construct the applications related to societal issues in AI with National and International Strategies on AI.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Definition of morality and ethics in AI - Impact on Society - Impact on human Psychology - Impact on the legal System - Impact on the environment and the Planet - Impact on trust.

UNIT II **9 Hours**

ETHICAL INITIATIVES IN AI

International ethical Initiatives - Ethical harms and Concerns - Case study: healthcare robots - Autonomous Vehicles - Warfare and weaponization.

UNIT III **9 Hours**

AI STANDARDS AND REGULATION

Model Process for Addressing Ethical Concerns During System Design - Transparency of Autonomous Systems-Data Privacy Process - Algorithmic Bias Considerations - Ontological Standard for Ethically Driven Robotics and Automation Systems.

UNIT IV **9 Hours**

ROBOETHICS SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS

Robot - Roboethics - Ethics and Morality - Moral Theories-Ethics in Science and Technology - Ethical Issues in an ICT Society - Harmonization of Principles - Ethics and Professional Responsibility Roboethics Taxonomy

UNIT V **9 Hours**

AI AND ETHICS CHALLENGES AND OPPORTUNITIES

Challenges – Opportunities - Ethical issues in artificial intelligence - Societal Issues Concerning the Application of Artificial Intelligence in Medicine – Decision-making role in Industries - National and International Strategies on AI.

Total: 45 Hours

Reference(s)

1. Towards a Code of Ethics for Artificial Intelligence (Artificial Intelligence: Foundations, Theory, and Algorithms) by Paula Boddington, November 2017
2. Mark Coeckelbergh, AI Ethics, The MIT Press Essential Knowledge series, April.
3. Y. Eleanor Bird, Jasmin Fox-Skelly, Nicola Jenner, Ruth Larbey, Emma Weitkamp and Alan Winfield, The ethics of artificial intelligence Issues and initiatives, EPRS European 189 Parliamentary Research Service Scientific Foresight Unit (STOA) PE 634.452 - March 2020.
4. Patrick Lin, Keith Abney, George A Bekey, Robot Ethics: The Ethical and Social Implications of Robotics, The MIT Press- January 2014.

22CS035 SOFTWARE QUALITY ASSURANCE 3 0 0 3

Course Objectives

- Understand the standards and components of software quality assurance.
- Understand software quality assurance activities with tools and techniques
- Study the metrics for software quality assurance.

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.
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.
PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Illustrate the components of software quality assurance system and its challenges
2. Identify the SQA components and the quality activities in the project life cycle
3. Analyze the procedures required to ensure software quality
4. Illustrate the project process control and its metrics in software quality assurance
5. Examine the standards and certifications of software quality assurance

Articulation Matrix

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

UNIT I **7 Hours**

INTRODUCTION

Software Quality Challenge - Software Quality Factors - Components of the Software Quality Assurance System. Pre-Project Software Quality Components - Contract Review - Development and Quality Plans.

UNIT II **10 Hours**

SQA COMPONENTS IN THE PROJECT LIFE CYCLE

Integrating quality activities in the project life cycle - Reviews - Software testing - Strategies -Software testing - Implementation - Assuring the quality of software maintenance - Assuring the quality of external participants" parts - Case tools and their effect on software quality.

UNIT III **9 Hours**

SOFTWARE QUALITY INFRASTRUCTURE COMPONENTS

Procedures and work instructions - Supporting quality devices - Staff Training instructing and certification - Preventive and corrective actions - Configuration management - Documentation and quality records controls.

UNIT IV **10 Hours**

SOFTWARE QUALITY MANAGEMENT COMPONENTS

Project progress control - Components of project progress control - Progress control of internal projects and external participants - Implementation of project progress control. Software Quality Metrics - Objectives of quality measurement - Process metrics - Product metrics. Software Quality Costs - Objectives of cost of software quality metrics - classic model of cost of software quality.

UNIT V **9 Hours**

STANDARDS- CERTIFICATION AND ASSESSMENT

SQA standards - ISO 9001 certification - Software process assessment. organizing for quality Assurance - Management and its role in quality assurance - The software quality assurance unit - SQA Trustees and committees.

Total: 45 Hours

Reference(s)

1. Daniel Galin - Software Quality Assurance: From Theory to Implementation - Pearson Addison-Wesley, 2012.
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. Ellis Horowitz, Sartaj Sahni and Susan Anderson-Freed, Fundamentals of Data Structures in C, Silicon Press, 2009.

22CS036 XML AND WEB SERVICES 3 0 0 3

Course Objectives

- Understand the proficiency in creating, manipulating, and validating XML documents, including understanding XML syntax, structure, and key concepts and use XML technologies such as XML Schema, XPath, and XSLT.
- Understanding of web services and their role in distributed systems. Explore SOAP and REST architectures, understand their differences.
- Acquire practical skills in implementing XML-based web services using industry-standard technologies like SOAP and WSDL.

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.
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.
PO12. 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Infer XML technologies including XML Schema, XPath, and XSLT, enabling effective data transformation and manipulation in XML-based systems.
2. Design scalable and secure web service architectures using industry-standard protocols like SOAP and REST, ensuring interoperability and efficient communication between distributed systems.
3. Building web services by creating service interfaces, defining operations, and implementing message exchange patterns, ensuring seamless integration and communication between heterogeneous systems.
4. Design and implement XML-based solutions for electronic data interchange (EDI), data validation, and interoperability, ensuring compliance with industry standards and optimizing e-business processes.
5. Design and implement XML-based content management solutions, including content modeling, metadata management, and content transformation.

Articulation Matrix

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

UNIT I **9 Hours**

XML TECHNOLOGY FAMILY

XML – Benefits – Advantages of XML over HTML – EDL –Databases – XML based standards – DTD – XML Schemas – X-Files – XML processing – DOM – SAX presentation technologies – XSL – XFORMS – XHTML – Voice XML – Transformation – XSLT – XLINK – XPATH –XQ

UNIT II **9 Hours**

ARCHITECTING WEB SERVICES

Business motivations for web services – B2B – B2C - Technical motivations – limitations of CORBA and DCOM – Service–oriented Architecture (SOA) – Architecting web services –Implementation view – Web services technology stack – Logical view – Composition of web services – Deployment view–from application server to peer to peer – Process view – Life in the runtime.

