B.Tech. (Artificial Intelligence and Data Science)

2022 Regulations, Curriculum & Syllabi

(for 2022-2026, 2023-2027,

2024-2028 Batch Students)

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

VISION OF THE DEPARTMENT

- To build a conducive academic and research environment to produce competent Professionals to the dynamic needs of the emerging trends in the field of Artificial Intelligence and Data Science.

MISSION OF THE DEPARTMENT

- To establish a unique learning environment and to enable the students to face the challenges in Artificial Intelligence and Data Science.
- To critique the role of information and analytics for a professional career, research activities and consultancy.
- To produce competent engineers with professional ethics and life skills.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1: Competent engineering professionals to use Artificial Intelligence and Data Science to solve engineering problems.

PEO2: Capable of pursuing higher studies and research, with wider opportunities in teaching and innovation.

PEO3: Improve communication skills, follow professional ethics and involve in team work in their profession.

PROGRAMME OUTCOMES (POs)

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

2. **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.

3. **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.

4. **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.

5. **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.

6. **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.

7. **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.

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

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

10. **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.

11. **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.

12. **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)

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

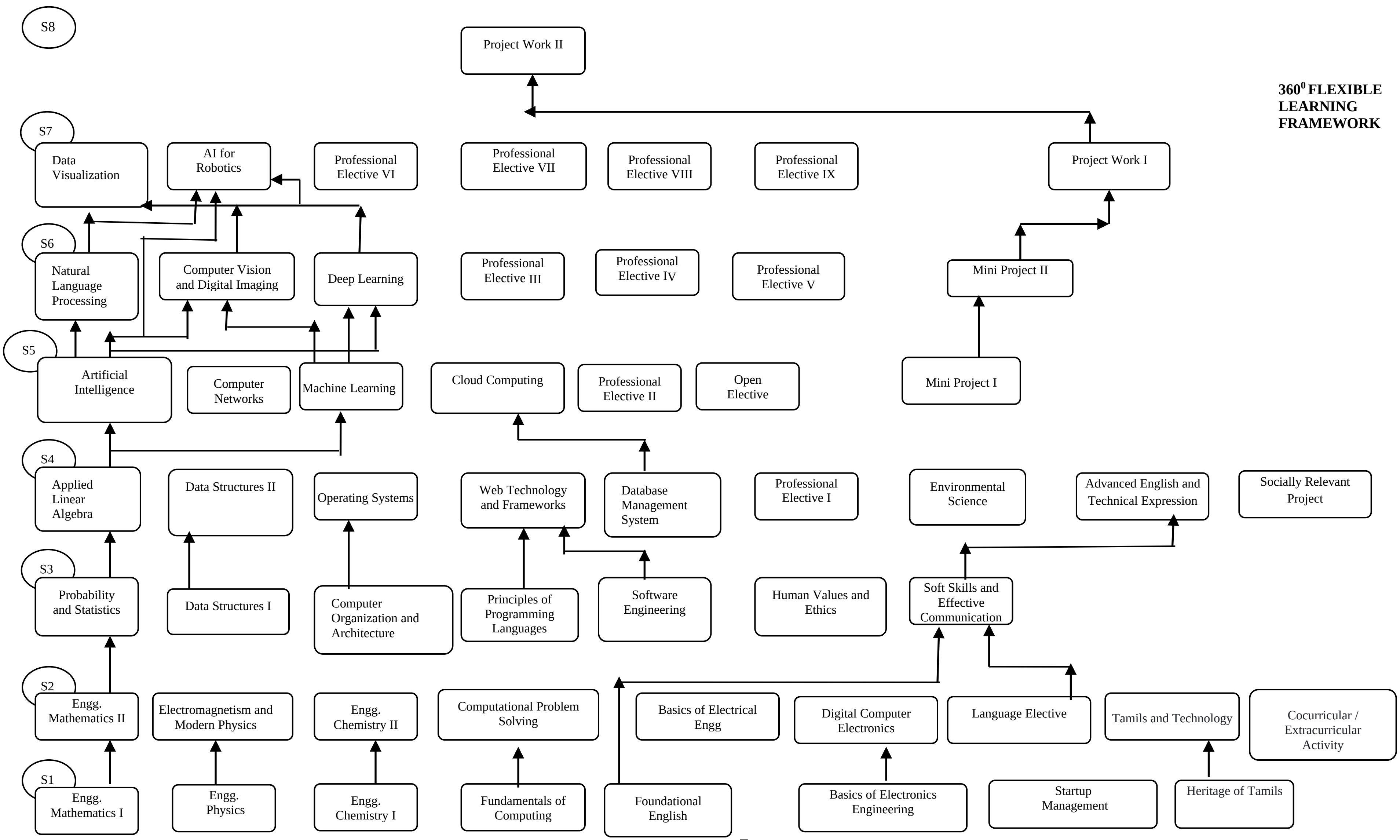
MAPPING OF PEOs WITH POs AND PSOs

POs	1	2	3	4	5	6	7	8	9	10	11	12	PSO1	PSO2
PEO 1	X	X	X		X		X				X		X	X
PEO 2			X	X		X						X	X	X
PEO 3								X	X	X			X	X

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

CURRICULUM DESIGN & INTERLINKING OF COURSES

CONNECTIVITY CHART



(Candidates admitted during the Academic Year 2022 - 2023)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
Minimum Credits to be Earned: 165

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
22AI108	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
22AI206	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**	
22AI301	PROBABILITY AND STATISTICS	3	1	0	4	4	40	60	100	BS
22AI302	DATA STRUCTURES I	3	0	2	4	5	50	50	100	ES
22AI303	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	3	3	40	60	100	PC
22AI304	PRINCIPLES OF PROGRAMMING LANGUAGES	3	0	2	4	5	50	50	100	PC
22AI305	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	EEC
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**	
22AI401	APPLIED LINEAR ALGEBRA	3	1	0	4	4	40	60	100	ES
22AI402	DATA STRUCTURES II	3	0	2	4	5	50	50	100	PC
22AI403	OPERATING SYSTEMS	3	1	0	4	4	40	60	100	PC
22AI404	WEB TECHNOLOGY AND FRAMEWORKS	2	0	2	3	4	50	50	100	PC
22AI405	DATABASE MANAGEMENT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	-	-	-	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	NC	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	100	0	100	EEC
Total		**-**	**-**	**-**	**23**	**-**	**-**	**-**	**-**	**-**

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AI501	ARTIFICIAL INTELLIGENCE	3	0	2	4	5	50	50	100	PC
22AI502	COMPUTER NETWORKS	3	0	2	4	5	50	50	100	PC
22AI503	MACHINE LEARNING	3	0	2	4	5	50	50	100	PC
22AI504	CLOUD COMPUTING	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE II	-	-	-	3	-	-	-	100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22AI507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**23**	**-**	**-**	**-**	**-**	**-**

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AI601	NATURAL LANGUAGE PROCESSING	3	0	2	4	5	50	50	100	PC
22AI602	COMPUTER VISION AND DIGITAL IMAGING	3	0	2	4	5	50	50	100	PC
22AI603	DEEP LEARNING	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
22AI607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		**-**	**-**	**-**	**22**	**-**	**-**	**-**	**-**	**-**

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AI701	DATA VISUALIZATION	3	0	2	4	5	50	50	100	PC
22AI702	AI FOR ROBOTICS	3	0	0	3	3	40	60	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
22AI707	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**	
22AI801	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
ELECTIVES										
LANGUAGE ELECTIVES										
							CIA	SEE	Total	
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
PROFESSIONAL ELECTIVES										
VERTICAL I – FULL STACK DEVELOPMENT										
22AI001	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22AI002	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22AI003	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
22AI004	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22AI005	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
22AI006	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL II – CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
22AI007	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
22AI008	CLOUD SERVICES AND DATA MANAGEMENT	3	0	0	3	3	40	60	100	PE
22AI009	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
22AI010	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
22AI011	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
22AI012	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE
VERTICAL III – CYBER SECURITY AND DATA PRIVACY										
22AI013	CYBER SECURITY	3	0	0	3	3	40	60	100	PE
22AI014	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE

22AI015	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
22AI016	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
22AI017	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22AI018	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
VERTICAL IV – AI AND ROBOTICS										
22AI019	ROBOTIC PROCESS AUTOMATION	3	0	0	3	3	40	60	100	PE
22AI020	REINFORCEMENT LEARNING	3	0	0	3	3	40	60	100	PE
22AI021	EDGE COMPUTING	3	0	0	3	3	40	60	100	PE
22AI022	INTELLIGENT ROBOTS AND DRONE TECHNOLOGY	3	0	0	3	3	40	60	100	PE
22AI023	INTELLIGENT TRANSPORTATION SYSTEMS	3	0	0	3	3	40	60	100	PE
22AI024	EXPERT SYSTEMS	3	0	0	3	3	40	60	100	PE
VERTICAL V – COMPUTATIONAL INTELLIGENCE										
22AI025	KNOWLEDGE ENGINEERING	3	0	0	3	3	40	60	100	PE
22AI026	HEALTH CARE ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI027	OPTIMIZATION TECHNIQUES	3	0	0	3	3	40	60	100	PE
22AI028	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI029	QUANTUM COMPUTING	3	0	0	3	3	40	60	100	PE
22AI030	COGNITIVE SCIENCE	3	0	0	3	3	40	60	100	PE
VERTICAL VI – DATA ANALYTICS										
22AI031	BIO MEDICAL IMAGE ANALYSIS	2	0	2	3	4	50	50	100	PE
22AI032	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22AI033	IMAGE AND VIDEO ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI034	CYBER THREAT ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI035	BUSINESS ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI036	DIGITAL MARKETING AND MANAGEMENT	3	0	0	3	3	40	60	100	PE
VERTICAL VII – DIVERSIFIED COURSES										
22AI037	TIME SERIES ANALYSIS AND FORECASTING	3	0	0	3	3	40	60	100	PE

22AI038	HUMAN COMPUTER INTERACTION	3	0	0	3	3	40	60	100	PE
22AI039	PATTERN RECOGNITION	3	0	0	3	3	40	60	100	PE
22AI040	ETHICS AND AI	3	0	0	3	3	40	60	100	PE
22AI041	MULTIMEDIA AND ANIMATION	2	0	2	3	4	50	50	100	PE
22AI042	SOFTWARE PROJECT MANAGEMENT	3	0	0	3	3	40	60	100	PE
VERTICAL VIII – DATA SCIENCE										
22AI043	PYTHON FOR DATA SCIENCE	3	0	0	3	3	40	60	100	PE
22AI044	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22AI045	FUNDAMENTALS OF MACHINE LEARNING	3	0	0	3	3	40	60	100	PE
22AI046	DEEP LEARNING ESSENTIALS	3	0	0	3	3	40	60	100	PE
22AI047	TEXT AND SPEECH ANALYSIS	3	0	0	3	3	40	60	100	PE
22AI048	COMPUTER VISION AND IMAGE PROCESSING	3	0	0	3	3	40	60	100	PE
HONOUR VERTICAL COURSES										
22AIH13	CYBER SECURITY	3	0	0	3	3	40	60	100	PE
22AIH14	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE
22AIH15	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
22AIH16	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
22AIH17	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22AIH18	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
MINOR VERTICAL COURSES										
22AIM43	PYTHON FOR DATA SCIENCE	3	0	0	3	3	40	60	100	PE
22AIM44	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22AIM45	FUNDAMENTALS OF MACHINE LEARNING	3	0	0	3	3	40	60	100	PE
22AIM46	DEEP LEARNING ESSENTIALS	3	0	0	3	3	40	60	100	PE
22AIM47	TEXT AND SPEECH ANALYSIS	3	0	0	3	3	40	60	100	PE

22AIM48	COMPUTER VISION AND IMAGE PROCESSING	3	0	0	3	3	40	60	100	PE
OPEN ELECTIVE (FOR OTHER DEPARTMENT)										
22OAI01	FUNDAMENTALS OF DATA SCIENCE	3	0	0	3	3	40	60	100	OE
OPEN ELECTIVES										
22OCE01	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 OILSEED 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
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										
22AI0XA	MACHINE LEARNING IN INTERNET OF ROBOTIC THINGS (IoRT)	1	0	0	1	-	100	0	100	EEC
22AI0XB	AUGMENTED REALITY	1	0	0	1	-	100	0	100	EEC
22AI0XC	STATISTICAL MODELLING IN R PROGRAMMING	1	0	0	1	-	100	0	100	EEC
22AI0XD	NODE.JS	1	0	0	1	-	100	0	100	EEC
22AI0XE	MLOps ESSENTIALS	1	0	0	1	-	100	0	100	EEC
22AI0XF	APACHE KAFKA	1	0	0	1	-	100	0	100	EEC

22AI0XG	FULL STACK DEVELOPMENT USING ADAPTIVE AI	1	0	0	1	-	100	0	100	EEC
22AI0XH	DEMYSTIFYING DIALOGUECRAFT AI AND APPLICATIONS	1	0	0	1	-	100	0	100	EEC
22AI0XI	AI BASED DEEPFAKE IMAGE CREATION	1	0	0	1	-	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS 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	14.54	15%	20%
2	ES	6	10	4	4					24	14.54	15%	20%
3	HSS	2	3	3						8	4.84	5%	10%
4	PC			10	15	16	12	7		60	36.36	30%	40%
5	PE				3	6	9	12		30	18.18	10%	15%
6	EEC	2		1	1	1	1	2	10	18	10.09	10%	15%
Total		21	23	22	23	23	22	21	10	165	100%	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

(Candidates admitted during the Academic Year 2023 - 2024)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
Minimum Credits to be Earned: 165

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
*22HS003	தமிழர் மரபு HERITAGE OF TAMILS	1	0	0	1	1	100	0	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 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
22AI206	DIGITAL COMPUTER ELECTRONICS	3	0	2	4	5	50	50	100	ES
	LANGUAGE ELECTIVE	1	0	2	2	3	100	0	100	HSS
*22HS006	தமிழரும் தொழில்நுட்பமும் TAMILS AND TECHNOLOGY	1	0	0	1	1	100	0	100	HSS
Total		**17**	**1**	**10**	**23**	**28**	-	-	-	-

* 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	
22AI301	PROBABILITY AND STATISTICS	3	1	0	4	4	40	60	100	BS
22AI302	DATA STRUCTURES I	3	0	2	4	5	50	50	100	ES
22AI303	COMPUTER ORGANIZATION AND ARCHITECTURE	3	1	0	4	4	40	60	100	PC
22AI304	PRINCIPLES OF PROGRAMMING LANGUAGES	3	0	2	4	5	50	50	100	PC
22AI305	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	EEC
Total		**17**	**2**	**6**	**22**	**25**	-	-	-	-

IV SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22AI401	APPLIED LINEAR ALGEBRA	3	1	0	4	4	40	60	100	ES
22AI402	DATA STRUCTURES II	3	0	2	4	5	50	50	100	PC
22AI403	OPERATING SYSTEMS	3	1	0	4	4	40	60	100	PC
22AI404	WEB TECHNOLOGY AND FRAMEWORKS	2	0	2	3	4	50	50	100	PC
22AI405	DATABASE MANAGEMENT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	-	-	-	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	NC	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	60	40	100	EEC
Total		-	-	-	**23**	-	-	-	-	-

V SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AI501	ARTIFICIAL INTELLIGENCE	3	0	2	4	5	50	50	100	PC
22AI502	COMPUTER NETWORKS	3	0	2	4	5	50	50	100	PC
22AI503	MACHINE LEARNING	3	0	2	4	5	50	50	100	PC
22AI504	CLOUD COMPUTING	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE II				3				100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22AI507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		-	-	-	**23**	-	-	-	-	-

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AI601	NATURAL LANGUAGE PROCESSING	3	0	2	4	5	50	50	100	PC
22AI602	COMPUTER VISION AND DIGITAL IMAGING	3	0	2	4	5	50	50	100	PC
22AI603	DEEP LEARNING	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
22AI607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		-	-	-	**22**	-	-	-	-	-

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AI701	DATA VISUALIZATION	3	0	2	4	5	50	50	100	PC
22AI702	AI FOR ROBOTICS	3	0	0	3	3	40	60	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
22AI707	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**	
22AI801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	-	-	-	-

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
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
PROFESSIONAL ELECTIVES										
VERTICAL I – FULL STACK DEVELOPMENT										
22AI001	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22AI002	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22AI003	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
22AI004	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22AI005	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
22AI006	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL II – CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
22AI007	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
22AI008	CLOUD SERVICES AND DATA MANAGEMENT	3	0	0	3	3	40	60	100	PE
22AI009	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
22AI010	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
22AI011	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
22AI012	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE
VERTICAL III – CYBER SECURITY AND DATA PRIVACY										
22AI013	CYBER SECURITY	3	0	0	3	3	40	60	100	PE

22AI014	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE
22AI015	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
22AI016	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
22AI017	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22AI018	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
VERTICAL IV – AI AND ROBOTICS										
22AI019	ROBOTIC PROCESS AUTOMATION	3	0	0	3	3	40	60	100	PE
22AI020	REINFORCEMENT LEARNING	3	0	0	3	3	40	60	100	PE
22AI021	EDGE COMPUTING	3	0	0	3	3	40	60	100	PE
22AI022	INTELLIGENT ROBOTS AND DRONE TECHNOLOGY	3	0	0	3	3	40	60	100	PE
22AI023	INTELLIGENT TRANSPORTATION SYSTEMS	3	0	0	3	3	40	60	100	PE
22AI024	EXPERT SYSTEMS	3	0	0	3	3	40	60	100	PE
VERTICAL V – COMPUTATIONAL INTELLIGENCE										
22AI025	KNOWLEDGE ENGINEERING	3	0	0	3	3	40	60	100	PE
22AI026	HEALTH CARE ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI027	OPTIMIZATION TECHNIQUES	3	0	0	3	3	40	60	100	PE
22AI028	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI029	QUANTUM COMPUTING	3	0	0	3	3	40	60	100	PE
22AI030	COGNITIVE SCIENCE	3	0	0	3	3	40	60	100	PE
VERTICAL VI – DATA ANALYTICS										
22AI031	BIO MEDICAL IMAGE ANALYSIS	2	0	2	3	4	50	50	100	PE
22AI032	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22AI033	IMAGE AND VIDEO ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI034	CYBER THREAT ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI035	BUSINESS ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI036	DIGITAL MARKETING AND MANAGEMENT	3	0	0	3	3	40	60	100	PE

VERTICAL VII – DIVERSIFIED COURSES										
22AI037	TIME SERIES ANALYSIS AND FORECASTING	3	0	0	3	3	40	60	100	PE
22AI038	HUMAN COMPUTER INTERACTION	3	0	0	3	3	40	60	100	PE
22AI039	PATTERN RECOGNITION	3	0	0	3	3	40	60	100	PE
22AI040	ETHICS AND AI	3	0	0	3	3	40	60	100	PE
22AI041	MULTIMEDIA AND ANIMATION	2	0	2	3	4	50	50	100	PE
22AI042	SOFTWARE PROJECT MANAGEMENT	3	0	0	3	3	40	60	100	PE
VERTICAL VIII – DATA SCIENCE										
22AI043	PYTHON FOR DATA SCIENCE	3	0	0	3	3	40	60	100	PE
22AI044	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22AI045	FUNDAMENTALS OF MACHINE LEARNING	3	0	0	3	3	40	60	100	PE
22AI046	DEEP LEARNING ESSENTIALS	3	0	0	3	3	40	60	100	PE
22AI047	TEXT AND SPEECH ANALYSIS	3	0	0	3	3	40	60	100	PE
22AI048	COMPUTER VISION AND IMAGE PROCESSING	3	0	0	3	3	40	60	100	PE
HONOUR VERTICAL COURSES										
22AIH13	CYBER SECURITY	3	0	0	3	3	40	60	100	PE
22AIH14	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE
22AIH15	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
22AIH16	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
22AIH17	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22AIH18	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
MINOR VERTICAL COURSES										
22AIM43	PYTHON FOR DATA SCIENCE	3	0	0	3	3	40	60	100	PE
22AIM44	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22AIM45	FUNDAMENTALS OF MACHINE LEARNING	3	0	0	3	3	40	60	100	PE

22AIM46	DEEP LEARNING ESSENTIALS	3	0	0	3	3	40	60	100	PE
22AIM47	TEXT AND SPEECH ANALYSIS	3	0	0	3	3	40	60	100	PE
22AIM48	COMPUTER VISION AND IMAGE PROCESSING	3	0	0	3	3	40	60	100	PE
OPEN ELECTIVE (FOR OTHER DEPARTMENT)										
22OAI01	FUNDAMENTALS OF DATA SCIENCE	3	0	0	3	3	40	60	100	OE
OPEN ELECTIVES										
22OCE01	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 OILSEED 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
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										
22AI0XA	MACHINE LEARNING IN INTERNET OF ROBOTIC THINGS (IoRT)	1	0	0	1	-	100	0	100	EEC
22AI0XB	AUGMENTED REALITY	1	0	0	1	-	100	0	100	EEC
22AI0XC	STATISTICAL MODELLING IN R PROGRAMMING	1	0	0	1	-	100	0	100	EEC

22AI0XD	NODE.JS	1	0	0	1	-	100	0	100	EEC
22AI0XE	MLOps ESSENTIALS	1	0	0	1	-	100	0	100	EEC
22AI0XF	APACHE KAFKA	1	0	0	1	-	100	0	100	EEC
22AI0XG	FULL STACK DEVELOPMENT USING ADAPTIVE AI	1	0	0	1	-	100	0	100	EEC
22AI0XH	DEMYSTIFYING DIALOGUECRAFT AI AND APPLICATIONS	1	0	0	1	-	100	0	100	EEC
22AI0XI	AI BASED DEEPFAKE IMAGE CREATION	1	0	0	1	-	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS 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	14.54	15%	20%
2	ES	6	10	4	4					24	14.54	15%	20%
3	HSS	3	3	2						8	4.84	5%	10%
4	PC			11	15	16	12	7		61	36.96	30%	40%
5	PE				3	6	9	12		30	18.18	10%	15%
6	EEC	2		1	1	1	1	2	10	18	10.09	10%	15%
Total		21	23	22	23	23	22	21	10	165	100%		-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

(Candidates admitted during the Academic Year 2024 - 2025)

DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
Minimum Credits to be Earned: 165

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 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
22AI206	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	-	100	-	100	HSS
Total		**17**	**1**	**12**	**23**	**30**	-	-	-	-

* The lateral entry students have to complete these course during III and IV semesters

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AI301	PROBABILITY AND STATISTICS	3	1	0	4	4	40	60	100	BS
22AI302	DATA STRUCTURES I	3	0	2	4	5	50	50	100	ES
22AI303	COMPUTER ORGANIZATION AND ARCHITECTURE	3	1	0	4	4	40	60	100	PC
22AI304	PRINCIPLES OF PROGRAMMING LANGUAGES	3	0	2	4	5	50	50	100	PC
22AI305	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	EEC
Total		**17**	**2**	**6**	**22**	**25**	-	-	-	-

