B.Tech. (Artificial Intelligence and Data Science)

Revised 2018 Regulations, Curriculum & Syllabi

(Candidates admitted during Academic Year 2021-2022)

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: To become proficient engineering professionals capable of applying Artificial Intelligence and Data Science techniques to solve real-world engineering problems.

PEO2: To be capable of pursuing higher studies, research, innovation, and teaching in emerging areas of Artificial Intelligence and Data Science.

PEO3: To demonstrate effective communication skills, professional ethics, teamwork, and a commitment to lifelong learning for continuous professional development.

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.

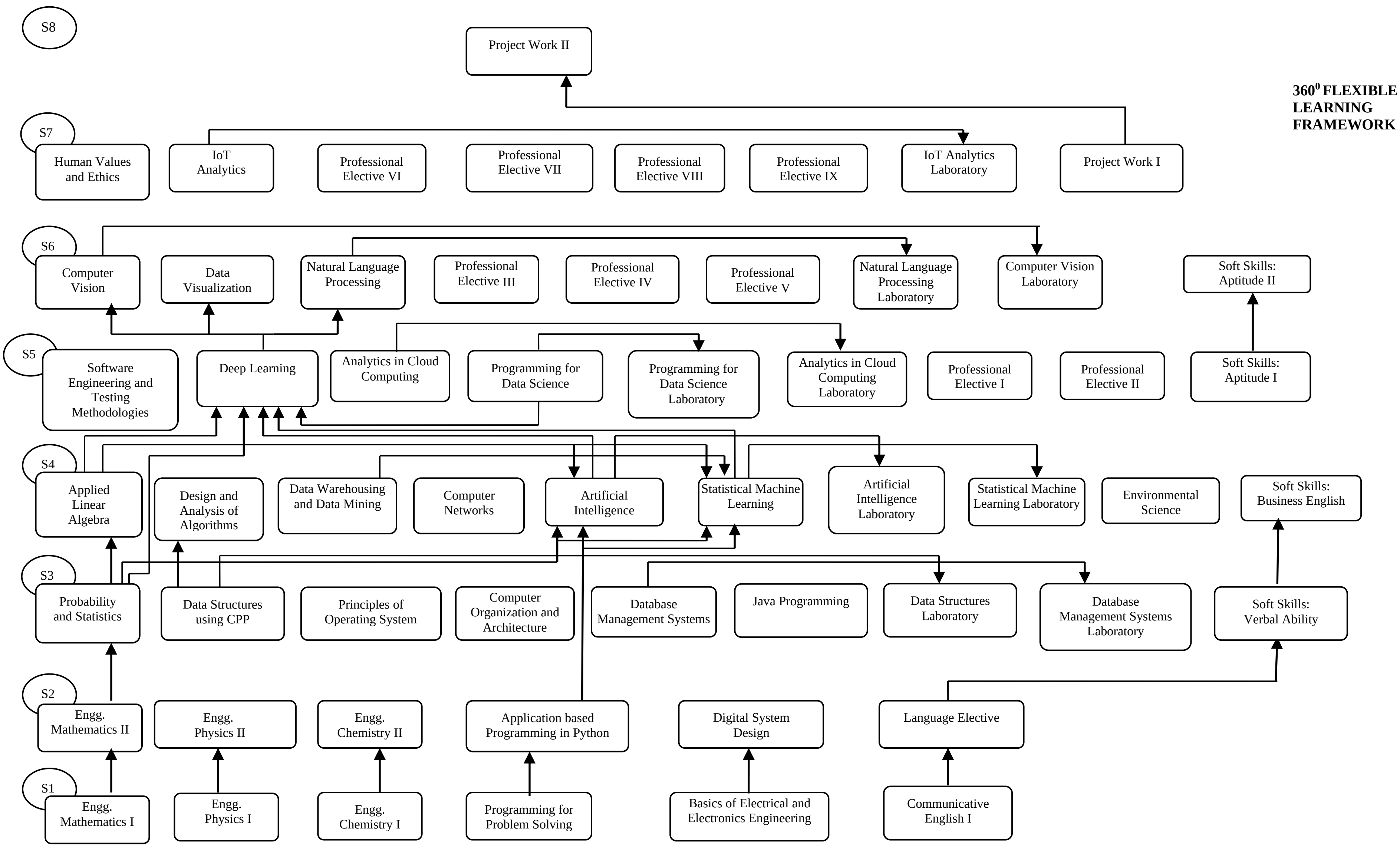
MAPPING OF PEOs WITH POs AND PSOs

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



DEPARTMENT OF ARTIFICIAL INTELLIGENCE AND DATA SCIENCE
Minimum Credits to be Earned: 161

I SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ESE	Total	
20AI101	ENGINEERING MATHEMATICS I	3	1	0	4	4	40	60	100	BS
20AI102	ENGINEERING PHYSICS I	2	0	2	3	4	50	50	100	BS
20AI103	ENGINEERING CHEMISTRY I	2	0	2	3	4	50	50	100	BS
20AI104	PROGRAMMING FOR PROBLEM SOLVING	2	0	2	3	4	50	50	100	ES
20AI105	BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING	2	0	2	3	4	50	50	100	ES
18HS101	COMMUNICATIVE ENGLISH I	1	0	2	2	3	100	0	100	HSS
Total		**12**	**1**	**10**	**18**	**23**				

II SEMESTER

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ESE	Total	
20AI201	ENGINEERING MATHEMATICS II	3	1	0	4	4	40	60	100	BS
20AI202	ENGINEERING PHYSICS II	2	0	2	3	4	50	50	100	BS
20AI203	ENGINEERING CHEMISTRY II	2	0	2	3	4	50	50	100	BS
20AI204	APPLICATION BASED PROGRAMMING IN PYTHON	3	0	2	4	5	50	50	100	ES
20AI205	DIGITAL SYSTEM DESIGN	3	0	2	4	5	50	50	100	ES
	LANGUAGE ELECTIVE	-	-	-	2	3	100	0	100	HSS
Total		**13**	**1**	**8**	**20**	**25**				

III SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
20AI301	PROBABILITY AND STATISTICS	3	1	0	4	4	40	60	100	BS
20AI302	DATA STRUCTURES USING CPP	3	0	0	3	3	40	60	100	PC
20AI303	PRINCIPLES OF OPERATING SYSTEM	3	0	0	3	3	40	60	100	PC
20AI304	COMPUTER ORGANIZATION AND ARCHITECTURE	3	0	0	3	3	40	60	100	PC
20AI305	DATABASE MANAGEMENT SYSTEMS	3	0	0	3	3	40	60	100	PC
20AI306	JAVA PROGRAMMING	2	0	2	3	4	50	50	100	PC
20AI307	DATA STRUCTURES LABORATORY	0	0	4	2	4	100	0	100	PC
20AI308	DATABASE MANAGEMENT SYSTEMS LABORATORY	0	0	4	2	4	100	0	100	PC
18GE301	SOFT SKILLS - VERBAL ABILITY	0	0	2	0	2	100	0	100	EEC
Total		**17**	**1**	**12**	**23**	**30**				

IV SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
20AI401	APPLIED LINEAR ALGEBRA	3	1	0	4	4	40	60	100	ES
20AI402	DESIGN AND ANALYSIS OF ALGORITHMS	3	0	0	3	3	40	60	100	PC
20AI403	DATA WAREHOUSING AND DATA MINING	2	0	2	3	4	50	50	100	PC
20AI404	COMPUTER NETWORKS	3	0	0	3	3	40	60	100	PC
20AI405	ARTIFICIAL INTELLIGENCE	3	0	0	3	3	40	60	100	PC
20AI406	STATISTICAL MACHINE LEARNING	3	0	0	3	3	40	60	100	PC
20AI407	ARTIFICIAL INTELLIGENCE LABORATORY	0	0	4	2	4	100	0	100	PC
20AI408	STATISTICAL MACHINE LEARNING LABORATORY	0	0	4	2	4	100	0	100	PC
18HS001	ENVIRONMENTAL SCIENCE	2	0	0	0	2	100	0	100	HSS
18GE401	SOFT SKILLS - BUSINESS ENGLISH	0	0	2	0	2	100	0	100	EEC
Total		**19**	**1**	**12**	**23**	**32**				

V SEMESTER											
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
21AI501	SOFTWARE ENGINEERING AND TESTING METHODOLOGIES	3	0	0	3	3	40	60	100	ES
21AI502	DEEP LEARNING	3	1	0	4	4	40	60	100	PC
21AI503	ANALYTICS IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PC
21AI504	PROGRAMMING FOR DATA SCIENCE	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE I	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE II	-	-	-	3	-	-	-	100	PE
21AI507	PROGRAMMING FOR DATA SCIENCE LABORATORY	0	0	4	2	4	100	0	100	PC
21AI508	ANALYTICS IN CLOUD COMPUTING LABORATORY	0	0	4	2	4	100	0	100	PC
18GE501	SOFT SKILLS - APTITUDE I	0	0	2	0	2	100	0	100	EEC
Total					**23**					

VI SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours/ Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
21AI601	COMPUTER VISION	3	0	0	3	3	40	60	100	PC
21AI602	DATA VISUALIZATION	3	0	2	4	5	50	50	100	PC
21AI603	NATURAL LANGUAGE PROCESSING	3	0	0	3	3	40	60	100	PC
	PROFESSIONAL ELECTIVE III	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE IV	-	-	-	3	-	-	-	100	PE
	PROFESSIONAL ELECTIVE V	-	-	-	3	-	-	-	100	PE
21AI607	NATURAL LANGUAGE PROCESSING LABORATORY	0	0	4	2	4	100	0	100	PC
21AI608	COMPUTER VISION LABORATORY	0	0	4	2	4	100	0	100	PC
18GE601	SOFT SKILLS-APTITUDE II	0	0	2	0	2	100	0	100	EEC
Total					**23**					

VII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
21HS002	HUMAN VALUES AND ETHICS	2	0	0	2	2	40	60	100	HSS
21AI702	IOT ANALYTICS	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
21AI707	IOT ANALYTICS LABORATORY	0	0	4	2	4	60	40	100	PC
21AI708	PROJECT WORK I	0	0	6	3	6	60	40	100	EEC
Total					**22**					

VIII SEMESTER										
Code No.	**Course**	**L**	**T**	**P**	**C**	**Hours /Week**	**Maximum Marks**			**Category**
							CA	**ESE**	**Total**	
21AI801	PROJECT WORK II	0	0	18	9	18	60	40	100	EEC
Total		**0**	**0**	**18**	**9**	**18**				

Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks CA	ES	Total	Category
ELECTIVES										
LANGUAGE ELECTIVES										
18HS201	COMMUNICATIVE ENGLISH II	1	0	2	2	3	100	0	100	HSS
18HSH01	HINDI	1	0	2	2	3	100	0	100	HSS
18HSG01	GERMAN	1	0	2	2	3	100	0	100	HSS
18HSJ01	JAPANESE	1	0	2	2	3	100	0	100	HSS
18HSC01	CHINESE	1	0	2	2	3	100	0	100	HSS
18HSF01	FRENCH	1	0	2	2	3	100	0	100	HSS
DISCIPLINE ELECTIVES										
VERTICAL I – FULL STACK DEVELOPMENT										
21AI001	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
21AI002	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
21AI003	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
21AI004	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
21AI005	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
21AI006	DEVOPS	3	0	0	3	3	40	60	100	PE
VERTICAL II – CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES										
21AI007	VIRTUALIZATION IN CLOUD COMPUTING	3	0	0	3	3	40	60	100	PE
21AI008	CLOUD SERVICES AND DATA MANAGEMENT	3	0	0	3	3	40	60	100	PE
21AI009	CLOUD STORAGE TECHNOLOGIES	3	0	0	3	3	40	60	100	PE
21AI010	CLOUD AUTOMATION TOOLS AND APPLICATIONS	3	0	0	3	3	40	60	100	PE
21AI011	SOFTWARE DEFINED NETWORKS	2	0	2	3	4	50	50	100	PE
21AI012	SECURITY AND PRIVACY IN CLOUD	3	0	0	3	3	40	60	100	PE
VERTICAL III – CYBER SECURITY AND DATA PRIVACY										
21AI013	CYBER SECURITY	3	0	0	3	3	40	60	100	PE
21AI014	MODERN CRYPTOGRAPHY	3	0	0	3	3	40	60	100	PE

21AI015	CYBER FORENSICS	3	0	0	3	3	40	60	100	PE
21AI016	ETHICAL HACKING	3	0	0	3	3	40	60	100	PE
21AI017	CRYPTOCURRENCY AND BLOCKCHAIN TECHNOLOGIES	2	0	2	3	4	50	50	100	PE
21AI018	MALWARE ANALYSIS	3	0	0	3	3	40	60	100	PE
VERTICAL IV – AI AND ROBOTICS										
21AI019	ROBOTIC PROCESS AUTOMATION	3	0	0	3	3	40	60	100	PE
21AI020	REINFORCEMENT LEARNING	3	0	0	3	3	40	60	100	PE
21AI021	EDGE COMPUTING	3	0	0	3	3	40	60	100	PE
21AI022	INTELLIGENT ROBOTS AND DRONE TECHNOLOGY	3	0	0	3	3	40	60	100	PE
21AI023	INTELLIGENT TRANSPORTATION SYSTEMS	3	0	0	3	3	40	60	100	PE
21AI024	EXPERT SYSTEMS	3	0	0	3	3	40	60	100	PE
VERTICAL V – COMPUTATIONAL INTELLIGENCE										
21AI025	KNOWLEDGE ENGINEERING	3	0	0	3	3	40	60	100	PE
21AI026	TEXT AND SPEECH ANALYSIS	2	0	2	3	4	50	50	100	PE
21AI027	OPTIMIZATION TECHNIQUES	3	0	0	3	3	40	60	100	PE
21AI028	BIG DATA ANALYTICS	3	0	0	3	3	40	60	100	PE
21AI029	QUANTUM COMPUTING	3	0	0	3	3	40	60	100	PE
21AI030	COGNITIVE SCIENCE	3	0	0	3	3	40	60	100	PE
VERTICAL VI – DATA ANALYTICS										
21AI031	BIOMEDICAL IMAGE ANALYSIS	2	0	2	3	4	50	50	100	PE
21AI032	RECOMMENDER SYSTEMS	3	0	0	3	3	40	60	100	PE
21AI033	VIDEO ANALYTICS	3	0	0	3	3	40	60	100	PE
21AI034	CYBER THREAT ANALYTICS	3	0	0	3	3	40	60	100	PE
21AI035	BUSINESS ANALYTICS	3	0	0	3	3	40	60	100	PE
21AI036	DIGITAL MARKETING AND TECHNIQUES	3	0	0	3	3	40	60	100	PE
DIVERSIFIED COURSES										
21AI037	TIME SERIES ANALYSIS AND FORECASTING	3	0	0	3	3	40	60	100	PE
21AI038	HUMAN COMPUTER INTERACTION	3	0	0	3	3	40	60	100	PE