UNIT III **9 Hours**

WEB SERVICES BUILDING BLOCK

Transport protocols for web services – Messaging with web services – Protocols – SOAP – Describing web services – WSDL – Anatomy of WSDL – Manipulating WSDL – Web service policy – Discovering web services – UDDI – Anatomy of UDDI - Web service inspection – Ad-Hoc Discovery – Securing web services

UNIT IV **9 Hours**

IMPLEMENTING XML IN E-BUSINESS

B2B - B2C Applications – Different types of B2B interaction – Components of e-business XML systems – ebXML – Rosetta Net Applied XML in vertical industry – Web services for mobile devices.

UNIT V **9 Hours**

XML AND CONTENT MANAGEMENT

Semantic Web – Role of Meta data in web content – Resource Description Framework – RDFschema – Architecture of semantic web – Content management workflow – XLANG –WSFL.

Total: 45 Hours

Reference(s)

1. Frank. P. Coyle, XML, Web Services and the Data Revolution, Pearson Education, 2007.
2. David Hunter, Jeff Rafter, Joe Fawcett, Eric Van der Vlist, Danny Ayers, Jon Duckett, Andrew Watt, Linda McKinnon, Begining XML , Fourth Edition, Wrox publication.
3. Deitel H M, Deitel P J, Nirto T R, Lin T M, XML How to Program, Pearson Edition, 2011.

22CS037 INFORMATION STORAGE MANAGEMENT 3 0 0 3

Course Objectives

- Understand the challenges in information storage and management.
- Describe the core elements in a data center.
- Understand RAID and its various levels for data backup.

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.

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.

PSO1. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Illustrate physical and logical components of a storage infrastructure including storage subsystems, RAID and intelligent storage systems
2. Describe storage networking technologies such as FC-SAN, IP-SAN, FCoE, NAS and object-based and unified storage
3. Illustrate and articulate business continuity solutions, backup and replications, along with archive for managing fixed content
4. Identify key characteristics, services, deployment models, and infrastructure components for a cloud computing
5. Implement the concept of security storage infrastructure management

Articulation Matrix

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

UNIT I **9 Hours**

STORAGE SYSTEM

Introduction to information storage - Virtualization and cloud computing - Key data center elements - Compute, application, and storage virtualization - Disk dive & flash drive components and performance – RAID - Intelligent storage system and storage provisioning (including virtual provisioning).

UNIT II **9 Hours**

STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION

Fibre Channel SAN components - FC protocol and operations - Block level storage virtualization - iSCL and FCIP as an IP-SAN solutions - Converged networking option FcoE - Network Attached Storage (NAS) components - Protocol and operations - File level storage virtualization - Object based storage and unified storage platform.

UNIT III **9 Hours**

BACKUP, ARCHIVE AND REPLICATION

Business continuity terminologies - Planning and solutions - Clustering and multipathing to avoid single points of failure - Backup and recovery methods - Targets and topologies - Data deduplication and backup in virtualized environment - Fixed content and data archive - Local replication in classic and virtual environments - Remote replication in classic and virtual environments - Three-site remote replication and continuous data protection.

UNIT IV **9 Hours**

CLOUD COMPUTING CHARACTERISTICS AND BENEFITS

Cloud Enabling Technologies - Characteristics of Cloud Computing - Benefits of Cloud Computing - Cloud Service Models Cloud deployment models - Cloud Computing Infrastructure - Cloud Challenges - Cloud migration considerations.

UNIT V **9 Hours**

SECURING AND MANAGING STORAGE INFRASTRUCTURE

Security threats, and countermeasures in various domains - Security solutions for FC-SAN, IP-SAN and NAS environments - Security in virtualized and cloud environments - Monitoring and managing various information infrastructure components in classic and virtual environments - Information lifecycle Management (ILM) and storage tiering.

Total: 45 Hours

Reference(s)

1. Information Storage and Management: Storing, Managing and Protecting Digital Information in classic, Virtualized and Cloud Environments, 2nd Edition, EMC Educations Services, Wiley, May 2012.
2. Information Storage and Management: Storing, Managing, and Protecting Digital Information, EMC Education Services, Wiley, January 2010.
3. Ulf Troppens, Rainer Erkens, Wolfgang Mueller-Friedt, Rainer Wolafka, Nils Haustein, "Storage Networks Explained: Basics and Application of Fibre Channel SAN, NAS, iSCSI, InfiniBand and FCoE, 2nd Edition, Wiley, July 2009.

22CS038 MOBILE APPLICATION DEVELOPMENT 3 0 0 3

Course Objectives

- Understand the basics of mobile application development.
- Work with mobile app development platforms

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.
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.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Understand the basics of mobile application development.
2. Design the architecture of android application development.
3. Develop software using android.
4. Develop applications using components of android framework.
5. Develop android applications including files and databases.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to Android - Android versions and its feature set - The various Android devices on the market - The Android Market application store - Android Development Environment - System Requirements - Android SDK - Installing Java, and ADT bundle - Eclipse Integrated Development Environment (IDE) - Creating Android Virtual Devices (AVDs).

UNIT II **9 Hours**

ANDROID ARCHITECTURE OVERVIEW AND CREATING AN EXAMPLE ANDROID APPLICATION

The Android Software Stack - The Linux Kernel - Android Runtime - Dalvik Virtual Machine - Android Runtime Core Libraries - Dalvik VM Specific Libraries - Java Interoperability Libraries - Android Libraries - Application Framework - Creating a New Android Project - Defining the Project Name and SDK Settings - Project Configuration Settings - Configuring the Launcher Icon - Creating an Activity - Running the Application in the AVD - Stopping a Running Application - Modifying the Example Application - Reviewing the Layout and Resource Files.