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AI401	APPLIED LINEAR ALGEBRA	3	1	0	4	4	40	60	100	ES
22AI402	DATA STRUCTURES II	3	0	2	4	5	50	50	100	PC
22AI403	OPERATING SYSTEMS	3	1	0	4	4	40	60	100	PC
22AI404	WEB TECHNOLOGY AND FRAMEWORKS	2	0	2	3	4	50	50	100	PC
22AI405	DATABASE MANAGEMENT SYSTEM	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	-	-	-	100	PE
22HS007	ENVIRONMENTAL SCIENCE	2	0	0	NC	2	100	0	100	HSS
22HS008	ADVANCED ENGLISH AND TECHNICAL EXPRESSION	0	0	2	1	2	60	40	100	EEC
22HS010	SOCIALLY RELEVANT PROJECT	-	-	-	NC	-	100	-	100	HSS
Total		-	-	-	**23**	-	-	-	-	-

V SEMESTER										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22AI501	ARTIFICIAL INTELLIGENCE	3	0	2	4	5	50	50	100	PC
22AI502	COMPUTER NETWORKS	3	0	2	4	5	50	50	100	PC
22AI503	MACHINE LEARNING	3	0	2	4	5	50	50	100	PC
22AI504	CLOUD COMPUTING	3	0	2	4	5	50	50	100	PC
	PROFESSIONAL ELECTIVE II				3				100	PE
	OPEN ELECTIVE	3	0	0	3	3	40	60	100	PE
22AI507	MINI PROJECT I	0	0	2	1	2	60	40	100	EEC
Total		-	-	-	**23**	-	-	-	-	-

VI SEMESTER										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CIA	SEE	Total	
22AI601	NATURAL LANGUAGE PROCESSING	3	0	2	4	5	50	50	100	PC
22AI602	COMPUTER VISION AND DIGITAL IMAGING	3	0	2	4	5	50	50	100	PC
22AI603	DEEP LEARNING	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
22AI607	MINI PROJECT II	0	0	2	1	2	60	40	100	EEC
Total		-	-	-	**22**	-	-	-	-	-

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
22AI701	DATA VISUALIZATION	3	0	2	4	5	50	50	100	PC
22AI702	AI FOR ROBOTICS	3	0	0	3	3	40	60	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
22AI707	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**	
22AI801	PROJECT WORK II	0	0	20	10	20	60	40	100	EEC
Total		**0**	**0**	**20**	**10**	**20**	-	-	-	-

ELECTIVES										
LANGUAGE ELECTIVES										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CIA	**SEE**	**Total**	
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
PROFESSIONAL ELECTIVES										
VERTICAL I – FULL STACK DEVELOPMENT										
22AI001	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
22AI002	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
22AI003	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
22AI004	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
22AI005	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
22AI006	DevOps	3	0	0	3	3	40	60	100	PE
VERTICAL II – CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
22AI007	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
22AI008	CLOUD SERVICES AND DATA MANAGEMENT	3	0	0	3	3	40	60	100	PE
22AI009	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
22AI010	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
22AI011	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
22AI012	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE
VERTICAL III – CYBER SECURITY AND DATA PRIVACY										
22AI013	CYBER SECURITY	3	0	0	3	3	40	60	100	PE

22AI014	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE
22AI015	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
22AI016	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
22AI017	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22AI018	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
VERTICAL IV – AI AND ROBOTICS										
22AI019	ROBOTIC PROCESS AUTOMATION	3	0	0	3	3	40	60	100	PE
22AI020	REINFORCEMENT LEARNING	3	0	0	3	3	40	60	100	PE
22AI021	EDGE COMPUTING	3	0	0	3	3	40	60	100	PE
22AI022	INTELLIGENT ROBOTS AND DRONE TECHNOLOGY	3	0	0	3	3	40	60	100	PE
22AI023	INTELLIGENT TRANSPORTATION SYSTEMS	3	0	0	3	3	40	60	100	PE
22AI024	EXPERT SYSTEMS	3	0	0	3	3	40	60	100	PE
VERTICAL V – COMPUTATIONAL INTELLIGENCE										
22AI025	KNOWLEDGE ENGINEERING	3	0	0	3	3	40	60	100	PE
22AI026	HEALTH CARE ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI027	OPTIMIZATION TECHNIQUES	3	0	0	3	3	40	60	100	PE
22AI028	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI029	QUANTUM COMPUTING	3	0	0	3	3	40	60	100	PE
22AI030	COGNITIVE SCIENCE	3	0	0	3	3	40	60	100	PE
VERTICAL VI – DATA ANALYTICS										
22AI031	BIO MEDICAL IMAGE ANALYSIS	2	0	2	3	4	50	50	100	PE
22AI032	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
22AI033	IMAGE AND VIDEO ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI034	CYBER THREAT ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI035	BUSINESS ANALYTICS	3	0	0	3	3	40	60	100	PE
22AI036	DIGITAL MARKETING AND MANAGEMENT	3	0	0	3	3	40	60	100	PE

VERTICAL VII – DIVERSIFIED COURSES										
22AI037	TIME SERIES ANALYSIS AND FORECASTING	3	0	0	3	3	40	60	100	PE
22AI038	HUMAN COMPUTER INTERACTION	3	0	0	3	3	40	60	100	PE
22AI039	PATTERN RECOGNITION	3	0	0	3	3	40	60	100	PE
22AI040	ETHICS AND AI	3	0	0	3	3	40	60	100	PE
22AI041	MULTIMEDIA AND ANIMATION	2	0	2	3	4	50	50	100	PE
22AI042	SOFTWARE PROJECT MANAGEMENT	3	0	0	3	3	40	60	100	PE
VERTICAL VIII – DATA SCIENCE										
22AI043	PYTHON FOR DATA SCIENCE	3	0	0	3	3	40	60	100	PE
22AI044	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22AI045	FUNDAMENTALS OF MACHINE LEARNING	3	0	0	3	3	40	60	100	PE
22AI046	DEEP LEARNING ESSENTIALS	3	0	0	3	3	40	60	100	PE
22AI047	TEXT AND SPEECH ANALYSIS	3	0	0	3	3	40	60	100	PE
22AI048	COMPUTER VISION AND IMAGE PROCESSING	3	0	0	3	3	40	60	100	PE
HONOUR VERTICAL COURSES										
22AIH13	CYBER SECURITY	3	0	0	3	3	40	60	100	PE
22AIH14	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE
22AIH15	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
22AIH16	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
22AIH17	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
22AIH18	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
MINOR VERTICAL COURSES										
22AIM43	PYTHON FOR DATA SCIENCE	3	0	0	3	3	40	60	100	PE
22AIM44	EXPLORATORY DATA ANALYSIS	2	0	2	3	4	50	50	100	PE
22AIM45	FUNDAMENTALS OF MACHINE LEARNING	3	0	0	3	3	40	60	100	PE

22AIM46	DEEP LEARNING ESSENTIALS	3	0	0	3	3	40	60	100	PE
22AIM47	TEXT AND SPEECH ANALYSIS	3	0	0	3	3	40	60	100	PE
22AIM48	COMPUTER VISION AND IMAGE PROCESSING	3	0	0	3	3	40	60	100	PE
OPEN ELECTIVE (FOR OTHER DEPARTMENT)										
22OAI01	FUNDAMENTALS OF DATA SCIENCE	3	0	0	3	3	40	60	100	OE
OPEN ELECTIVES										
22OCE01	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 OILSEED 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
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										
22AI0XA	MACHINE LEARNING IN INTERNET OF ROBOTIC THINGS (IoRT)	1	0	0	1	-	100	0	100	EEC
22AI0XB	AUGMENTED REALITY	1	0	0	1	-	100	0	100	EEC
22AI0XC	STATISTICAL MODELLING IN R PROGRAMMING	1	0	0	1	-	100	0	100	EEC

22AI0XD	NODE.JS	1	0	0	1	-	100	0	100	EEC
22AI0XE	MLOps ESSENTIALS	1	0	0	1	-	100	0	100	EEC
22AI0XF	APACHE KAFKA	1	0	0	1	-	100	0	100	EEC
22AI0XG	FULL STACK DEVELOPMENT USING ADAPTIVE AI	1	0	0	1	-	100	0	100	EEC
22AI0XH	DEMYSTIFYING DIALOGUECRAFT AI AND APPLICATIONS	1	0	0	1	-	100	0	100	EEC
22AI0XI	AI BASED DEEPFAKE IMAGE CREATION	1	0	0	1	-	100	0	100	EEC

SUMMARY OF CREDIT DISTRIBUTION

S.No	CATEGORY	CREDITS 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	14.54	15%	20%
2	ES	6	10	4	4					24	14.54	15%	20%
3	HSS	3	3	2						8	4.84	5%	10%
4	PC			11	15	16	12	7		61	36.96	30%	40%
5	PE				3	6	9	12		30	18.18	10%	15%
6	EEC	2		1	1	1	1	2	10	18	10.09	10%	15%
Total		21	23	22	23	23	22	21	10	165	100%	-	-

BS - Basic Sciences
ES - Engineering Sciences
HSS - Humanities and Social Sciences
PC - Professional Core
PE - Professional Elective
EEC - Employability Enhancement Course
CA - Continuous Assessment
ES - End Semester Examination

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

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 $y= ab^x$ 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: 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.

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.

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 patient’s 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.
- Analyze 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: 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. 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. Analyze endothermic and exothermic processes and exchange of energy during chemical reactions.
5. Analyze 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 **5 Hours**

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

EXPERIMENT 2 **5 Hours**

Investigate the amount of Iron (Fe2) 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 **5 Hours**

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

EXPERIMENT 5 **3 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. Rose Marie Gallagher and Author Paul Ingram, Complete Chemistry Cambridge IGCSE, 2nd Edition, Oxford university press, 2020.
2. Peter Atkins, Julio D Paula and James Keeler, Atkins' Physical Chemistry, 12th Edition, Oxford university press, 2019.
3. Gareth Price, Thermodynamics of chemical processes, 2nd Edition, Oxford university press, 2019.
4. D Tabor, Gases, liquids and solids and other states of matter, 3rd Edition, Oxford University press, 2018.
5. P L Soni, Text book of inorganic chemistry, Chand publishers, New Delhi, 2017.
6. J.D. Lee, Concise inorganic chemistry, 5th edition (Reprint), Blackman Science Ltd, France, Wiley-India, 2016.

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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

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

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 - its flow, functions and control - 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 in formal and informal contexts
- Improve reading fluency and increased vocabulary
- Prowess in interpreting complex texts
- Fluency and comprehensibility in self-expression
- Develop abilities as critical readers and writers
- Improve ability to summarize information from longer text, and distinguish between primary and supporting ideas

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 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 IGCSE, 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 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. 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	3	3	3	2										
3	3	3	3	2										
4	3	3	3	2										
5	3	3	3	1										

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 — 4 Hours

Design and Implement a simple device to communicate basic information between two different small distance points using wired and wireless methods.

EXPERIMENT 2 — 6 Hours

Design and Implement different wave shaping Circuits using PN Junction Diodes.

EXPERIMENT 3 — 4 Hours

Design and Implement Voltage Multiplier Circuit using PN Junction Diodes and Capacitors.

EXPERIMENT 4 — 4 Hours

Design and Implement t a three Stage Circuit to convert 220V 50Hz AC mains supply to 12V DC supply.

EXPERIMENT 5 — 4 Hours

Design and Implement a BJT Amplifier Circuit to amplify audio input signal.

EXPERIMENT 6 **4 Hours**

Design and Implement Basic Logic Gates using PN Junction Diodes.

EXPERIMENT 7 **4 Hours**

Design and Implement Basic Logic Gates using BJTs.

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

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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 Hour**

Analysis of various business sectors

EXPERIMENT 2 **2 Hours**

Developing a Design Thinking Output Chart

EXPERIMENT 3 **1 Hour**

Creating Buyer Personas

EPERIMENT 4 **3 Hours**

Undertake Market Study to understand market needs and assess market potential

EXPERIMENT 5 **2 Hours**

Preparation of Business Model Canvas

EXPERIMENT 6 **15 Hours**

Developing Prototypes

EXPERIMENT 7 **2 Hours**

Organizing Product Design Sprints

EXPERIMENT 8 **2 Hours**

Preparation of Business Plans

EXPERIMENT 9 **2 Hours**

Preparation of Pitch Decks

Total: 15+30 = 45 Hours

Reference(s)

1. Rashmi Bansal, Connect the Dots, Westland and Tranquebar Press, 2012
2. Pavan Soni, Design Your Thinking: The Mindsets, Toolsets and Skill Sets for Creative Problem-solving, Penguin Random House India, 2020
3. Ronnie Screwvala, Dream with Your Eyes Open: An Entrepreneurial Journey, Rupa Publications, 2015
4. Stephen Carter, The Seed Tree: Money Management and Wealth Building Lessons for Teens, Seed Tree Group, 2021
5. Kotler Philip, Marketing Management, Pearson Education India, 15th Edition
6. Elizabeth Verkey and Jithin Saji Isaac, Intellectual Property, Eastern Book Company, 2nd Edition, 2021

22HS003 HERITAGE OF TAMILS 1 0 0 1

Course Objectives

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

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, Leatherpuppetry, Silambattam, Valari, Tiger dance - Sports and Games of Tamils.

UNIT IV **3 Hours**

THINAI CONCEPT OF TAMILS

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

UNIT V **3 Hours**

CONTRIBUTION OF TAMILS TO INDIAN NATIONAL MOVEMENT AND INDIAN CULTURE

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

Total: 15 Hours

Reference(s)

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

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 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: 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.

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.

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 of 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: 30+30 = 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 how catalyst increases the reaction rate
- Summarize the variation in properties and reactivity of isotopes

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. Apply the electrochemical principles 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 – recent applications of radioactive isotopes

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: 30+30 = 60 Hours

Reference(s)

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

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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

UNIT I **6 Hours**

VISUAL PROCESS MODELING

Scenario decomposition - logical sequencing - drawing flowchart - preparing 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 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.

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. Interpret the behavior of electric charges in different medium using coulombs law.
2. Analyze the electric field due to different charge distributions.
3. Analyze 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	3	2	2								2	2		
2	2	2	2	3							3	2		
3	2	2	1	3							2	2		
4	3	2	1	2							2	2		
5	2	2									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 conductors, 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 behaviour of a fixed resistor in an electric heater.

8 Hours

EXPERIMENT 2

Construct an electrical wiring layout for a basic household application.

7 Hours

EXPERIMENT 3

Analysis the self and mutual induction in a domestic fan.

8 Hours

EXPERIMENT 4

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

22AI206 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 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. 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											
2	2	2	2											
3	2	2	2											
4	2	2												
5	2	2												

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

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

UNIT III **3 Hours**

MANUFACTURING TECHNOLOGY

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

UNIT IV **3 Hours**

AGRICULTURE AND IRRIGATION TECHNOLOGY

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

UNIT V **3 Hours**

SCIENTIFIC TAMIL & TAMIL COMPUTING

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

Total: 15 Hours

Reference(s)

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

22HS009 COCURRICULAR OR EXTRACURRICULAR ACTIVITIES

Course Objectives

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

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.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

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

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

22AI301 PROBABILITY AND STATISTICS 3 1 0 4

Course Objectives

- Understand the basic concepts of probability with characteristics and also two-dimensional random variables
- Learn how to formulate and test hypotheses about means, variances and proportions and to draw conclusions based on the results of statistical tests.
- Apply the concepts of probability and statistics in the field of Artificial Intelligence and Data 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.

Course Outcomes (COs)

1. Demonstrate and apply the basic probability axioms and concepts of random phenomena in the core areas
2. Calculate the relationship of two-dimensional random variables using Correlation techniques
3. Conclude on a particular scenario based on different types of hypothesis
4. Design an experimental analysis for one-way, two-way classifications and Latin square designs
5. Summarize the measurements and procedure for statistical quality control.

Articulation Matrix

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

UNIT I **9 Hours**

PROBABILITY AND RANDOM VARIABLES

Introduction to probability concepts-Types of Events, axioms, theorems-Conditional probability-Multiplication theorem- Characteristics of random variables-Discrete case: Probability Mass function-Cumulative distribution function-Characteristics of random variables-Continuous case: Probability density function-Cumulative distribution function-Central and Raw Moments-Expectation-Variance-Moment generating function of discrete and continuous random variable.

UNIT II **9 Hours**

TWO - DIMENSIONAL RANDOM VARIABLES

Joint Distributions-Marginal and Conditional Distributions- Covariance-Correlation and Linear Regression-Transformation of Random Variables-Central Limit Theorem (For Independent and Identically Distributed Random Variables).

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-Tests based on t - distribution- Chi-square and F distributions for mean, Variance and proportion-Contingency table (Test for independent)-goodness of fit.

UNIT IV **9 Hours**

DESIGN OF EXPERIMENTS

One way and two way classifications-Completely randomized design-Randomized block design-Latin square design- 2 x 2 factorial design.

UNIT V **9 Hours**

STATISTICAL QUALITY CONTROL

Control charts for measurements (X and R Charts)-Control charts for attributes (P, C and NP Charts)-Tolerance limits- Acceptance sampling

Total: 45+15 = 60 Hours

Reference(s)

1. Devore. J.L., Probability and Statistics for Engineering and The Sciences, Cengage Learning, New Delhi, 8th Edition, 2012.
2. Walpole. R.E., Myers. R.H., Myers. S.L.,Probability and Statistics For Engineers And Scientists, Pearson Education, Asia , 8th Edition, 2007.
3. Seymour Lipschuts, Introduction to Probability and Statistics, 1st Ediion, McGraw Hill, 2012.
4. Richard A Johnson, Miller and Feunds Probability and Statistics for Engineers, 8thEdiion, Phi Learning Private Ltd, 2014.
5. Spiegel. M.R., Schiller. J. And Srinivasan. R.A., Schaum S Outline of Theory and Problems of Probability and Statistics, Tata McGraw Hill Edition, 2004.

22AI302 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 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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.

22AI303 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 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. 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		
2	3	3	2	2								2		
3	2	2	2									2		
4	2	2	2	2	3							2		
5	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.

22AI304 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 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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

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

EXPERIMENT 2 — 3 Hours

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

EXPERIMENT 3 — 3 Hours

Create an application program that helps a user decide on their next vacation destination based on their preferences.

EXPERIMENT 4 **3 Hours**

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**

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

22AI305 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 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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. 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.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

UNIT I **10 Hours**

SELF-EXPRESSION

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

UNIT II **10 Hours**

CREATIVE EXPRESSION

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

UNIT III **10 Hours**

FORMAL EXPRESSION

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

Total: 30 Hours

Reference(s)

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

22AI401 APPLIED LINEAR ALGEBRA 3 1 0 4

Course Objectives

- Understand the basic concepts of Matrices, Eigen values, Eigenvectors and their Decomposition techniques to solve the given system.
- Analyze the system of vectors by different vector space and Inner product space techniques
- Apply the concepts of linear algebra in the field of Artificial Intelligence and Data 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.

Course Outcomes (COs)

1. Understand the characteristics of matrices and determinants and apply them in computer engineering.
2. Analyze the characteristics of a linear system with Eigen values and Eigenvectors.
3. Implement various matrix decomposition techniques to solve the given system.
4. Analyze the linear dependence and compute the basis and dimension of vector spaces.
5. Analyze the systems through the techniques of Inner product space.

Articulation Matrix

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

UNIT I **9 Hours**

MATRICES

Types of matrices- Matrix operations -Determinants-Orthogonal Matrices-Block Matrices-Rank of a matrix-Solution of Linear system: Matrix inversion method-Rank Method-Consistency of system.

UNIT II **9 Hours**

DIAGONALIZATION

Characteristics equation(including Block matrices)-Cayley- Hamilton Theorem-Diagonalization-Algebraic and Geometric Multiplicity-Minimal polynomial(including Block matrices)-Characteristic and minimal polynomial of Block Matrices-Iterative method: Eigen values and Eigen vectors by power method.

UNIT III **9 Hours**

MATRIX DECOMPOSITIONS

Nature of Matrices-Echelon Matrices-Row canonical form-Gauss elimination method-Gauss Jordan Method-Single value decomposition -LU decomposition.

UNIT IV **9 Hours**

VECTOR SPACES

Vector spaces-subspaces-Linear Combinations-Spanning Sets-Linear dependence and independence -Basis and Dimensions -Rank and nullity.

UNIT V **9 Hours**

INNER PRODUCT SPACES

Inner product spaces-Vector norms -Cauchy -Schwarz inequality -Orthogonality-Gram -Schmidt orthogonalization -QR decomposition.

Total: 45+15 = 60 Hours

Reference(s)

1. Kreyszig Erwin, Advanced Engineering Mathematics, 7th Edition, John Wiley, 1993.
2. B. S. Grewal, Higher Engineering Mathematics, Khanna Publication, 2017.
3. Lloyd N. Trefethen, David Bau III, Numerical Linear Algebra, Society for Industrial and Applied Mathematics, 1997.
4. James W. Demmel, Applied Numerical Linear Algebra, The Orient Blackswan, 1st Edition,2017.
5. Gilbert Strang, Introduction to linear algebra, Fifth Edition, ANE Books, 2016.

22AI402 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

UNIT II **9 Hours**
GRAPH
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 **9 Hours**
GRAPH MST
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 **9 Hours**
ALGORITHM DESIGN TECHNIQUES
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 **9 Hours**
MODERN DATA STRUCTURES
Segment Tree - Interval Tree - Fenwick Tree - K-D Tree - Quadtree and Octree - Circular Buffer (Ring Buffer) - Marshalling / Unmarshalling - JSON - benefits - Schema - limitations - Protobuf.

EXPERIMENT 1 **4 Hours**
Implement a trie data structure to efficiently support autocomplete suggestions based on user input in google docs.

EXPERIMENT 2 **5 Hours**
Implement an algorithm to find the shortest route and travel time between two locations within a city's transportation network.

EXPERIMENT 3 **6 Hours**
Design a cost-efficient telecommunication network to connect multiple cities using Kruskal's algorithm

EXPERIMENT 4 **5 Hours**
Implement a chess game application using backtracking.

EXPERIMENT 5 **5 Hours**

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

EXPERIMENT 6 **5 Hours**

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

22AI403 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world 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

22AI404 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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) – Web Assembly 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 **6 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 **5 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.

22AI405 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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	2	3
3	2	3	3	2	2						2	2	2	3
4	3	3	3	3	2						3	3	2	3
5	3	2	3	3	3						3	3	2	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- NoSQL Databases: 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 **5 Hours**
Create a relational database for e-commerce applications and add primary key, foreign key, check constraints and triggers.

EXPERIMENT 3 **4 Hours**
Create an ER diagram for the library management system and implement the database schema in RDBMS.

EXPERIMENT 4 **4 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 **5 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: NoSQL and 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

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

UNIT I **15 Hours**

CREATIVE EXPRESSION

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 **15 Hours**

FORMAL EXPRESSION

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. Business Correspondence and Report Writing by Prof. R.C. Sharma & Krishna Mohan, Tata McGraw Hill & Co. Ltd., 2001
4. Personality Development, Harold R. Wallace & L.Ann Masters, Cengage Learning, New Delhi
5. Developing Communication Skills by Krishna Mohan, Meera Bannerji- Macmillan India Ltd. 1990, Delhi
6. English Grammar, Composition and Usage by N.K.Agrawal & F.T.Wood, 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

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.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

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			2			3	3	3		2	2	2
2		3						3	3	3		2	2	2
3			3		2			3	3	2		2	2	2
4								2	2	2		2	2	2
5								3	3	3		2	2	2
6								2	1	2		2	2	2

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

22AI501 ARTIFICIAL INTELLIGENCE 3 0 2 4

Course Objectives

- To understand the fundamental concepts of artificial intelligence.
- To impart the different paradigms in knowledge representation and reasoning.
- To determine the problems to solve using artificial intelligence and machine 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand the awareness of intelligent agents and problem solving using uninformed, informed and local search methods.
2. Implement the different searching techniques to solve real time problems.
3. Identify the knowledge representation and reasoning techniques in logic programming.
4. Implement the use of planning and simple decision making.
5. Interpret the different types of learning in artificial intelligence.