21AI039	PATTERN RECOGNITION	3	0	0	3	3	40	60	100	PE
21AI040	ETHICS AND AI	3	0	0	3	3	40	60	100	PE
21AI041	AUGMENTED REALITY/VIRTUAL REALITY	3	0	0	3	3	40	60	100	PE
21AI042	SOFTWARE PROJECT MANAGEMENT	3	0	0	3	3	40	60	100	PE
HONOURS										
VERTICAL I – FULL STACK DEVELOPMENT										
21AIH01	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
21AIH02	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
21AIH03	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
21AIH04	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
21AIH05	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
21AIH06	DEVOPS	3	0	0	3	3	40	60	100	PE
MINOR										
VERTICAL I – FULL STACK DEVELOPMENT										
21AIM01	AGILE SOFTWARE DEVELOPMENT	3	0	0	3	3	40	60	100	PE
21AIM02	UI AND UX DESIGN	3	0	0	3	3	40	60	100	PE
21AIM03	WEB FRAMEWORKS	3	0	0	3	3	40	60	100	PE
21AIM04	APP DEVELOPMENT	2	0	2	3	4	50	50	100	PE
21AIM05	SOFTWARE TESTING AND AUTOMATION	3	0	0	3	3	40	60	100	PE
21AIM06	DEVOPS	3	0	0	3	3	40	60	100	PE
OPEN ELECTIVES										
21OCE01	ENERGY CONSERVATION AND MANAGEMENT	3	0	0	3	3	40	60	100	OE
21OEC01	BASICS OF ANALOG AND DIGITAL ELECTRONICS	3	0	0	3	3	40	60	100	OE
21OEC02	MICROCONTROLLER PROGRAMMING	3	0	0	3	3	40	60	100	OE
21OEC03	PRINCIPLES OF COMMUNICATION SYSTEMS	3	0	0	3	3	40	60	100	OE
21OEI01	PROGRAMMABLE LOGIC CONTROLLER	3	0	0	3	3	40	60	100	OE
21OEI02	SENSOR TECHNOLOGY	3	0	0	3	3	40	60	100	OE
21OEI03	FUNDAMENTALS OF VIRTUAL INSTRUMENTATION	3	0	0	3	3	40	60	100	OE

21OEI04	OPTOELECTRONICS AND LASER INSTRUMENTATION	3	0	0	3	3	40	60	100	OE
21OME01	DIGITAL MANUFACTURING	3	0	0	3	3	40	60	100	OE
21OME02	INDUSTRIAL PROCESS ENGINEERING	3	0	0	3	3	40	60	100	OE
21OME03	MAINTENANCE ENGINEERING	3	0	0	3	3	40	60	100	OE
21OME04	SAFETY ENGINEERING	3	0	0	3	3	40	60	100	OE
21OBT01	BIOFUELS	3	0	0	3	3	40	60	100	OE
21OFD01	TRADITIONAL FOODS	3	0	0	3	3	40	60	100	OE
21OFD02	FOOD LAWS AND REGULATIONS	3	0	0	3	3	40	60	100	OE
21OFD03	POST HARVEST TECHNOLOGY OF FRUITS AND VEGETABLES	3	0	0	3	3	40	60	100	OE
21OFD04	CEREAL, PULSES AND OIL SEED TECHNOLOGY	3	0	0	3	3	40	60	100	OE
21OFT01	FASHION CRAFTSMANSHIP	3	0	0	3	3	40	60	100	OE
21OFT02	INTERIOR DESIGN IN FASHION	3	0	0	3	3	40	60	100	OE
21OFT03	SURFACE ORNAMENTATION	3	0	0	3	3	40	60	100	OE
21OPH01	NANOMATERIALS SCIENCE	3	0	0	3	3	40	60	100	OE
21OPH02	SEMICONDUCTOR PHYSICS AND DEVICES	3	0	0	3	3	40	60	100	OE
21OPH03	APPLIED LASER SCIENCE	3	0	0	3	3	40	60	100	OE
21OPH04	BIO-PHOTONICS	3	0	0	3	3	40	60	100	OE
21OPH05	PHYSICS OF SOFT MATTER	3	0	0	3	3	40	60	100	OE
21OCH01	CORROSION SCIENCE AND ENGINEERING	3	0	0	3	3	40	60	100	OE
21OCH02	POLYMER SCIENCE	3	0	0	3	3	40	60	100	OE
21OCH03	ENERGY STORING DEVICES	3	0	0	3	3	40	60	100	OE
21OMA01	GRAPH THEORY AND COMBINATORICS	3	0	0	3	3	40	60	100	OE
21OGE01	PRINCIPLES OF MANAGEMENT	3	0	0	3	3	40	60	100	OE
21OGE02	ENTREPRENEURSHIP DEVELOPMENT I	3	0	0	3	3	40	60	100	OE
21OGE03	ENTREPRENEURSHIP DEVELOPMENT II	3	0	0	3	3	40	60	100	OE
21OGE04	NATION BUILDING: LEADERSHIP AND SOCIAL RESPONSIBILITY	3	0	0	3	3	40	60	100	OE
ONE CREDIT COURSES										
20AI0XA	TENSORFLOW	1	0	0	1	-	100	0	100	EEC

20AI0XB	TABLEAU	1	0	0	1	-	100	0	100	EEC
20AI0XC	TYPESCRIPT WITH JEST TESTING FRAMEWORK	1	0	0	1	-	100	0	100	EEC
20AI0XD	REACT JS	1	0	0	1	-	100	0	100	EEC
20AI0XE	BUILDING WIDGETS APPLICATIONS	1	0	0	1	-	100	0	100	EEC
20AI0XF	BLOCKCHAIN PROGRAMMING AND SMART CONTRACTS	1	0	0	1	-	100	0	100	EEC
20AI0XG	CONTAINERS ORCHESTRATION TECHNIQUES	1	0	0	1	-	100	0	100	EEC
20AI0XH	REAL TIME BIG DATA ANALYTICS	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	14.90	15%	20%
2	ES	6	8		4	3				21	13.04	15%	20%
3	HSS	2	2					2		6	3.73	5%	10%
4	PC			19	19	14	14	5		71	44.09	30%	40%
5	PE					6	9	12		27	16.77	10%	15%
6	EEC							3	9	12	7.45	10%	15%
	Total	18	20	23	23	23	23	22	9	161	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

20AI101 ENGINEERING MATHEMATICS I 3 1 0 4

Course Objectives

- Understand the concepts of vectors and Eigenvectors for different matrices to describe the stability of the linear systems in engineering fields.
- Exemplify the concepts of differentiation and integration to identify the area of 2D and 3D surfaces in engineering problems.
- Explain the concepts of analytic functions in complex domain to predict the nature of different engineering 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.

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

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

Course Outcomes (COs)

1. Apply concepts of complex numbers, vector algebra, and matrix theory to solve algebraic and geometric problems using eigenvalues, eigenvectors, and vector operations.
2. Examine the continuity and differentiability of functions to characterize functional behavior and rate-of-change phenomena.
3. Evaluate definite and improper integrals using appropriate integration techniques and convergence tests to obtain accurate analytical solutions.
4. Apply differential and integral calculus to solve optimization and geometric problems involving curves, areas, volumes, and related rates.
5. Compute complex integrals and analytic functions using standard tools of complex analysis to evaluate contour-based problems.

Articulation Matrix

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

UNIT I **9 Hours**

COMPLEX NUMBERS, VECTORS AND MATRICES

Complex plane, polar coordinates and polar form of complex numbers, powers and roots, fundamental theorem of algebra. Vector algebra in 2-D and 3-D space, dot product and cross product. Matrices: Eigen values and Eigen vectors, Properties of eigen values and eigen vectors.

UNIT II **9 Hours**

CALCULUS

Limits and Continuity of Functions: Limits of functions, types of limits, evaluation of limits, continuity of functions, properties of continuous functions. Derivatives: Derivatives, differentiability, rules and properties, differentiation of transcendental functions, higher order derivatives, implicit differentiation, and differentiation of hyperbolic functions. Integration: Anti-derivatives, Riemann Sum, indefinite and definite integration, Mean Value Theorem for definite integral, Fundamental Theorem of Calculus.

UNIT III **9 Hours**

INTEGRATION METHODS

Basic integration formulae for algebraic and transcendental functions. Integration by special devices: integration by parts, rationalizing substitution or trigonometric substitution, partial fractions, reduction formulas, improper integrals, convergence tests.

UNIT IV **9 Hours**

APPLICATIONS OF DERIVATIVES AND INTEGRATIONS

Extreme values, points of inflection and curve sketching, Rolles Theorem, Mean Value Theorem, optimization, indeterminate forms, L Hopitals Rule. Area between curves, volume of a general solid by slicing and cylindrical shell methods, volume of a solid of revolution, length of plane curves, area of a surface of revolution.

UNIT V **9 Hours**

COMPLEX ANALYSIS

Analytic Functions- Properties of Analytic function - Determination of Analytic Function using Milne Thompson method. Cauchys Integral Formula - Classification of Singularities - Cauchys Residue Theorem.

Total: 45+15=60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.
3. Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
4. Anton H, Calculus with Analytic Geometry, 5th edition, John Wiley & Sons, 1995.
5. Ayres F Jr and Mendelson E, Schaum s Outline of Theory and Problems of Calculus, 4th edition, McGraw Hill, 1999.
6. S.C. Gupta, Fundamentals of Statistics, 7th Edition, Himalaya Publishing House Pvt. Ltd. 2018.

20AI102 ENGINEERING PHYSICS I **2 0 2 3**

Course Objectives

- Illustrate the Newtons laws of motion and wave motion with applications
- Understand the basic properties of electricity, magnetism and optics
- Differentiate the special theory of relativity and quantum physics from classical physics

Programme 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.

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.

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

Course Outcomes (COs)

1. Apply Newtonian mechanics principles to analyze forces, motion, and equilibrium of particles using laws of motion and related physical models.
2. Analyze oscillatory and wave phenomena using energy relations and wave equations to determine frequency, wavelength, and energy transfer characteristics.
3. Apply electromagnetic field laws and induction principles to determine electric and magnetic field characteristics and associated energy storage.
4. Interpret geometrical and wave-optics phenomena to analyze image formation, interference, and diffraction patterns for optical systems and experimental measurements.
5. Examine relativistic and quantum concepts to explain radiation laws, wave particle duality, and experimental observations in modern physics.

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

UNIT I **6 Hours**

MECHANICS

Newtons laws of motion: Concept of force and its nature-Newtons first law and inertial frames- definition of mass -Newtons second law-gravitational force and weight -Newtons third law. Applications of Newtons laws: particle in equilibrium, particle under net force-weighing a mass in an elevator, the atwood machine and acceleration of two objects connected by a cord

UNIT II **6 Hours**

OSCILLATIONS AND WAVES

Fundamentals of simple harmonic motion -energy of simple harmonic oscillator -spring mass system -time period of simple pendulum, compound pendulum and torsional pendulum - Damped oscillations. Travelling wave motion -sinusoidal waves on strings -speed of a wave -reflection and transmission -rate of energy transfer in wave motion

UNIT III **6 Hours**

ELECTRICITY AND MAGNETISM

Point charges-electric fields -Gauss law and its applications -electric potential -capacitance -energy stored in a capacitor. Concept and source of magnetic fields -Amperes theorem -determination of magnetic field due to different current distributions -Faradays law -self-induction and mutual induction -energy stored in an inductor

UNIT IV **6 Hours**

LIGHT AND OPTICS

Nature of light -laws of reflection and refraction -refractive index and Snells law -dispersion of light -total internal reflection -image formation: concave mirrors -convex mirrors -thin lenses -compound microscope -human eye. Conditions of interference -Youngs double slit experiment - intensity distribution of interference -phase change due to reflection -diffraction-narrow slit diffraction -single slit and two slit - intensity distribution -diffraction grating -applications

UNIT V **6 Hours**

MODERN PHYSICS

Special theory of relativity -simultaneity and time dilation -twin paradox -length contraction -relativistic mass variation -space time graph. Black body radiation and Planck hypothesis -allowed energy levels -thermal radiation from different objects -photoelectric and Compton Effect. Matter waves -de-Broglie hypothesis -wave nature of particles –Davission - Germer experiment

EXPERIMENT 1 **5 Hours**
Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

EXPERIMENT 2 **5 Hours**
Determination of moment of inertia-Torsional pendulum

EXPERIMENT 3 **5 Hours**
Determination of wavelength of mercury spectral lines-spectrometer

EXPERIMENT 4 **4 Hours**
Determination of refractive index of solid and liquid-travelling microscope

EXPERIMENT 5 **3 Hours**
Determination of wavelength of laser-diffraction grating

EXPERIMENT 6 **4 Hours**
Determination of frequency of a tuning fork-Meldes apparatus

EXPERIMENT 7 **4 Hours**
Thickness of a thin wire using interference of light-Air wedge method

Total: 30+30=60 Hours

Reference(s)

1. R A Serway and J W Jewitt, Physics for Scientists and Engineers, Thomson Brooks/Cole, 2011
2. Halliday and Resnick, Fundamentals of Physics, John Wiley and Sons, Inc, 2011
3. H C Verma, Concepts of Physics (Vol I & II), Bharathi Bhawan Publishers & Distributors, New Delhi, 2017
4. H D Young and R A Freedman, Sears and Zemanskys University Physics with Modern Physics, Pearson education, 2016
5. R K Gaur and S L Gupta, Engineering Physics, DhanpatRai Publications, 2012

20AI103 ENGINEERING CHEMISTRY I 2 0 2 3

Course Objectives

- Identify the properties and applications of optical materials for smart screen
- Summarize the conducting materials and explain its applications to smart screens
- Classify the materials for data storage in electronic devices
- Outline the applications of organic materials in data storage
- Choose the suitable materials for the fabrications of microprocessors in 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.