UNIT III **9 Hours**

ANDROID SOFTWARE DEVELOPMENT PLATFORM

Understanding Java SE and the Dalvik Virtual Machine - The Directory Structure of an Android Project - Common Default Resources Folders - The Values Folder - Leveraging Android XML- Screen Sizes - Launching Your Application: The AndroidManifest.xml File - Creating Your First Android Application.

UNIT IV **9 Hours**

ANDROID FRAMEWORK OVERVIEW

Android Application Components - Android Activities: Defining the UI - Android Services: Processing in the Background - Broadcast Receivers: Announcements and Notifications Content Providers: Data Management - Android Intent Objects: Messaging for Components - Android Manifest XML: Declaring Your Component - Views and View Groups - Android Layout Managers - The View Hierarchy - Designing an Android User Interface using the Graphical Layout Tool.

UNIT V **9 Hours**

FILES, CONTENT PROVIDERS, AND DATABASES

Saving and Loading Files - SQLite Databases - Android Database Design - Exposing Access to a Data Source through a Content Provider - Content Provider Registration - Native Content Providers.

Total: 45 Hours

Reference(s)

1. Code Complete: A Practical Handbook of Software Construction, 2nd Edition by Steve McConnell.
2. Mobile Apps Made Simple: The Ultimate Guide to Quickly Creating, Designing and Utilizing Mobile Apps for Your Business, 2nd Edition by Jonathan McCallister.
3. Android Application Development Cookbook- Second Edition by Rick Boyer and Kyle Mew.

22CS039 INTERNET OF THINGS **3 0 0 3**

Course Objectives

- Understand the components and protocols used in IOT.
- To Understand the IoT Reference Architecture and Real World Design Constraints
- Ability to understand the Security requirements in IoT.

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.
PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Identify physical design, communication and Technologies used in IOT.
2. Illustrate the IoT reference models and IoT protocols.
3. Examine the components, interfacing devices and communication models of IoT
4. Analyze the cloud storage models and web service and data analytics for IoT
5. Analyse the security requirements and threats in IOT.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO INTERNET OF THINGS

IOT fundamentals - Characteristics of IoT - Physical Design of IoT - IoT Protocols - IoT communication models - IOT Communication APIs -IOT enabled Technologies - Wireless Sensor Networks - Cloud computing - Big data analytics and communication protocols - Embedded systems - IOT levels and templates.

UNIT II **9 Hours**

IOT REFERENCE ARCHITECTURE

Introduction - State of the art - Architecture reference model - IOT reference model - IOT Protocols: Zigbee, RFID, BLE, NFC, BACnet, 6LowPAN, RPL, XMPP, CoAP, and MQTT.

UNIT III **9 Hours**

IOT DEVICES AND INTERFACING

IOT components - Sensors - Actuators - Hardware Platforms - Interfacing with devices: Setting up the board -Programming for IOT - Reading from sensors - Communication: Connecting microcontroller with mobile devices - communication through Bluetooth, wifi, Ethernet

UNIT IV **9 Hours**

IOT CLOUD, WEB SERVICES AND DATA ANALYTICS

Introduction to cloud storage models - Cloud services and IOT - Communication APIs - Cloud for IOT - Web server: Web server for IOT - Amazon Web services for IOT - Data analytics for IOT.

UNIT V **9 Hours**

IOT SECURITY

Security Requirements in IOT - Security concerns in IOT Applications - Security architecture in the Internet of Things - Insufficient authentication/authorization - Insecure access control - Threats to Access control, Privacy, and availability - Attacks specific to IOT - Vulnerabilities - Secrecy and Secret- Key capacity - Authentication/authorization for smart devices - Transport encryption.

Total: 45 Hours

Reference(s)

1. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.
2. Vijay Madisetti and ArshdeepBahga, Internet of Things (A Hands-on-Approach), 1stEdition, VPT, 2014.
3. Olivier Hersent, David Boswarthick, Omar Elloumi , The Internet of Things Key applications and Protocols, Wiley, 2012
4. Getting Started with the Internet of Things: Connecting Sensors and Microcontrollers to the Cloud (Make: Projects) [Kindle Edition] by CunoPfister,2011 Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van Duren.

22CS040 BUSINESS ANALYTICS 3 0 0 3

Course Objectives

- Comprehend the process of acquiring Business Intelligence.
- Understand various types of analytics for Business Forecasting.
- Apply analytics for different functions of a business.

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.

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.

PSO2. Design and develop cost-effective solutions based on cutting-edge hardware and software tools and techniques to meet the global requirements.

Course Outcomes (COs)

1. Infer the real-world business problems and model with analytical solutions.
2. Interpret the business processes for extracting Business Intelligence.
3. Apply predictive analytics for business fore-casting
4. Apply analytics for supply chain and logistics management
5. Apply analytics for marketing and sales.

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	3		3	3									2
4	3	3		3	3									2
5	3	3		3	3									2

UNIT I **9 Hours**

INTRODUCTION TO BUSINESS ANALYTICS

Analytics and Data Science – Analytics Life Cycle – Types of Analytics – Business Problem Definition – Data Collection – Data Preparation – Hypothesis Generation – Modeling – Validation and Evaluation – Interpretation – Deployment and Iteration

UNIT II **9 Hours**

BUSINESS INTELLIGENCE

Data Warehouses and Data Mart - Knowledge Management –Types of Decisions - Decision Making Process - Decision Support Systems – Business Intelligence –OLAP – Analytic functions.

UNIT III **9 Hours**

BUSINESS FORECASTING

Introduction to Business Forecasting and Predictive analytics - Logic and Data Driven Models – Data Mining and Predictive Analysis Modeling –Machine Learning for Predictive analytics.

UNIT IV **9 Hours**

HR AND SUPPLY CHAIN ANALYTICS

Human Resources – Planning and Recruitment – Training and Development - Supply chain network - Planning Demand, Inventory and Supply – Logistics – Analytics applications in HR & Supply Chain. Apply HR Analytics to make a prediction of the demand for hourly employees for a year.