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

UNIT I 9 Hours

INTRODUCTION

Intelligent Agents - Agents and environments - good behavior - The nature of environments - Structure of agents - Problem Solving - Problem solving agents- Uniformed search strategies - Avoiding repeated states-Searching with partial information.

UNIT II **9 Hours**

SEARCHING TECHNIQUES

Informed search and exploration - Informed search strategies - heuristic function - Local search algorithms and optimization problems- Local search in continuous spaces - Online search agents and unknown environments -Constraint satisfaction problems (CSP)-Backtracking search and Local search for CSP

UNIT III **9 Hours**

KNOWLEDGE REPRESENTATION

First order logic - Representation revisited - Syntax and semantics for first order logic - Using first order logic -Knowledge engineering in first order logic - Inference in First order logic - Prepositional versus first order logic - Unification and lifting - Forward chaining - Backward Chaining-Ontological Engineering

UNIT IV **9 Hours**

PLANNING

Planning problem- Planning with state space search - Partial order planning - Planning graphs - Planning with proportional logic - Time, Schedules, and Resources - Hierarchical task Planning - Conditional Planning - Execution monitoring and re planning-Continuous planning

UNIT V **9 Hours**

LEARNING

Learning from observations - forms of learning - Inductive learning - Learning decision trees - Ensemble learning - Knowledge in learning - Logical formulation of learning - Explanation based learning - Learning using relevant information-Statistical Learning Methods-AI Governance

EXPERIMENT 1 **4 Hours**

Using logic programming, develop a map coloring problem to highlight regions with promotional offers or discounts in a travel web page.

EXPERIMENT 2 **4 Hours**

Develop a program for Solving the Farmer, the Wolf, the Goat, and the Cabbage Puzzle Using Logic Programming

EXPERIMENT 3 **4 Hours**

Develop a program to generate a valid Sudoku puzzle using a metaheuristic search.

EXPERIMENT 4 **6 Hours**

Develop a bot application to receive traffic assistance and route recommendations in mobile apps.

EXPERIMENT 5 **6 Hours**

Implement a program for applying Bayes' Inference Rule to identify Disease Diagnosis Based on Test Results.

EXPERIMENT 6 **6 Hours**

Develop a program for predicting Student Course Success Based on Attendance and Participation using Bayesian Belief Network.

Total: 45+30 = 75 Hours

Reference(s)

1. Stuart Russell and Peter Norvig, Artificial Intelligence - A Modern Approach, Prentice Hall India, 2012
2. Alex Berson and Stephen J Smith, Data Warehousing, Data Mining, and OLAP, Tata Mcgraw-Hill, 1997.
3. Elaine Rich, Kevin Knight and Shivashankar B Nair, Artificial Intelligence, Tata McGraw Hill, 2010.
4. M. Tim Jones, Artificial Intelligence: A Systems Approach, Jones and Bartlett Publisher, 2010.
5. Fabio Bellifemine, Giovanni Caire, Dominic Greenwood, Developing Multi agent Systems with JADE, John Wiley and Sons Ltd, 2007.

22AI502 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 networks 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 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.

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

22AI503 MACHINE LEARNING 3 0 2 4

Course Objectives:

- To introduce students to the basic concepts and techniques of Machine Learning.
- To have a thorough understanding of the Supervised and Unsupervised learning techniques.
- To study the various probability-based learning techniques.
- To understand graphical models of machine learning algorithms.

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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Provide solutions for regression approaches in real-world applications.
2. Apply data preprocessing techniques for modeling.
3. Choose an appropriate classification technique to analyze the data
4. Choose an appropriate clustering technique to solve real world problems.
5. Apply Graph models to reduce the dimension of the dataset used in machine learning algorithms.

Articulation Matrix

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

UNIT I **9 Hours**
INTRODUCTION
Learning – Types of Machine Learning – Supervised -Unsupervised Learning - Relationship between attributes using Covariance and Correlation-Relationship between multiple variables- Regression - Linear-Multivariate in prediction.

UNIT II **9 Hours**
DATA PREPROCESSING
Data Objects and attribute types - Basic statistical description of data - Data visualization - Measuring data similarity and dissimilarity - Data cleaning - Integration - Data reduction - Data transformation and data discretization

UNIT III **9 Hours**
CLASSIFICATION
Naive Bayes Classifier -Model Assumptions, Probability Estimation-Required data processing- M-estimates, Feature selection- -K-Nearest Neighbor algorithm- Aspects to consider while designing K-Nearest Neighbor-Support Vector Machines-Linear learning machines and Kernel space, Making Kernels and working in feature space-Decision Trees- ID4, C4.5, CART

UNIT IV **9 Hours**
CLUSTERING
Distance measures-Different clustering methods -Distance-Density-Hierarchical-Iterative distance-based clustering-Dealing with continuous, categorical values in K-Means-Constructing a hierarchical cluster-K-Medoids, k-Mode and density-based clustering-Measures of quality of clustering.

UNIT V **9 Hours**
GRAPHICAL MODELS
Markov Chain Monte Carlo Methods – Sampling – Proposal Distribution – Bayesian Networks – Markov Random Fields – Hidden Markov Models – Tracking Methods.

EXPERIMENT 1 **5 Hours**
Implement a Linear Regression model to forecast salary packages using student CGPA data, and evaluate the applied model's performance.

EXPERIMENT 2 **5 Hours**
Implement Hypothesis Testing and Validation in Predicting Student Exam Scores using a Multivariate Regression model.

EXPERIMENT 3 **5 Hours**
Develop a spam classifier using Naive Bayes model to classify emails as spam or not spam from the spam_or_not_spam dataset and demonstrate the model's accuracy.

EXPERIMENT 4 **5 Hours**
Implement the K-Nearest Neighbors (KNN) algorithm to classify handwritten digits in a MNIST dataset, and evaluate the model's performance in accuracy.

EXPERIMENT 5 **5 Hours**
Implement and evaluate the performance of a Support Vector Machine (SVM) model to classify brain tumors from MRI images, and assess its accuracy.

EXPERIMENT 6 **5 Hours**
Implement the K-Means clustering algorithm to identify the optimal number of clusters for segmenting social media users into similar communities, and evaluate its metrics.

Total: 45+30 = 75 Hours

Reference(s)

1. Peter Flach, ―Machine Learning: The Art and Science of Algorithms that Make Sense of Data, First Edition, Cambridge University Press, 2012.
2. Jason Bell, ―Machine learning – Hands on for Developers and Technical Professionals, First Edition, Wiley, 2014
3. Ethem Alpaydin, ―Introduction to Machine Learning 3e (Adaptive Computation and Machine Learning Series), Third Edition, MIT Press, 2014
4. Jiawei Han, Micheline Kamber and Jian Pai, Data Mining: Concepts and Techniques, Morgan Kauffman, 2013

22AI504 CLOUD COMPUTING 3 0 2 4

Course Objectives

- To provide the ideal solution to manage enterprise resources effectively and efficiently by cloud computing.
- To identify the security and privacy issues in cloud computing.
- To 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 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Outline 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. Identify 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	2	2											2	1
2	2	2											2	1
3	3	3	3		3								2	1
4	3	3	2		2								2	1
5	3	3	3		3								2	1

UNIT 1 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 APPLICATIONS & STORAGE
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**
Develop the procedure to install Linux or Windows OS on Virtual Box / VMware.

EXPERIMENT 2 **4 Hours**
Create a C program for Arithmetic Calculator using C compiler in Virtual Box.

EXPERIMENT 3 **4 Hours**
Design the procedure to transfer Text File from one virtual machine to another using Open Stack.

EXPERIMENT 4 **4 Hours**
Design the web application to display Personal Portfolio and host the application on Google APP Engine.

EXPERIMENT 5 **4 Hours**
Develop the application for Data Center to allocate resources using First Come First Serve (FCFS) policy and simulate the scenario using CloudSim.

EXPERIMENT 6 **5 Hours**
Develop and deploy a Chatbot application using Microsoft Windows Azure.

EXPERIMENT 7 **5 Hours**
Develop the application to Count Number of Words in the given text file using Hadoop

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/

22AI507 MINI PROJECT I 0 0 2 1

Course Objectives

- To identify the problem statement and apply the engineering concepts to find the solution.
- To improve the analyzing capability of the students.
- To 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 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.
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.
PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

22AI601 NATURAL LANGUAGE PROCESSING 3 0 2 4

Course Objectives

- To apply basic mathematical models and methods in NLP applications to formulate computational solutions.
- To apply the logistic for classification and sentiment analysis.
- To analyze the syntax and semantics of natural languages.

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.
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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes

1. Evaluate the fundamental mathematical models and algorithms in the field of NLP.
2. Analyze the logistic regression for classification and sentiment analysis.
3. Implement semantic parsing for measuring word semantics and evaluation.
4. Apply the principles of language resource annotation to annotate the data.
5. Implement the NLP to solve the real-time problems.

Articulation Matrix

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

UNIT I **9 Hours**
INTRODUCTION
Introduction -Regular Expressions- Words - Text Normalization, Minimum Edit Distance - N-gram Language Models - Evaluating Language Models - Sampling sentences from a language model – Smoothing.

UNIT II **9 Hours**
SENTIMENT CLASSIFICATION AND LOGISTIC REGRESSION
Naive Bayes Classifiers - Optimizing for Sentiment Analysis - Evaluation: Precision, Recall, F-measure - Logistic Regression: Classification with Logistic Regression - Multinomial logistic regression - Learning in Logistic Regression - The cross-entropy loss: Gradient Descent - Regularization.

UNIT III **9 Hours**
SEMANTIC PARSING
Lexical Semantics - Vector Semantics - Words and Vectors - Cosine for measuring similarity - TF-IDF: Weighing terms in the vector - Pointwise Mutual Information - Word2vec - Visualizing Embeddings - Bias and Embeddings - Evaluating Vector Models.

UNIT IV **9 Hours**
ANNOTATING LINGUISTIC STRUCTURE
Context-Free Grammars and Constituency Parsing: Context-Free Grammars – Treebanks - Grammar Equivalence and Normal Form – Ambiguity - Span-Based Neural Constituency Parsing - Evaluating Parsers - Dependency Parsing: Dependency Relations - Transition-Based Dependency Parsing - Graph-Based Dependency Parsing – Evaluation.

UNIT V **9 Hours**
NLP APPLICATIONS
Machine Translation: Language Divergences and Typology - Machine Translation using Encoder-Decoder - Translating in low-resource situations - MT Evaluation - Question Answering and Information Retrieval: Information Retrieval - IR-based Factoid Question Answering - Entity Linking - Knowledge-based Question Answering - Using Language Models to do QA.

EXPERIMENT 1 **3 Hours**
Use stemming and tokenization process to get the root words in the given sentences.

EXPERIMENT 2 **3 Hours**
Split the words and display the words and count of the words in the given sentence using tokenizer function.

EXPERIMENT 3 **4 Hours**
Remove connectors and prepositions in a sentence. (Note: connectors and prepositions represent stop words take them in a text file for required output)

EXPERIMENT 4 **3 Hours**
Remove Stop words and identify parts of speech in the given sentence.

EXPERIMENT 5 **3 Hours**
Use n-gram language model to predict the next sequence of word or letter in sentence.

EXPERIMENT 6 **4 Hours**
Construct a parse tree that satisfies the given rule for the sentence using chunk parsing.

EXPERIMENT 7 **3 Hours**

Find the probability of given sentence using PCF Parsing.

EXPERIMENT 8 **4 Hours**

Implement a program that processes a word and discovers synonym, definition and example.

EXPERIMENT 9 **3 Hours**

Apply sentiment analysis and categorizing opinions expressed in a piece of text.

Total: 45+30 = 75 Hours

Reference(s)

1. Daniel Jurafsky, James H. Martin—Speech and Language Processing: An Introduction to natural Language Processing, Computational Linguistics and Speech, Pearson Publication, 2023.
2. Foundations of Statistical Natural Language Processing by Christopher D. Manning and HinrichSchuetze, MIT Press, 2018
3. Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, O'ReillyMedia; 1 edition, 2009
4. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

22AI602 COMPUTER VISION AND DIGITAL IMAGING 3 0 2 4

Course Objectives
- To understand the algorithms and techniques used in image formation.
- To analyze the Hough Transform for line, circle and ellipse detections.
- To implement the motion computation and 3D vision to generate 3-dimensional images of an object.

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.
PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)
1. Apply foundational image processing techniques for computer vision.
2. Implement shape analysis and boundary tracking techniques to detect semantic boundaries in images.
3. Utilize Hough Transform for detecting lines, circles, and ellipses in images.
4. Analyze motion estimation and 3D reconstruction techniques for visual data interpretation.
5. Apply computer vision methodologies to address real-world problems effectively

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

UNIT I **9 Hours**

FOUNDATIONS OF IMAGE PROCESSING

Images and Image Operations - Classical Filtering Operations – Thresholding Techniques – Edge Detection Techniques – Corner and Interest Point Detection – Mathematical morphology – Texture.

UNIT II **9 Hours**

SHAPES AND REGIONS

Binary Shape Analysis – Connectedness – Object Labeling and Counting – Size Filtering – Distance Functions – Skeletons and Thinning – Deformable Shape Analysis – Boundary Pattern Analysis - Boundary Tracking Procedures – Centroidal Profiles – Tackling the Problems of Occlusion –Boundary Length Measures.

UNIT III **9 Hours**

HOUGH TRANSFORM

Design Concepts - Modular design - Design heuristic - Design model and document - Architectural design - Software architecture - Data design - Transform and transaction mapping - User interface design - Component level Design: Designing Class based components, traditional Components-Introduction to Design Patterns

UNIT IV **9 Hours**

MOTION ESTIMATION

Methods for 3D vision – projection schemes for 3D vision – Three-Dimensional Object Recognition Schemes – Image Transformations and Camera Calibration - Image Rectification - Introduction to motion – triangulation – bundle adjustment – translational alignment – parametric motion – spline-based motion – optical flow – layered motion.

UNIT V **9 Hours**

3D RECONSTRUCTION AND APPLICATIONS

Shape from X – Active Range Finding – Surface Representations – Point-Based Representation – Model-Based Representation – Recovering Texture Maps and Albedos - Emotion Recognition– Gesture Recognition – Face Detection- Biometrics Augmented Reality- Stitching and document processing.

EXPERIMENT 1 **3 Hours**

Detect the shape and label the name of the shape in images.

EXPERIMENT 2 **3 Hours**

Remove the noise in image using noise removal algorithms.

EXPERIMENT 3 **3 Hours**

Detect the edges of an object using Edge detection algorithm.

EXPERIMENT 4 **3 Hours**

Build the own lane detection system for indicating the traffic flow, where a vehicle should drive using Perspective projection.

EXPERIMENT 5 **3 Hours**

Detect the corners of an object using corner detection algorithm.

EXPERIMENT 6 **3 Hours**

Detect the particular color from the image.

EXPERIMENT 7 **3 Hours**
Recognize the hand gestures in video streams.

EXPERIMENT 8 **6 Hours**
Detect if this is a Face or not and further recognize whose face is it.

EXPERIMENT 9 **3 Hours**
Classify the vehicles on the road and count the number of vehicles that travel through a road.

Total: 45+30 = 75 Hours

Reference(s)

1. E. R. Davies, "Computer & Machine Vision", Fourth Edition, Academic Press, 2012
2. R. Szeliski, "Computer Vision: Algorithms and Applications", Springer 2011.
3. Simon J. D. Prince, "Computer Vision: Models, Learning, and Inference", Cambridge University Press, 2012.
4. David A. Forsyth, Jean Ponce, "Computer Vision a Modern Approach", Pearson, 2012.

22AI603 DEEP LEARNING 3 0 2 4

Course Objectives

- To understand the basic concepts and principles of neural networks.
- To analyze the Recurrent Neural Network (RNN) to model the sequence data.
- To apply deep generative models to solve problems with 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 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.
PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Illustrate the fundamental principles and architectures of Neural Networks and Deep Learning.
2. Develop Convolutional Neural Network (CNN) models to enhance performance in image classification tasks.
3. Apply advanced neural network architectures and training techniques to address complex sequential data challenges.
4. Implement Autoencoder algorithms for dimensionality reduction and deep learning applications.
5. Design and implement deep learning models to address real-world problems effectively.

Articulation Matrix

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

UNIT I **9 Hours**
FOUNDATIONS OF NEURAL NETWORKS AND DEEP LEARNING
Neural Networks: Perceptron - Multilayer Feed Forward Networks -Training in Neural Networks: Back propagation Learning-Common Architectural Principles of Deep Networks: Layers-Activation Functions-Loss Functions

UNIT II **9 Hours**
CONVOLUTIONAL NEURAL NETWORKS
Introduction to CNN – Layers – Filters - Weight and Bias - Epoch and Batch Size - Data Augmentation - Parameter sharing – Regularization - Popular CNN Architectures: ResNet, AlexNet.

UNIT III **9 Hours**
RECURRENT NEURAL NETWORKS
Recurrent Neural Networks - Bidirectional RNNs -Encoder-decoder sequence to sequence architectures – Backpropagation through time (BPTT) for training RNN - Long Short-Term Memory (LSTM).

UNIT IV **9 Hours**
AUTOENCODERS
Introduction to Autoencoders - Architecture of Autoencoders – Undercomplete Autoencoders - Regularized Autoencoders – Denoising – Contractive- Predictive Sparse Decomposition - Drawing Samples from Autoencoders -Applications of Autoencoders.

UNIT V **9 Hours**
DEEP GENERATIVE MODELS
Deep Belief networks, Boltzmann Machines - Deep Boltzmann Machine, Generative Adversarial Networks – Case Study: Object Detection using CNN – Automatic Image Captioning.

EXPERIMENT 1 **4 Hours**
Solve XOR problem using Multilayer perceptron.

EXPERIMENT 2 **4 Hours**
Implement character and Digit Recognition using ANN.

EXPERIMENT 3 **4 Hours**
Develop a code to design object detection and classification for traffic analysis using CNN.

EXPERIMENT 4 **4 Hours**
Implement image generation using GAN.

EXPERIMENT 5 **4 Hours**
Implement LSTM for Anomaly Detection in Time Series.

EXPERIMENT 6 **5 Hours**
Implement the dimensionality reduction and Image denoising using autoencoders.

EXPERIMENT 7 **5 Hours**
Implement Sentiment Analysis using LSTM.

Total: 45+30 = 75 Hours

Reference(s):

1. Josh Patterson and Adam Gibson, “Deep learning: A practitioner's approach”, O'Reilly Media, First Edition, 2017
2. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
3. Simon Haykin, “Neural Networks and Learning Machines”, 3rd Edition, Pearson Prentice Hall.
4. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
5. Chao Pan, “Deep Learning Fundamentals: An Introduction for Beginners”, AI Sciences LLC, 2018.

22AI607 MINI PROJECT II 0 0 2 1

Course Objectives

- To identify the problem statement and apply the engineering concepts to find the solution.
- To improve the analyzing capability of the students.
- To 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 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.
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.
PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

22AI701 DATA VISUALIZATION 3 0 2 4

Course Objectives

- To understand the fundamental concepts and components used in the data visualization.
- To learn tools and techniques for creating interactive and effective visualizations.
- To apply visualization methods for solving real-world and security-related problems.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Illustrate the fundamentals and key design principles of data visualization.
2. Apply visualization methods to represent complex data.
3. Implement data acquisition and processing techniques for visualization.
4. Create interactive visualizations using D3 data.
5. Develop visualizations for security applications like intrusion detection and vulnerability analysis.

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

UNIT I **9 Hours**

INTRODUCTION TO DATA VISUALIZATION

Context of data visualization – Definition, Methodology, Visualization design objectives. Key Factors – Purpose, visualization function and tone, visualization design options – Data representation, Data Presentation, Seven stages of data visualization, widgets, data visualization tools.

UNIT II **9 Hours**

DATA VISUALIZATION METHODS

Mapping - Time series - Connections and correlations – Indicator-Area Chart-Pivot table- Scatter charts, Scatter maps - Tree maps, Space filling and non-space filling methods-Hierarchies and Recursion - Networks and Graphs -Matrix representation for graphs- Info graphics

UNIT III **9 Hours**

DATA VISUALIZATION PROCESS

Acquiring data, - Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Parsing data - Levels of Effort, Tools for Gathering Clues, Text Markup Languages, Regular Expressions (regexps), Vectors and Geometry, Binary Data Formats.

UNIT IV **9 Hours**

INTERACTIVE DATA VISUALIZATION

Technology Fundamentals- Setting up D3- Drawing with data – Scales – Axes – Updates, Transition and Motion – Interactivity - Layouts – Geomapping – Exporting, Framework – T3 JavaScript Framework- Tableau

UNIT V **9 Hours**

SECURITY DATA VISUALIZATION

Port scan visualization - Vulnerability assessment and exploitation - Firewall log visualization - Intrusion detection log visualization -Attacking and defending visualization systems – Creating security visualization system.

EXPERIMENT 1 **3 Hours**

Data preprocessing and cleaning methods on student datasets

Create an Employee Table with training data set which includes attributes like name, id, salary, experience, gender, phone number. Preprocess the given data by checking the constraints on each attribute

EXPERIMENT 2 **3 Hours**

Import a dataset in any one of the data visualization tools and provide graphical representation in following formats: Bar Chart, Pie Chart, Area Chart, Scatter Chart and Scatter plot

EXPERIMENT 3 **3 Hours**

Wise Owl Travel Agents					
Country	**Resort Name**	**No of Days**	**Travel Method**	**Price**	**Holiday ID**
Australia	Great Barrier Reef	32	Plane	£750	I990AUS
Australia	Perth	28	Plane	£985	AUS112J
Chile	Santiago	21	Plane	£1,259	CH266H
England	London	3	Train	£69	I456UK
England	Bognor	1	Coach	£12	BG726H
France	Lyon	14	Plane	£399	A7995FR
France	Paris - Euro Disney	5	Train	£269	TH789FR
France	Paris - Euro Disney	3	Train	£125	TH788FR

Create a pivot table from this data, then use the filters within to view the average prices of holidays that have a Travel Method of Plane and a Resort Name that begins with the letter S. Confirm that there are 3 holidays in total, by using the drill-down feature.

EXPERIMENT 4 **3 Hours**

Pick a single data series and create an appropriate data visualization technique for it using Processing. A single series contains one set of values for a single variable. An example might be data representing your height for every year of your life, petrol cost over the last 10 years, or the relative popularity of the top 10 learning websites.

EXPERIMENT 5 **3 Hours**

Take multiple data series and make a visualization in Processing that allows someone to easily compare them visually.

EXPERIMENT 6 **3 Hours**

Use the batch yields dataset and construct a monitoring chart using the 300 yield values. Use a subgroup of size 5. Report the target value, lower control limit and upper control limit

EXPERIMENT 7 **3 Hours**

Using the Website traffic data set

1. Create a chart that shows the variability in website traffic for each day of the week.
2. Use the same data set to describe any time-based trends that are apparent.

EXPERIMENT 8 **3 Hours**

Load the room temperature dataset into any one of the tools like R, Python or MATLAB, or whichever software tool you prefer to plot with.

1. Plot the 4 trajectories, FrontLeft, FrontRight, BackLeft and BackRight on the same plot.
2. Comment on any features you observe in your plot.