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 (COs)

1. Examine inorganic and organic optical materials to relate their chemical structure to functional performance in smart screen technologies.
2. Interpret electrical conductivity behavior of conducting oxides and glass materials to assess their suitability for touch screen and display applications.
3. Differentiate magnetic, optical, and solid-state storage materials based on composition and physicochemical properties relevant to data storage performance.
4. Assess organic nanoscale materials used in flexible data storage to explain charge transport and memory behavior at reduced dimensions.
5. Analyze semiconductor materials and fabrication techniques used in microprocessor fabrication.

Articulation Matrix

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

UNIT I **6 Hours**

OPTICAL MATERIAL FOR SMART SCREEN

Types: Inorganic: Rare earth metals [yttrium, lanthanum, cerium, praseodymium, neodymium, europium, terbium and dysprosium] - organic: Organic dielectric material [Polystyrene, PMMA] - organic light emitting diodes [polythiopene]

UNIT II **6 Hours**

CONDUCTING MATERIALS FOR SMART SCREEN

Conductive components: Indium tin oxide [properties and applications] - touch screen [resistive and capacitive]. Chemical components in glass - alumino silicate - gorilla glass

UNIT III **5 Hours**

MATERIALS FOR DATA STORAGE

Classification - magnetic storage [Iron oxide, cobalt alloy, chromium oxide and barium ferrite] - optical storage [photochromic materials] - solid storage

UNIT IV **5 Hours**

ORGANIC NANOSCALE MATERIAL FOR DATA STORAGE

Data Storage - classification [media, access, information and volatility] - flexible data storage [transistor Structure] - flexible floating gate - flexible charge trap- flexible ferroelectric- flexible resistive memory with organic material

UNIT V **7 Hours**

MATERIALS FOR MICROPROCESSOR FABRICATION

Micro electrical components: Fabrication (CVD method) and use of metal oxide materials. Integrated circuit manufacturing - preparation of silicon wafer - masking - photo-resistant materials - classification. Doping: Atomic diffusion, ion implantation, making successive layers. Microcapacitors: Types - electrochemical capacitors, electrolytic capacitors and supercapacitors. Soldering materials: copper, tin and silver

EXPERIMENT 1 **5 Hours**

Estimation of copper content in a sample solution prepared from copper doped optical light emitting diodes

EXPERIMENT 2 **5 Hours**

Determination of conductivity of aluminium chloride, aluminium silicate and tin oxide compounds using conductivity meter

EXPERIMENT 3 **5 Hours**

Estimation of barium content in a sample solution prepared from iron alloy used in magnetic storage material

EXPERIMENT 4 **4 Hours**

Estimation of iron content in sample solution prepared from ferro electric materials using spectrophotometer

EXPERIMENT 5 **6 Hours**

Electroless plating of copper on polymeric material used in IC fabrication

EXPERIMENT 6 **6 Hours**

Electroless plating of nickel on polymeric material used in IC fabrication

Total: 29+31=60 Hours

Reference(s)

1. Padma L Nayak, Polymer Science, 1st Edition, Kalyani Publishers, New Delhi, 2005.
2. Smart Materials Taxonomy, Victor Goldade, Serge Shilko, Aleksander Neverov, CRC publication, 2015.
3. Advanced Magnetic and Optical Materials, edited by Ashutosh Tiwari, Parameswar K. Iyer, Vijay Kumar, Hendrik Swart, wiley publication, 2016.
4. Recent Advances of Flexible Data Storage Devices Based on Organic Nanoscaled Materials- Li Zhou, Jingyu Mao, Yi Ren, Su-Ting Han, V A. L. Roy and Ye Zhou, Small 1703126, 2018.
5. G.M. Crean, R. Stuck, J.A. Woollam. Semiconductor Materials Analysis and Fabrication Process Control Elsevier publication, 2012.

20AI104 PROGRAMMING FOR PROBLEM SOLVING 2 0 2 3

Course Objectives

- Understand the basics of C primitives, operators and expressions.
- Gain knowledge about the different primitive and user defined data types.
- Impart knowledge about the structural programming concepts.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply 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.

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

Course Outcomes (COs)

1. Apply fundamental C programming constructs including data types, operators, and input–output statements to develop solutions for basic computational problems.
2. Design C programs using decision-making and iterative control structures to implement structured problem-solving techniques.
3. Develop C programs using arrays and strings to perform efficient data storage and manipulation operations.
4. Construct modular programs using functions, pointers, recursion, and preprocessor directives to improve program structure and reusability.
5. Implement structured data management in C using structures, unions, and file handling techniques for real-world applications.

Articulation Matrix

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

UNIT I **6 Hours**

INTRODUCTORY CONCEPTS

C Primitives: Introduction to C, planning and writing a C program, Character Set, Keywords and Identifiers, Data Types, Variables and Constants, Compiling and executing the C program, Operators and Expressions: Arithmetic, Relational, Logical, Increment and decrement, Conditional, Bitwise, Comma, Size of (), Assignment, Shift operator, Precedence and order of evaluation Type Conversion, Input and Output Operations: Formatted I/O functions, getchar and putchar function, gets and puts functions

UNIT II **6 Hours**

CONTROL STATEMENTS

Decision Making and Branching: simple if statement, if else statement, nesting of if else Statement, Switch Statement. Decision Making and Looping: while statement, do while statement, for statement, Nested for statement Jump Statement: goto, break, continue, return statement.

UNIT III **6 Hours**

ARRAYS AND STRINGS

Arrays: Introduction, one dimensional array, declaration, Initialization of one dimensional array, two dimensional arrays, initializing two dimensional arrays, multi-dimensional arrays. Strings: Declaring and initializing string variables, Reading strings from terminal, writing string to screen, String handling functions.

UNIT IV **6 Hours**

FUNCTIONS AND POINTERS

User Defined Functions: Elements of user defined functions , Definition of functions, return values and their types, function calls, function declaration, categories of function, call by value and call by reference, recursion, Preprocessor directives and macros. Pointers: Understanding Pointers, accessing the address of the variable, declaring pointer variables, Initialization of pointer variables, accessing a variable through its pointer.

UNIT V **6 Hours**

STRUCTURES AND FILES

Storage Class Specifiers: Auto, registers, static, extern, typedef Structures and Unions: Introduction, defining a structure, declaring structure variables, accessing structure members, structure initialization, Unions, Enumerated data type File Management in C: Defining and opening a file, closing a file, Input/output operations on files, Command line arguments

EXPERIMENT 1 **4 Hours**

Write a C program to perform arithmetic operations on integers and floating-point numbers.

EXPERIMENT 2 **4 Hours**

Write a C program to implement ternary operator and relational operators.

EXPERIMENT 3 **2 Hours**

Write a C program to read the values of A, B, C through the keyboard. Add them and after addition check if it is in the range of 100 to 200 or not. Print separate message for each.

EXPERIMENT 4 **2 Hours**

Write a C program to display the roots of a quadratic equation with their types using switch case.

EXPERIMENT 5 **2 Hours**

Write a C program to generate the following triangle.

1
1 2 3
1 2 3 4 5
1 2 3 4 5 6 7

EXPERIMENT 6 **4 Hours**

Write a C program to get a matrix of order 3x3 and display a matrix of order of 4x4, with the fourth row and column as the sum of rows and columns respectively.

EXPERIMENT 7 **2 Hours**

Write a c program to remove the occurrence of "the" word from entered string.

EXPERIMENT 8 **2 Hours**

Write a C program to find the factorial of given number.

EXPERIMENT 9 **4 Hours**

Design a structure to hold the following details of a student. Read the details of a student and display them in the following format Student details: roll no, name, branch, year, section, cgpa.

****

NAME:
ROLLNO:
BRANCH:
YEAR:
SECTION:
CGPA:

EXPERIMENT 10 **4 Hours**

Create two files test1.txt and test2.txt and write a C program to read the file text1.txt character by character on the screen and paste it at the end of test2.txt

Total: 30+30=60 Hours

Reference(s)

1. Herbert Schildt, C -The complete Reference, Tata McGraw-Hill, 2013
2. Byron Gottfried, Programming with C, Schaum""s Outlines, Tata Mcgraw-Hill, 2013
3. E.Balagurusamy, Programming in ANSI C, Tata McGraw-Hill, 2012
4. Kernighan B W and Ritchie O M, The C programming Language. Prentice-Hall of India, 2009
5. Kelley A and I. Pohl, A Book on C: Programming in C, Pearson Education, 1998
6. Ashok.N.Kamthane, Programming in C, Pearson education,2013

20AI105 BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING **2 0 2 3**

Course Objectives

- To understand the basic concepts of electric circuits and magnetic circuits.
- To illustrate the construction and operation of various electrical machines and semiconductor devices.
- To learn the fundamentals of communication 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.

Course Outcomes (COs)

1. Apply the fundamental laws of electric and magnetic circuits to analyze voltage, current, power, and energy relationships in electrical networks.
2. Examine the construction and operating principles of DC machines and evaluate their performance characteristics for engineering applications.
3. Analyze the working principles of transformers and induction machines to determine their operational characteristics and applications.
4. Evaluate the speed control techniques and operational behavior of electrical drives used in electromechanical systems.
5. Analyze the characteristics of semiconductor devices and basic communication systems used in electronic circuits and signal transmission.

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

UNIT I **7 Hours**

ELECTRIC CIRCUITS

Definition of Voltage, Current, Electromotive force, Resistance, Power & Energy, Ohms law and Kirchoffs Law & its applications - Series and Parallel circuits - Voltage division and Current division techniques - Generation of alternating emf - RMS value, average value, peak factor and form factor- Definition of real, reactive and apparent power.

UNIT II **5 Hours**

DC MACHINES

Introduction of magnetic circuits - Law of Electromagnetic induction, Flemings Right & Left hand rule- Types of induced emf - Definition of Self and Mutual Inductance - DC Motor- Construction - Working Principle- Applications.

UNIT III **6 Hours**

AC MACHINES

Single Phase Transformer - Alternator - Three phase induction motor - Single phase induction motor - Construction - Working Principle - Applications.

UNIT IV **5 Hours**

ELECTRICAL DRIVES

Speed control of dc shunt motor and series motor - Armature voltage control - Flux control - Construction and operation of DC servo motor - Construction and operation of DC servo motor stepper motor.

UNIT V **7 Hours**

ELECTRON DEVICES AND COMMUNICATION

Characteristics of PN Junction diode and Zener diode - Half wave and Full wave Rectifiers - Bipolar Junction Transistor - Operation of NPN and PNP transistors - Logic gates - Introduction to communication systems.

EXPERIMENT 1 **4 Hours**

Analyze the VI characteristics of a fixed resistor and a lamp by varying its temperature.

EXPERIMENT 2 **4 Hours**

Apply the voltage division and current division techniques for series and parallel connections of lamp loads.

EXPERIMENT 3 **4 Hours**

Understand the concept of electromagnetic induction using copper coil.

EXPERIMENT 4 **4 Hours**

Understand the construction and working principle of DC machines.

EXPERIMENT 5 **6 Hours**

Determine the VI Characteristics of PN Junction diode and plot the input and output wave shapes of a half wave rectifier.

EXPERIMENT 6 **4 Hours**

Realize the working of transistor as an electronic switch through experiments.

EXPERIMENT 7 **4 Hours**

Lighting applications using logic gates principle.

Total: 30+30=60 Hours

Reference(s)

1. T. K. Nagsarkar and M. S. Sukhija, Basic of Electrical Engineering, Oxford University Press, 2011.
2. Smarjith Ghosh, Fundamentals of Electrical and Electronics Engineering, Prentice Hall (India) Pvt. Ltd., 2010.
3. A. Sudhakar, Shyammohan S Palli, Circuits and Networks Analysis and Synthesis, Tata McGraw Hill, 2010
4. R. S. Sedha, A Textbook of Applied Electronics, S.Chand & Company Ltd, 2013

18HS101 COMMUNICATIVE ENGLISH I 1 0 2 2

Course Objectives

- Read and understand the main points on familiar matters regularly encountered in work, school or leisure.
- Listen and respond in most common situations where English is spoken.
- Write simple connected texts on topics which are familiar or of personal interest.
- Describe experiences and events, hopes and ambitions and briefly give reasons and explanations for opinions and plans.

Programme 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.

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. Apply appropriate grammatical structures and usage conventions to produce accurate and contextually appropriate sentences in written and spoken communication.
2. Analyze factual, functional, and visual texts to locate, interpret, and transfer relevant information using effective reading strategies.
3. Develop structured written communications using appropriate tone, format, and coherence to handle professional and workplace correspondence.
4. Interpret spoken discourse in academic and professional contexts to identify key ideas, specific details, and implied meaning.
5. Demonstrate effective spoken interaction skills to participate confidently in discussions, negotiations, and decision-making situations.