UNIT V **9 Hours**

MARKETING AND SALES ANALYTICS

Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales. Do predictive analytics for customers' behaviour in marketing and sales.

Total: 45 Hours

Reference(s)

1. R. Evans James, Business Analytics, 2017.
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2016.
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016.
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Mahadevan B, “Operations Management - Theory and Practice”, 3rd Edition, Pearson Education, 2018.

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 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.
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.
PO12: 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.
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	PO12	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.

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 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.
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	PO11	PO12	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	PO12	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.

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 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.
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.
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.
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 the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

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	PO12	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.

UNIT II **8 Hours**

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 the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning 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	PO12	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 the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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	PO12	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 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.
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	PO12	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 **9 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 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.
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	PO12	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 **9 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 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.
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.
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	PO12	PSO1	PSO2
1	2	2												2
2	2	2												2
3					2	2	1							2
4	1	2	1		2	2	2							2
5	2	2	2		1	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 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.

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.

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.

PO12: 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. 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	PO12	PSO1	PSO2
1					2	1		1						
2					1			3						
3	2											3		
4	2	3							2					
5					2					3				

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 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.

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, demonstrate the knowledge of, and need for sustainable development.

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	PO12	PSO1	PSO2
1	1	1	2				3							
2	2	1		3			1							
3	1	2		2			3							
4	2	3				2	3							
5	1	2				2	1							

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 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.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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	PO12	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 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.

PO6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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	1						
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 the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

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

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

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.

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	PO12	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 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.

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.

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.

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	PO12	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 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: 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 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.
PO12: 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.

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	PO12	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: Demonstrate the knowledge and technical skills in software development.

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	PO12	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 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.
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.
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	PO12	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 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 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. 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. 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.

PO12. 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. 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	PO12	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 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 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. 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. 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.

PO12. 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.

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	PO12	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 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 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. 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.

PO12. 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. 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	PO12	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 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 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. 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. 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.

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	PO12	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 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 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	PO12	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

9 Hours

UNIT IV

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

9 Hours

UNIT V

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 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.
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.

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	PO12	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 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.

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	PO12	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 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.

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.

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	PO12	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.

22OGE01 PRINCIPLES OF MANAGEMENT 3 0 0 3

Course Objectives

- To develop cognizance about importance of management principles.
- Extract the functions and responsibilities of managers.
- To Study and understand the various HR related activities.
- Learn the application of the theories in an organization.
- Analyze the position of self and company goals towards business.

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

Course Outcomes (COs)

1. Students will be able to understand the basic concepts of Management.
2. Have some basic knowledge on planning process and its Tools & Techniques.
3. Ability to understand management concept of organizing and staffing.
4. Ability to understand management concept of directing.
5. Ability to understand management concept of controlling.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO MANAGEMENT AND ORGANIZATIONS

Definition of Management Science or Art Manager Vs Entrepreneur-types of managers - Managerial roles and skills Evolution of Management Scientific, Human Relations, System and Contingency approaches Types of Business organization - Sole proprietorship, partnership, Company - public and private sector enterprises - Organization culture and Environment Current Trends and issues in Management.

UNIT II **9 Hours**
PLANNING
Nature and purpose of planning - Planning process - Types of planning – Objectives - Setting objectives - Policies - Planning premises - Strategic Management - Planning Tools and Techniques - Decision making steps and process.

UNIT III **9 Hours**
ORGANISING
Nature and purpose – Formal and informal organization - Organization chart - Organization Structure Types - Line and staff authority - Departmentalization - Delegation of authority - Centralization and decentralization - Job Design - Human Resource - Management - HR Planning, Recruitment, Selection, Training and Development, Performance Management, Career planning and management.

UNIT IV **9 Hours**
DIRECTING
Foundations of individual and group behaviour - Motivation-Motivation theories - Motivational techniques - Job satisfaction - Job enrichment - Leadership-types and theories of leadership - Communication-Process of communication - Barrier in communication Effective communication-Communication and IT.

UNIT V **9 Hours**
CONTROLLING
System and process of controlling - Budgetary and non-Budgetary control techniques - Use of Computers and IT in Management control - Productivity problems and management - Control and Performance-Direct and preventive control - Reporting.

Total: 45 Hours

Reference(s)

1. Robbins S, Management, (13th ed.), Pearson Education, New Delhi, 2017.
2. Stephen A. Robbins and David A. Decenzo and Mary Coulter, Fundamentals of Management, Pearson Education, 7th Edition, 2011.
3. Robert Kreitner and Mamata Mohapatra, Management, Biztantra, 2008.
4. L. M. Prasad, Principles and Practice of Management. 7th Edition, Sultan Chand & Sons, 2007.
5. P. C. Tripathi and P. N. Reddy, Principles of Management, Fourth Edition, Tata McGraw Hill, 2008.

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 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 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. 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	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**

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 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 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: 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.
PO12: 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	PO12	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.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO12: 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	PO12	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	PO12	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	PO12	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 **9 Hours**
INSTRUMENTATION SYSTEMS
Optical sensors , Pressure Sensors - Ultrasonic Sensors - Tactile Sensors - Thermal sensors -Biosensor - Linear Actuators, Central monitoring station - Alarm system - Regulation and standards.

UNIT V **9 Hours**
APPLICATIONS
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: 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.

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	PO12	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)

PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and 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	PO12	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 society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

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	PO12	PSO1	PSO2
1	1	1				2	1							
2	1	1				1	2	2						
3	1	1				2		2	1					
4	1	1				2	1							
5	1	1				2	1	2	1					

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.

22OCB01 INTERNATIONAL BUSINESS MANAGEMENT 3 0 0 3

Course Objectives

- To enable the students to understand the fundamentals of international business
- To provide competence to the students on making international business decisions
- To enable the students to understand the financial and promotional assistance available for exporters

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.
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 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. 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	PO12	PSO1	PSO2
1	3						2		2				1	1
2	3						3		2				1	1
3	3						3		2				1	2
4	3						2		2				1	2
5	3						2		2				1	1

UNIT I **9 Hours**
INTRODUCTION
Definition, Drivers of International Business, Domestic Vs. International Business, Trade and Investment Theories: Interventionist Theories, Free Trade Theories, Theories Explaining Trade Patterns: PLC Theory, The Porter Diamond, Factor Mobility Theory.