EXPERIMENT 9 **3 Hours**

Load the six-point board thickness dataset, available from datasets website.

1. Plot a boxplot of the first 100 rows of data to match the figure in these notes
2. Explain why the thick center line in the box plot is not symmetrical with the outer edges of the box.

EXPERIMENT 10 **3 Hours**

Create an information dashboard on COVID cases in a particular location. Map the raw data into a meaningful information

Total: 45+30 = 75 Hours

Reference(s)

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008
2. Scott Murray, “Interactive data visualization for the web”, O’Reilly Media, Inc., Second Edition, 2017.
3. Greg Conti, “Security Data Visualization: Graphical Techniques for Network Analysis”,NoStarch Press Inc, 2007

22AI702 AI FOR ROBOTICS 3 0 0 3

Course Objectives

- To understand the concepts of robot locomotion and kinematic models with its constraints.
- To analyze the methods for mobile robot Localization, Path planning and Navigation of Robots.
- To implement the localization algorithms to locate a robot with respect to its 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.

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Illustrate the locomotion mechanisms of legged, wheeled, and aerial mobile robots.
2. Apply kinematic models and constraints to analyze and control robot motion.
3. Apply sensors and statistical methods to extract features and manage uncertainty in robotic perception.
4. Implement probabilistic techniques for robot localization and map-based navigation.
5. Develop planning and navigation strategies for autonomous robots.

Articulation Matrix

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

UNIT I 9 Hours

ROBOT LOCOMOTION

Introduction to AI and Robotics – robot locomotion – legged mobile robots – wheeled mobile robots – aerial mobile robots.

UNIT II **9 Hours**

MOBILE ROBOT KINEMATICS

Kinematic models and constraints – mobile robot maneuverability – mobile robot workspace – advanced kinematics – motion control.

UNIT III **9 Hours**

ROBOT PERCEPTION

Sensors for mobile robots – representing uncertainty: statistical representation – error propagation – Feature extraction.

UNIT IV **9 Hours**

MOBILE ROBOT LOCALIZATION

Introduction to localization – noise and aliasing – localization-based navigation – belief representation – map representation – probabilistic map-based localization – autonomous map building.

UNIT V **9 Hours**

ROBOT PLANNING AND NAVIGATION

Planning and Navigation – planning and reacting – path planning – obstacle avoidance – navigation architectures.

Total: 45 Hours

Reference(s)

1. R. Siegwart, I. R. Nourbaksh, and D. Scarramuzza, "Introduction to Autonomous Mobile Robots", Second Edition, MIT Press, 2011.
2. Stuart Russel and Peter Norvig, "Artificial Intelligence: A Modern Approach", Fourth Edition, Pearson Education, 2020.
3. Bhaumik and Arkapravo "From AI to Robotics: Mobile, Social, and Sentient Robots" by CRC Press Taylor & Francis 2017.

22AI707 PROJECT WORK I 0 0 4 2

Course Objectives

- To work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- To understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- To develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- To effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

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.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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, 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

22AI801 PROJECT WORK II 0 0 20 10

Course Objectives

- To work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- To understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- To develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- To effectively communicate information relating to all aspects of the design process in written, oral, and graphical form.

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.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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, 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

LANGUAGE ELECTIVES

22HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Command over the English language for day-to-day transactions.
- Improve listening and reading skills
- Increase ability to comprehend complex content
- Enhance confidence in expressing with clarity and elegance
- Enthusiastic and reflective use of the language through sufficient and focused practice
- Articulate fluently and confidently in challenging situations

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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Engage with the English language in functional contexts
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									3	3		3	1	1
2									3	3		3	1	1
3									3	3		3	1	1
4									3	3		3	1	1
5									3	3		3	1	1

UNIT I **15 Hours**

SELF-EXPRESSION

Personal Goals and Values - Being a Team Player-Expressing strengths and weaknesses-Abstract nouns -Adjectives-Active Listening Skills-Note Making-Pronunciation and Accent Personal goals and values - Reading for Gist and Details-Professional ethics -Reported Speech-Conjunctions Reading skills - phonemics, word/phrase recognition, sight words Personal Goals and Values-Conditional clauses- Hypothetical questions and answers-Sentence Structure-Simple Present Tense-Perfect tense

UNIT II **15 Hours**

CREATIVE EXPRESSION

Instructive and Expository Expression - Creating brochures, catalogues, and manuals for products/ services, Giving directions, Process writing, Sequencing experiments, Concept Explanation-Reported speech-Voice Sentence Equivalence-Proofreading

UNIT III **15 Hours**

FORMAL EXPRESSION

Notices and Announcements-Writing: Creating notices and circulars for events, announcing college tours and lost and Found-Varied Vocabulary - Gender Sensitive Vocabulary, Non-discriminatory Vocabulary, Concise Vocabulary-Paragraph writing - Effective titles, topics and supporting sentences, calling in registrations and queries. Effective communication- Understanding purpose, reach and target audience, achieving complete communication Punctuation - Capitalization, Numeration, Use of proper nouns and Articles-Spelling-Reading: Analyzing and interpreting notices and Circulars-Understanding the gist of short real-world notices, and messages. Culling out keywords Information words vs Supporting words-Interpreting Abbreviations, Acronyms and Short-forms-Listening: Analyzing and interpreting announcements Decoding - Screening for salient points-Note making-Raising queries for clarification-Speaking: Announcements-Giving complete information-Pronunciation and Enunciation Pace, Intonation, and Pitch-Conducting Events-Speaking: Master of ceremonies, Short speeches - welcome speech, the vote of thanks/ valedictory speech, award-acceptance speech Writing: Invitations, Preparation of script/draft after interviewing someone. Adjectives-Pronunciation/ Punctuation Precision and Concision-Politeness markers

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 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.

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

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

PROFESSIONAL ELECTIVES

22AI001 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 qualityassurance.

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.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

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

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 SoftwareDevelopment, 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 inComputer Science‖, Springer, VIII edition, 2009
4. Craig Larman, ―Agile and Iterative Development: A manager's Guide, Addison-Wesley,2004
5. Kevin C. Desouza, ―Agile information systems: conceptualization, construction, and management‖, Butterworth-Heinemann, 2007.

22AI002 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 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 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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 for digital products.

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		1								2	2
3		3	3		1								2	2
4		2	2										2	2
5		2	2										2	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 - Masterthe 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 AND 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 and Quantitative evaluation - Guerilla testing - A/B Testing - Unmoderated remote usability testing - Card sorting - Session recording - Think aloud : Introduction and advantages - Designing evaluation protocol - Conducting usability evaluation study - Conduct Usability Test explicit - Synthesize Test Findings - practices in corporate World - Product Design : Types of products & solutions - Design Psychology for e-commerce sites , CMS - Design Thinking Life Cycle

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.
7. Baecker, Ronald M., Jonathan Grudin, et al. Readings in Human-Computer Interaction: Towardthe Year 2000. 2nd ed. Morgan Kaufmann, 1995. ISBN: 9781558602465.
8. Shneiderman, Ben, and Catherine Plaisant. Designing the User Interface: Strategies for Effective Human-Computer Interaction. 4th ed. Addison Wesley, 2004. ISBN: 9780321197863.
9. Dix, Alan J., Janet E. Finlay, et al. Human-Computer Interaction. 2nd ed. Prentice Hall, 1998. ISBN: 9780132398640.
10. Olsen, Dan R. Developing User Interfaces (Interactive Technologies). Morgan Kaufmann, 1998. ISBN: 9781558604186.

22AI003 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Apply modules and components and Animations for creating Forms and developing webpages
2. Create web applications by performing CRUD operations in database using webframeworks
3. Design Progressive Web Application with dynamic HTML web pages using Angular.
4. Design single page applications with reusable UI components using React CSS andSaaS
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	1		1		3								2	2
3	1		2		2								2	2
4	1		1		3								2	2
5	1		1		3								2	2

UNIT I 9 Hours

ANGULAR FRONTEND FRAMEWORK

Introduction - Setup - Architecture: Modules, Components, Services and DI fundamentals - Components and Templates – Configuration- Forms - Observables and 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 BACKEND FRAMEWORK

Node.js basics - Local and Export Modules - Node Package Manager - Node.js web server - Node.js File system - Node Inspector - Node.js Event Emitter - 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, andNode, 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, O’Reilly;First edition, 2018

22AI004 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 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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, iPhonemarketplace.

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 happenbased 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 SIGNIN using the Username and Password created during signup activity. If the Username andPassword 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 Afternoonor Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

EXPERIMENT 5 **4 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 **5 Hours**

Implement UI elements like Text Fields, Label, Tool bar, Status bar, Tab bar.

Total: 30+30 = 60 Hours

Reference(s)

1. Lauren Darcey and Shane Conder, “Android Wireless Application Development”,Pearson Education, 2nd ed. (2011)
2. Reto Meier, “Professional Android 2 Application Development”, Wiley India Pvt Ltd.
3. Mark L Murphy, “Beginning Android”, Wiley India Pvt Ltd 3. R3. Android Application Development All in one for Dummies by Barry Burd.
4. Alberto Miola, “Flutter Complete Reference: Create beautiful, fast and native apps forany device” ISBN-13 9780141044804.
5. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS6Development: Exploring the iOS SDK”, Apress, 2013.55.

22AI005 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 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand the importance of testing in the software development process
2. Compare the different test case design strategies
3. Analyze the different levels of testing and their importance
4. Apply test management techniques and the role of a test specialist
5. Analyze the software test automation and its requirements

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Basic definitions – Software Testing Principles – The Tester's Role in a Software Development Organization – Origins of Defects – Cost of Defects – Defect Classes – The Defect Repository andTest 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 – Skillsneeded 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

Textbook(s)

1. Srinivasan Desikan and Gopalaswamy Ramesh, “Software Testing – Principles andPractices”, Pearson Education, 2006.
2. Ron Patton, “Software Testing”, Second Edition, Sams Publishing, Pearson Education,2007.

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, NewYork, 1990.
4. Aditya P. Mathur, “Foundations of Software Testing _ Fundamental Algorithms and Techniques”, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

22AI006 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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 AND GRADLE

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 and 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

Textbook(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

Reference(s)

1. 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 (English Edition) Paperback – 1 January 2020 by Mitesh Soni.
2. Jeff Geerling, “Ansible for DevOps: Server and configuration management for humans”, First Edition, 2015.
3. David Johnson, “Ansible for DevOps: Everything You Need to Know to Use Ansible for DevOps”, Second Edition, 2016.
4. Mariot Tsitoara, “Ansible 6. Beginning Git and GitHub: A Comprehensive Guide to Version Control, Project Management, and Teamwork for the New Developer”, Second Edition, 2019.
5. https://www.jenkins.io/user-handbook.pdf
6. https://maven.apache.org/guides/getting-started/

22AI007 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Analyze the concept of virtualization and its properties.
2. Apply different forms of virtualization.
3. Implement various architectures for implementing virtualization methods.
4. Create virtual machines and installing various operating systems.
5. Evaluate the performance of the virtual machines and deployed applications.

Articulation Matrix

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

UNIT I **9 Hours**

UNDERSTANDING VIRTUALIZATION

Describing Virtualization-Microsoft Windows Drives Server Growth -Explaining Moore's Law-Understanding the Importance of Virtualization -Examining Today's Trends -Virtualization and Cloud Computing -Understanding Virtualization Software Operation -Virtualizing Servers -Virtualizing Desktops -Virtualizing Applications

UNIT II **9 Hours**

HYPERVISORS

Describing a Hypervisor -Exploring the History of Hypervisors -Understanding Type 1 Hypervisors - Type 2 Hypervisors - Role of a Hypervisor -Holodecks and Traffic Cops -Resource Allocation -Comparing Today's Hypervisors -VMware ESX -Citrix Xen -Microsoft Hyper-V -Other Solutions.

UNIT III **9 Hours**

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 AND CONFIGURATIONS

Understanding Configuration Options-Installing Windows on a Virtual Machine- Installing Linux on a Virtual Machine-Installing VirtualBox Guest Additions- Managing CPUs for a Virtual Machine-Configuring VM CPU Options-Managing Storage for a Virtual Machine- Managing Networking for a Virtual Machine- Copying a Virtual Machine- Managing Additional Devices in Virtual Machines

UNIT V **9 Hours**

AVAILABILITY AND APPLICATIONS IN A VIRTUAL MACHINE

Increasing Availability-Protecting a Virtual Machine-Protecting Multiple Virtual Machines-Protecting Data Centers - Examining Virtual Infrastructure Performance Capabilities -Deploying Applications in a Virtual Environment-Understanding Virtual Appliances and vApps -Open Stack and Containers.

Total: 45 Hours

Reference(s)

1. Matthew Portney, Virtualization Essentials, John Wiley & Sons, Second Edition, 2016
2. Kailash Jayaswal, Jagannath Kallakurchi, Donald J.Houde, Dr.devan Shah, Cloud Computing Black Book, Dreamtech press, 2015
3. Rajkumar Buyya, Christian Vecchiola and Thamarai Selvi S, Mastering in Cloud Computing, McGraw Hill Education, (India) Private Limited, 2013
4. Bernard Golden, Amazon Web Services for Dummies, John Wiley & Sons, First Edition, 2013
5. http//www.microsoft.com/learning/default.mspx
6. https://www.oreilly.com/library/view/cloud- security-and/9780596806453/ch04.html

22AI008 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Apply Cloud Computing reference architecture for developing clouds
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	1
2		1	3	2									2	1
3		2	1	3									2	1
4	1	2	1	3									2	1
5	1	3		2									2	1

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, O'reilly, SPD, 2011

22AI009 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

UNIT I **8 Hours**

STORAGE SYSTEMS

Cloud Storage Fundamentals and Architecture - Cloud Storage Providers and Services - Access methods (RESTful APIs, SDKs) for cloud object storage - Block storage technologies in cloud environments - File Storage in the Cloud: Network File System (NFS) and Server Message Block (SMB) protocols -Hybrid Cloud Storage - Data Migration - Data Lifecycle Management in the Cloud

UNIT II **9 Hours**

INTELLIGENT STORAGE SYSTEMS AND RAID

Storage Tiering and Caching - Automated Data Placement and Load Balancing: Intelligent Algorithms for Data Placement, Load Balancing Strategies for Distributed Storage Systems, Dynamic Resource Allocation - RAID Technologies in Cloud Storage: RAID Levels - Data Striping, Mirroring, and Parity for Fault Tolerance - RAID Configuration and Performance Optimization

UNIT III **10 Hours**

STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION

Storage Networking in Cloud Environments - Understanding storage protocols - Network-attached storage (NAS) vs. storage area network (SAN) - Storage virtualization techniques and technologies - Network-Attached Storage (NAS) - Storage Area Network (SAN) - iSCSI and Fiber Channel over IP (FCIP) in Cloud Storage - Network Virtualization and Overlay Networks - Storage Virtualization and Abstraction - Network Performance Optimization - Network Security in Cloud Storage

UNIT IV **9 Hours**

BACKUP, ARCHIVE AND REPLICATION

Cloud Backup: Strategies and Architecture, Data duplication and Compression, Security - Cloud Archive: Strategies and Architecture, Replication for Data Redundancy: Synchronous and asynchronous replication methods - Disaster Recovery in the Cloud - Hybrid Backup and Archiving in Cloud Environments - Backup and Archive Management in Cloud Environments

UNIT V **9 Hours**

SECURING STORAGE INFRASTRUCTURE

Storage Security Fundamentals: Key Security Principles, Threats and Vulnerabilities in Storage Infrastructure, Access Control and Authentication: Role-based Access Control (RBAC) and Permissions Management, Multi-factor authentication (MFA) for Storage Systems - Storage-level Encryption and Application-level Encryption - Storage infrastructure Management Functions and Processes.

Total: 45 Hours

Reference(s)

1. George Reese, "Cloud Application Architectures: Building Applications and Infrastructure in the Cloud: Transactional Systems for EC2 and Beyond (Theory in Practice) ‖, O'Reilly, 2009.
2. Kai Hwang, Geoffrey C. Fox, Jack G. Dongarra, "Distributed and Cloud Computing, From Parallel Processing to the Internet of Things", Morgan Kaufmann Publishers, 2012.
3. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security‖, CRC Press, 2017.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical Approach‖, Tata Mcgraw Hill, 2009.

22AI010 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

UNIT I **7 Hours**

UNDERSTANDING THE CLOUD AUTOMATION

Introduction to Automation & Configuration Tools. Introduction to Terraform. Understanding Terraform Vs CloudFormation. Deploying & Destroying AWS environment with Terraform. Introduction to Packer.

UNIT II **9 Hours**

ABSTRACTION AND VIRTUALIZATION

Introduction to Virtualization Technologies, Load Balancing and Virtualization, Understanding hypervisors Porting Applications, Virtual Machines Provisioning and Manageability, Virtual Machine Migration Services, Virtual Machine Provisioning and Migration in Action, Provisioning in the Cloud Context, Virtualization of CPU, Memory, I/O Devices, Virtual Clusters and Resource management, Virtualization for Data Centre Automation.

UNIT III **9 Hours**

AUTOMATION AND CONFIGURATION MANAGEMENT IN THE CLOUD

Cloud automation at scale, Cloud Configuration Management –unmanaged and managed configuration management, Modification of the capacity of the service, horizontal and vertical scaling, and automatic versus manual scaling. Migrating the business to Cloud. Automating cloud deployments –Balancers.

UNIT IV **9 Hours**

LOAD BALANCING AND AUTO SCALING IN CLOUD

Managed instance groups, Auto scaling and health check, Overview of HTTP(S) load balancing. Example: HTTP load balancer, HTTP(S) load balancing, Configuring an HTTP Load Balancer with Auto scaling, SSL proxy load balancing, TCP proxy load balancing, Network load balancing, Internal load balancing, Configuring an Internal Load Balancer, Choosing a load balancer.

UNIT V **11 Hours**

AWS CLOUDFORMATION USECASE

Introduction to AWS CloudFormation, AWS CloudFormation Features and Components, Working of AWS CloudFormation, setting up AWS CloudFormation, building a Pipeline for Test and Production Stacks, AWS CloudFormation Artifacts, Parameter Override Functions with Code Pipeline, Using AWS CLI. AWS CloudFormation, Terraform, VMware vs Center Configuration Manager (VCM), and Puppet.

Total: 45 Hours

Reference(s)

1. Bernd Ruecker, Practical Process Automation: Orchestration and Integration in Micro services and Cloud Native Architectures, O'Reilly Media, First Edition, 2021.
2. Douglas Comer, The Cloud Computing Book: The Future of Computing Explained, Chapman and Hall/CRC, First Edition, 2021.
3. Karen Tovmasyan, Mastering AWS CloudFormation: Plan, develop, and deploy your cloud infrastructure effectively using AWS CloudFormation, Packt Publishing Limited, First Edition, 2020.
4. Mikael Krief, Mitchell Hashimoto, Terraform Cookbook: Efficiently define, launch, and manage Infrastructure as Code across various cloud platforms, Packet Publishing Limited, 2020.
5. Yogesh Raheja, Dennis McCarthy, Automation with Puppet 5.0, Wiley, First Edition, 2018.

22AI011 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 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. Understand the basic concepts of 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		1	3	2										
3		2	1	3										
4	1	2	1	3										
5	1	3		2										

UNIT I **6 Hours**

INTRODUCTION TO SDN

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**

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 **6 Hours**

Setup your own virtual SDN lab
i) Virtual box/Mininet Environment for SDN - http://mininet.org
ii) https://www.kathara.org
iii) GNS3

EXPERIMENT 2 **6 Hours**

Create a simple mininet topology with SDN controller and use Wireshark to capture and visualize the OpenFlow messages such as OpenFlow FLOW MOD, PACKET IN, PACKET OUT etc.

EXPERIMENT 3 **6 Hours**

Create a SDN application that uses the Northbound API to program flow table rules on the switch for various use cases like L2 learning switch, Traffic Engineering, Firewall etc.

EXPERIMENT 4 **6 Hours**

Create a simple end-to-end network service with two VNFs using vim-emu https://github.com/containernet/vim-emu

EXPERIMENT 5 **6 Hours**

Install OSM and onboard and orchestrate network service.

Total: 30+30 = 60 Hours

Reference(s)

1. Fei Hu, Network Innovation through OpenFlow and SDN: Principles and Design, 1st Edition, CRC Press, 2014.
2. Ken Gray, Thomas D. Nadeau, Network Function Virtualization, Morgan Kauffman, 2016.
3. Oswald Coker, Siamak Azodolmolky, Software-Defined Networking with OpenFlow, 2nd Edition, O'Reilly Media, 2017.
4. Paul Goransson, Chuck Black Timothy Culver, Software Defined Networks: A Comprehensive Approach, 2nd Edition, Morgan Kaufmann Press, 2016.
5. Thomas D Nadeau, Ken Gray, SDN: Software Defined Networks, O'Reilly Media, 2013.
6. William Stallings, Foundations of Modern Networking: SDN, NFV, QoE, IoT and Cloud, Pearson Education, 1st Edition, 2015.

22AI012 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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. Applying the various architectural and design considerations for security in the cloud.
5. Delivers various risks, audit and monitoring mechanisms 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	1
2	1	3	2	3	1								2	1
3	3	2	2	3	2								2	1
4	2	1	2	3	3								2	1
5	1	3	3	1	1								2	1

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.

22AI013 / 22AIH13 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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 engineeringAttack – 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

Textbook(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/

Reference(s)

1. David Kim, Michael G. Solomon, "Fundamentals of Information Systems Security", Jones& Bartlett Learning Publishers, 2013.
2. Patrick Engebretson, "The Basics of Hacking and Penetration Testing: Ethical Hacking and Penetration Testing Made easy", Elsevier, 2011.
3. Kimberly Graves, "CEH Official Certified Ethical Hacker Review Guide", Wiley Publishers,2007.
4. William Stallings, Lawrie Brown, "Computer Security Principles and Practice", ThirdEdition, Pearson Education, 2015.
5. Georgia Weidman, "Penetration Testing: A Hands-On Introduction to Hacking", No StarchPress, 2014.

22AI014 / 22AIH14 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 Pseudo random 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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

UNIT V **9 Hours**

MESSAGE AUTHENTICATION CODES

Introduction to 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 - Analyzing Cryptographic Protocols - Zero Knowledge Proofs and Protocols.

Total: 45 Hours

Reference(s)

1. William Stallings, "Cryptography and Network Security: Principles and Practice", PHI 7th Edition, 2017.
2. Oded Goldreich, 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.

22AI015 / 22AIH15 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.
- To analyze the various hacking techniques and their impacts.

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.

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

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Analyse the basics of computer forensics, legal and ethical considerations, and theimportance of maintaining the integrity of digital evidence.
2. Apply computer forensic tools to preserve the integrity of data in thenetwork.
3. Analyse and validate forensics data from the communicating devices to detect intruders.
4. Apply firewall techniques to detect the vulnerabilities in the networks.
5. Implement real-world hacking techniques to test system security and to ensure thesystem's 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					1	1
2	2	2	3	2	3			2					1	1
3	2	1	3	2	2			3					1	1
4	2	1	2	3	3			3					1	1
5	2	2	2	2	3			3					1	1

UNIT I **9 Hours**

INTRODUCTION TO COMPUTER FORENSICS

Introduction to Traditional Computer Crime, Traditional problems associated with Computer Crime. Introduction to Identity Theft & 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 AND FIREWALLS

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”, CengageLearning, 2nd Edition, 2005.
5. Man Young Rhee, “Internet Security: Cryptographic Principles”, “Algorithms and Protocols”, Wiley Publications, 2003.