Articulation Matrix

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

UNIT I **9 Hours**

GRAMMAR

Tenses Future continuous, Past continuous, Past perfect, Past simple, Past tense responses, Present perfect continuous, Present perfect/past simple Reported speech Adverbs intensifiers Comparatives and superlatives Conditionals 2nd and 3rd Connecting words expressing cause and effect, contrast Phrasal verbs Prepositions of place Simple passive - Wh-questions in the past Question tags Will and going to, for prediction-Gender Sensitive Vocabulary

UNIT II **9 Hours**

READING

Understanding short real-world notices, messages Detailed comprehension of factual material; skimming and scanning skills - Interpreting visual information Reading for detailed factual information Reading for gist and specific information - Grammatical accuracy and understanding of text structure - Reading and information transfer.

UNIT III **9 Hours**

WRITING

Internal communication including note, message, memo or email - arranging / rearranging appointments, asking for permission, giving instructions - Business correspondence including letter, fax, email apologizing and offering compensation, making or altering reservations, dealing with requests, giving information about a product-Hierarchy in Business Correspondence

UNIT IV **9 Hours**

LISTENING

Listening for specific information Listening for numbers and letters Note completion Listening for gist listening to monologues (presentations, lectures, announcements and briefings) listening to interacting speakers (telephone conversations, face-to-face conversations, interviews and discussions).

UNIT V **9 Hours**

SPEAKING

Exchanging personal and factual information expressing and finding out about attitudes and opinions organize a larger unit of discourse Turn-taking, negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing and/or disagreeing, suggesting, speculating, comparing and contrasting, and decision-making.

Total: 45 Hours

Reference(s)

1. Alexander Garrett, Cambridge BEC Preliminary Students Book with Answers, Cambridge University Press, 2016.
2. Lan Wood, Anne Williams and Anna Cowper. Pass Cambridge BEC Preliminary, Second Edition, New Delhi, 2014.
3. Norman Whitby. Cambridge Business Benchmark. Pre-Intermediate to Intermediate, Students Book. South Asian Edition, 2018.

20AI201 ENGINEERING MATHEMATICS II 3 1 0 4

Course Objectives

- Understand the concepts of partial derivatives and multiple integrals to define the area, volume and extreme values of various surfaces in engineering fields.
- Classify the sequences and series in linear systems is convergent or divergent.
- Formulate the real time engineering problem into mathematical model using ordinary differential equation and solve it by appropriate method.

Programme 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.
PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Investigate multivariable functions to identify directional behavior, extrema, and geometric characteristics relevant to engineering problems.
2. Compute areas, volumes, and flux quantities by applying multiple integration techniques and vector integral theorems.
3. Analyze sequences and series using convergence tests and power series expansions to determine their convergence behavior and approximation validity.
4. Model and solve first-order differential equations to interpret basic engineering systems.
5. Derive solutions of second-order differential equations using standard analytical methods to interpret dynamic engineering models.

Articulation Matrix

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

UNIT I **9 Hours**

PARTIAL DIFFERENTIATION

Functions of several variables, plotting of 2-variable functions, introduction to cylindrical and spherical coordinates, chain rule, total differential, gradient, directional derivatives, normal lines and tangent planes, extreme of functions of two variables, applications.

UNIT II **9 Hours**

MULTIPLE INTEGRALS

Double integrals, regions of integrations, triple integrals, applications (Cartesian coordinates only- Greens theorem and Gauss Divergence theorem).

UNIT III **9 Hours**

SEQUENCES AND SERIES

Sequences and series, convergence and divergence of series, absolute convergence, conditional convergence, test for convergence and divergence. Power series for functions, interval of convergence, Taylor and Maclaurin series, Taylors Theorem with remainder.

UNIT IV **9 Hours**

FIRST ORDER DIFFERENTIAL EQUATIONS

Separable differential equations, homogeneous differential equations, exact differential equations, integrating factor, Bernoulli"s equation, applications.

UNIT V **9 Hours**

SECOND ORDER DIFFERENTIAL EQUATIONS

Second order homogeneous and non-homogeneous equations with constant coefficients, variation of parameters, method of undetermined coefficients, series solutions of differential equations, applications.

Total: 45+15=60 Hours

Reference(s)

1. Finney RL, Weir MD and Giordano FR, Thomas Calculus, 10th edition, Addison-Wesley, 2001.
2. Smith RT and Minton RB, Calculus, 2nd Edition, McGraw Hill, 2002.Kreysgiz E, Advanced Engineering Mathematics, 8th edition, John Wiley & Sons, 1999.
3. Ray Wylie and C Louis Barrett, Advanced Engineering Mathematics, Sixth Edition, Tata McGraw-Hill Publishing Company Ltd, 2003.
4. Peter V. O Neil, Advanced Engineering Mathematics, Seventh Edition, Cengage Learning India Private Limited, 2012.
5. Glyn James, Advanced Engineering Mathematics, Third Edition, Wiley India, 2014.

20AI202 ENGINEERING PHYSICS II 2 0 2 3

Course Objectives

- Understand the applications of laser and fibre optics in the field of engineering
- Impart knowledge in crystallography and semiconductors
- Differentiate the different types of magnetic materials and their 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.
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. Analyze the principles and characteristics of laser systems and holography to explain their role in optical data storage and imaging applications.
2. Apply the principles of fiber optics to determine numerical aperture, modes of propagation, and their use in communication and sensing systems.
3. Classify crystalline materials by analyzing lattice structures and Miller indices to understand structure property relationships.
4. Assess semiconductor behavior using band theory, Hall effect, and device characteristics to interpret electronic and optoelectronic applications.
5. Investigate magnetic material properties through hysteresis behavior and magneto resistive effects to support data storage technologies

Articulation Matrix

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

UNIT I **7 Hours**

LASER

Principle - interaction of radiation with matter - characteristics of laser radiation - pumping mechanisms - types: CO2 laser -homo junction GaAs laser -applications: optical data storage and retrieval techniques - holography: principle -types - comparison of holography with photography - construction - reconstruction of hologram –applications

UNIT II **7 Hours**

FIBER OPTICS

Principle- conditions to achieve total internal reflection- structure- acceptance angle and numerical aperture (qualitative treatment only)- types- modes of propagation- refractive index profile- block diagram of fiber optic communication system- fiber optic sensors- intensity modulated sensor-endoscopy - merits of fiber cables over conventional communication systems

UNIT III **5 Hours**

CRYSTAL PHYSICS

Crystalline and amorphous materials - lattice -lattice point -basis - unit cell - crystal systems - Bravais lattices -planes in crystals- Miller indices -procedure for finding Miller indices- important features of Miller indices-unit cell characteristics of SC, BCC, FCC and HCP structures

UNIT IV **6 Hours**

SEMICONDUCTING MATERIALS

Characteristics -elemental and compound semiconductors- energy band description and current conduction in intrinsic semiconductors- energy band description of n-type and p-type semiconductors- conductivity of extrinsic semiconductors - variation of Fermi level with temperature and impurity concentration-temperature dependence on carrier concentration - Hall effect-applications - solar cells - photodiodes

UNIT V **5 Hours**

MAGNETIC MATERIALS

Fundamental definitions -Bohr magneton- classification of dia, para and ferromagnetic materials - domain theory - hysteresis curve - soft and hard magnetic materials -energy product and its importance - anti-ferromagnetic materials - ferrites -giant magneto resistance (GMR) effect -application: Principles of Magnetic Recording- Magnetic Digital Recording- Magneto-Optic Recording

EXPERIMENT 1 **2 Hours**
Exposure to Engineering Physics Laboratory and precautionary measures

EXPERIMENT 2 **4 Hours**
Determine the wavelength of given laser source by applying the principle of diffraction

EXPERIMENT 3 **4 Hours**
Determination of acceptance angle and numerical aperture of a given fibre

EXPERIMENT 4 **4 Hours**
Evaluation of band gap of given material using band gap kit.

EXPERIMENT 5 **4 Hours**
Determine the V-I characteristics of a solar cell

EXPERIMENT 6 **4 Hours**
Using Hall Effect, determine the nature of given material

EXPERIMENT 7 **4 Hours**
Find the refractive index of a transparent solid with the aid of travelling microscope

EXPERIMENT 8 **4 Hours**
Determination of energy loss per cycle of a ferromagnetic material using hysteresis curve

Total: 30+30=60 Hours

Reference(s)

1. Balasubramaniam, R. Callisters Materials Science and Engineering Wiley India Pvt. Ltd, 2014
2. Kasap, S.O. Principles of Electronic Materials and Devices McGraw-Hill Education,2017
3. Wahab, M.A. Solid State Physics: Structure and Properties of Materials Alpha Science International Ltd., 2017
4. Donald A. Neamen. Semiconductor Physics and Devices, McGraw-Hill, 2011
5. K. Thiyagarajan and A. K. Ghatak, LASERS: Fundamentals and Applications, Springer, USA, 2015
6. B.D. Cullity, Introduction to Magnetic Materials, Addison-Wesley

20AI203 ENGINEERING CHEMISTRY II 2 0 2 3

Course Objectives

- Classify the traditional and materials used to manage heat developed in electronic devices
- Classify the traditional and advanced materials used to manage heat developed in electronic devices
- Summarize the terminologies of electrochemistry and explain the applications of energy storage devices for computers
- Indicate the types, properties and applications of nanochips and carbon nanotubes used in electronic devices
- Outline sources of e-wastes and its effects on environment and its 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.
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.
PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

Course Outcomes (COs)

1. Analyze the properties and suitability of conventional thermal management materials used in electronic packaging to correlate composition with heat dissipation performance.
2. Compare advanced composite and nanoscale thermal materials to judge their effectiveness for microelectronic and optoelectronic thermal control.
3. Apply electrochemical principles to determine cell potential and assess the performance of various energy storage devices used in computing systems.
4. Analyze nanomaterials to relate structural features with functional properties in technological applications.
5. Assess chemical composition and environmental impact of electronic waste to support safe recycling and resource recovery practices

Articulation Matrix

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

UNIT I **6 Hours**

THERMAL MANAGEMENT MATERIALS

Heat generation - purpose - classification of electronic packaging - types of thermal management materials - traditional thermal management materials: Metals [Cu, Al, W and Mo] - compounds [Al2O3, BeO, AlN, SiC and Kovar alloy]

UNIT II **7 Hours**

ADVANCED THERMAL MANAGEMENT MATERIALS

Alloys: W-Cu, Mo-Cu, Cu/MoCu/Cu, AlSiC, Cu/SiC and W85-Cu. Fiber-reinforced material - sandwich structure of composite - thermal management materials for microelectronics and optoelectronics: Carbon nanotubes and aluminium/diamond composites

UNIT III **7 Hours**

ENERGY STORAGE DEVICES FOR COMPUTERS

Cell - cell potential - determination of potential. Batteries - types: Primary battery [Zinc-carbon]. Secondary battery: lead-sulphur. Modern battery: lithium polymer battery and fuel cells

UNIT IV **5 Hours**

NANOMATERIALS

Nano chips - types of material - properties - applications. Carbon nanotubes - fullerene, graphene: Types and applications

UNIT V **5 Hours**

E- WASTE MANAGEMENTS

Sources - toxicity due hazardous substances - impact to environment. E-waste management- Hazardous materials recycling (Gallium and Arsenic)

EXPERIMENT 1 **8 Hours**

General introduction and Determination of thermal stability of aluminium oxide using thermo gravimetric analysis

EXPERIMENT 2 **4 Hours**

Determination of thermal stability of copper alloys using thermo gravimetric analysis

EXPERIMENT 3 **6 Hours**

Determination of single electrode potential of zinc and copper electrodes

EXPERIMENT 4 **6 Hours**

Preparation of cadmium nanoparticles and its characterization

EXPERIMENT 5 **6 Hours**

Estimation of chromium and lead content in sample solution prepared from e-waste [PCB] using spectrophotometer

Total: 30+30=60 Hours

Reference(s)

1. Ravi Kandasamy, Arun S. Mujumdar. Thermal Management of Electronic Components. Lap Lambert Academic Publishing GmbH KG, 2010.
2. Guosheng Jiang, Liyong Diao, Ken Kuang. Advanced Thermal Management Materials. Springer Science & Business Media, 2012.
3. Nihal Kularatna. Energy Storage Devices for Electronic Systems: Rechargeable Batteries and Supercapacitors. Academic Press, 2014.
4. Odne Stokke Burheim. Engineering Energy Storage. Academic Press, 2017.
5. M. S. Dresselhaus, G. Dresselhaus, P. C. Eklund. Science of Fullerenes and Carbon Nanotubes: Their Properties and Applications. Elsevier, 1996.
6. Kazuyoshi Tanaka, S. Iijima. Carbon Nanotubes and Graphene. Edition 2, Newnes, 2014.

20AI204 APPLICATION BASED PROGRAMMING IN PYTHON 3 0 2 4

Course Objectives

- Develop a basic understanding Python programming language
- Solve problems requiring the writing of well-documented programs in the Python language, including use of the logical constructs of that language
- Demonstrate significant experience in data structures with the Python program

Programme 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.

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 fundamental Python programming concepts and object-oriented features to develop basic software applications.
2. Design Python programs using decision-making statements, loops, and functions to solve computational problems.
3. Develop Python programs using strings, lists, and sets to perform efficient data processing and manipulation.
4. Implement Python programs using tuples, dictionaries, and arrays to manage structured data effectively.
5. Develop Python applications using file handling, exception handling, modules, and packages for modular and robust software development.

Articulation Matrix

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

UNIT I **9 Hours**

THEORY COMPONENT CONTENTS BASICS OF PYTHON PROGRAMMING

Introduction-Python - Object Oriented Programming - Classes , Object and Instances- Constructor, class attributes and destructors - decorator pattern - real time uses of class in live projects - inheritance, overlapping and overloading operators- adding and retrieving dynamic attributes of classes - programming using Oops Support.