UNIT II **9 Hours**

GLOBALIZATION

Globalization: Implications, Challenges - Protectionism: Tariff Barriers, Non-Tariff Barriers- Forms of Integration, Role of WTO and IMF in International Business, Economic, Political, Cultural and Technological Environments

UNIT III **9 Hours**

INTERNATIONAL BUSINESS STRATEGIES

Market Entry Strategies, Multinational Strategy, Production Strategy, Marketing Strategy, Human Resource Strategy.

UNIT IV **9 Hours**

FOREIGN EXCHANGE

Foreign Exchange Market – Functions, Theories of Exchange Rate Determination, Exchange Rate Forecasting, Convertibility of Currency, Risks associated with Foreign Exchange.

UNIT V **9 Hours**

EXPORTS AND ETHICS IN INTERNATIONAL BUSINESS

Exports – Risks, Management of Exports, Regulatory frameworks, Export financing, Countertrade, Ethics – Issues, Dilemma and Theory.

Total: 45 Hours

Reference(s)

1. John D Daniels, Lee Raudabaugh, and Sullivan, “International Business”, New Delhi: Pearson Education, 2018.
2. Charles W L Hill and Arun Kumar Jain, “International Business”, New Delhi: Tata McGraw Hill, 2017.
3. Francis Cherunilam, “International Business”, New Delhi: Prentice Hall of India, 2020.
4. Simon Collinson, Rajneesh Narula, Alan M. Rugman, “International Business”, New Delhi: Pearson Education, 2020.
5. K. Aswathappa, “International Business”, New Delhi: Tata McGraw Hill, 2020.

22CS0XA EDGE AI FOR DATA SCIENCE 1 0 0 1

Course Objectives

- To understand the fundamental concepts of AI and their applications
- To Understand the intuition behind the fundamental components of AI.

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.
PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Build a comprehensive knowledge base and gain hands-on experience in EDGE AI.
2. Explore and implement hardware technologies for AI

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	1	
2		1	2	2		1		1					1	

UNIT I **15 Hours**

IT PERSPECTIVE FOR AI

The IT perspective for AI - The hardware technologies for AI - Technological evolution and AI revolution The IT architecture for AI on Cloud - Machine- and deep-learning-as-a-service - Hardware accelerators fueling AI - Computing anywhere: IoT and Edge for AI - AI for IoT - Edge AI - Motivation behind Edge AI -Edge AI applications - Implementation process of Algorithms Inferences deployment on Edge.

Total: 15 Hours

Reference(s)

1. Serverless Edge Computing Vision and Challenges M.S. Aslanpour and A.N. Toosi,2021
2. Edge-centric computing: vision and challenges", P. Garcia Lopez, 2015.
3. Edge AI: Convergence of Edge Computing and Artificial Intelligence , X. Wang, and Y. Han, 2020.
4. Towards a Serverless Platform for Edge Ai , V. Muthusamy, 2019.

22CS0XB GENERATIVE ADVERSARIAL NETWORKS FOR DATA SCIENCE

1 0 0 1

Course Objectives

- To understand the fundamental concepts of GANs and their applications
- To Understand the intuition behind the fundamental components of GANs.

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.
PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
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.
PO12. 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Develop the ability to conceptualize and build conditional GANs capable of generating examples from determined categories
2. Explore and implement multiple GAN architectures

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	1	
2		1	2	2		1		1					1	

UNIT I **15 Hours**

GENERATIVE MODELS

Generative models - Real Life GANs - Intuition behind GANs - Discriminator - Generator - BCE Activations (Basic Properties) - Mode collapse and problems with BCE Loss- Common Activation Functions batch normalization - Review of Pytorch-Convolutions - Padding and stride - Pooling and Upsampling - Transposed convolutions- Earth movers distance (Wasserstein Distance)- Wasserstein-Loss

Total: 15 Hours

Reference(s)

1. GANs in Action Jakub Langr and Vladimir Bok,2019.
2. Generative Deep Learning, David Foster,2019.
3. Learning Generative Adversarial Networks, Kuntal Ganguly, 2017.
4. Generative Adversarial Networks Projects, Kailash Ahirwar, 2019.

22CS0XC AUTOML FOR DATA SCIENCE 1 0 0 1

Course Objectives

- Understand the fundamental concepts and techniques of exploratory data analysis.
- Develop skills in analyzing and visualizing data to gain insights and make informed decisions.
- Apply exploratory data analysis techniques to real-world datasets.

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.
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.
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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.
PO12. 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. Demonstrate knowledge of the principles and techniques of exploratory data analysis
2. Apply appropriate statistical and visual methods to analyze and interpret data.
3. Communicate insights and findings effectively through data visualization and reporting

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	1	
2	-	1	2	2		1		1					1	
3	1	1	2	2		1		1					1	

UNIT I **15 Hours**

EXPLORATORY DATA ANALYSIS

Introduction to Exploratory Data Analysis (EDA) and its importance in data analysis - Data types and data structures - Descriptive statistics- summary statistics - Data visualization techniques - Data cleaning and preprocessing - Exploring relationships between - Analyzing individual variables and relationships between variables - Introduction to statistical inference and hypothesis testing - Case studies and hands-on exercises: applying EDA techniques to real-world datasets.

Total: 15 Hours

Reference(s)

1. Exploratory Data Analysis with Python by Pratap Dangeti
2. Python for Data Analysis by Wes McKinney.
3. The Visual Display of Quantitative Information by Edward R. Tufte.
4. Data Visualization: A Practical Introduction by Kieran Healy.
5. Online resources and tutorials from data science communities and platforms (e.g., Kaggle, Towards Data Science).