22AI016 / 22AIH16 ETHICAL HACKING 3 0 0 3

Course Objectives

- To learn about the importance of information security.
- To explain different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To analyse 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Apply the fundamentals of ethical hacking, penetration testing, and network security protocols to real-world scenarios.
2. Apply scanning and enumeration techniques using hacking tools for vulnerability assessment
3. Demonstrate password cracking, privilege escalation, and countermeasures for system security.
4. Develop security tools using programming languages to identify and mitigate system vulnerabilities.
5. Implement network protection mechanisms to secure network systems.

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

UNIT I **9 Hours**

INTRODUCTION

Ethical Hacking Overview - Role of Security and Penetration Testers - Penetration-TestingMethodologies-Laws of the Land - Overview of TCP/IP- The Application Layer - The TransportLayer - 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 andNetwork Defense”, Cengage Learning, 2013.
4. Patrick Engebretson, “The Basics of Hacking and Penetration Testing – Ethical Hackingand Penetration Testing Made Easy”, Second Edition, Elsevier, 2013.
5. Rafay Boloch, “Ethical Hacking and Penetration Testing Guide”, CRC Press, 2014.

22AI017 / 22AIH17 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand emerging abstract models for Blockchain Technology.
2. Implement bitcoin script in blockchain transactions.
3. Implement Consensus in blockchain for transaction validation.
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								2	1
2	3	3	3	1	2								2	1
3	2	2	1	1									2	1
4		2	2		3								2	1
5	1	2	3	1	2								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 – 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 AND ETHEREUM

Architecture of Hyperledger fabric v1.1- chain code- Ethereum: Ethereum network, EVM, Transaction fee, Mist Browser, Ether, Gas, Solidity.

UNIT V **6 Hours**

BLOCKCHAIN APPLICATIONS

Smart contracts - Truffle Design and issue - DApps – NFT - Blockchain Applications in Supply Chain Management, Logistics, Smart Cities, Finance and Banking, Insurance, etc - Case Study.

EXPERIMENT 1 **5 Hours**

Install and understand Docker container, Node.js, Java and Hyperledger Fabric, Ethereum and perform necessary software installation on local machine/create instance on cloud to run.

EXPERIMENT 2 **5 Hours**

Create and deploy a blockchain network using Hyperledger Fabric SDK for Java Set up and initialize the channel, install and instantiate chain code, and perform invoke and query on your blockchain network.

EXPERIMENT 3 **5 Hours**

Interact with a blockchain network. Execute transactions and requests against a blockchain network by creating an app to test the network and its rules.

EXPERIMENT 4 **5 Hours**

Deploy an asset-transfer app using blockchain. Learn app development within a Hyperledger Fabric network.

EXPERIMENT 5 **5 Hours**

Use blockchain to track fitness club rewards. Build a web app that uses Hyperledger Fabric to track and trace member rewards

EXPERIMENT 6 **5 Hours**

Car auction network: A Hello World example with Hyperledger Fabric Node SDK and IBM Blockchain Starter Plan. Use Hyperledger Fabric to invoke chain code while storing results and data in the starter plan.

Total: 30+30 = 60 Hours

Textbook(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.

Reference(s)

1. Daniel Drescher, "Blockchain Basics", First Edition, Apress, 2017.
2. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Bitcoin and cryptocurrency technologies: a comprehensive introduction. Princeton University Press, 2016.
3. Melanie Swan, "Blockchain: Blueprint for a New Economy", O'Reilly, 2015
4. Ritesh Modi, "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain", Packt Publishing
5. Handbook of Research on Blockchain Technology, published by Elsevier Inc. ISBN: 9780128198162, 2020.

22AI018 / 22AIH18 MALWARE ANALYSIS 3 0 0 3

Course Objectives

- To understand the fundamentals of malware, types and its effects.
- To 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world 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	2	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 – APKTool- APKInspector - Dex2Jar - JD-GUI - Static and Dynamic Analysis - Case Study: Smartphone (Apps) Security

Total: 45 Hours

Textbook(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 & Bartlett Publishers, 2009.

Reference(s)

1. Jamie Butler and Greg Hoglund, "Rootkits: Subverting the Windows Kernel" by 2005, Addison-Wesley Professional.
2. Bruce Dang, Alexandre Gazet, Elias Bachaalany, Sébastien Josse, "Practical Reverse Engineering: x86, x64, ARM, Windows Kernel, Reversing Tools, and Obfuscation", 2014.
3. Victor Marak, "Windows Malware Analysis Essentials" Packt Publishing, O'Reilly, 2015.
4. Ken Dunham, Shane Hartman, Manu Quintans, Jose Andre Morales, Tim Strazzere, "Android Malware and Analysis", CRC Press, Taylor & Francis Group, 2015.
5. Windows Malware Analysis Essentials by Victor Marak, Packt Publishing, 2015.

22AI019 ROBOTIC PROCESS AUTOMATION 3 0 0 3

Course Objectives

- To understand the basic concepts, methodologies and tools in RPA.
- To understand the UiPath building blocks in the RPA.
  To implement the exception handling and automation techniques using RPA.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Interpret the basic concepts and methodologies in RPA.
2. Infer the UiPath building blocks in the RPA.
3. Apply the RPA techniques to automate the application.
4. Implement the exception handling and BOT in RPA.
5. Implement the RPA to solve real time problems.

Articulation Matrix

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

UNIT I **9 Hours**

RPA AND PROCESS METHODOLOGIES

Introduction to RPA: Definition, importance, and benefits of RPA – Comparison of RPA with BPO, BPM, and BPA-Understanding RPA Skills: On-Premise Vs. the Cloud - Lean and Six Sigma Methodologies for Process Improvement - Overview of Agile Methodologies and its importance in RPA

UNIT II **9 Hours**

UiPath ESSENTIALS

Introduction to UiPath: Installation and activation-UiPath Activities: Flowcharts, Sequences, and Data Manipulation-UiPath Variables and Data Types-Debugging techniques in UiPath-Overview of UiPath Orchestrator: BOT Development and Management-UiPath Automation Best Practices

UNIT III **9 Hours**

ADVANCED RPA TECHNIQUES

Data Manipulation: Collections and Data Table Usage-File Operations: CSV/Excel to data table and vice versa-Working with UiExplorer and Desktop Automation-Web Automation: Basic and Desktop Recording-Advanced Screen Scraping Techniques-Data Scraping and Extraction from Websites

UNIT IV **9 Hours**

HANDLING EXCEPTIONS AND USER EVENTS

Exception Handling Techniques: Try-Catch, Re-throwing Exceptions, and Custom Exception Handling-Logging, Debugging, and Error Reporting Techniques- Handling User Events: Assistant bots, System Event Triggers, and Image and Element Triggers- Monitoring Techniques in RPA- Launching an Assistant bot on a Keyboard Event

UNIT V **9 Hours**

DEPLOYMENT AND MAINTENANCE OF BOT

Overview of Orchestration Server and its functionalities- Orchestrator to Control Bots and Deploy Bots-Uploading Packages, Managing Packages, and Deleting Packages- Publishing and Managing Updates-Continuous Integration and Continuous Deployment (CI/CD) in RPA

Total: 45 Hours

Reference(s)

1. Tom Taulli, "The Robotic Process Automation Handbook: A Guide to Implementing RPA Systems", Monrovia, CA, USA, APress, 2020.
2. Alok Mani Tripathi, "Learning Robotic Process Automation", Packt Publishing, 2018.
3. Richard Murdoch, Robotic Process Automation: Guide to Building Software Robots, Automate Repetitive Tasks & Become an RPA Consultant.
4. Srikanth Miranda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation.
5. Christian Czarnecki, Peter Fettke, "Robotic Process Automation: Management, Technology, Applications", 2021.
6. Frank Casale, Rebecca Dilla, Heidi Jaynes, Lauren Livingston, "Introduction to Robotic Process Automation: a Primer", Institute of Robotic Process Automation, 1st Edition 2015.
7. Lim Mei Ying, "Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes", Packt Publishing, 1st Edition 2018.
8. https://www.uipath.com/rpa/robotic-process-automation
9. https://www.academy.uipath.com

22AI020 REINFORCEMENT LEARNING 3 0 0 3

Course Objectives

- To understand the core principles behind the RL, including policies, value functions, deriving Bellman equations.
- To acquire the knowledge to define Markov Decision Processes with its properties.
- To explore the Monte Carlo Methods 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Apply reinforcement learning concepts to solve basic decision-making tasks.
2. Analyze agent-environment interactions using Markov decision processes.
3. Apply Bellman equations to derive optimal policies in reinforcement learning.
4. Implement dynamic programming techniques for decision optimization.
5. Apply Monte Carlo methods for prediction and control in reinforcement learning.

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

UNIT I 10 Hours

REINFORCEMENT LEARNING PRIMITIVES

The Reinforcement Learning Problem- Elements of Reinforcement Learning - Limitations and Scope - Multi-arm Bandits - An n-Armed Bandit Problem - Tracking a Non stationary Problem - Upper-Confidence-Bound Action Selection - Gradient Bandits.

UNIT II **10 Hours**

MARKOV DECISION PROCESS

The Agent–Environment Interface - Goal and Rewards - Returns - Unified Notation for Episodic and Continuing Tasks - The Markov Property - Markov Decision Processes - Sequential Decision Making with Evaluative Feedback - Learning Action Values - Estimating Action Values Incrementally.

UNIT III **9 Hours**

VALUE FUNCTIONS AND BELLMAN EQUATIONS

Specifying Policies-Value Functions - Bellman Equation Derivation -Why Bellman Equations - Optimal Policies - Optimal Value Functions - Using Optimal Value Functions to Get Optimal Policies.

UNIT IV **9 Hours**

DYNAMIC PROGRAMMING

Policy Evaluation vs. Control - Iterative Policy Evaluation - Dynamic Programming: Polices -Evaluation - Improvement - Iteration - Value Iteration - Asynchronous Dynamic Programming - Generalized Policy Iteration - Efficiency of Dynamic Programming.

UNIT V **7 Hours**

MONTE CARLO METHODS

Monte Carlo Prediction - Estimation of Action Values - Control and Control without Exploring Starts - Off-policy Prediction via Importance Sampling - Incremental Implementation - Off-Policy Monte Carlo Control - Importance Sampling on Truncated Returns – Applications of Reinforcement Learning.

Total: 45 Hours

Reference(s)

1. Richard S. Sutton and Andrew G. Barto, "Reinforcement learning: An Introduction", Second Edition, MIT Press, 2019.
2. Phil Winder, “Reinforcement Learning”, O'Reilly Media, First Edition, 2020
3. Michael Wooldridge, “An Introduction to Multi Agent Systems”, John Wiley, 2002.
4. Marco Wiering, Martijn Van Otterlo, "Reinforcement learning State-of-the-Art", Springer Berlin Heidelberg, 2012

22AI021 EDGE COMPUTING 3 0 0 3

Course Objectives

- To outline an overview of Edge Computing.
- To implement data analytics techniques over edge.
- To apply various security schemes for manipulation and storage service.
- To perform optimization problem using modeling framework.
- To use RaspberryPi for implement edge computing for industry and commercial purpose.

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.

methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand the fundamentals of Edge Computing
2. Implement the data analytics techniques over edge.
3. Apply security schemes for manipulation and storage service.
4. Perform optimization problem using modelling framework.
5. Use RaspberryPi to implement edge computing for industry and commercial purpose.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to Edge Computing Scenario's and Use cases - Edge computing purpose and definition, Edge computing use cases, Edge computing hardware architectures, Edge platforms, Edge vs Fog Computing, Communication Models - Edge, Fog and M2M.

UNIT II **9 Hours**

EDGE ANALYTICS

Data types - Data Analytics – Goals, Real-Time Applications - Phases of Data Analytics – Types of Data Analytics – Edge Data Analytics, Potential & Architecture of Edge Analytics, Case study, Machine learning for Edge Devices.

UNIT III **9 Hours**

EDGE DATA SECURITY

Security – Data Confidentiality – Identity & Attribute based encryption, Honey & search Encryption, Homomorphic Encryption– Authentication - Single, Cross & Handover – Privacy Preserving Schemes – Secure search and Storage service in Edge.

UNIT IV **9 Hours**

OPTIMIZATION PROBLEMS

Case for optimization, Formal modeling framework for Fog & Edge computing, Metrics & Performance measures for Edge optimization, Optimization opportunities for service life cycle.

UNIT V **9 Hours**

APPLICATIONS

Edge computing with RaspberryPi, Industrial and Commercial IoT and Edge, Edge computing and solutions.

Total: 45 Hours

Reference(s)

1. Edge Computing Fundamentals, Advances and Applications By K. Anitha Kumari, G. Sudha Sadasivam, D. Dharani, M. Niranjanamurthy · 2021, ISBN:9781000483598, 1000483592.
2. Fog and Edge Computing: Principles and Paradigms by Rajkumar Buyya, Satish Narayana Srirama, wiley publication, 2019, ISBN: 9781119524984.
3. Fog/Edge Computing For Security, Privacy, and Applications by Jie Wu, Wei Chang, and Springer International Publishing, 2021, ISBN: 9783030573287, 3030573281.
4. IoT and Edge Computing for Architects - Second Edition, by Perry Lea, Publisher: Packt Publishing, 2020, ISBN: 9781839214806.
5. David Jensen, "Beginning Azure IoT Edge Computing: Extending the Cloud to the Intelligent Edge, MICROSOFT AZURE
6. Raspberry Pi Cookbook, 3rd Edition, by Simon Monk, Publisher: O'Reilly Media, Inc., 2019, ISBN: 978149204322.

22AI022 INTELLIGENT ROBOTS AND DRONE TECHNOLOGY 3 0 0 3

Course Objectives

- To understand the Robot types and its sensors, actuators end effectors.
- To understand the basics of Unmanned Arial Vehicles (Drones) and its various applications.
- To impart the knowledge of how to fly a drone by considering the rules and regulations to the specific country.
- To understand the safety measures to be taken during flight.

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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Select the robot and its grippers based on application.
2. Select sensors and actuators for any robotic system.
3. Implement the various types of frame design for the UAV/Drones
4. Understand the basic working principal behind the electronic components used and its specification to build a drone from scratch.
5. To identify and understand various functional modules of the controller using a preprogrammed controller used in the UAV/Drones.

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

UNIT I **9 Hours**

ROBOTS INTRODUCTION

Introduction – History and growth - Applications - Laws of Robotics – Classifications - Work envelope - Selection and Design Considerations - robot teaching - specification.

UNIT II **9 Hours**

ACTUATORS AND SENSORS

Actuators and types, DC motors, BLDC servo motors. Introduction to sensors, characteristics, sensor types-Touch, Potentiometer, Encoder, Force, Range and proximity. Economic Analysis of Robots.

UNIT III **9 Hours**

DRONES FUNDAMENTALS

Introduction to UAVs/Drones - Drones– Working Principle and Design- Types of Drones –Motors – Battery – connectors – Assembling the Drones – Frame – aerodynamics needed for flying Drone.

UNIT IV **9 Hours**

DRONE AND CONTROLLERS

How to Build a Drone – Preparing – APM planner – Building Fellow me drone – Arduino based drones – GPS tracker using ESP8266.

CONTROLLERS

Building mission control drones – Using Drones and delivery man –Record Videos – Photography Drone – Controlling Camera.

UNIT V **9 Hours**

MAINTENANCE AND APPLICATIONS

Building Prototype Drones – Gilding Drones – Racing Drones – Maintaining and troubleshooting-Artificial Intelligence techniques in Drones – Case study: INS Vikrant, Flying Projects.

Total: 45 Hours

Reference(s)

1. Fu. K.S, Gonzalez. R.C, Lee. C.S.G ―Robotics –Control, Sensing, Vision, and Intelligence‖, McGraw Hill, 2015.
2. Pratihar.D.K, ―Fundamentals of Robotics, Narosa Publishing House, India, 2019.
3. Syed Omar Faruk Towaha, Building Smart Drones with ESP8266 and Arduino: Build exciting drones by leveraging the capabilities of Arduino and ESP8266, Packt Publishing, 2018.
4. Theory, Design, and Applications of Unmanned Aerial Vehicles- by A. R. Jha 2016.
5. Handbook of Unmanned Aerial Vehicles- Editors: Valavanis, K., Vachtsevanos, George J.(Eds.), 2014
6. Jane's Unmanned Aerial Vehicles and Targets -by Kenneth Munson (Editor), 2010
7. Guidance of Unmanned Aerial Vehicles- by Rafael Yanushevsky (Author), 2011.

22AI023 INTELLIGENT TRANSPORTATION SYSTEMS 3 0 0 3

Course Objectives

- To learn the fundamentals of ITS.
- To study the ITS functional areas.
- To have an overview of ITS implementation in developing countries.

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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcome (COs)

1. Demonstrate the functionality of the transport system and security issues.
2. Classify the building blocks of intelligent transport system.
3. Construct the various data collection methodologies for ITS.
4. Summarize various communication protocols that can be used in transportation system.
5. Interpret the significance of ITS for Indian transport conditions.

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

UNIT I **9 Hours**

INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM

Introduction to Intelligent Transportation Systems (ITS) - Functions of ITS Components - Challenges and Opportunities in ITS - Architecture – ITS Architecture Framework - Logical Architecture – Physical Architecture – Organizational Architecture

UNIT II **9 Hours**

TECHNOLOGY BUILDING BLOCKS OF ITS

Data Acquisition – Data Analysis – wireless adhoc networks – Tele communication technologies – Cellular wires – Wireless application protocols - Data and Information processing technologies – Data warehousing – Online Analytical Processing – Voice Processing and Internet.

UNIT III **9 Hours**

DATA COLLECTION METHODS FOR ITS

Detection and Sensing technologies – Road way sensors – Environmental Sensors – probe-based sensors – Blue tooth – RFID – Passive – Active and BAP RFID systems – Real time traffic monitoring using GPS probe – Emergency management – Incident management.

UNIT IV **9 Hours**

TRANSPORT MANAGEMENT SYSTEM

Vehicle to infrastructure communication – Mobility management - Integrated Traffic Management – Junction Management Strategies- ATMS - Route Guidance - Predictive Guidance – Dynamic Traffic Assignment (DTA).

UNIT V **9 Hours**

TRAVELLER AND INFORMATION SYSTEM

Basic TIS Concepts - Pre-Trip and Enroute Methods - Smart Route System – Dissemination to Travelers – Evaluation of Information – Value of Information – Business Opportunities. Case Study: Kavach system, Automatic train track switching system.

Total: 45 Hours

Reference(s)

1. Sarkar, Pradip Kumar, Amit Kumar Jain, Intelligent Transport Systems, PHI Learning, 2018.
2. Rodolfo I. Meneguette, Robson E. De Grande, Intelligent Transport System in Smart Cities: Aspects and Challenges of vehicular networks and cloud, Springer, 2018.
3. R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Fifth Edition, 2019.
4. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010.
5. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.
6. Turban E.,"Decision Support and Export Systems Management Support Systems", Maxwell Macmillan, 1998.
7. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

22AI024 EXPERT SYSTEMS 3 0 0 3

Course Objectives

- To understand the concepts of intelligent agents, searching, knowledge and reasoning, planning and learning in expert systems.
- To illustrate the knowledge representation and acquisition in expert systems.
- To analyze the features, tools, limitations and applications of expert 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Interpret the features, tools, limitations and applications of expert systems.
2. Infer the procedure to build an expert system.
3. Analyze the requirement of knowledge acquisition in expert systems.
4. Represent the knowledge representation using rules, semantic nets, and frame in expert systems.
5. Interpret the concept of fuzzy expert systems.

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

UNIT I **9 Hours**

INTRODUCTION TO EXPERT SYSTEMS

Definition – Features of an expert system – Architecture and Components of Expert System – Roles in Expert Systems – Stages in the Expert System development life cycle – Sources of Error in Expert System Development –Limitations and Applications of Expert Systems.

UNIT II **9 Hours**

BUILDING AN EXPERT SYSTEMS

Expert system tools - Selecting a tool - Evaluating the System Building tool – Knowledge acquisition process - Resources, Inherent Limitations - Common pitfalls in planning, development - Pitfalls in dealing with Domain Expert.

UNIT III **9 Hours**

KNOWLEDGE ACQUISITION IN EXPERT SYSTEMS

Knowledge Basics - Knowledge Engineering – Views of Knowledge Engineering – Knowledge Acquisition Techniques – Natural Techniques - Contrived Techniques - Modelling Techniques.

UNIT IV **9 Hours**

KNOWLEDGE REPRESENTATION IN EXPERT SYSTEMS

Definition- Characteristics - Properties of the symbolic representation of knowledge – Categories of Knowledge Representation Schemes –Types of Knowledge Representational Schemes – Formal Logic – Semantic Net – Frames – Scripts – Conceptual Dependency.

UNIT V **9 Hours**

FUZZY EXPERT SYSTEMS

Fuzzy Systems: Fuzzy Rule – Fuzzy Reasoning. Fuzzy Expert Systems: Need for Fuzzy Expert Systems – Operations - Fuzzy Inference Systems - The Fuzzy Inference Process in a Fuzzy Expert System - Types of Fuzzy Expert Systems - Fuzzy Controller

Total: 45 Hours

Reference(s)

1. Gupta, G. Nagpal, "Artificial Intelligence and Expert Systems", Mercury Learning & Information, 2020.
2. Donald. A. Waterman, “A Guide to Expert Systems”, 3rd Edition, Pearson Education, 2009.
3. J. Giarratano and G. Riley, “Expert Systems -- Principles and Programming”, 4th Edition, PWS Publishing Company, 2004.
4. Peter Jackson, “Introduction to Expert Systems”, Addison Wesley Longman, 1999.
5. Patterson, “Introduction to Artificial Intelligence and Expert Systems”, Pearson Education India, 2015.
6. Nikolopoulos, “Expert Systems”, Marcel Dekker Inc. 1997

22AI025 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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.

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

Textbook(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.

Reference(s)

1. Ronald J. Brachman, Hector J. Levesque: Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.
2. John F. Sowa: Knowledge Representation: Logical, Philosophical, and Computational Foundations, Brooks/Cole, Thomson Learning, 2000.
3. King, Knowledge Management and Organizational Learning, Springer, 2009.
4. Jay Liebowitz, Knowledge Management Learning from Knowledge Engineering, 1st Edition,2001.

22AI026 HEALTH CARE ANALYTICS 3 0 0 3

Course Objectives

- Learn the significance and need of data analysis and data visualization
- Learn the use of machine learning and deep learning algorithms in healthcare
- Apply healthcare analytics for critical care 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.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand the health data formats, health care policy and standards.
2. Analyze the significance and need of data analysis and data visualization.
3. Apply the data management techniques for healthcare data.
4. Implement deep learning algorithms for health data analysis.
5. Implement health data analytics for real time applications.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO HEALTHCARE ANALYSIS

Overview - History of Healthcare Analysis Parameters on medical care systems- Health care policy-Standardized code sets – Data Formats – Machine Learning Foundations: Tree Like reasoning, Probabilistic reasoning, Weighted sum approach.