UNIT II **9 Hours**

CONTROL STATEMENTS AND FUNCTIONS IN PYTHON

Conditional (if), alternative (if-else), chained conditional (if-elif-else); Iteration: state, while, for, Break, continue, pass; Functions: Introduction, inbuilt functions, user defined functions, passing parameters, return values, recursion

UNIT III **9 Hours**

DATA STRUCTURES: STRINGS, LISTS, SET

Strings: string slices, immutability, string methods and operations; Lists: creating lists, list operations, list methods, mutability, aliasing, cloning lists, list and strings, list and functions; list processing: list comprehension, searching and sorting, Sets: creating sets, set operations.

UNIT IV **8 Hours**

DATA STRUCTURES: TUPLES, DICTIONARIES, ARRAYS

Tuples: Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value; Dictionaries: operations and methods, Nested Dictionaries, Arrays: operations and methods

UNIT V **10 Hours**

FILES, MODULES, PACKAGES

Files and exception: text files, reading and writing files, format operator, exception handling, modules, packages

EXPERIMENT 1 **2 Hours**

Programs using expressions and input and output statements.

EXPERIMENT 2 **2 Hours**

Programs using operators and built in functions.

EXPERIMENT 3 **2 Hours**

Programs using conditional statements.

EXPERIMENT 4 **2 Hours**
Programs performing all string operations.

EXPERIMENT 5 **2 Hours**
Programs using functions

EXPERIMENT 6 **2 Hours**
Programs to find square root, GCD, exponentiation, sum an array of numbers

EXPERIMENT 7 **2 Hours**
Programs to perform linear search, binary search

EXPERIMENT 8 **2 Hours**
Programs to perform operations on list

EXPERIMENT 9 **2 Hours**
Programs using dictionary and set

EXPERIMENT 10 **2 Hours**
Programs to work with Tuples.

EXPERIMENT 11 **2 Hours**
Programs to sort elements (Selection, Insertion, Merge, Quick)

EXPERIMENT 12 **2 Hours**
Program to perform word count in file.

EXPERIMENT 13 **2 Hours**
Program to perform file operations

EXPERIMENT 14 **2 Hours**
Program to count the number of characters, words and lines in a text file

EXPERIMENT 15 **2 Hours**
Programs using modules and packages

Total: 45+30=75 Hours

Reference(s)

1. Ashok Namdev Kamthane,Amit Ashok Kamthane, Programming and Problem Solving with Python , Mc-Graw Hill Education,2018.
2. Allen B. Downey, Think Python: How to Think Like a Computer Scientist, Second edition, Updated for Python 3, Shroff Reilly Publishers, 2016
3. John V Guttag, Introduction to Computation and Programming Using Python, Revised and expanded Edition, MIT Press, 2013.
4. Robert Sedgewick, Kevin Wayne, Robert Dondero, Introduction to Programming in Python: An Inter-disciplinary Approach, Pearson India Education Services Pvt. Ltd., 2016.
5. Timothy A. Budd, Exploring Python, Mc-Graw Hill Education (India) Private Ltd., 2015.
6. Kenneth A. Lambert, Fundamentals of Python: First Programs, CENGAGE Learning, 2012.

20AI205 DIGITAL SYSTEM DESIGN 3 0 2 4

Course Objectives

- Understand the fundamentals of digital logic
- Understand the implementation of logic circuits
- Analyze and design various combinational and sequential circuits

Programme 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.
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. Derive optimized logic expressions using Boolean algebra and Karnaugh map techniques to realize efficient digital circuits.
2. Develop combinational circuit solutions for arithmetic operations and code conversions through systematic analysis and design procedures.
3. Design sequential circuits with flip-flops, counters, and registers to model and simulate state-based systems.
4. Examine asynchronous circuit behavior to identify race conditions and hazards and ensure stable digital operation.
5. Develop digital functions using MSI components and programmable logic devices to achieve flexible combinational designs

Articulation Matrix

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

UNIT I **9 Hours**

BOOLEAN ALGEBRA AND LOGIC GATES

Number systems and conversions - Boolean algebra - Minterm - Maxterm - SOP and POS forms - NAND and NOR implementation - Simplification of Boolean functions: K Map – Don't care conditions - Five variable K map - Quine Maccluskey method - Logic gates.

UNIT II **9 Hours**

COMBINATIONAL LOGIC

Combinational circuits - Analysis procedures - Design procedures - Adders - Subtractors - Binary adder - Carry Look Ahead Adder - BCD Adder - Magnitude comparator - Code Converters - Multiplexers and Demultiplexers- Function realization using multiplexers - Decoders and encoders.

UNIT III **10 Hours**

SYNCHRONOUS SEQUENTIAL LOGIC

Sequential circuits - Flip flops - Flip Flop Conversion - Analysis procedures - Design procedures - Moore and Mealy models - State reduction and state assignment - Shift Registers - Counters.

UNIT IV **10 Hours**

ASYNCHRONOUS SEQUENTIAL LOGIC

Design of Asynchronous sequential circuits - Analysis procedure: Transition Table - Flow Table - Race Condition- stability, Design Procedure: Primitive Flow Table- Reduction- Transition Table- Race Free State Assignment- Hazards.

UNIT V **7 Hours**

DESIGN WITH MSI DEVICES

Programmable Logic Devices (PLD) - Programmable Logic Array (PLA) - Programmable Array Logic (PAL) - Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL.

EXPERIMENT 1 **2 Hours**

Implement Boolean Laws using Logic Gates

EXPERIMENT 2 **4 Hours**

Implement arithmetic circuits (Adder, Subtractor)

EXPERIMENT 3 **2 Hours**

Construct Code convertors (BCD, Gray, Excess -3)

EXPERIMENT 4 **4 Hours**
Construct Parity generator and parity checker

EXPERIMENT 5 **2 Hours**
Construct Magnitude comparator

EXPERIMENT 6 **4 Hours**
Demonstrate Multiplexer and Demultiplexers

EXPERIMENT 7 **2 Hours**
Function realization using multiplexers

EXPERIMENT 8 **4 Hours**
Demonstrate Encoder and Decoder

EXPERIMENT 9 **2 Hours**
Construct synchronous and Ripple counter

EXPERIMENT 10 **4 Hours**
Implement shift register (SISO, SIPO, PISO, PIPO)

Total: 45+30=75 Hours

Reference(s)

1. M.Morris Mano and Michael D Ciletti, Digital Design with an introduction to the VHDL, Pearson Education, 5th Edition, 2013
2. A Anand Kumar, Fundamentals of Digital Circuits, 3rd Edition,2014
3. Charles H.Roth, Jr., Fundamentals of Logic Design, 4th Edition, Jaico Publishing House, 2000
4. Mandal, Digital Electronics Principles & Application, McGraw Hill Edu, 2013.
5. Donald D.Givone, Digital Principles and Design, Tata McGraw-Hill, 2003.
6. John M.Yarbrough, Digital Logic, Application & Design, Thomson, 2002.

20AI301 PROBABILITY AND STATISTICS 3 1 0 4

Course Objectives

- Understand the basic concepts of probability and the distributions with characteristics and also two-dimensional random variables.
- Apply the basic rules and theorems of probability theory to determine probabilities that help to solve engineering problems.
- Determine the expectation and variance of a random variable from its distribution.
- Learn how to formulate and test hypotheses about means, variances and proportions and to draw conclusions based on the results of statistical tests.

Programme 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 probability axioms and random variable concepts to represent uncertainty in engineering problems.
2. Interpret relationships between two-dimensional random variables using joint distributions, covariance, correlation, and transformation techniques.
3. Implement statistical hypothesis testing methods based on normal, t, chi-square, and F distributions to derive inferences from sample data.
4. Analyze experimental data using one-way and two-way classifications and factorial design techniques.
5. Assess process performance using statistical quality control tools such as control charts and acceptance sampling methods.

Articulation Matrix

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

UNIT I **9 Hours**

PROBABILITY AND RANDOM VARIABLES

Introduction to probability concepts, Types of Events, axioms, theorems, Conditional probability, Multiplication theorem, Applications. Characteristics of random variables - Discrete case, Probability Mass function, Cumulative distribution function, Applications, Characteristics of random variables - Continuous case, , Probability density function, Cumulative distribution function, Applications, Central and Raw Moments, Expectation, variance, Applications, 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, 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 - 22 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. Ross, S.M., Introduction to Probability and Statistics for Engineers and Scientists, 3rd Edition, Elsevier, 2004.
4. 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.

20AI302 DATA STRUCTURES USING CPP 3 0 0 3

Course Objectives

- Understand the concepts of Object-Oriented Programming.
- Implement ADTs such as arrays, lists, stacks, queues, trees, graphs, search trees in C++ to solve real world problems.
- Analyze various searching and sorting 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.

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. Apply object-oriented programming principles in C++ to develop modular programs.
2. Develop stack, queue, and list ADTs using suitable data structures to solve computational problems.
3. Construct tree-based data structures and perform traversal operations for hierarchical data processing.
4. Solve graph-based problems using appropriate representations and traversal algorithms.
5. Analyze searching, sorting, and hashing techniques for efficient data retrieval.

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

UNIT I **9 Hours**

INTRODUCTION

Need for Object Oriented Programming-Characteristics of Object Oriented Programming-Classes and Objects-Member Functions- Constructors and Destructors - Operator Overloading-Inheritance -Function Overloading.

UNIT II **9 Hours**

STACKS AND QUEUES

Classification of Data Structures-Abstract Data Types(ADTs)- Array Implementation-Linked List Implementation-Types of Linked List-Applications of List-Stack ADT- Operations- Applications of Stack-Queue ADT - Operations - Circular Queue- Priority Queue-Dequeue-Applications of Queue.

UNIT III **9 Hours**

TREES

Tree ADT - Tree Traversals-Binary Tree ADT - Expression Trees- Applications of Trees-Binary Search Tree ADT - AVL Trees-Heap Tree-B-Tree-B+ Tree-Heap-Applications of Heap.

UNIT IV **9 Hours**

GRAPHS

Definition - Representation of Graph - Types of Graph - Breadth-First Traversal - Depth-First Traversal - Topological Sort - Shortest Path Algorithms: Unweighted Shortest Paths - Dijkstra"s Algorithm - Minimum Spanning Tree: Prim"s Algorithm - Kruskal"s Algorithm

UNIT V **9 Hours**

SEARCHING, SORTING AND HASHING TECHNIQUES

Searching:Linear Search-Binary Search-Sorting:Bubble Sort- Selection Sort-Insertion Sort-Shell Sort - Radix Sort-Merge Sort -Hashing:Hash Functions-Separate Chaining-Open Addressing -Rehashing-Extendible Hashing.

Total: 45 Hours

Reference(s)

1. E.Balagurusamy, "Object Oriented Programming with C++", Seventh Edition, McGraw Hill Education, 2017.
2. Robert Lafore, "Object Oriented Programming in C++", Galgotia Publication, 2010.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Fourth Edition, Pearson Education, 2014.
4. Michael T. Goodrich, Roberto Tamassia and David M. Mount, Data structures and Algorithms in C++, Second Edition, Wiley India, 2011.
5. Sartaj Sahni, ata Structures, Algorithms, And Applications in C++, Second Edition, Silicon Press, 2004.
6. John Hubbard, Data Structures with C++, First Edition, McGraw Hill Education, 2017.

20AI303 PRINCIPLES OF OPERATING SYSTEM 3 0 0 3

Course Objectives

- To understand the concepts of the basic functionalities of an Operating Systems
- To analyze and evaluate the process of Operating Systems
- To provide knowledge on the structure and operations of memory 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.

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.

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. Interpret the architecture, services, and system call interface of operating systems to understand their functional components.
2. Analyze CPU scheduling algorithms using performance metrics such as waiting time, turnaround time, and throughput.
3. Apply synchronization mechanisms and deadlock handling techniques to manage concurrent processes effectively.
4. Assess memory management and virtual memory techniques including paging, segmentation, and page replacement strategies.
5. Investigate file system organization and storage management methods used for efficient data access and disk utilization.

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

UNIT I **9 Hours**

OVERVIEW OF OPERATING SYSTEM

Introduction - operating system structure - Operating System Operations- Process Management - Memory Management - Storage Management- I/O systems-Protection and Security- Operating System Services- System Calls - Types of System Calls- System Programs - Operating system services and kernel Features.

UNIT II **9 Hours**

PROCESS MANAGEMENT

Processes-Process Concept-Process Scheduling-Operations on Processes-Inter-process Communication. Threads: Overview- Multithreading Models-Threading Issues. CPU Scheduling-Basic Concepts-Scheduling Criteria-Scheduling Algorithms-Overview of Multiprocessor Scheduling and Real time scheduling.

UNIT III **9 Hours**

SYNCHRONIZATION AND DEADLOCK

Process Synchronization: Introduction - The Critical Section Problem - Synchronization Hardware - Semaphores -Deadlocks: System Model - Deadlock Characterization - Methods for Handling Deadlock - Deadlock Prevention - Deadlock Avoidance - Deadlock Detection - Recovery from Deadlock.

UNIT IV **8 Hours**

MEMORY MANAGEMENT

Main Memory: Background- Swapping- Contiguous Memory Allocation- Segmentation- Paging- Structure of the Page Table. Virtual Memory: Background- Demand Paging- Page Replacement - Resident set management, cleaning policy, fetch policy - Allocation of Frames- Thrashing.

UNIT V **10 Hours**

STORAGE MANAGEMENT

Overview of Mass Storage Structure-Disk Structure and attachment-Disk Scheduling-Disk Management-Swap-Space Management. File-System Interface: File Concept-Access Methods- File System Implementation: File-System Structure-Directory Implementation-Allocation Methods-Free-Space Management.