22CS0XD FULL STACK WEB DEVELOPMENT 1 0 0 1

Course Objectives

- To understand the responsive UI components, implementing user authentication and setting up backend communication through APIs
- To develop robust web applications using React for dynamic front-end interfaces and Java for creating APIs, ensuring seamless communication and functionality between the two layers.

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.
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PO6. The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
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.
PO12. 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. Apply suitable algorithmic thinking and data management practices to design, develop, and evaluate effective solutions for real-life and research problems.

Course Outcomes (COs)

1. To develop web applications using React for the front end and Java for backend.
2. To integrate the web application APIs using deployment strategies.

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	1	
2		1	2	2		1		1					1	

UNIT I **15 Hours**

WEB APPLICATION INTEGRATION AND DEPLOYMENT

Overview of React in Web Applications - Setting Up the development environment - Creating React component for Community web application - Designing Responsive UI - Hands-on to work on development for overview page - Creating API for backend communication in java - Implementing User Authentication and Access Control - Enhancing the UI with additional Features - Deployment strategies and future scalability considerations.

Total: 15 Hours

Reference(s)

1. https://www.linkedin.com/pulse/ultimate-guide-web3-community-management-tips-tricks-building-martin
2. https://core.ac.uk/download/pdf/161432422.pdf
3. https://www.ijraset.com/research-paper/developing-an-e-commerce-web-application-with-react-js-and-firebase
4. http://irjaes.com/wp-content/uploads/2022/02/IRJAES-V7N1P162Y22.pdf

22CS0XE GENERATIVE AI 1 0 0 1

Course Objectives

- To understand the Fundamentals concepts and techniques behind generative artificial intelligence
- To explore various generative models and to develop the ability to critically evaluate the strengths, weakness, and ethical implications of generative AI technologies
- To engage in hands-on projects and assignments to apply generative AI techniques to real-world problems and creative endeavours.

Programme Outcomes (POs))

PO1 **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complexengineering 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 problemsand design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and Norms of the engineering practice.

PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication:** Communicate effectively on complex engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1 Formulate mathematical models and problem-solving skills through programming techniques for addressing real life problems using appropriate algorithms.

Course Outcomes (COs)

The students will be able to

1. Apply the knowledge of various generative AI models to generate realistic and novel data samples across different modalities such as image, text and audio.
2. Design and execute experiments such as conditional generation, style transfer and unsupervised representation learning.
3. Collaborate effectively with peers on projects and assignments fostering teamwork and communication skills.

Articulation Matrix

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

GENERATIVE AI **20 Hours**

Introduction to Generative AI - Importance and Applications - Types of Generative models - Autoencoders and Variational Autoencoders (VAEs) - Introduction to Generative Adversarial Networks (GANs) - Autoregressive Models - Text Generation and Language Modeling - Diffusion Models - Applications of Generative AI in Various Domains. Deep Learning Based Natural Language Processing - Advanced NLP - Word Embeddings and Representation Learning - Sequence-to-SequenceModels - Encoder- Decoder Architectures - seq2seq with Attention - Self Attention - Transformers - Self Supervised learning . Text Generation and Language Models: Introduction to Text Generation and Language Models - Transformer Architecture (Understanding BERT, T5, GPT) - Implementing language models using Huggingface Transformers library. Introduction to ChatGPT & Prompt Engineering: Understanding Prompt Engineering - Zero shot, One shot and Few shot learning - Applications and Practical Exercises - OpenAI API - Using Self Hosted LLMS (Mistral, LLAMA2)
- Building Retrieval augmented generation (RAG) using Lang Chain. Image Generation: Foundations of Advanced Generative AI - Contrastive Learning - SimCLR- Multimodal Language Models- Multimodal Language Models - Understanding CLIP, DALLE

Total: 20 Hours

References

1. "Generative Deep Learning: Teaching Machines to Paint, Write, Compose, and Play" by DavidFoster.
2. "Generative Adversarial Networks: An Overview" edited by Shengyong Chen and ShuiwangJi.

22CS0XF 3D ANIMATIONS 1 0 0 1

Course Objectives

- To demonstrate the basic and fundamental concepts in 3D animation
- To understand the texture operations in 3D objects
- To learn the basics of Modelling with 3D animation

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.

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.

PO6 **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1 Formulate mathematical models and problem-solving skills through programming techniques for addressing real life problems using appropriate algorithms.

Course Outcomes (COs)

The students will be able to

1. Apply the knowledge of animation and texturing in developing 3D animated models for various applications.
2. Analyze the existing 3D animated models and apply visual effects for more realistic nature.
3. Develop a mini project with complete documentation using the basic steps in creating 3D animated model.

Articulation Matrix

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

3D ANIMATION **15 Hours**

3D Animation Overview - 3D Animation Preproduction - Postproduction - Understanding digital imaging - digital video - Exploring animation, story and pre -visualization - Understanding modelling and Texturing - Rigging and Animation - Understanding visual effects, lights and rendering - Modelling with 3D- Lights - camera and materials - 3D Motion Graphics - FX Rendering and V-Ray - Digital FX - 3D Animation - Architectural Visualization Portfolio - Stop Motion Pro - 3Ds Max 2010 - Adobe After Effects CS4 Professional - texture operations in 3D - Pre-production-Texturing with Max - Using the material editor & the material explorer.

Total 15 Hours

References

1. Andy Beane, 3D Animation Essentials, John Wiley & Sons, 2012.

22CS0XG CLOUD DEPLOYMENT (AWS) 1 0 0 1

Course Objectives

- To understand the Fundamentals of Cloud computing
- To deploy and manage various AWS resources and to demonstrate the ability to configure and optimize the resources
- To implement effective monitoring and logging practices in AWS.

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.

PO4 **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7 **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and Norms of the engineering practice.

PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication:** Communicate effectively on complex engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

Course Outcomes (COs)

The students will be able to

1. Apply the knowledge of deploying the cloud to effectively manage AWS resources by optimizing configurations.
2. Design and deploy scalable and high performance architecture on AWS, employing strategies such as load balancing, auto scaling and resource optimization.
3. Create comprehensive documentation for AWS deployments, including architectural diagrams, configurations and deployment procedures and effectively communicate technical information.