UNIT II **9 Hours**
ANALYTICS ON MACHINE LEARNING
Machine Learning Pipeline – Pre-processing –Visualization – Feature Selection – Training model parameter – Evaluation model : Sensitivity , Specificity , PPV ,NPV, FPR ,Accuracy , ROC , Precision Recall Curves , Valued target variables –Python: Variables and types, Data Structures and containers , Pandas Data Frame :Operations – Scikit –Learn : Pre-processing , Feature Selection.

UNIT III **9 Hours**
HEALTH CARE MANAGEMENT
IOT- Smart Sensors – Migration of Healthcare Relational database to NoSQL Cloud Database – Matrix block Cipher System – Semantic Framework Analysis – Histogram bin Shifting and Rc6 Encryption – Clinical Prediction Models – Visual Analytics for Healthcare.

UNIT IV **9 Hours**
HEALTHCARE AND DEEP LEARNING
Introduction on Deep Learning – DFF network CNN- RNN for Sequences – Biomedical Image and Signal Analysis – Natural Language Processing and Data Mining for Clinical Data – Mobile Imaging and Analytics – Clinical Decision Support System.

UNIT V **9 Hours**
CASE STUDIES
Predicting Mortality for cardiology Practice –Smart Ambulance System using IOT –Hospital Acquired Conditions (HAC) program- Healthcare and Emerging Technologies – ECG Data Analysis.

Total: 45 Hours

Reference(s)

1. Chandan K.Reddy, Charu C. Aggarwal, “Health Care data Analysis”, First edition, CRC, 2015.
2. Vikas Kumar, “Health Care Analysis Made Simple”, Packt Publishing, 2018.
3. Nilanjan Dey, Amira Ashour, Simon James Fong, Chintan Bhatl, “Health Care Data Analysis and Management, First Edition, Academic Press, 2018.
4. Hui Jang, Eva K.Lee, “HealthCare Analysis: From Data to Knowledge to Healthcare Improvement”, First Edition, Wiley, 2016.
5. Kulkarni, Siarry, Singh ,Abraham, Zhang, Zomaya , Baki, “Big Data Analytics in HealthCare”, Springer, 2020

22AI027 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 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.
PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Apply operations research techniques to solve linear programming problems.
2. Solve integer programming and transportation problems using transshipment models.
3. Apply dynamic programming and simulation techniques to real-world problems.
4. Develop project schedules using CPM, PERT, and Gantt charts.
5. Solve optimization problems using classical methods and Kuhn-Tucker conditions.

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	3	2	2										3	1
3	3	3	2										3	1
4	2	2	2										3	1
5	3	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, Bellman's 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.

22AI028 BIG DATA ANALYTICS 3 0 0 3

Course Objectives

- To acquire a deep understanding of big data and NoSQL.
- To develop expertise in map reduce analytics using Hadoop and related tools
- To 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 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Explore big data concepts, technologies, and applications to address real-world challenges.
2. Apply NoSQL data management techniques to handle unstructured and distributed data.
3. Analyze MapReduce workflows and their execution for efficient data processing.
4. Implement data analysis and processing workflows using Hadoop and its distributed file system.
5. Apply Hadoop-related tools to perform big data analytics and develop scripts.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	1	1		1								2	3
2	2	2	3		3								3	3
3	1	3	3		3								3	3
4	2	2	2		3								3	3
5	2	2	1		3								3	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 MR Unit – 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 Ambiga Dhiraj, "Big Data, Big Analytics: Emerging Business Intelligence and Analytic Trends for Today's Businesses", Wiley,2013.
2. Eric Sammer, "Hadoop Operations", O'Reilly, 2012.
3. Sadalage, Pramod J. “NoSQL distilled”, 2013
4. E. Capriolo, D. Wampler, and J. Rutherglen, "Programming Hive", O'Reilly, 2012.
5. Lars George, "HBase: The Definitive Guide", O'Reilly, 2011.
6. Eben Hewitt, "Cassandra: The Definitive Guide", O'Reilly, 2010.
7. Alan Gates, "Programming Pig", O'Reilly, 2011.

22AI029 QUANTUM COMPUTING 3 0 0 3

Course Objectives

- To understand the background of classical computing and quantum computing.
- To acquire the knowledge about the hardware and mathematical models of quantum computation.
- To interpret quantum security in order to ensure that any attempt to intercept.

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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Utilize quantum mechanics and linear algebra principles to represent quantum systems and qubits.
2. Design quantum circuits and apply quantum error correction techniques to enhance computation reliability.
3. Evaluate quantum algorithms used in the circuit model
4. Analyze quantum information theory concepts over noisy quantum channels.
5. Implement cryptographic techniques and quantum key distribution protocols to ensure data security in quantum systems

Articulation Matrix

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

UNIT I **9 Hours**

QUANTUM COMPUTING BASIC CONCEPTS

Complex Numbers - Matrices and Operators - Quantum Mechanics – Linear Algebra - The Postulates of Quantum Mechanics - Quantum Bits - Representations of Qubits – Superpositions

UNIT II **9 Hours**

QUANTUM GATES AND CIRCUITS

Quantum Computation - Single qubit gates - Multiple qubit gates – Quantum Circuits – Qubit Copying Circuit - Circuit development - Quantum error correction.

UNIT III **9 Hours**

QUANTUM ALGORITHMS

Quantum parallelism - Deutsch's algorithm - The Deutsch–Jozsa algorithm - Quantum Fourier transform and its applications - Quantum Search Algorithms: Grover's Algorithm: Grover's Algorithm - Quantum search as a quantum simulation - Quantum counting.

UNIT IV **9 Hours**

QUANTUM INFORMATION THEORY

Data compression - Shannon's noiseless channel coding theorem - Schumacher's quantum noiseless channel coding theorem – Communication Over Noisy Quantum Channels – Quantum Information Over Noisy Quantum Channels.

UNIT V **9 Hours**

QUANTUM CRYPTOGRAPHY

Principles of Information Security – One-Time Pad - Public key cryptography – RSA Coding Scheme - Quantum Cryptography – Quantum Key Distribution - BB84 - Ekart 91.

Total: 45 Hours

Reference(s)

1. Parag K Lala, " Quantum Computing, A Beginners Introduction", First Edition, Mc Graw Hill Education, 2020.
2. Michael A. Nielsen, Issac L. Chuang, "Quantum Computation and Quantum Information", Cambridge University Press, tenth Edition, 2010
3. Chris Bernhardt, "Quantum Computing for Everyone", The MIT Press; Reprint edition (8 September 2020).
4. Scott Aaronson, "Quantum Computing Since Democritus ", Cambridge University Press, 2013.

22AI030 COGNITIVE SCIENCE 3 0 0 3

Course Objectives

- To understand the fundamentals of Cognitive Science
- To apply advanced analytics to cognitive science functions
- To explore how cognitive science used in healthcare 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.

PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Interpret the underlying theory behind cognition.
2. Connect to the cognition elements computationally.
3. Outline the mathematical functions through WebPPL.
4. Examine applications using cognitive inference model.
5. Outline the applications of cognitive science in healthcare system.

Articulation Matrix

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

UNIT I 9 Hours

INTRODUCTION TO COGNITIVE SCENCE

The mind in cognitive science- Logic and science of the mind – Place of psychology within cognitive science – Cognitive Neuroscience - Perception - Decision – Learning and memory –Language understanding and processing – Mental- Physical relation – From materialism to mental science.

UNIT II 9 Hours

COGNITIVE INTELLIGENCE

Machines and Cognition - Artificial intelligence – Architectures of Cognition – Knowledge based systems – Logical representation and Reasoning – Logical decision making – Decision making under uncertainty – Learning – Language – Vision – Robotics.

UNIT III **9 Hours**

PROBABILISTIC PROGRAMMING LANGUAGE

WebPPL Language – Syntax – Using Java script libraries – Manipulating probability types and distributions – Finding inference - Exploring random computation - Coroutines: Functions that receive continuations – Enumeration - Other basic computation.

UNIT IV **9 Hours**

INFERENCE MODELS OF COGNITION

Generative Models – Conditioning – Casual and statistical dependence – Conditional dependence – Data analysis - Algorithm for inference.

UNIT V **9 Hours**

LEARNING MODELS OF COGNITION

Learning as Conditional Inference – Learning with a Language of Thought – Hierarchical Models – Occam's razor – Learning (Deep) Continuous function – Mixture Models.

Total: 45 Hours

Reference(s)

1. Vijay V Raghavan, Venkat N.Gudivada, Venu Govindaraju, C.R. Rao, Cognitive Computing: Theory and Applications: (Handbook of Statistics 35), Elsevier publications, 2016
2. Judith Hurwitz, Marcia Kaufman, Adrian Bowles, Cognitive Computing and Big Data Analytics, Wiley Publications, 2015
3. Robert A. Wilson, Frank C. Keil, the MIT Encyclopedia of the Cognitive Sciences, the MIT Press, 1999.
4. Jose Luis Bermudez, Cognitive Science -An Introduction to the Science of the Mind, Cambridge University Press 2020

22AI031 BIOMEDICAL IMAGE ANALYSIS 2 0 2 3

Course Objectives

- Understand Nature of Biomedical Images, Image Enhancement and Filtering for removal of artifacts
- Understand the image segmentation and analysis of Image shape and Texture
- Understand the pattern classification and diagnostic decision.

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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Capable of survey image processing techniques.
2. Apply the theoretical background of Image processing to solve biomedical imaging problems.
3. Represent and recognize objects through patterns in application.
4. Analyze various techniques involved in biomedical systems.
5. Modelling biomedical systems.

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

UNIT I **6 Hours**

THE NATURE OF BIOMEDICAL IMAGES

The Nature of Biomedical Images: Objectives of Biomedical Image Analysis - Computer aided Diagnosis-Image Quality and Information Content: Acquisition and Analysis -The Fourier Transform and Spectral Content.

UNIT II **6 Hours**

REMOVAL OF ARTIFACTS

Removal of Artifacts: Random noise -Signal dependent noise - Space domain Local statistics-based Filters - Frequency domain Filters - Image Enhancement: Greyscale Transforms - Histogram Transformation - Convolution Mask Operators - Homomorphism Filtering for Enhancement - Detection of Regions of Interest

UNIT III **6 Hours**

ANALYSIS OF SHAPE

Analysis of Shape: Representation of Shapes and Contours - Shape Factors - Fourier Descriptors - Analysis of Texture: Texture in Biomedical Images - Statistical Analysis of Texture - Fourier domain Analysis of Texture.

UNIT IV **6 Hours**

ANALYSIS OF ORIENTED PATTERNS

Analysis of Oriented Patterns: Oriented Patterns in Images - Measures of Directional Distribution- Directional Filtering - Gabor Filters - Directional Analysis via Multiscale Edge Detection

UNIT V **6 Hours**

PATTERNS ANALYSIS DECISION

Pattern Classification and Diagnostic Decision: Pattern Classification - Probabilistic Models and Statistical Decision - Logistic Regression - Neural Networks - Measures of Diagnostic Accuracy - Reliability of Features - Classifiers and Decisions.

EXPERIMENT 1 **6 Hours**

Cell Counting and Nucleus Detection in Microscopy Images

Develop and implement algorithms for automated cell counting and nucleus detection in microscopy images. Utilize Cell Profiler, a modular high-throughput image analysis software, to enhance the structure, function, and compatibility of the analysis.

EXPERIMENT 2 **6 Hours**

Automated Detection of Diabetic Retinopathy in Fundus Images

Create and validate a deep learning algorithm for automated detection of diabetic retinopathy in retinal fundus photographs. Employ advanced computational methods to aid in the early and accurate identification of diabetic retinopathy for effective medical intervention.

EXPERIMENT 3 **6 Hours**

Segmentation and Characterization of Tumor Regions in Breast MRI

Focus on developing robust segmentation techniques to identify and characterize tumor regions in breast MRI images. Implement quantitative imaging biomarkers, such as the Yen method, to improve the accuracy and efficiency of breast cancer diagnosis and assessment.

EXPERIMENT 4 **6 Hours**

Analysis of White Matter Tracts in Diffusion Tensor Imaging (DTI)

Utilize diffusion tensor imaging (DTI) to analyze white matter tracts in the brain. Implement three-dimensional tracking methods to visualize and track axonal projections, providing critical insights into brain connectivity and neurological conditions.

EXPERIMENT 5 **6 Hours**

Quantification of Cardiac Function using Echocardiography

Develop a system to quantitatively analyze cardiac function parameters, including ejection fraction and wall motion abnormalities, using echocardiography images. Adhere to the recommendations provided by the American Society of Echocardiography and the European Association of Cardiovascular Imaging for accurate cardiac disease assessment.

Total: 30+30 = 60 Hours

Reference(s)

1. Rangaraj M Rangayyan, R. M. Biomedical Image Analysis, CRC Press, 2005.
2. Gonzalez, Rafael C. and Woods, Richard E. Digital Image Processing, Addison Wesley, 3rdEdition, reprint 2008.
3. Jain, Anil K. Fundamentals of digital image processing, PHI, 2002.
4. Chanda and Majumder,D. Dutta. Digital image processing and Analysis, PHI, 2002.
5. M. A. Joshi, Digital Image Processing: An algorithmic approach, 2nd Edition. PHI 2009
6. John C.Russ, The Image Processing Handbook, CRC Press,2007.
7. Mark Nixon, Alberto Aguado, Feature Extraction and Image Processing, Academic Press,2008.
8. Chris Soloman, Toby Breckon, Fundamentals of Digital Image Processing: A PracticalApproach with examples in Matlab, Wiley-Blackwell, 2010
9. Rafael C. Gonzalez, Richard Eugene Woods, Steven L. Eddins, Digital Image Processing using Matlab, Pearson Education India, 2004.
10. Sinha G. R, Patel, B. C., Medical Image Processing: Concepts and Applications,PrenticeHall, 2014
11. Chityala, Ravishankar; Pudipeddi, Sridevi, Image Processing and Acquisition usingPython, CRC Press 2020

22AI032 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 Recommendersystems
- To learn about 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Apply the taxonomy, methods, and dimensionality reduction techniques in recommender systems.
2. Design content-based systems using item and user profiles, and similarity-based retrieval.
3. Implement collaborative filtering methods, focusing on nearest-neighbor techniques and neighborhood-based approaches.
4. Develop strategies to detect and resist attacks on recommender systems.
5. Evaluate recommender systems using accuracy metrics and addressing evaluation limitations.

Articulation Matrix

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

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, andneighborhood 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, RecommenderSystems: 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.

22AI033 IMAGE AND VIDEO ANALYTICS 3 0 0 3

Course Objectives

- To understand the basics of image processing techniques for computer vision.
- To learn the techniques used for image pre-processing.
- To discuss the various object detection techniques.
- To understand the various Object recognition mechanisms.
- To elaborate on the video analytics 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand the basics of image processing techniques for computer vision and video analysis.
2. Explain the techniques used for image pre-processing.
3. Develop various object detection techniques.
4. Understand the various face recognition mechanisms.
5. Elaborate on deep learning-based video analytics.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Computer Vision – Image representation and image analysis tasks - Image representations – digitization – properties – color images – Data structures for Image Analysis - Levels of image data representation - Traditional and Hierarchical image data structures.

UNIT II **9 Hours**

IMAGE PRE-PROCESSING

Local pre-processing - Image smoothing - Edge detectors - Zero-crossings of the second derivative - Scale in image processing - Canny edge detection - Parametric edge models - Edges in multi-select images - Local pre-processing in the frequency domain - Line detection by local pre-processing operators - Image restoration.

UNIT III **9 Hours**

OBJECT DETECTION USING MACHINE LEARNING

Object detection – Object detection methods – Deep Learning framework for Object detection – bounding box approach - Intersection over Union (IoU) – Deep Learning Architectures - R-CNN - Faster R-CNN -You Only Look Once(YOLO) - Salient features-Loss Functions -YOLO architectures

UNIT IV **9 Hours**

FACE RECOGNITION AND GESTURE RECOGNITION

Face Recognition – Introduction - Applications of Face Recognition -Process of Face Recognition - DeepFace solution by Facebook - FaceNet for Face Recognition - Implementation using FaceNet- Gesture Recognition.

UNIT V **9 Hours**

VIDEO ANALYTICS

Video Processing – use cases of video analytics -Vanishing Gradient and exploding gradient problem - ResNet architecture - ResNet and skip connections-Inception Network - GoogleNet architecture - Improvement in Inception v2 -Video analytics - Inception v3.

Total: 45 Hours

Reference(s)

1. Milan Sonka, Vaclav Hlavac, Roger Boyle, “Image Processing, Analysis, and Machine Vision”, 4nd edition, Thomson Learning, 2013.
2. Vaibhav Verdhan,(2021, Computer Vision Using Deep Learning Neural Network Architectures with Python and Keras,Apress 2021.
3. Richard Szeliski, “Computer Vision: Algorithms and Applications”, Springer Verlag London Limited, 2011.
4. Caifeng Shan, FatihPorikli, Tao Xiang, Shaogang Gong, “Video Analytics for Business Intelligence”, Springer, 2012.
5. D. A. Forsyth, J. Ponce, “Computer Vision: A Modern Approach”, Pearson Education, 2003.
6. E. R. Davies, (2012), “Computer & Machine Vision”, Fourth Edition, Academic Press.

22AI034 CYBER THREAT ANALYTICS 3 0 0 3

Course Objectives

- Understand the security problems and defend the cyberspace.
- Understand and protect against attacks, threats and intrusion
- Understand how to leverage intelligence to understand adversary behavior and make use of indicators of compromise to detect and stop 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Develop incident response skills to combat network and system.
2. Classify various types of attacks and learn the tools to launch the attacks
3. Evaluate the security of network and system.
4. Review and analyze threat intelligence logs and reports.
5. Discover and Respond to the threats.

Articulation Matrix

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

UNIT I **9 Hours**

CYBER ATTACKS, INTRUSIONS, THREATS

Introduction to cyber-attacks, attack model, Adversary Types, Vulnerability Types, Threat Types, Attacks vs. Intrusion, DDoS, Types, Malware, malware Types, Introduction to Dark net, Cybercrimes.

UNIT II **9 Hours**

CYBER THREATS AND INTRUSION KILL CHAIN

Introduction to Advanced Persistent Threats, Intrusion Kill Chain, Zero days, Attack surface, Attack vectors, Evasion techniques – Host and Network level evasions, Covert Communication: Infiltration and Exfiltration, Advanced Evasion techniques

UNIT III **9 Hours**

THREAT INTELLIGENCE

Cyber Threat Intelligence (CTI), Overview of Threat Intelligence Lifecycle and Frameworks, CTI types, generic threat actor, Indicators of Compromise (IoCs).

UNIT IV **9 Hours**

THREAT INTELLIGENCE MODEL

Campaign analysis, Diamond model, Threat intel methodologies, Intrusion reconstruction, OSINT, Challenges with detection intrusions.

UNIT V **9 Hours**

SECURITY OPERATION CENTRE (SOC)

Introduction to SIEM, Threat Intelligence Data Collection, Threat Intelligence Collection Management, Threat Intelligence Data Feeds and Sources, Data Processing and analysis, building your own SOC, Visualizing the threat intelligence data. Threat Intelligence Reports: Baseline and Diff, Blacklists and Whitelists, Tracking, Integration.

Total: 45 Hours

Reference(s)

1. Wilson Bautista, Practical Cyber Intelligence: How Action-based Intelligence Can be anEffective Response to Incidents, 2018, Packt publisher.
2. Arun E Thomas, Security Operations Center - SIEM Use Cases and Cyber ThreatIntelligence, 2018.
3. Michael Hale Ligh, Andrew Case, Jamie Levy, Aaron Walters, The Art of Memory Forensics: Detecting Malware and Threats in Windows, Linux and Mac Memory, WileyPublisher.
4. Eoghan Casey, Digital Evidence and Computer Crime: Forensic Science, Computers, andthe Internet, Elsevier.
5. John Sammons, The Basics of Digital Forensics: The Primer for Getting Started inDigital Forensics, Syngress publisher.

22AI035 BUSINESS ANALYTICS 3 0 0 3

Course Objectives

- To comprehend the process of acquiring Business Intelligence.
- To understand various types of analytics for Business Forecasting.
- To 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Apply the analytics life cycle to address business problems
2. Utilize business intelligence tools for decision-making processes.
3. Develop predictive analytics models using data-driven and machine learning techniques for business forecasting
4. Implement HR and supply chain analytics to predict demand, optimize logistics, and improve workforce planning.
5. Apply predictive analytics to understand customer behavior and optimize marketing and sales strategies.

Articulation Matrix

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2											3	2
2	2	2		2									3	3
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 TO BUSINESS ANALYTICS

Blockchain- 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

Smart Marketing Strategy, Marketing Mix, Customer Behaviour –selling Process – Sales Planning – Analytics applications in Marketing and Sales. Do predictive analytics for customers' behaviour in marketing andsales.

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.

22AI036 DIGITAL MARKETING AND MANAGEMENT 3 0 0 3

Course Objectives

- To introduce the fundamentals of digital marketing, including platforms, strategies, and the role of a digital marketing manager.
- To analyze customer behavior, social media strategies, and search engine marketing techniques.
- To develop and manage digital marketing plans, leveraging customer relationship management (CRM) tools, analytics, and automation..

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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Apply the fundamentals of digital marketing and the role of a digital marketing manager, to real-world scenarios.
2. Apply various digital models and analyze the behavior and profiles of digital customers.
3. Develop strategies for social media marketing, search engine marketing, and online advertising.
4. Implement CRM tools and techniques for customer profiling, personalization, and lifecycle marketing.
5. Design a comprehensive digital marketing plan, incorporating budgeting, analytics, and security measures.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO DIGITAL MARKETING

Basics of Marketing – Types of Marketing - Digital Marketing Platforms- Types of Organic and Paid Digital Marketing- Difference between Traditional Marketing and digital Marketing- Advantage of Digital Marketing - Role of a Digital Marketing Manager–Remix.

UNIT II **9 Hours**

DIGITAL MODEL AND DIGITAL CUSTOMER

Digital Model – Revenue Model – Intermediary Model – Attribution Model – Communication Model – Processing Model – Loyalty Model – Social Media Model – Digital Customers: Introduction to Digital Customer – Online information process – Online buying process – Customer Profiles & Customer types.

UNIT III **9 Hours**

SOCIAL MEDIA MARKETING AND SEARCH ENGINE

Social Media Marketing - Benchmarking and Setting - Strategy and plan to manage social media – Social listening - online reputation management - content marketing - social media communications strategy - Social Media optimization - Search Engine Marketing - Paid or Pay Per Click search marketing - Banner VS Native advertising - Online partnerships - Viral marketing - Offline traffic building.

UNIT IV **9 Hours**

CUSTOMER LIFECYCLE MANAGEMENT

e-CRM - customer lifecycle marketing - Database marketing and marketing automation – marketing technology to support CRM - Profiling - Personalization - Email marketing - Control issues - Cleaning the database - social business through implementing social CRM - reviewing digital marketing capabilities.

UNIT V **9 Hours**

DIGITAL MARKETING PLAN AND MANAGEMENT

Managing digital marketing - Budgeting for digital marketing - digital marketing investment- suppliers for digital marketing - Change management - digital analytics & Automation - Digital business security – digital marketing planning - Situational analysis – Tactics, Action, and Control - The 3Ms resources – case study.