Total: 45 Hours

Reference(s)

1. William Stallings, "Operating Systems Internals and Design Principles", Pearson Education, Eighth Edition, 2015.
2. John J Donovan, "System Programming", McGraw Hill Publication, Reprint, 2014.
3. William Stallings, "Operating System", Pearson Education, Sixth Edition, 2012
4. Andrew S. Tanenbaum, "Modern Operating Systems", Third Edition Prentice Hall of India Pvt. Ltd, 2010

20AI304 COMPUTER ORGANIZATION AND ARCHITECTURE 3 0 0 3

Course Objectives

- Understand the basic structure and operation of a digital computer
- Familiarize with the implementation of fixed point and floating-point arithmetic operations
- Explore the processing of instruction and control unit design
- Acquire the knowledge of Parallel processing and memory hierarchy 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.

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.

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.

Course Outcomes (COs)

1. Apply system performance metrics to assess the efficiency of computer organization and architectural design.
2. Evaluate arithmetic operations including fixed-point and floating-point computations implemented in computer hardware.
3. Interpret instruction execution and control unit mechanisms involved in processor operation.
4. Analyze instruction-level and thread-level parallelism techniques used to enhance processor performance.
5. Assess memory hierarchy and input/output system design for efficient data storage and access.

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

UNIT I **9 Hours**

COMPUTER STRUCTURE

Evolution of Computers - Functional units and its operational concepts-Performance and Metrics for Performance Measurement - Memory operations, locations and addresses - Instruction and instruction sequencing - Addressing modes - Assembly language.

UNIT II **10 Hours**

ARITHMETIC OPERATIONS

Hardware for Addition and Subtraction -Addition and subtraction of signed numbers - Design of fast adders - Multiplication of positive numbers - Signed operand multiplication and fast multiplication-Integer division - Floating point numbers and operations.

UNIT III **9 Hours**

BASIC PROCESSING AND CONTROL UNIT

ALU Operation-Execution of a complete instruction Control Unit-Hardwired Control - Microprogrammed Control - Data path and control consideration -Pipelining and its Hazards.

UNIT IV **9 Hours**

PARALLELISM

Instruction level parallelism - Concepts and Challenges, Basic Compiler Techniques for Exposing ILP, Reducing Branch Costs with Advanced Branch Prediction, Dynamic Scheduling- Thread Level Parallelism - Introduction, Shared-Memory Multicore Systems, Performance Metrics for Shared-Memory Multicore Systems-Flynn"s classification multithreading- Data Level Parallelism- Introduction, Vector Architecture, SIMD Instruction Set Extensions for Multimedia, Graphics Processing Units, GPU Memory Hierarchy.

UNIT V **8 Hours**

MEMORY MANGEMENT AND I/O SYSTEMS

Introduction- Advanced Optimizations of Cache Performance- Memory Technology and Optimizations- Virtual Memory and Virtual Machines - The Design of Memory Hierarchy - Introduction to Pin Instrumentation and Cache grind.

Total: 45 Hours

Reference(s)

1. David A Patterson and John L Hennessey, Computer organization and design, fifth edition, Morgan Kauffman, 2014.
2. J.L. Hennessy and D.A. Patterson. Computer Architecture: A Quantitative Approach. 5th Edition, Morgan Kauffmann Publishers, 2012.
3. Carl Hamacher, Zvonko G Varanesic and Safat G Zaky, Computer Organisation, sixth edition, Mc Graw-Hill Inc, 2012.
4. William Stallings, Computer Organization and Architecture, seventh Edition, Pearson Education, 2006.
5. John P Hayes, Computer architecture and Organisation, third edition, Tata McGraw-Hill, 1998.
6. Morris Mano, Computer System Architecture, third edition, Prentice-Hall of India, 2000.

20AI305 DATABASE MANAGEMENT SYSTEMS 3 0 0 3

Course Objectives

- Understand the data models, conceptualize and depict a database system using E-R diagram.
- Gain knowledge on the design principles of a relational database system and SQL.
- 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.

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.

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 entity–relationship modeling concepts to represent application requirements for conceptual database design.
2. Construct relational schemas and formulate SQL queries using relational algebra and normalization principles.
3. Analyze database storage structures, indexing techniques, and query processing methods for efficient data retrieval.
4. Implement transaction management and concurrency control mechanisms to ensure consistency and reliability in database systems.
5. Evaluate advanced database models including distributed, object-relational, and XML databases for modern data management applications.

Articulation Matrix

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

UNIT I **8 Hours**

INTRODUCTION

Introduction: Database system application, purpose of database system View of Data -Database Languages-Data Storage and Querying-Database Architecture - Database design and ER model: Overview of the design process-The ER Model - Constraints - Removing redundant attributes in Entity Sets-ER Diagram - Reduction to Relational Schemas - ER Design Issues. Case Studies on Designing Database Models

UNIT II **9 Hours**

RELATIONAL MODEL AND DATABASE DESIGN

Introduction to Relational Model - Formal Relational Query Languages - Introduction to SQL: Data definition-Basic structure of SQL Queries-Additional Basic operations -Set operations-Aggregate functions Nested sub queries-Intermediate SQL: Joins-Views-Integrity Constraints. Functional Dependencies - Normal Forms Based on primary Keys-General Definition of Second and Third Normal Form - Boyce Codd Normal Form - Multi valued dependencies and Fourth Normal Form. Case Study Implementation on Handling Data

UNIT III **8 Hours**

DATA STORAGE AND QUERY PROCESSING

Overview of Physical Storage Media - Magnetic disk Flash storage -RAID-File and Record Organization - Indexing and Hashing: Ordered Indices - B+ Tree Index File-Static Hashing -Dynamic Hashing-Query Processing: Overview-measures of Query Cost. Importing / Exporting Large Amount of Data into a database.

UNIT IV **9 Hours**

TRANSACTION MANAGEMENT

Transactions: Transaction Concept-Transaction Atomicity and Durability-Transaction Isolation-Serializability-Transaction Isolation and Atomicity-Transaction Isolation Levels-Implementation of Isolation Levels-Concurrency Control: Lock based protocols -Deadlock handling-Time stamp-based protocols-Recovery system: Failure classification -Storage-Recovery and atomicity.

UNIT V **11 Hours**

ADVANCED TOPICS

Distributed Databases: Architecture, Data Storage, Transaction Processing-Object-based Databases: Object Database Concepts, Object-Relational features, ODMG Object Model, ODL, OQL-XML Databases: XML Hierarchical Model, DTD, XML Schema, XQuery- Information Retrieval: IR Concepts, Retrieval Models, Queries in IR systems.

Total: 45 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw - Hill, 2015
2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems, Pearson Education, 2008
3. Raghu Ramakrishnan, Database Management System, Tata McGraw-Hill Publishing Company, 2003
4. C.J.Date, An Introduction to Database system, Pearson Education, 2006
5. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management, Thompson Learning Course Technology, 2003

20AI306 JAVA PROGRAMMING 2 0 2 3

Course Objectives

- Impart the basics of Java primitives, operators, classes and objects.
- Implement the object-oriented thinking in Java.
- Develop knowledge of standalone desktop and database applications using Java.

Programme 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.

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. Apply fundamental Java programming constructs and object-oriented principles to develop simple applications.
2. Implement inheritance, polymorphism, abstraction, and interfaces to build modular Java programs.
3. Apply exception handling mechanisms and input/output streams to manage errors and file operations in Java programs.
4. Utilize generics, collections, and multithreading techniques to develop concurrent Java applications.
5. Develop event-driven Java applications using Applet, AWT, and Swing components with event handling and JDBC connectivity for interactive applications.

Articulation Matrix

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

UNIT I **6 Hours**

BASICS OF JAVA

The Evolution of Java- Characteristics of Java-Java Environment-Compilation and Execution-Overview of Object Oriented Programming - -Elementary Programming structures in Java- Datatypes, Variables, Arrays, Operators, Control Statements-Classes-Methods-Objects-this-Constructors and Destructors.

UNIT II **6 Hours**

OBJECT ORIENTED PROGRAMMING

Inheritance: Basics - Using Super - Types of Inheritances – Polymorphism - Method overloading and Method overriding – Abstraction - Using Abstract Classes and abstract Methods – Interfaces - Definitions and Implementation-Packages - Access Protection - Importing Packages.

UNIT III **6 Hours**

EXCEPTION AND I/O PROGRAMMING

Exception - Exception Hierarchy - Checked and Unchecked Exception - Exception Handling - Try and Catch - Throw and Throws - custom exceptions - Input/Output Basics – Streams - Byte streams and Character streams - Reading and Writing Files – Serialization - String Handling: Special String operations and Methods - String Buffer and String Builder

UNIT IV **6 Hours**

GENERIC AND CONCURRENT PROGRAMMING

Generics Types - Generic Classes and Methods - Wild Cards and Type Erasure -Restrictions on Generics-Collection Interfaces -Collection Classes-Multithreaded Programming-Thread Model-Creating Threads-Inter Thread Communication. Lambda Expression and Annotations

UNIT V **6 Hours**

EVENT PROGRAMMING

Applet Basics - Applet Architecture - Applet Display Methods - Event Handling Mechanisms - Event Classes - Event Listener - Working with Windows, Graphics, Colours and Fonts - AWT Controls - Introduction to Swing - Swing Components-Layout Managers- JDBC Concepts

EXPERIMENT 1 **3 Hours**

Program on Classes and Method

EXPERIMENT 2 **2 Hours**

Implementation of Inheritance

EXPERIMENT 3 **3 Hours**
Implementation of Interfaces and Packages

EXPERIMENT 4 **3 Hours**
Implementation of Exception handling mechanisms

EXPERIMENT 5 **2 Hours**
Develop a program to implement String Handling Methods

EXPERIMENT 6 **3 Hours**
Implementation of I/O Streams

EXPERIMENT 7 **3 Hours**
Implementation of Collections Interfaces and Classes

EXPERIMENT 8 **3 Hours**
Implementation of Multithreaded Programming

EXPERIMENT 9 **2 Hours**
Implementation of Applet Programs

EXPERIMENT 10 **2 Hours**
Write a program to implement Event classes

EXPERIMENT 11 **2 Hours**
Implementation of Swing programs and layout managers

EXPERIMENT 12 **2 Hours**
Implementation of JDBC concepts

Total: 30+30=60 Hours

Reference(s)

1. Herbert Schildt, Java: The Complete Reference, 11th Edition, McGraw Hill Education, 2018.
2. Y Daniel Liang, Introduction to Java Programming, 11thEdition, Pearson Publication, 2018.
3. Deitel and Deitel, Java How to Program,11th edition, Prentice Hall of India, 2020
4. Cay S Horstmann, Gary Cornell, Core Java Volume - I Fundamentals, 11th Edition, Prentice Hall, 2018.
5. Cay S Horstmann, Gary Cornell, Core Java Volume - II Advanced Features, 11th Edition, Prentice Hall, 2018.

20AI307 DATA STRUCTURES LABORATORY 0 0 4 2

Course Objectives

- Implement the operations of linear and non-linear data structures
- Build solutions for real world applications using searching, sorting and hashing 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.

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 linear data structures using C++ to solve computational problems.
2. Implement non-linear data structures using C++ for efficient data organization and processing.
3. Design and implement C++ programs using recursion, searching, sorting, and hashing techniques.
4. Analyze the performance of data structure–based algorithms using appropriate complexity measures.

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

EXPERIMENT 1 **2 Hours**

Implement Towers of Hanoi puzzle using recursion

EXPERIMENT 2 **4 Hours**

Design a singly linked list data structure that performs the following operations efficiently:
i. Create a list
ii. Insert an element to the list
iii. Delete the maximum element from the list
iv. Arrange the list as sorted order
v. Display the elements of the list

EXPERIMENT 3 **6 Hours**

Design a doubly linked list data structure that performs the following operations efficiently:
i. Create a list
ii. Insert an element to the list
iii. Delete the maximum element from the list
iv. Arrange the list as sorted order
v. Display the elements of the list

EXPERIMENT 4 **8 Hours**

i. Design a web browser application using Stack that performs that following operations:
a. 'Create history' function that stores the URLs of web pages visited
b. 'Go back' function removes the recently visited web page from the Stack
ii. Design a music player using Queue with the following functions:
a. 'Play-Next' function should display the next song in the songs list
b. 'Play-Previous' function should display the previously played songs in the list
c. 'Display' function display all the songs added to the queue in order

EXPERIMENT 5 **4 Hours**

Create a binary search tree of characters and perform preorder, inorder and post order Traversals.

EXPERIMENT 6 **6 Hours**

Create an expression tree and traverse the expression tree to generate infix, prefix and post expressions.

EXPERIMENT 7 **7 Hours**

Implement Prim's algorithm and Kruskal's algorithm to find the Minimum Spanning Tree of a Graph.

EXPERIMENT 8 **4 Hours**

Create function templates to search for a key element in a list of elements using Linear search and Binary search.

EXPERIMENT 9 **15 Hours**

Write a C program that arranges a list of ATM transactions done by a particular user based on date of transaction using:
a. Insertion sort
b. Selection sort
c. Bubble sort
d. Quick sort
e. Heap sort
f. Merge sort
Analyze the time complexities of each of the above algorithms and identify the best one.

EXPERIMENT 10 **4 Hours**

Implement the functions of a Dictionary ADT using hashing techniques

Total: 60 Hours

Reference(s)

1. E.Balagurusamy, "Object Oriented Programming with C++", Seventh Edition, McGraw Hill Education, 2017.
2. Robert Lafore, "Object Oriented Programming in C++", Galgotia Publication, 2010.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++, Fourth Edition, Pearson Education, 2014.
4. Michael T. Goodrich, Roberto Tamassia and David M. Mount, Data structures and Algorithms in C++, Second Edition, Wiley India, 2011.
5. Sartaj Sahni, ata Structures, Algorithms, And Applications in C++, Second Edition, Silicon Press, 2004.
6. John Hubbard, Data Structures with C++, First Edition, McGraw Hill Education, 2017.