Articulation Matrix

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

CLOUD DEPLOYMENT (AWS) **20 Hours**

Introduction to Cloud Computing - Overview of AWS - Benefits of using AWS - AWS Global Infrastructure - AWS Management Console - Introduction to Virtualization - C2 (Elastic Compute Cloud) Basics - AWS Storage Services (S3, EBS, Glacier) - AWS Database Services (RDS, DynamoDB) - AWS Networking (VPC, Route 53) - AWS Security (IAM, Security Groups) - Overview of AWS Lambda - Serverless Computing with AWS Lambda. Setting up an AWS Free Tier account - Launching an EC2 Instance - Setting up S3 bucket and uploading files - Configuring a VPC and setting up security groups - Creating a simple Lambda function.

Total 20 Hours

References

1. Cloud Deployment Models A Complete Guide - 2019 Edition, Gerardus Blokdyk.
2. Amazon Web Services in Action, Third Edition - An in-depth guide to AWS, Andreas Wittig and Michael Wittig

22CS0XH EXTENDED REALITY (XR) 1 0 0 1

Course Objectives

- To understand the Foundations of Extended Reality (XR)
- To designing and developing XR Applications
- To investigate advanced concepts and emerging trends in extended reality

Programme Outcomes (POs)

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

PO2 **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences

PO3 **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4 **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5 **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6 **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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PO9 **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 **Communication:** Communicate effectively on complex engineering activities with the Engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11 **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12 **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

PSO1 Formulate mathematical models and problem-solving skills through programming techniques for addressing real life problems using appropriate algorithms.

Course Outcomes (COs)

1. Apply the knowledge of XR in developing real world applications.
2. Analyze the existing XR applications and technologies, evaluating their effectiveness, usability and potential for impact across diverse domain.
3. Develop a miniproject with complete documentation using the XR technology that includes safety measures and sustainability to the environment.

Articulation Matrix

CO No	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO10	PO11	PO12	PSO 1	PSO 2
1	2	1	1		2								2	
2	2	3		2	3				2			1	2	
3			2			2	2	1	2	3	3	3	2	

EXTENDED REALITY (XR) **20 Hours**

Fundamentals of Extended Reality - Project Conceptualization - Asset Creation - Introduction to Unreal Engine 5 - Project Anatomy and Working with Assets - Advanced Materials in Unreal - Introduction to Lighting - Introduction to Blueprints - Gameplay Framework - VR Overview - Introduction to Oculus and Unreal - VR Project and Scene Setup - VR User Experience - Optimization and Deployment - Introduction to AR - Lens Studio AR Walkthrough - Tracking the Face AR Lens Design - Marker Tracking Lens Design. VR in Unreal Engine – AR using SnapAR.

Total: 20 Hours

References

1. Virtual and Augmented Reality (VR/AR): Foundations and Methods of Extended Realities (XR), Ralf Doerner, Wolfgang Broll, Paul Grimm, Bernhard Jung, Springer International Publishing, 2022.
2. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability) 1st Edition, SteveAukstakalnis.

22CS0XK AWS Sage Maker Machine Learning Engineering 1 0 0 1

Course Objectives

- To learn Image and Text Labelling Jobs using ASW Sage Maker Ground Truth
- To learn Machine Learning Regression and Classifier Models using No-Code AWS Canvas
- To analyse the output of trained models by deploying an endpoint using Amazon Sage Maker, perform inference and generate predictions.

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.

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.

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)

The students will be able to

1. Understand the machine learning model deployment in AWS Sage Maker
2. Interpret comprehensive exploratory data analysis (EDA) and visualization using Pandas, Seaborn, and Matplotlib libraries, gaining insights into data distributions, correlations, and patterns
3. Implement end-to-end deployment pipelines using AWS SageMaker and Lambda functions
4. Apply advanced hyperparameter optimization techniques to fine-tune machine learning models
5. Analyze the performance of machine learning models using regression and classification KPIs.

Articulation Matrix

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

MACHINE LEARNING WITH AWS SAGE MAKER **20 Hours**

AWS Fundamentals – AI/ML Fundamentals- Machine Learning: The Big Picture- Key Ingredients to Build Machine Learning Models - Simple Storage Service (S3) Deep Dive & Demo - S3 and EC2 Fundamentals – Introduction to Sage Maker- Introduction to Sage Maker Studio 101 – Introduction to Sage Maker Canvas 101- Data Labelling in AWS – Data Labelling Challenges and Applications – Labelling Text Data in Sage Maker – Semantic Segmentation – Exploratory Data Analysis and Visualizations using Pandas, Seaborn, and Matplotlib libraries in Sage Maker – Hyperparameter optimization - Train Machine Learning Model in Sage Maker - End- to-end deployment pipelines. Hands on Skill Training Real time IRIS detection and Classification in AWS Sage Maker – Real Time Object Detection using Yolo V3 in AWS Sage Maker – Number plate detection
using Yolo V3 in AWS Sage Maker.

References **20 Hours**

1. Learn Amazon SageMaker by Julien Simon (Published by Packtz), 2020
2. Mastering Machine Learning on AWS by Saket S.R. Mengle (Published by Packtz), 2019

22ME0XL REAL-TIME AI PROGRAMMING USING MOJO 1 0 0 1

Course Objectives

- To learn the Mojo's syntax, semantics, and internal architecture
- To learn real-time AI programming using Mojo
- To acquire practical hands-on-experience in various AI use cases using MOJO.

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.

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.