Total: 45 Hours

Reference(s)

1. Chaffey, D., & Smith, P. R. (2017). Digital marketing excellence: planning, optimizing and integrating online marketing. Taylor & Francis.
2. Dodson, I. (2016). The art of digital marketing: the definitive guide to creating strategic, targeted, and measurable online campaigns. John Wiley & Sons.
3. Kaufman, I., & Horton, C. (2014). Digital marketing: Integrating strategy and tactics with values, a guidebook for executives, managers, and students. Routledge.
4. Royle, J., & Laing, A. (2014). The digital marketing skills gap: Developing a Digital Marketer Model for the communication industries.
5. Stokes, R. (2011). E-Marketing: The essential guide to digital marketing. Quirk eMarketing.

22AI037 TIME SERIES ANALYSIS AND FORECASTING 3 0 0 3

Course Objectives

- Understand the basic concepts of Time Series data and its analysis.
- Acquire the knowledge of Statistical and State Space models in Time series.
- Illustrate how to process time series data using Machine and Learning and Deep 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Illustrate the time series data analysis and different types of plotting and visualization techniques used for time series data.
2. Interpret the stochastic process for time series data.
3. Categorize the Stationary and Non-Stationary Time series models.
4. Illustrate the regression analysis and forecasting process for time series data.
5. Infer the forecasting methods of Time series analysis.

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to time series analysis – Components: Trend, seasonality, cycles and residuals- Stationarity in time series data - Familiar methods - Visualization and Applications- Popular time series databases and file solutions

UNIT II **9 Hours**

STOCHASTIC PROCESS IN TIME SERIES

Auto covariance – Auto correlation functions - Partial autocorrelation function - White noise process - Estimation of mean auto co variances and autocorrelations

UNIT III **9 Hours**

TIME SERIES MODELS

Stationary Model - Auto Regressive Process - Moving Average Process - Difference between Auto Regression Vs Moving Average process - Auto Regressive moving average process – Non-Stationary Model - ARIMA – SARIMA model

UNIT IV **9 Hours**

REGRESSION ANALYSIS AND FORECASTING

Linear regression analysis – predictions of new observation - Model adequacy checking – Variable selection methods in regression - Generalized least squares – Regression Models for General Time Series Data - Econometric models

UNIT V **9 Hours**

FORECASTING METHODS

Multivariate / Univariate time series **-** State Space Models –The Kalman Filter – Neural Networks and forecasting – Bayesian Methods in forecasting - The holt winter algorithm

Total: 45 Hours

Reference(s)

1. Douglas C. Montgomery, Cheryl L. Jennings, Murat Kulich, Introduction to Time Series Analysis and Forecasting (2016)
2. Aileen Nielsen, “Practical Time Series Analysis - Prediction with Statistics and Machine Learning”, O’Reilly publications, First Edition, 2019.
3. Peter J. Brockwell Richard, A. Davis, “Introduction to Time Series and Forecasting”, Second Edition, Springer, 2016.
4. James Douglas Hamilton, "Time Series Analysis", Princeton University Press, 2020
5. William.W.S.Wei, “Time Series Analysis – Univariate and Multivariate Methods”, Second Edition, Pearson, 2006.
6. Chatfield, C., “The Analysis of Time Series”, Chapman & Hall/CRC, 2004.

22AI038 HUMAN COMPUTER INTERACTION 3 0 0 3

Course Objectives

- To learn the foundations of Human Computer Interaction.
- To become familiar with the design technologies for individuals and persons with disabilities.
- To learn the model and theories of human computer interaction
- To be aware of mobile computer systems and its applications.
- To learn the guidelines for designing web user interfaces.

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.

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

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Collect fundamental design and evaluation methodologies of computer
2. Design effective HCI for individuals and persons with disabilities.
3. Explain the HCI implications for designing multimedia/ ecommerce/ e-learning Websites.
4. Design mobile application framework using HCI tools
5. Develop a web interface using various tools.

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

UNIT I **9 Hours**

FOUNDATIONS OF HCI

The Human: I/O channels – Memory – Reasoning and problem solving; The Computer: Devices-Memory – processing and networks; Interaction: Models – frameworks – Ergonomics – styles- elements – interactivity- Paradigms. - Case Studies

UNIT II **9 Hours**

DESIGN AND SOFTWARE PROCESS

Interactive Design: Basics – process – scenarios – navigation – screen design – Iteration and prototyping. HCI in software process: Software life cycle – usability engineering – Prototyping in practice – design rationale. Design rules: principles, standards, guidelines, rules. Evaluation Techniques – Universal Design

UNIT III **9 Hours**

MODELS AND THEORIES

HCI Models: Cognitive models: Socio-Organizational issues and stakeholder requirements – Communication and collaboration models-Hypertext, Multimedia and WWW.

UNIT IV **9 Hours**

MOBILE HCI

Mobile Ecosystem: Platforms, Application frameworks- Types of Mobile Applications: Widgets, Applications, Games- Mobile Information Architecture, Mobile 2.0, Mobile Design: Elements ofMobile Design, Tools. - Case Studies

UNIT V **9 Hours**

WEB INTERFACE DESIGN

Designing Web Interfaces – Drag & Drop, Direct Selection, Contextual Tools, Overlays, Inlays and Virtual Pages, Process Flow - Case Studies

Total: 45 Hours

Reference(s)

1. Alan Dix, Janet Finlay, Gregory Abowd, Russell Beale, ―Human Computer Interaction,3rd Edition, Pearson Education, 2004.
2. Brian Fling, ―Mobile Design and Development, First Edition, O ‘Reilly Media Inc.,2009.
3. Bill Scott and Theresa Neil, ―Designing Web Interfaces, First Edition, O ‘Reilly, 2009.

22AI039 PATTERN RECOGNITION 3 0 0 3

Course Objectives

- Understand the fundamental concepts of pattern recognition.
- To describe different techniques involved in pattern recognition.
- To familiarize various classification and clustering 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Illustrate the basic concepts of pattern recognition.
2. Implement classification techniques to classify the pattern.
3. Implement clustering techniques to group the patterns.
4. Apply feature selection algorithms to select the features.
5. Implement template matching process for pattern classification.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO PATTERN RECOGNITION

Introduction to Pattern Recognition: Learning paradigms, supervised and unsupervised learning– Features - Feature Vectors and Classifiers - Bayes Decision Theory: Minimum-error-rate classification - Discriminant Functions and Decision Surfaces

UNIT II **9 Hours**

CLASSIFIERS

Introduction – Decision-Making Hyperplanes – Least Square Methods – Mean Square Estimation Revisited - Parametric Techniques: Maximum Likelihood Estimation - Non-parametric techniques for density estimation: Parzen Window method - Classifier Ensembles: Bagging, Boosting

UNIT III **9 Hours**

CLUSTERING

Introduction – Unsupervised Bayesian Learning - Mixture Densities and Identifiability - Criterion functions for clustering: Sum-of-Squared Error – Related minimum variance – Cluster Validity Measures – Low-dimensional Representations and Multidimensional scaling (MDS)

UNIT IV **9 Hours**

FEATURE EXTRACTION AND SELECTION

Feature Selection Based on Statistical Hypothesis Testing – Feature subset Selection - Basis Vectors and Images - Entropy Minimization – Karhunen-Loeve Transformation (KLT) – Feature Selection through Functions Approximation – Binary Feature Selection.

UNIT V **9 Hours**

TEMPLATE MATCHING

Introduction – Template Matching Process – Correlation Measures: Sum of Squared Differences (SSD), Normalized Cross Correlation (NCC), Zero-mean Normalized Cross Correlation (ZNCC) – Template Matching Algorithms: Exhaustive Search, Efficient Search Techniques

Total: 45 Hours

Reference(s)

1. Pattern Recognition: Sergios Theodoridis, Konstantinos Koutroumbas, Elsevier India Pvt. Ltd (Paper Back), 2nd edition
2. Richard O. Duda, Peter E. Hart, David G. Stork, “Pattern Recognition”, John Wiley & Sons, 2021.
3. Sergios Theodoridis, Aggelos Pikrakis, Konstantinos Koutroumbas, Dionisis Cavouras, “Introduction to Pattern Recognition”, Elsevier India Pvt. Ltd, 4th edition 2009.
4. Andrew R. Webb, Keith D. Copsey, “Statistical Pattern Recognition”, 3rd Edition, Wiley Publication, November 2011.
5. Christopher M. Bishop, “Pattern Recognition and Machine Learning (Information Science and Statistics)” Hardcover, 2010.
6. Pattern Recognition and Image Analysis Earl Gose: Richard Johnsonbaugh, Steve Jost, ePub eBook.

22AI040 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand 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			2					3	3
2	2	2	3		3			2					3	3
3	1	3	3		3			2					3	3
4	2	2	2		3			2					3	3
5	2	2	1		3			2					3	3

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**

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**

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.

22AI041 MULTIMEDIA AND ANIMATION 2 0 2 3

Course Objectives

- Understand the basic knowledge of multimedia Systems and related technologies.
- To 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

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. Create the 2D animation and develop the storyboards.
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								1	
2	2	2	2	2	2								1	
3	3												1	
4	2	2	2										1	
5	2	3	2										1	

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 & 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 Modeling - 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 - Basic Operations on images using any image editing software

EXPERIMENT 2 **3 Hours**
Implementation of audio and Video Editing techniques

EXPERIMENT 3 **3 Hours**
Sketching of cartoon characters

EXPERIMENT 4 **3 Hours**
Design 2D Logo using the image editing tool

EXPERIMENT 5 **3 Hours**
Creating gif animated images in 2D Animation

EXPERIMENT 6 **3 Hours**
Exploring the Interface of 3D application & Primitive Modelling

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 & Rendering

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.
7. Mark Gaimbruno, "3D Graphics and Animation", Second Edition, New Riders, 2002.
8. Rogers David, "Animation: Master – A Complete Guide (Graphics Series)", Charles RiverMedia, 2006.
9. Rick parent, "Computer Animation: Algorithms and Techniques", Morgan Kauffman, 3rdEdition, 2012.

22AI042 SOFTWARE PROJECT MANAGEMENT 3 0 0 3

Course Objectives

- To understand the Software Project Planning and Evaluation techniques.
- To plan and manage projects at each stage of the software development life cycle.
- To learn about the activity planning and risk management principles.
- To manage software projects and control software deliverables.
- To develop skills to manage the various phases involved in project management and people management.
- To deliver successful software projects that support organization's strategic goals.

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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand Project Management principles while developing software.
2. Gain extensive knowledge about the basic project management concepts, framework and the process models.
3. Obtain adequate knowledge about software process models and software effort estimation techniques.
4. Estimate the risks involved in various project activities.
5. Define the checkpoints, project reporting structure, project progress and tracking mechanisms using project management principles

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

UNIT I **9 Hours**

PROJECT EVALUATION AND PROJECT PLANNING

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

UNIT II **9 Hours**

PROJECT LIFE CYCLE AND EFFORT ESTIMATION

Software process and Process Models – Choice of Process models - Rapid Application development – Agile methods – Dynamic System Development Method – Extreme Programming– Managing interactive processes – Basics of Software estimation – Effort and Cost estimation techniques – COSMIC Full function points - COCOMO II - a Parametric Productivity Model.

UNIT III **9 Hours**

ACTIVITY PLANNING AND RISK MANAGEMENT

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical path (CRM) method – Risk identification – Assessment – Risk Planning –Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.

UNIT IV **9 Hours**

PROJECT MANAGEMENT AND CONTROL

Framework for Management and control – Collection of data – Visualizing progress – Cost monitoring – Earned Value Analysis – Prioritizing Monitoring – Project tracking – Change control – Software Configuration Management – Managing contracts – Contract Management.

UNIT V **9 Hours**

STAFFING IN SOFTWARE PROJECTS

Importance of Software Project Management – Activities - Methodologies – Categorization of Software Projects – Setting objectives – Management Principles – Management Control – Project portfolio Management – Cost-benefit evaluation technology – Risk evaluation – Strategic program Management – Stepwise Project Planning.

Total: 45 Hours

Reference(s)

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
2. Robert K. Wysocki "Effective Software Project Management" – Wiley Publication, 2011.
3. Walker Royce: "Software Project Management"- Addison-Wesley, 1998.
4. Gopalaswamy Ramesh, "Managing Global Software Projects" – McGraw Hill Education (India), Fourteenth Reprint 2013

22AI043 / 22AIM43 PYTHON FOR DATA SCIENCE 3 0 0 3

Course Objectives

- To develop a basic understanding of Python programming language
- To use Python data structures - lists, tuples, dictionaries to represent complex data.
- To develop Python programs for solving 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Interpret the basic concepts of Python programming
2. Implement Python programs using control statement, strings and functions
3. Develop Python programs using list, tuple, set and dictionary
4. Implement mathematical computing using NumPy and data manipulation with Pandas
5. Apply data visualization practices in real-world scenarios

Articulation Matrix

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

UNIT I **7 Hours**

DATA TYPES, EXPRESSIONS, STATEMENTS

Python interpreter and interactive mode – Debugging -Keyword and Identifiers – Variables- Data types – Numbers – Strings - Python Statements – Comments - Basic Syntax - Printing on Screen - Getting user input - tuple assignment – Operators - precedence of operators

UNIT II **10 Hours**

CONTROL FLOW, FUNCTIONS, STRINGS

Conditionals: conditional (if) - alternative (if-else) - chained conditional (if-elif-else); Iteration: for-while - break – continue -pass; Functions: inbuilt functions- user defined functions- passing parameters -return values - recursion; Strings: string slices -immutability- string functions and methods -string module

UNIT III **10 Hours**

LISTS, TUPLES, SET, DICTIONARIES

Lists: list operations- list slices -list methods - list loop - mutability, aliasing; Tuples: Tuple assignment - Operations on Tuples - tuple as return value; Sets: creating sets -set operations; Dictionaries: operations and methods -Nested Dictionaries

UNIT IV **10 Hours**

NUMPY AND PANDAS

NumPy: NumPy Data Types - Creating Single and Multi-Dimensional Arrays - Operations Using NumPy-NumPy – Indexing & Slicing; Pandas: Pandas Series- Pandas Data Frames- Pandas Object creation- Viewing Pandas data- Selection on Pandas Data- Operations on Pandas Data

UNIT V **8 Hours**

DATA VISUALIZATION USING MATPLOTLIB

Introduction to Data Visualization- Factors of Data Visualization-Line plots- Multiple Plots and Subplots-Plot with Annotation-Scatter plots -Pie Chart-Bar Chart-Contour plots- Histograms-Legends-Colors-Three-dimensional plotting- Visualizing Errors – Data Visualization Tools: Tableau

Total: 45 Hours

Textbook(s)

1. Allen B. Downey, “Think Python: How to Think like a Computer Scientist”, 2nd Edition, O’Reilly Publishers, 2016.
2. Karl Beecher, “Computational Thinking: A Beginner's Guide to Problem Solving and Programming”, 1st Edition, BCS Learning & Development Limited, 2017.

Reference(s)

1. Paul Deitel and Harvey Deitel, “Python for Programmers”, Pearson Education, 1st Edition, 2021.
2. G Venkatesh and Madhavan Mukund, “Computational Thinking: A Primer for Programmers and Data Scientists”, 1st Edition, Notion Press, 2021.
3. John V Guttag, "Introduction to Computation and Programming Using Python: With Applications to Computational Modeling and Understanding Data”, Third Edition, MIT Press, 2021
4. Martin C. Brown, “Python: The Complete Reference”, 4th Edition, Mc-Graw Hill, 2018.
5. Claus O. Wilke, “Fundamentals of Data Visualization -A Primer on Making Informative and Compelling Figures”, O'Reilly, April 2019

22AI044 / 22AIM44 EXPLORATORY DATA ANALYSIS 2 0 2 3

Course Objectives

- To implement data cleaning and preparation techniques.
  To perform descriptive statistics and data visualization techniques to present insights from the data.
- To analyze the relationships between variables using EDA analysis techniques.
- To apply 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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 **5 Hours**

Explore the Titanic dataset using descriptive statistics and data visualization.

1. Load the Titanic dataset.
2. Calculate the descriptive statistics for each variable.
3. Create a variety of data visualizations to explore the relationships between variables.
4. Interpret the results of the descriptive statistics and data visualizations.

EXPERIMENT 2 **5 Hours**

Clean and prepare the California housing dataset for analysis.

1. Identify and handle missing data.
2. Identify and remove outliers.
3. Convert categorical variables to numerical variables.
4. Explore the distribution of the data after cleaning and preparing it.

EXPERIMENT 3 **5 Hours**

Perform univariate analysis on the Iris dataset.

1. Calculate the descriptive statistics for each variable.
2. Create a variety of data visualizations to explore the distribution of each variable.
3. Interpret the results of the descriptive statistics and data visualizations.

EXPERIMENT 4 **5 Hours**

Perform bivariate analysis on the Boston housing dataset.

1. Explore the relationship between housing prices and different features of the houses, such as the number of rooms, the lot size, and the crime rate.
2. Use data visualization to explore the relationships between variables.
3. Interpret the results of the bivariate analysis.

EXPERIMENT 5 **5 Hours**

Perform multivariate analysis on the Wine dataset.

1. Explore the relationships between different features of the wine, such as the color, the acidity, and the alcohol content.
2. Use data visualization to explore the relationships between variables.
3. Interpret the results of the multivariate analysis.

EXPERIMENT 6 **5 Hours**

Apply dimensionality reduction techniques to the MNIST dataset.

1. Use PCA to reduce the dimensionality of the dataset from 784 dimensions to 2 dimensions.
2. Visualize the reduced data using a scatter plot.
3. Interpret the results of the dimensionality reduction.

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 “O’Reilly Media, Inc.", 2013. (Unit 1)
2. McKinney, Wes. “Python for Data Analysis." O'Reilly Media, Inc.", 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.” O'Reilly Media, Inc.", 2016. (Unit 3)
5. Wickham, Hadley, and Garrett Grolemund. “R for data science: import, tidy, transform, visualize, and model data." O'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.

22AI045 / 22AIM45 FUNDAMENTALS OF MACHINE LEARNING 3 0 0 3

Course Objectives

- To understand the basic concepts of machine learning.
- To understand and build supervised learning and unsupervised models
- To apply neural networks to solve complex problems
- To 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Apply machine learning concepts and algorithms, to real-world applications.
2. Implement classification and regression algorithms for data analysis tasks.
3. Analyze clustering algorithms and reinforcement learning techniques for unsupervised data analysis and decision-making processes.
4. Apply neural network models to solve classification and sequence tasks
5. Apply generative models and recommendation systems for data-driven tasks

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Need for Machine Learning- Examples of machine learning applications- Machine Learning Process – Types of Machine Learning - Concept Learning: VC Dimension- Find-S algorithm, 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 – Generative Adversarial Networks - Autoencoders – Recommendation System: Collaborative Filtering Recommendation System - Content Based Recommendation System - Hybrid Recommendation System

Total: 45 Hours

Reference(s)

1. Ethem Alpaydin, Introduction to Machine Learning, Second edition, MIT press.
2. Stephen Marsland, “Machine Learning: An Algorithmic Perspective, “Second Edition”, CRC Press, 2014.
3. Tom M. Mitchell, Machine Learning, India Edition 2013, McGraw Hill Education.
4. Mehryar Mohri, Afshin Rostamizadeh, Ameet Talwalkar, “Foundations of Machine Learning”, Second Edition, MIT Press, 2018.
5. Ian Goodfellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2016

22AI046 / 22AIM46 DEEP LEARNING ESSENTIALS 3 0 0 3

Course Objectives

- To understand the basic ideas and principles of neural networks.
  To understand the deep learning techniques to support real-time applications.
- To apply deep generative models to solve problems with 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Apply neural network concepts to design deep learning models.
2. Apply convolutional neural networks to enhance image recognition and processing tasks.
3. Design the Recurrent Neural Network to model the sequential data.
4. Implement deep generative models to solve problems with high dimensional data.
5. Develop GANs and DBNs for object detection and image captioning.

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

UNIT I **9 Hours**

FOUNDATIONS OF NEURAL NETWORKS AND DEEP LEARNING

Neural Networks: Perceptron - Multilayer Feed Forward Networks -Training in Neural Networks: Back Propagation Learning-Common Architectural Principles of Deep Networks: Layers-Activation Functions-Batch Normalization and Dropout-Loss Functions

UNIT II **9 Hours**

CONVOLUTIONAL NEURAL NETWORKS

Introduction to CNN – Layers – Filters - Weight and Bias - Epoch and Batch Size - Data Augmentation - Parameter sharing – Regularization - Popular CNN Architectures: ResNet, AlexNet.

UNIT III **9 Hours**

RECURRENT NEURAL NETWORKS

Recurrent Neural Networks - Bidirectional RNNs -Encoder-decoder sequence to sequence architectures – Backpropagation through time (BPTT) for training RNN - Long Short-Term Memory (LSTM).

UNIT IV **9 Hours**

AUTOENCODERS

Introduction to Autoencoders - Architecture of Autoencoders – Undercomplete Autoencoders - Regularized Autoencoders – Denoising – Contractive- Predictive Sparse Decomposition - Drawing Samples from Autoencoders -Applications of Autoencoders.

UNIT V **9 Hours**

DEEP GENERATIVE MODELS

Deep Belief networks - Boltzmann Machines - Deep Boltzmann Machine - Generative Adversarial Networks – Case Study: Object Detection using CNN – Automatic Image Captioning.

Total: 45 Hours

Reference(s)

1. Josh Patterson and Adam Gibson, “Deep learning: A practitioner's approach”, O'Reilly Media, First Edition, 2017
2. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
3. Simon Haykin, “Neural Networks and Learning Machines”, 3rd Edition, Pearson Prentice Hall.
4. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
5. Chao Pan, “Deep Learning Fundamentals: An Introduction for Beginners”, AI Sciences LLC, 2018.
6. https://onlinecourses.nptel.ac.in/noc24_ee04/preview

22AI047 / 22AIM47 TEXT AND SPEECH ANALYSIS 3 0 0 3

Course Objectives

- To acquire a deep understanding of natural language processing (NLP) techniques.
- To develop expertise in text analysis through practical implementation of advanced techniques.
- To 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 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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

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 – 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 Chatbots 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

22AI048 / 22AIM48 COMPUTER VISION AND IMAGE PROCESSING 3 0 0 3

Course Objectives

- To understand the fundamental concepts related to Image formation and processing.
- To understand feature detection and matching, feature based alignment and motion estimation.
- To develop innovative image processing and computer vision 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.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand the basic concepts of computer vision in Image Processing.
2. Implement various image enhancement and filtering techniques.
3. Apply feature-based image alignment, image segmentation and object detection techniques.
4. Apply feature extraction and matching techniques.
5. Develop innovative image processing and computer vision applications

Articulation Matrix

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

UNIT I **9 Hours**

IMAGE FORMATION AND PROCESSING

Overview of Computer Vision – Applications – Image Formation: Geometric primitives and transformations - Photometric image formation - The digital camera – Image Processing: Point operators - Linear Filtering – More neighborhood operators - Pyramids and wavelets - Geometric transformations

UNIT II **9 Hours**

IMAGE ENHANCEMENT AND FILTERING

Introduction to Image Enhancement Techniques-Histogram Equalization, Contrast Stretching-Spatial Domain Filtering – Mean Filter, Median Filter-Frequency Domain Filtering –Fourier Transform, High Pass Filter, Low Pass Filter – Image Denoising techniques – Gaussian Filtering, Bilateral Filtering

UNIT III **9 Hours**

IMAGE SEGMENTATION AND OBJECT DETECTION

Introduction to Image Segmentation algorithms – Thresholding, Region based Segmentation-Edge Detection Techniques-Sobel, Canny-Contour Detection and Object Representation –Introduction to object detection algorithms-Haar cascades, SSD, YOLO.