20AI308 DATABASE MANAGEMENT SYSTEMS LABORATORY

0 0 4 2

Course Objectives

- Understand the DDL, DML, TCL and DCL commands in SQL.
- Understand the design principles of a relational database system and SQL.
- Implement programs using SQL and PL/SQL.

Programme 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.

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

Course Outcomes (COs)

1. Implement SQL queries and commands to create, manipulate, and control relational database data.
2. Design and implement PL/SQL programs using procedures, functions, cursors, triggers, and exception handling.
3. Develop database applications by integrating relational databases with front-end tools.

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
2	2	2	3		3							1	3	3
3	2	2	3		3							1	3	3

EXPERIMENT 1 **4 Hours**

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

EXPERIMENT 2 **8 Hours**

Performing Single- row functions and group functions in SQL.

EXPERIMENT 3 **4 Hours**
Execute simple queries using joins and Integrity constraints.

EXPERIMENT 4 **8 Hours**
Creation and manipulation of database objects.

EXPERIMENT 5 **4 Hours**
Implementation of cursor in PL/SQL block.

EXPERIMENT 6 **8 Hours**
Generate trigger in PL/SQL block.

EXPERIMENT 7 **8 Hours**
Write PL/SQL block Programs using exception handling.

EXPERIMENT 8 **8 Hours**
Design a PL/SQL blocks using subprograms namely functions and procedures

EXPERIMENT 9 **8 Hours**
Database Connectivity with Front End Tools

Total: 60 Hours

Reference(s)

1. Abraham Silberschatz, Henry F. Korth and S. Sudarshan, Database System Concepts, McGraw - Hill, 2015
2. Ramez Elmasri and Shamkant B. Navathe, Fundamental Database Systems, Pearson Education, 2008
3. Raghu Ramakrishnan, Database Management System, Tata McGraw-Hill Publishing Company, 2003
4. C.J. Date, An Introduction to Database system, Pearson Education, 2006
5. Peter Rob and Corlos Coronel, Database System, Design, Implementation and Management, Thompson Learning Course Technology, 2003

18GE301 SOFT SKILLS - VERBAL ABILITY 0 0 2 0

Course Objectives

- To help students gain adequate proficiency in vocabulary
- To help students become proficient in basic writing skills related to workplace communication
- To read and understand unabridged text

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.

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. Take up verbal ability part of the placement tests with confidence
2. Write with confidence in professional and workplace communication
3. Distinguish fact from opinion by reading passages from a text

Articulation Matrix

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

UNIT I **15 Hours**

INTRODUCTION

Synonyms - Antonyms - Word Groups - Verbal Analogies - Etymology - Critical Reasoning - Cloze Test - One Word Substitution - Idioms and Phrases - Text & Paragraph Completion.

UNIT II **15 Hours**

BASICS OF VERBAL APTITUDE

Sentence Formation - Paragraph Formation - Change of Voice - Change of Speech - Reading Comprehension - Sentence Equivalence - Jumbled Sentences - Spotting Errors -Homophones Homonyms - Commonly Mispronounced/Misspelt Words.

Total: 30 Hours

Reference(s)

1. Murphy, Raymond. English Grammar in Use a Self-Study Reference and Practice Book for Intermediate Learners of English. IV Edition. United Kingdom: Cambridge University Press. 2012.
2. Lewis, Norman. Word Power Made Easy. New York: Pocket Books. 1991.
3. Baron"s The Official Guide for New GMAT Review, New Jersey: John Wiley & Sons, Inc. 2015.

20AI401 APPLIED LINEAR ALGEBRA 3 1 0 4

Course Objectives

- Understand the basic concepts of Matrices, Eigenvalues, 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.

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 matrix operations and determinant properties to solve systems of linear equations.
2. Analyze eigenvalues and eigenvectors using characteristic equations and diagonalization techniques to study properties of linear systems.
3. Apply matrix decomposition techniques such as LU, SVD, and row reduction to obtain solutions for linear systems.
4. Determine linear dependence, basis, and dimension of vector spaces using vector space concepts.
5. Apply inner product space techniques including orthogonality and QR decomposition to solve vector space problems.

Articulation Matrix

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

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: Eigenvalues 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.

20AI402 DESIGN AND ANALYSIS OF ALGORITHMS 3 0 0 3

Course Objectives

- Identify the various algorithm design techniques.
- Impart knowledge on runtime analysis of algorithms.
- Empathize the limits of computation.

Programme 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.

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. Estimate algorithm efficiency using asymptotic notations and mathematical analysis techniques.
2. Apply brute force and divide-and-conquer strategies to solve sorting and searching problems.
3. Analyze greedy and dynamic programming algorithms for optimal problem solving.
4. Implement backtracking and branch-and-bound techniques for combinatorial optimization problems.
5. Assess NP-complete and NP-hard problems with respect to computational complexity and solution strategies.

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

UNIT I **9 Hours**

FUNDAMENTALS OF THE ANALYSIS OF ALGORITHM EFFICIENCY

Analysis Framework - Asymptotic notations - Basic Efficiency classes - Mathematical Analysis of Non-recursive Algorithm - Mathematical Analysis of Recursive Algorithm - Example: Fibonacci Numbers - Empirical Analysis of Algorithms

UNIT II **8 Hours**

BRUTE FORCE AND DIVIDE AND CONQUER STRATEGIES

Brute Force Strategy: Selection Sort and Bubble Sort, Sequential Search and Brute-force string matching - Divide and conquer: Presorting, Balanced Search trees AVL Trees, Heaps and Heap sort.

UNIT III **10 Hours**

GREEDY STRATEGIES AND DYNAMIC PROGRAMMING

Greedy Technique: Prims Algorithm, Kruskals Algorithm, Dijkstra Algorithm, Huffman trees-The simplex method, The stable marriage problem- Dynamic Programming: All pairs shortest path, optimal binary Search tree, Warshalls and Floyd Algorithm, multistage graphs, Knapsack problem.

UNIT IV **9 Hours**

BACKTRACKING AND BRANCH AND BOUND

Backtracking: Solution space and tree organization, N - queens problem, Sum of subset problem, Graph coloring, Knapsack problem-Branch and Bound: 0/1 Knapsack problem, Traveling salesman problem, Assignment problem, Least Cost branch and bound.

UNIT V **9 Hours**

ALGORITHM DESIGN TECHNIQUES TO NP COMPLETE AND NP HARD PROBLEMS

NP Complete problems backtracking: n-Queens Problem, Hamiltonian Circuit problem, Subset-Sum problem, Branch and bound: Assignment problem, Knapsack problem, Traveling salesman problem-Approximation algorithms for NP hard problems: Travelling salesman and knapsack problem

Total: 45 Hours

Reference(s)

1. Anany Levitin, Introduction to the Design and Analysis of Algorithms, Third Edition, Pearson Education Asia, 2011
2. T.H. Cormen, C.E. Leiserson, R.L. Rivest and C. Stein, Introduction to Algorithms, PHI Pvt. Ltd., 2009
3. Sara Baase and Allen Van Gelder, Computer Algorithms Introduction to Design and Analysis, Pearson Education Asia, 2010
4. A.V.Aho, J.E. Hopcroft and J.D.Ullman, The Design and Analysis of Computer Algorithms, Pearson Education Asia, 2003

20AI403 DATA WAREHOUSING AND DATA MINING 2 0 2 3

Course Objectives

- Gather and analyze large sets of data to gain useful business understanding.
- Understand the data mining functionalities, technologies and steps in preprocessing the data.
- Learn data mining algorithms, methods and tools.

Programme 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.

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. Design data warehouses using dimensional modeling techniques and ETL processes.
2. Analyze data preprocessing techniques to prepare data for effective data mining.
3. Evaluate association rule mining techniques for discovering frequent patterns and relationships in datasets.
4. Analyze classification techniques based on statistical, machine learning, and neural network models for data prediction.
5. Interpret clustering results to identify meaningful groups and patterns in real-world datasets.

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

UNIT I **9 Hours**

DATA WAREHOUSE FUNDAMENTALS

Introduction, OLTP Systems, Characteristics & Functions of Data Warehouses, Advantages and Applications of Data Warehouse, Top- Down and Bottom-Up Development Methodology, Tools for Data warehouse development, Multidimensional Data Model, Data Warehouse architecture, ETL Overview, ETL Requirements and Steps, ETL Tools.

UNIT II **9 Hours**

DATA MINING AND DATA PREPROCESSING

Types of Data, Data Mining Functionalities, Interestingness of Patterns, Classification of Data Mining Systems, Data Mining Task Primitives, Integration of a Data Mining System with a Data Warehouse, Descriptive Data Summarization, Data Preprocessing Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation.

UNIT III **9 Hours**

ASSOCIATION RULE MINING

Frequent Itemsets, Closed Itemsets, and Association Rules, Frequent Pattern Mining, The Apriori Algorithm, Generating Association Rules from Frequent Itemsets, Mining Frequent Itemsets without Candidate Generation, Mining Frequent Itemsets Using Vertical Data Format, Mining Closed Frequent Itemsets.

UNIT IV **9 Hours**

CLASSIFICATION

Classification: Basic Concepts, General approach to solve classification problem, Decision Trees Induction, Rule Based Classifiers, Nearest Neighbor Classifiers, Bayesian Classifiers, Estimating Predictive accuracy of classification methods, improving accuracy of classification methods, Evaluation criteria for classification methods.

UNIT V **9 Hours**

CLUSTER ANALYSIS

Overview, Features of cluster analysis, Data similarity and dissimilarity measures, Types of cluster analysis methods, Partitioning Methods: K-Means and K-Medoids, Hierarchical Methods: Agglomerative and Divisive Hierarchical Clustering, Outlier Analysis: Statistical Distribution-Based Outlier Detection, Distance-Based Outlier Detection.

EXPERIMENT 1 **3 Hours**

An member club data warehouse application online has most member clubs, members earn points through activities such as purchases, subscriptions, and consumptions of services. Members can use points in lieu of money towards these activities. Assume that there are 1 million members and 100,000 unique web pages. Draw the star and snowflake schema for the member club data warehouse.

EXPERIMENT 2 **2 Hours**

For example, let's say there are following numbers 99, 19, 2, 44, 51, 44, 56, 78, 44, 99, 86.
Perform statistical operations such as mean, median, mode and variance on the numbers.

EXPERIMENT 3 **1 Hour**

Perform data cleaning operations on the text Welcome To Artificial Intelligence written in four different ways (with different spacing between the words).

EXPERIMENT 4 **3 Hours**

A Decision Tree can operate on both categorical and numerical data. For a dataset with Outlook, Temperature, Humidity and Windy Predictor variables and Play Golf as the class variable, compute the frequency table for the above decision tree.

EXPERIMENT 5 **3 Hours**

Generate a candidate set of 1, 2 and 3-itemsets with minimum support count on All Electronics transaction database, D. Assume there are nine transactions in the database, that is, |D|=9.

EXPERIMENT 6 **3 Hours**

Cluster the following eight points (with (x, y) representing locations) :
A1(2, 10), A2(2, 5), A3(8, 4), A4(5, 8), A5(7, 5), A6(6, 4), A7(1, 2), A8(4, 9)
Initial cluster centers are: A1(2, 10), A4(5, 8) and A7(1, 2).
The distance function between two points a = (x1, y1) and b = (x2, y2) is defined as
P(a, b)=|x2-x1|plus|y2-y1|
Compute the distance table which shows the Point belongs to Cluster for the given points :
A1(2, 10), A2(2, 5), A3(8, 4), A4(5, 8), A5(7, 5), A6(6, 4), A7(1, 2), A8(4, 9) with Clusters (2, 10), (5, 8) and (1,2).

Total: 45+15=60 Hours

Reference(s)

1. Jiawei Han, Micheline Kamber and Jian Pei, Data Mining Concepts and Techniques, Third Edition, Elsevier, 2012.
2. Paulraj Ponniah, Data Warehousing Fundamentals: A Comprehensive Guide for IT Professionals, Wiley, 2010.
3. Alex Berson, Stephen J Smith, Data warehousing, Data mining, and OLAP, Tata McGraw Hill edition, 2007.
4. Pang-Ning Tan, Michael Steinbach and Vipin Kumar, Introduction to Data Mining, Pearson Education, 2007.
5. G. K. Gupta, Introduction to Data Mining with Case Studies, Easter Economy Edition, Prentice Hall of India, 2006.

20AI404 COMPUTER NETWORKS 3 0 0 3

Course Objectives

- Understand the principles and standards of networking and communication
- Cognize the different layer of networks and interpret the functionalities and protocols used in each layer of TCP/IP protocol suite
- Gain knowledge in the trends and application of networks.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO4: Conduct Investigations of Complex Problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
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. Examine data communication systems in terms of components, data representation, and networking standards.
2. Analyze data link layer mechanisms for error control, flow control, and medium access.
3. Assess network layer services, routing algorithms, and IP addressing schemes for packet delivery.
4. Analyze transport layer protocols with respect to reliability, flow control, and congestion control mechanisms.
5. Evaluate application layer protocols and their interaction with underlying network layers.

Articulation Matrix

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

UNIT I **9 Hours**

DATA COMMUNICATIONS

Introduction: Data Communications, Networks, Network Types, Protocol Layering, TCP/IP Protocol Suite, OSI Model - Physical Layer: Data and Signals-Digital and Analog Signals-Multiplexing-Spread Spectrum-Transmission Media-Guided and unguided media-Switching

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 - Ethernet: IEEE 802.3 - IEEE 802.11.