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)

The students will be able to

1. To understand Mojo's structure and syntax for performing AI development tasks
2. To design Mojo Programs to solve real-world scenarios
3. To combine Mojo with the Python ecosystem, expanding the toolkit for AI development

Articulation Matrix

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

INTRODUCTION TO MOJO PROGRAMMING **20 Hours**

Introduction to Mojo Programming Language- Setup and Installation- Mojo Fundamentals-Functions and Data handling in Mojo- Methods-constructors and Method Overloading-Decorators, Parameterization & Metaprogramming in Mojo- Object-Oriented Programming in Mojo- Python Integration with Mojo- Mojo Modules and Packages-Mojo Built-in Modules Extending Functionality-Interoperability of Mojo Programming Language with Python Echo System. **Hands on Skill Training -** Mojo Use Cases - Simple Prediction Program using Mojo - Calculator Program using Mojo - Classification Program using Mojo.

References **20 Hours**

1. Savage, Neil. "Revamping Python for an AI World." (2023): 13-14.

22ME0XM MODELLING TIME SERIES AND SEQUENTIAL DATA 1 0 0 1

Course Objectives

- Understand the various types of time series analysis techniques.
- Learn how to apply the modeling techniques to solve real-world business problems.
- Interpret the results of time series and sequential data models.

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.

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.

PO9 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)

The students will be able to

1. Understand the fundamental concepts of time series analysis and sequential data modeling.
2. Apply statistical and machine learning methods to model and analyze time series data, including techniques such as ARIMA, exponential smoothing, and modern deep learning approaches for sequential data.
3. Evaluate the suitability of different modeling approaches for different types of time series and sequential data.
4. Implement and interpret the results of time series and sequential data models using industry- standard tools and programming languages.
5. Integrate the limitations, challenges, and ethical considerations of modeling time series and sequential data in real-world applications.

Articulation Matrix

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

INTRODUCTION TO TIME SERIES DATA **20 Hours**

Introduction to time series forecasting and its applications - Autoregressive (AR) models - Autoregressive Integrated Moving Average (ARIMA) models - Introduction to state-space models - Exponential Smoothing methods - Sequential Data Modelling with Neural Networks: Recurrent Neural Networks (RNNs) - Long Short- Term Memory (LSTM) networks - Applications of RNNs and LSTMs in time series and sequential data analysis- Model validation techniques - Interpreting model outputs and making decisions - Application of time series and sequential data models to real-world data sets.

References

1. "Recurrent Neural Networks for Short-Term Load Forecasting: An Overview and Comparative Analysis" by António S. Gomes, Hugo Morais, and Tiago Pinto
2. "Time Series Analysis and Its Applications: With R Examples" by Robert H. Shu David S. Stoffer

22CS0XN BUSINESS INTELLIGENCE USING POWER BI 1 0 0 1

Course Objectives

- Understand the fundamentals of business intelligence and its role in data-driven decision-making.
- To explore the key functionalities of Power BI Desktop and its intuitive interface.
- To analyze visually compelling reports and dashboards to communicate insights effectively.

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.

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.

PO9 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)

The students will be able to

1. Implement Power BI to solve real-world business intelligence challenges.
2. Extract meaningful insights from data and communicate them effectively through reports and dashboards.
3. Make data-driven decisions to improve business performance.

Articulation Matrix

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

INTRODUCTION TO POWER BI, BUILDING REPORTS & DASHBOARDS 15 Hours

Business Intelligence Overview, Introduction to Power BI Desktop: User interface, workspace navigation, and data import options, Connecting to Data Sources, Data Modeling & Transformation Visualizations, Creating Stunning Reports Interactivity & Filters, Using DAX Functions, Designing Effective Dashboards: Layout principles, best practices, and accessibility considerations, Connecting Reports & Visuals: Building cohesive dashboards for holistic views, Sharing & Collaboration: Publishing dashboards for colleagues and stakeholders.

Total: 15 Hours

References

1. http://projanco.com/Library/INTRODUCTION%20TO%20MICROSOFT%20POWER%20BI.pdf
2. Microsoft Power BI Quick Start Guide: Build dashboards and visualizations to make your data come to life Kindle Edition by Devin Knight (Author), Brian Knight (Author), Mitchell Pearson (Author), Manuel Quintana (Author)

22ME0XO SYSTEM SECURITY - AN INDUSTRY PERSPECTIVE 1 0 0 1

Course Objectives

- To understand the system security principles.
- To explore data and operating system security.
- To understand network and web security.
- To explore ethical hacking and penetration testing.

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.
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.

PO12 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. Work with system security tools.
2. Apply various encryption algorithms.
3. Perform intrusion detection and user authentication.
4. Work with ethical hacking and penetration testing tools.

Articulation Matrix

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

SYSTEM SECURITY - AN INDUSTRY PERSPECTIVE **15 Hours**

AAA, Non-repudiation, Principle of least privilege, access control, and operating systems security, Security controls, exploits, defenses, Tools for system security, Information Security, OWASP, Secure Software Development. OS SECURITY AND DATA SECURITY- Unix security basics, virus lab - Overview of Cryptography, Symmetric encryption, Public Key Cryptography, Block Cyphers, Message integrity, Authenticated Encryption, Algorithms - RSA, SHA, DES, Triple DES, PKI, PGP, Digital Signatures. NETWORK SECURITY: Introduction to NW Security, Secure networks, attacks (DOS etc), IP Security, Analysis of protocols (including routing), Standards SSL, TLS, x.509, MAC, Kerberos, Packet filtering/firewalls, VPN, Intrusion detection, Intrusion prevention, DLP, DNS Security, Wireless security. WEB SECURITY: Basic web security model, HTTPS, Cookies, Web application security, JAAS, session management, user authentication, content security, threats, malware -Programs using JAAS. ETHICAL HACKING AND PENETRATION TESTING: Open source hacking tools lab – Kali Linux based - Open Source penetration testing tools.

Total: 15 Hours

References

1. Behrouz A. Forouzan, "Data communication and Networking", McGraw-Hill, Fifth Edition, 2013.
2. Shari Lawrence Pfleeger, Charles P. Pfleeger, Jonathan Margulies, "Security in Computing", Fifth Edition,PearsonEducation,2015
3. William Stallings, "Cryptography And Network Security Principles And Practice" ,Seventh Edition, Pearson,2017