UNIT IV **9 Hours**

FEATURE EXTRACTION

Introduction to Feature Extraction-Feature Extraction Techniques-SIFT, SURF, ORB-Local feature descriptors-HOG, LBP-Feature Matching Algorithms-Brute Force matching, FLANN-Feature tracking and optical flow

UNIT V **9 Hours**

DEEP LEARNING FOR COMPUTER VISION

Introduction to Deep Learning and Neural Networks – Convolutional Neural Networks (CNNs) for Image Classification-Transfer Learning and Pre-trained models - Object Detection using CNNs - U-Net - Familiarity with popular libraries such as OpenCV and PyTorch

Total: 45 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. Rafael C. Gonzalez, Richard E. Woods,” Digital Image Processing”, Third Edition, Pearson,2017.
4. E. R. Davies, Computer and Machine Vision, Fourth Edition, Academic Press, 2012.
5. Christopher M. Bishop; Pattern Recognition and Machine Learning, First Edition, Springer, 2006.
6. Richard Hartley and Andrew Zisserman, “Multiple View Geometry in Computer Vision”, Second Edition, Cambridge University Press, March 2004.
7. Adrian Kaehler, Gary Bradski,” Learning OpenCV 4: Computer Vision with Python”, Third Edition, O’Reilly Media 2019.
8. Adrian Rose Brock:” Deep Learning for Computer Vision with Python”, First Edition, PYImage Search,2020
9. https://onlinecourses.nptel.ac.in/noc23_cs77/preview

OPEN ELECTIVES

22OAI01 FUNDAMENTALS OF DATA SCIENCE 3 0 0 3

Course Objectives

- To learn the basics of data science and statistical inference.
- To understand the concept of data pre-processing.
- To visualize the processed data using visualization 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Interpret the basics of data science and exploratory data analysis.
2. Represent the useful information using mathematical skills.
3. Demonstrate the usage of statistical inference and regression models.
4. Perform various data operations for cleaning and grouping of data.
5. Implement the visualization of data using visualization tools.

Articulation Matrix

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

UNIT I **9 Hours**
INTRODUCTION
Need for data science – benefits and uses – facets of data – data science process – setting the research goal – retrieving data – cleaning, integrating, and transforming data – exploratory data analysis – build the models – presenting and building applications.

UNIT II **9 Hours**
DESCRIPTIVE STATISTICS I
Frequency distributions – Outliers – relative frequency distributions – cumulative frequency distributions – frequency distributions for nominal data – interpreting distributions – graphs – averages – mode – median – mean – averages for qualitative and ranked data – describing variability– range – variance – standard deviation – degrees of freedom – interquartile range.

UNIT III **9 Hours**
DESCRIPTIVE STATISTICS II
Normal distributions – z scores – normal curve problems – finding proportions – finding scores – more about z scores – correlation – correlation coefficient for quantitative data – computational formula for correlation coefficient – regression – regression line – least squares regression line – standard error of estimate – interpretation of r2.

UNIT IV **9 Hours**
PYTHON FOR DATA HANDLING
Basics of Numpy arrays – aggregations – computations on arrays – comparisons, masks, boolean logic – fancy indexing – structured arrays – Data manipulation with Pandas – data indexing and selection – operating on data – missing data – hierarchical indexing – combining datasets – aggregation and grouping.

UNIT V **9 Hours**
DATA VISUALIZATION
Types of data visualization: Exploratory, Explanatory, visualization with matplotlib – line plots – scatter plots – visualizing errors – density and contour plots – histograms, binnings, and density – three-dimensional plotting– geographic data – data analysis using statmodels and seaborn – graph plotting using Plotly - Visualization Tools: Tableau

Total: 45 Hours

Reference(s)

1. David Cielen, Arno D. B. Meysman, and Mohamed Ali, “Introducing Data Science”, Manning Publications, 2016. (Unit I)
2. Robert S. Witte and John S. Witte, “Statistics”, Eleventh Edition, Wiley Publications, 2017. (Units II and III)
3. Jake VanderPlas, “Python Data Science Handbook”, O’Reilly, 2016. (Units IV and V)
4. Allen B. Downey, “Think Stats: Exploratory Data Analysis in Python”, Green TeaPress, 2014.

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.

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.

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. Classify and characterize the various energy utilization techniques.
2. Identify suitable technique to provide an energy efficient system.
3. Identify the need for thermal systems with latest technologies.
4. Choose suitable techniques doe conserving energy with respect to emerging trends.
5. Assess the impact economics on the conservation of energy.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Energy - Power – Past & Present scenario of World; National Energy consumption Data – Environmental aspects associated with energy utilization – Energy Auditing: Need, Types, Methodology and Barriers. Role of Energy Managers. Instruments for energy auditing.

UNIT II **9 Hours**

ELECTRICAL SYSTEMS

Components of EB billing – HT and LT supply, Transformers, Cable Sizing, Concept of Capacitors, Power Factor Improvement, Harmonics, Electric Motors - Motor Efficiency Computation, Energy Efficient Motors, Illumination – Lux, Lumens, Types of lighting, Efficacy, LED Lighting and scope of Encon in Illumination.

UNIT III **9 Hours**

THERMAL SYSTEMS

Stoichiometry, Boilers, Furnaces and Thermic Fluid Heaters – Efficiency computation and Encon measures. Steam: Distribution &U sage: Steam Traps, Condensate Recovery, Flash Steam Utilization, Insulators & Refractories

UNIT IV **9 Hours**

ENERGY CONSERVATION IN MAJOR UTILITIES

Pumps, Fans, Blowers, Compressed Air Systems, Refrigeration and Air Conditioning Systems – Cooling Towers – D.G. sets

UNIT V **9 Hours**

ECONIMICS

Energy Economics – Discount Rate, Payback Period, Internal Rate of Return, Net Present Value, Life Cycle Costing –ESCO concept.

Total: 45 Hours

Reference(s)

1. Energy Manager Training Manual (4 Volumes) available at www.energymanager training.com, a website administered by Bureau of Energy Efficiency (BEE), a statutory body under Ministry of Power, Government of India, 2004.
2. Witte. L.C., P.S. Schmidt, D.R. Brown, “Industrial Energy Management and Utilization” Hemisphere Publ, Washington, 1988.
3. Callaghn, P.W. “Design and Management for Energy Conservation”, Pergamon Press, Oxford, 1981.
4. Dryden. I.G.C., “The Efficient Use of Energy” Butterworths, London, 1982
5. Turner. W.C., “Energy Management Hand book”, Wiley, New York, 1982.
6. Murphy. W.R. and G. Mc KAY, “Energy Management”, Butterworths, London 1987.

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.

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

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

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 OPTICALCOMMUNICATION

Satellite Communication Systems-Keplers Law, LEO and GEO Orbits, footprint, Link Model-Optical Communication 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.

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

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 FUNCTONS

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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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 sensors
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	1
2	2	3	2	1	1								1	1
3	1	2	3	3	1								1	1
4	2	1	1	3	3								1	1
5	1	2	1	2	3								1	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, type 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.

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

UNIT I **9 Hours**

CAD MODELING

Introduction - Design process - Stages. CAD - Input and Output devices, Modelling 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.

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

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 center 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.

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. 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		2				3							
2	2						1							
3	1						3							
4	2						3							
5	1						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 and thermal 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 21000, ISO 14000, ISO 17025, PAS 21000, FSSC 21000, 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.

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								
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 aspect's 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.

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	3	2	3				1		2	3		2		
3	3	2	3				2		2	3		2		
4	3	2	3				2		2	3		2		
5	3	2	3				2		2	3		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
- To impart knowledge on applying principles and elements of interior design to different situations.

Programme Outcomes (POs)

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

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

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

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

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

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.

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					
3	2	3	2		3									
4	2	2	2						2					
5	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

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 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. 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		
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**

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 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.

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. 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 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.

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

BIO-NANO-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 properties 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 & GELS

Forces between colloidal particles: vander Waals forces-electrostatic double layer forces-steric hindrance-depletion interactions. Stability and phase behaviour: Crystallisation-strong colloids-weak colloids. Physical and chemical gels-classical theory of gelation-elasticity of gels

UNIT III **9 Hours**

LIQUID CRYSTALS

Liquid crystal phases-distortions and topological defects-electrical and magnetic properties-polymer liquid crystals-Fredricks transition and liquid crystal displays

UNIT IV **9 Hours**

SUPRAMOLECULAR SELF ASSEMBLY

Aggragation and phase separation-types of micelles- bilayers and vesicles. Phase behaviour of concentrated surfactant solutions-phase separation in polymers, copolymers and block copolymers

UNIT V **9 Hours**

SOFT MATTER IN NATURE

Components and structures of life-Nucleic acids-proteins-interaction between proteins-polysaccharides-membranes

Total: 45 Hours

Reference(s)

1. Richard A L Jones, Soft Condensd 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, Create Space Independent Publishing Platform, 1st Edition, 2016.
2. E. McCafferty, Introduction to Corrosion Science, Springer, 1st 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, 2nd Edition, 2008.
5. David E.J. Talbot and 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 - photo galvanic 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 - photo biochemical conversion cell.

Total: 45 Hours

Reference(s)

1. S.P. Jiang and Q. Li, Introduction to fuel cells, Springer, 2021.
2. M.M. Eboch, The Future of Energy: From solar cells to flying wind farms, Capstone publishers, 2020.
3. N. Eliaz and E. Gileadi, Physical electrochemistry, fundamentals, techniques and applications, Wiley, 2019.
4. J. Garche and K. Brandt, Electrochemical power sources: Fundamentals systems and applications, Elsevier, 2018.
5. A. Iulianelli and 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurships, 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.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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. Analyze 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 Entrepreneurships, 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Examine the strategies and plans in marketing management.
2. Analyze 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, Factories Act 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 Level Institutions-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, Market survey 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.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand religion-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	1	1
2	2		2				2					2	1	1
3	2		1				1					2	1	1
4	2		3				3					3	1	1
5	2		1				1					2	1	1

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. Director General NCC Website: https://indiancc.nic.in/ncc-general-elective-subject-course-design/
2. Grooming Tomorrow's Leaders, published by DG, NCC. https://indiancc.nic.in/
3. Youth in Action, published by DG, NCC. https://indiancc.nic.in/
4. The Cadet, Annual Journal of the NCC. https://indiancc.nic.in/
5. Précis Issued by respective Service Headquarters on specialized subject available to PI Staff as reference material. https://indiancc.nic.in/

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. Analyze 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 and Health; 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
INSTRUMENTATION SYSTEMS **9 Hours**

Optical sensors , Pressure Sensors - Ultrasonic Sensors - Tactile Sensors - Thermal sensors -Biosensor - Linear Actuators, Central monitoring station - Alarm system - Regulation and standards.

UNIT V
APPLICATIONS **9 Hours**

Business intelligence & executive dashboards - Radio-Frequency Identification (RFID)- based patient and asset tracking solutions - Tablet-based applications for bed side access to doctors/nurses - Healthcare CRM for patient relationship management - Patient kiosk, tele-health – HIS integration.

Total: 45 Hours

Reference(s)

1. Khandpur RS, Handbook of Biomedical Instrumentation, Prentice Hall of India, New Delhi, 3 rd edition, 2014.
2. Joseph J. Carr and John M. Brown, Introduction to Biomedical Equipment Technology, Pearson Education India, Delhi, 4 th edition 2008
3. Curtis Johnson D Process Control Instrumentation Technology, Prentice Hall of India, 8th edition 2006
4. John V. Grimaldi and Rollin H. Simonds., Safety Management, All India Travelers Book seller, New Delhi, 1989
5. N.V. Krishnan, Safety in Industry, Jaico Publisher House, 1996.

22OAG01 RAINWATER HARVESTING TECHNIQUES 3 0 0 3

Course Objectives

- To enhance the awareness about water resources management and conservation.
- To acquire knowledge about water harvesting techniques and their implementation.
- To practice the design aspects of sustainable rainwater harvesting solutions for communities.

Programme Outcomes (POs)

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

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

PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO7: 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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. 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 - CO_2 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

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	1
4	3						2		2				1	1
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.

ONE CREDIT COURSES

22AI0XA MACHINE LEARNING IN INTERNET OF ROBOTIC THINGS (IoRT) 1 0 0 1

Course Objectives

- To enhance the capabilities of robotic systems within the context of the Internet of Things
- To understand various applications in robotic systems within the IOT framework and 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Identify components of IoT and Machine Learning.
2. Implement the techniques for robotic localization and mapping.

Articulation Matrix

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

Robotics and IoT Components-Type of Robots-Avatar vs Humanoid -Data preprocessing and feature engineering for robotic and IoT Datasets-Machine Learning for Sensor Data Analysis: Time-series analysis and anomaly detection in sensor data-sensors and actuators in robotic systems-Localization and Mapping in IoRT: Techniques for robotic localization and mapping-Simultaneous Localization and Mapping (SLAM) algorithms-Integration of localization data with IoT infrastructure

Total: 15 Hours

Reference(s)

1. https://spacecraft.ssl.umd.edu/academics/788XF14/788XF14L17/788XF14L17.SLAMx.pdf
2. https://mscetmech2017.files.wordpress.com/2016/10/sensors-and-actuators-1.pdf
3. AI and IoT-Based Intelligent Automation in Robotics -Ashutosh kumar Dubey 20221
4. Encyclopedia of Data Science and Machine Learning-2023-IGI Global

22AI0XB AUGMENTED REALITY 1 0 0 1

Course Objectives

- Apply advanced AR techniques to create interactive and immersive experiences.
- Design and develop multi-faceted AR projects using cutting edge technologies.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Differentiate between Augmented Reality and other immersive technologies
2. Develop a functional AR application using common development platforms, incorporating virtual elements into a real-world environment.
3. Develop advanced multi-user interactions for shared AR environments.

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	3	3	3		3								1	
3	3	3	3		3								1	

Introduction to Augmented Reality and Compare with AR vs VR vs MR - AR Technologies and Devices - User Experience and Interaction Design- Human factors and considerations in AR design- Unity Basics- AR Core - Creating a Simple AR application in (Marker- Based AR, Marker less AR, Location Based)- Advanced Spatial Interaction - Complex Object Recognition - Collaborative Multi-User AR.

Total: 15 Hours

References:

1. Dieter Schmalstieg Tobias Höllerer, “Augmented Reality: Principles and Practice”, Pearson Education, 2016.
2. Papagiannis, Helen, “Augmented Human: How Technology is Shaping the New Reality” O’Reilly Media, 2017.

22AI0XC STATISTICAL MODELLING IN R PROGRAMMING 1 0 0 1

Course Objectives

- Understand the mathematical fundamentals of linear models
- Explore the role of regression models, which are used to model a variable of interest as a function of explanatory variables.
- Work with the R programming language to perform analyses and generate reproducible reports.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Identify and diagnose violations of the assumptions of linear models and add complexity to regression models using transformations and interactions.
2. Use variable selection techniques to select a model. Perform regression analyses for a binary response.

Articulation Matrix

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

Data, Statistics, and R, Simple Linear Regression, Inference for Simple Linear Regression, Multiple Linear Regression, Categorical Predictors and Interactions, Diagnostics and Transformations, Collinearity and Model Selection, Regression for a Binary Response

Total: 15 Hours

Reference(s)

1. Murray Aitkin, Brian Francis, John Hinde, and Ross Darnell, “Statistical Modelling in R”, Oxford university press
2. David Dalpiaz, “Applied Statistics with R “GitHub.
3. P.M.E.Altham, "Introduction to statistical modelling in R" Statistical Laboratory, University of Cambridge.

22AI0XD **NODE.JS** **1 0 0 1**

Course Objectives

- To understand how to set up a node js environment.
- To incorporate various libraries and modules, and to create and execute scripts in node js.
- To build modern, fast and scalable server-side web applications with node js.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

Course Outcomes (COs)

1. Experiment with Node JS Modules and Node Package Manager.
2. Develop applications to handle events in Node JS and make use of Web Server to manage database

Articulation Matrix

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

Introduction to Node JS - Advantages of Node JS- Setup Development Environment: Install Node.js on Windows- Node JS Modules: Functions, Buffer, Module- Modules Types- Node Package Manager: Introduction to NPM, Installing Packages Locally- Installing package globally- Creating Web Server: Web Server Creation- Sending Requests - File System: Fs.readFile -Writing a File Opening a file - Deleting a file- Debugging Node JS Application: Core Node JS Debugger- Events: Event Emitter class- Inheriting Events- REST-Express JS: Configuring Routes- Serving Static Resources: Serving Static Files- Database Connectivity: Connecting String, Configuring- Updating Records- Project Development using Node JS

Total: 15 Hours

Reference(s)

1. Dhruti Shah, “Node.JS Guidebook”, BPB Publications, 2018.
2. Basarat Ali Syed, Beginning Node.js, A press, 2014.
3. https://nodejs.org/en/docs/

22AI0XE MLOps ESSENTIALS 1 0 0 1

Course Objectives

- To understand the technologies essential for MLOps, including version control systems, containerization tools and orchestration platforms.
- To implement Continuous Integration and Continuous Delivery (CI/CD) pipelines for automating the testing, deployment, and monitoring of machine learning 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.

PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PSO1: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Design, build, and deploy ML models and systems to solve real-world problems.
2. Utilize Git for version control in machine learning projects.

Articulation Matrix

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

Introduction to MLOps - Version Control Basics- Basics of Continuous Integration and Continuous Deployment (CI/CD)- Introduction to Containerization with Docker- Basics of Model Monitoring and Governance- Collaboration Tools and Basics of DevOps- Scaling ML Workloads- Future Trends and Career Opportunities in MLOps

Total: 15 Hours

Reference(s)

1. https://www.datacamp.com/tutorial/tutorial-machine-learning-pipelines-mlops-deployment
2. https://www.udemy.com/course/mlops-for-beginners/

22AI0XF APACHE KAFKA 1 0 0 1

Course Objectives

- To learn the basic concepts and architecture of Apache Kafka.
- To understand the role of Kafka in modern data processing 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 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Develop Kafka producer applications to publish messages and Kafka consumer applications to consume messages.
2. Implement strategies for data retention, partitioning, and replication to optimize Kafka's performance and reliability.

Articulation Matrix

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

Introduction to Apache Kafka: Overview of Apache Kafka- Key features and benefits - Use cases (real-time data processing, event sourcing, etc.)- Synchronous and Asynchronous communication- Data Replication and Mirroring - Kafka Architecture: High-level architecture diagram (brokers, topics, partitions, producers, consumers)- How Kafka handles data streaming and storage- Kafka Core Concepts: partitions - Producers and consumers- Message format and serialization- Replication and fault tolerance - Installation and Setup: Steps to download and install Kafka- Setting up a single-node Kafka cluster- Basic configuration options-Producing and Consuming Messages: Demonstration of producing and consuming messages- Command-line tools for interaction

Total: 15 Hours

Reference(s)

1. Kafka: The Definitive Guide 2nd Edition, by Gwen Shapira, Todd Palino, Rajini Sivaram, Krit Petty
2. https://developer.confluent.io/courses/apache-kafka/kafka-connect/

22AI0XG **FULL STACK DEVELOPMENT USING ADAPTIVE AI** **1 0 0 1**

Course Objectives

- To understand how to integrate frontend with backend.
- To understand the Setting up data drift monitoring in a Flask application.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Develop a Backend Application with Python and Flask.
2. Deploy AutoML-generated models with Flask and implement model retraining automatically when data drift is detected.

Articulation Matrix

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

Basics of Python Flask framework- Develop Prediction from WebUI: Integrating frontend with backend-Understand API calls from frontend to backend-Implement prediction endpoints in Flask backend- Develop prediction features in the web UI-Train and Deployment of Model using AutoML-Introduction to AutoML (Automated Machine Learning)-Overview of AutoML platforms - Use AutoML for initial model training and deployment-Deploy AutoML-generated models with Flask-Monitoring of Data Drifts and Retraining: Data Drift - Implementing monitoring techniques for data drift detection- Setting up data drift monitoring in a Flask application- Implement logic for model retraining upon detecting data drift- Retrain the model automatically when data drift is detected

Total: 15 Hours

Reference(s)

1. https://www.automl.org/automl/
2. https://www.leewayhertz.com/how-to-implement-adaptive-ai/

22AI0XH DEMYSTIFYING DIALOGUECRAFT AI AND APPLICATIONS 1 0 0 1

Course Objectives

- To gain a comprehensive understanding of DialogueCraft AI technology and its core principles.
- To explore diverse applications of DialogueCraft AI across various industries and domains.
- To develop critical thinking skills to evaluate the benefits and limitations of DialogueCraft AI.
- To engage in hands-on activities to experience and experiment with DialogueCraft AI 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 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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Interpret the benefits and limitations of DialogueCraft AI compared to traditional chatbots.
2. Implement the key components of dialogue systems and their roles in interaction flow.
3. Apply critical thinking skills to identify and address potential biases in DialogueCraft AI systems.
4. Analyze the quality and quantity of training data required for effective dialogue system performance.

Articulation Matrix

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

Getting Started with DialogueCraft AI Platforms: Setting up accounts and exploring popular platforms-Navigating platform interfaces and understanding basic functionalities-Creating simple dialogue systems using pre-built components and templates-Experimenting with basic dialogue flows and user interactions-Building and Training Dialogue Systems-Customizing Dialogue Responses and Functionality-Developing Real-World Applications-Identifying potential biases in your training data and mitigation strategies-Implementing techniques to ensure privacy and security of user data.

Total: 15 Hours

Reference(s)

1. "Speech and Language Processing", by Daniel Jurafsky and James H. Martin, 3rd Edition.
2. “Building Chatbots with Python: A Practical Guide to Chatbot Development”, by Sumit Raj.
3. “Dialogue Systems for the Real World”, by Luis Fernando-Ruiz and Pablo Gervas.

22AI0XI AI BASED DEEPFAKE IMAGE CREATION 1 0 0 1

Course Objectives

- Understand the core concepts and techniques behind deepfake image generation using AI.
- Gain hands-on experience with popular deepfake image creation tools and frameworks.
- Explore the ethical considerations and potential societal impacts of deepfakes.
- Develop critical thinking skills to analyze and evaluate deepfake content.

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: Ability to design and develop Artificial Intelligence algorithms, tools and techniques for solving real world problems.

PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Understand the core concepts and principles of Deepfake AI technology and its application in image creation.
2. Implement the popular Deepfake image creation tools and platforms for basic manipulation and experimentation.
3. Apply different types of Deepfake techniques and their underlying algorithms.
4. Analyze the potential benefits and limitations of Deepfakes in various domains.

Articulation Matrix

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

Explore popular Deepfake image creation tools- Learn techniques for collecting and sourcing high-quality images for Deepfakes-Understand concepts like alignment, pose, and lighting consistency for optimal results- Apply pre-processing techniques like cropping, resizing, and normalization to training data-Experiment with data augmentation to improve model generalizability-Choose appropriate Deepfake algorithms based on desired tasks and image types- Set up training environments and understand hyperparameter tuning for optimization- Train simple Deepfake models using provided datasets and monitor performance metrics-Advanced Techniques and Enhancements-Deepfake Detection and Analysis.

Total: 15 Hours

Reference(s)

1. "Generative Deep Learning: Teaching Machines to Create" by David Foster.
2. "Deep Learning with Python", by François Chollet, 2nd Edition.
3. "Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow", by Aurélien Géron,3rd Edition