UNIT III **9 Hours**

NETWORK LAYER

Network Layer Services - Packet Switching - IPV4 Addresses - Forwarding of IP Packets - Network Layer Protocols: IP, ICMPv4, Mobile IP - Routing Algorithms- Unicast Routing Protocols-Multicast 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 - FTP - Electronic Mail - Telnet - SSH - DNS - SNMP - DHCP - MQTT - IMAP - TLS/SSL-IP Security.

Total: 45 Hours

Reference(s)

1. Behrouz A. Forouzan, Data Communication and Networking, Fifth Edition, McGraw Hill Education (India) Private Limited, 2013.
2. William Stallings, Data and Computer Communications, Tenth Edition, Prentice Hall, 2014.
3. Andrew S Tanenbaum and David J Wetherall, Computer Networks, Fifth Edition, Pearson Education, 2011.
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.

20AI405 ARTIFICIAL INTELLIGENCE 3 0 0 3

Course Objectives

- To impart knowledge about Artificial Intelligence.
- To give understanding of the main abstractions and reasoning for intelligent systems.
- To enable the students to understand the basic principles of Artificial Intelligence in various 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.

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.

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 artificial intelligence concepts to identify characteristics and applications of intelligent systems.
2. Analyze the structure, behavior, and rationality of intelligent agents in different task environments.
3. Implement search strategies and problem-solving methods to obtain solutions for AI problems.
4. Examine knowledge representation and logical inference mechanisms used in knowledge-based systems.
5. Evaluate adversarial search techniques and game playing strategies for decision making in competitive environments.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO AI

Introduction - Definition - Characteristics of Intelligent Agents - Typical Intelligent Agents - Problem Solving Approach to Typical AI problems, History of Artificial Intelligence, The State of the Art, Future of Artificial Intelligence, Risks and Benefits of AI.

UNIT II **9 Hours**

INTELLIGENT AGENTS

Agents and Environment, The Concept of Rationality: Performance measures, Rationality, Omniscience, learning, and autonomy, Agent architectures (e.g., reactive, layered, cognitive), The Nature of Environments: Specifying the task environment, Properties of task environments, The Structure of Agents.

UNIT III **9 Hours**

PROBLEM-SOLVING

Solving Problems by Searching: Problem-Solving Agents, Search problems and solutions, Formulating problems, Search Algorithms, Breadth-first search, Depth-first search, A* search, The effect of heuristic accuracy on performance, Generating heuristics from relaxed problems. Local Search and Optimization Problem, Hill-climbing search, Constraint Satisfaction Problem, Variations on the CSP formalism.

UNIT IV **9 Hours**

KNOWLEDGE AND REASONING

Logical Agents: Knowledge-Based Agents, Logic, Propositional Logic: A Very Simple Logic, Syntax, Semantics, A simple knowledge base, A simple inference procedure, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Conjunctive normal form, A resolution algorithm, Completeness of resolution, Forward and backward chaining.

UNIT V **9 Hours**

ADVERSARIAL SEARCH AND GAMES

Game theory, classification of games, game playing strategies, prisoner's Dilemma, Game playing techniques, minimax procedure, alpha-beta cut-offs, Complexity of alpha-beta search, Limitations of game search algorithms.

Total: 45 Hours

Reference(s)

1. S.Russell and P.Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Fourth Edition, 2021.
2. I. Bratko, Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc, 2011
3. David L. Poole and Alan K. Mackworth, Artificial Intelligence: Foundations of Computational Agents, Cambridge University Press, 2010.
4. Deepak Khemani, Artificial Intelligence, Tata McGraw Hill Education 2013
5. Mishra R B, Artificial Intelligence, PHI Learning Pvt. Ltd., New Delhi, 2013.

20AI406 STATISTICAL MACHINE LEARNING 3 0 0 3

Course Objectives

- To understand the concepts of Machine Learning.
- To appreciate supervised learning and their applications.
- To appreciate the concepts and algorithms of unsupervised learning.
- To understand the basic concept of reinforcement learning algorithm and its applications.
- To study about modelling, aggregation and knowledge representation using graphical models.

Programme Outcomes (POs)

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

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

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

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

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

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.

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 machine learning concepts and linear regression models to analyze bias–variance trade-off in predictive modeling.
2. Implement supervised learning algorithms for real-world datasets to support intelligent decision making.
3. Analyze clustering and dimensionality reduction techniques to identify patterns in unlabeled data.
4. Apply reinforcement learning algorithms to solve real-world sequential decision problems.
5. Examine probabilistic discriminative, generative, and graphical models for machine learning applications.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO MACHINE LEARNING

Machine Learning - Machine Learning Foundations - Overview - applications - Types of machine learning - basic concepts in machine learning Examples of Machine Learning -Applications - Linear Models for Regression - Linear Basis Function Models - The Bias-Variance Decomposition - Bayesian Linear Regression - Bayesian Model Comparison

UNIT II **9 Hours**

SUPERVISED LEARNING

Linear Models for Classification - Discriminant Functions -Probabilistic Generative Models - Probabilistic Discriminative Models - Bayesian Logistic Regression. Decision Trees - Classification Trees- Regression Trees - Pruning. Ensemble methods- Bagging- Boosting.

UNIT III **9 Hours**

UNSUPERVISED LEARNING

Clustering- K-means - EM - Mixtures of Gaussians - The EM Algorithm in General -Model selection for latent variable models - high-dimensional spaces - The Curse of Dimensionality -Dimensionality Reduction - Factor analysis - Principal Component Analysis - Probabilistic PCA- Independent components analysis

UNIT IV **9 Hours**

REINFORCEMENT LEARNING

Passive reinforcement learning- direct utility estimation- adaptive dynamic programming- temporal difference learning- active reinforcement learning- exploration- learning an action-utility function- Generalization in reinforcement learning- policy search- applications in game playing- applications in robot control.

UNIT V **9 Hours**

PROBABILISTIC GRAPHICAL MODELS

Graphical Models-Undirected Graphical Models-Markov Random Fields-Directed Graphical Models-Bayesian Networks-Conditional Independence properties-Markov Random Fields-Hidden Markov Models-Conditional Random Fields (CRFs).

Total: 45 Hours

Reference(s)

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Stephen Marsland, Machine Learning- An Algorithmic Perspective, Chapman and Hall, CRC Press, Second Edition, 2014.
3. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014.
4. Christopher Bishop, Pattern Recognition and Machine Learning Springer, 2007.
5. P. Flach, Machine Learning: The art and science of algorithms that make sense of data, Cambridge University Press, 2012.

20AI407 ARTIFICIAL INTELLIGENCE LABORATORY 0 0 4 2

Course Objectives

- To provide skills for designing and analyzing AI based algorithms.
- To enable students to work on various AI tools.
- To provide skills to work towards solution of real-life 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.

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

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

PSO1: 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 problem requirements and data to formulate appropriate artificial intelligence solutions.
2. Implement search algorithms and knowledge representation techniques using suitable AI tools.
3. Develop artificial intelligence–based applications to solve real-world problems.

Articulation Matrix

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

EXPERIMENT 1 **6 Hours**
Installation and working on various AI tools viz Scikit Learn, Tensorflow, Keras, CNTK

EXPERIMENT 2 **6 Hours**
Data pre-processing and annotation and creation of datasets.

EXPERIMENT 3 **4 Hours**
Implementation of Breadth First searching techniques.

EXPERIMENT 4 **4 Hours**
Implementation of Depth First searching techniques.

EXPERIMENT 5 **4 Hours**
Implementation of Hill climbing algorithm

EXPERIMENT 6 **4 Hours**
Implementation of A* Algorithm

EXPERIMENT 7 **8 Hours**
Designing a Chat bot application.

EXPERIMENT 8 **4 Hours**
Implementation of Knowledge base system

EXPERIMENT 9 **4 Hours**
Implementation of Inference system.

EXPERIMENT 10 **4 Hours**
Write a program to solve 4-Queen problem.

EXPERIMENT 11 **4 Hours**
Write a program to solve traveling salesman problem.

EXPERIMENT 12 **4 Hours**
Implementation of Tic-Tac-Toe game

EXPERIMENT 13 **4 Hours**
Implementation of snake game in python

Total: 60 Hours

Reference(s)

1. S.Russell and P.Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, Fourth Edition, 2021.
2. I. Bratko, Prolog: Programming for Artificial Intelligence, Fourth edition, Addison-Wesley Educational Publishers Inc., 2011
3. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
5. P. Flach, Machine Learning the art and science of algorithms that make sense of data, Cambridge University Press, 2012.
6. Stephen Marsland, Artificial Intelligence, Chapman and Hall, CRC Press, Second Edition, 2014.

20AI408 STATISTICAL MACHINE LEARNING LABORATORY

0 0 4 2

Course Objectives

- To understand the concepts of Machine Learning.
- To implement supervised learning and their applications.
- To implement the concepts and algorithms of unsupervised learning.
- To practice modelling, aggregation and knowledge representation using graphical models.

Programme Outcomes (POs)

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

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

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

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

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

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

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 supervised and semi-supervised learning algorithms on real-world datasets for predictive modeling.
2. Analyze classification and clustering results using appropriate performance evaluation measures.
3. Develop reinforcement learning models to solve sequential decision-making 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				1			1	3	3
2	3	3	3	2	2				1			1	3	3
3	3	3	3	2	2				1			2	3	3

EXPERIMENT 1 **6 Hours**

Load Real Time data Set and Python Libraries, Installing Libraries through Anaconda Prompt, Perform data pre-processing through Pandas Library.

EXPERIMENT 2 **6 Hours**

Implement the Naive Bayesian classifier for a sample training data set stored as a .CSV file. Compute the accuracy of the classifier, considering few test data sets

EXPERIMENT 3 **6 Hours**

Implement decision tree based ID3 algorithm. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.

EXPERIMENT 4 **6 Hours**

Implement the non-parametric Locally Weighted Regression algorithm in order to fit data points. Select appropriate data set for your experiment and draw graphs.

EXPERIMENT 5 **6 Hours**

Apply EM algorithm to cluster a set of data stored in a .CSV file. Use the same data set for clustering using k-Means algorithm. Compare the results of these two algorithms and comment on the quality of clustering

EXPERIMENT 6 **6 Hours**

Implement k-Nearest Neighbour algorithm to classify the iris data set. Print both correct and wrong predictions. Java/Python ML library classes can be used for this problem

EXPERIMENT 7 **6 Hours**

Assuming a set of documents that need to be classified, use the Semi Supervised Classifier model to perform this task. Built-in Java classes/API can be used to write the program. Calculate the accuracy, precision, and recall for your data set.

EXPERIMENT 8 **6 Hours**

Implement Q Learning with Linear Function Approximation.

EXPERIMENT 9 **6 Hours**

Implement the Policy Gradient concept in Reinforcement learning. Compare the Reinforce with Baseline with Actor Critic with Baseline.

EXPERIMENT 10 **6 Hours**

Consider a time series data set. Plot the data, identify the components of the Time Series data, Calculate the seasonality and stationarity and identify the trend patter present in the time series data. Remove the white noise if available in the time series data.

Total: 60 Hours

Reference(s)

1. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, MIT Press, 2012
2. Stephen Marsland, Machine Learning - An Algorithmic Perspective, Chapman and Hall, CRC Press, Second Edition, 2014.
3. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Third Edition, 2014.
4. Christopher Bishop, Pattern Recognition and Machine Learning, Springer, 2007.
5. P. Flach, Machine Learning: The art and science of algorithms that make sense of data, Cambridge University Press, 2012.

18HS001 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.

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.

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 utilization, over-exploitation, and environmental impacts of major natural resources.
2. Examine ecosystem structure, functions, biodiversity values, and conservation strategies.
3. Analyze the causes, effects, and control measures of major environmental pollution types and disasters.
4. Evaluate social and environmental issues to recommend sustainable development and resource management practices.
5. Assess human population impacts on the environment and examine the role of information technology in promoting environmental and health awareness.

Articulation Matrix

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

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, bio magnification). 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 and 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 Edition, 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

18GE401 SOFT SKILLS - BUSINESS ENGLISH 0 0 2 0

Course Objectives

- To acquire command of both the receptive skills (Listening, Reading) and the productive skills (Writing and Speaking) of English language
- To understand and make effective use of English language in business contexts

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.

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. Analyze listening and reading materials to identify key information, interpret meaning, and recognize linguistic patterns in various contexts.
2. Apply appropriate writing and speaking strategies to communicate ideas effectively in professional and social interactions

Articulation Matrix

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

UNIT I 15 Hours

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analyzing the distractors - identify grammatical and semantic relationships

UNIT II **15 Hours**

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologizing reassuring - complaining - describing - summarizing - recommending – persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organizing a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

1 **15 Hours**

LISTENING AND READING

Listening for writing short answers - filling gaps in sentences - identifying topic, context and function - identify different functions of language in business situations - identify prompts -identify paraphrases of required information - Scanning - reading for gist - understanding sentence structure - error identification - identify paraphrases - cohesive words and phrases - understand the importance of analyzing the distractors - identify grammatical and semantic relationships

2 **15 Hours**

WRITING AND SPEAKING

Business emails - notes - memos to colleagues or friends - giving instructions - explaining a development - asking for comments - requesting information - agreeing to requests - explaining - apologizing - reassuring - complaining - describing - summarizing - recommending - persuading turn - taking - sustaining interaction - initiating - responding - giving personal information - talking about present circumstances, past experiences and future plans - expressing opinion - speculating - organizing a larger unit of discourse - giving information - expressing and justifying opinions - speculating - comparing and contrasting - agreeing and disagreeing

Total: 60 Hours

Reference(s)

1. Whitehead, Russell and Michael Black. Pass Cambridge BEC Vantage Self - study Practice Tests with Key, Heinle - a part of Cengage Learning, Delhi, 2003.

21AI501 SOFTWARE ENGINEERING AND TESTING METHODOLOGIES 3 0 0 3

Course Objectives

- Understand the phases in a software project.
- Analyze and design software systems for any given specification.
- Apply basic software quality assurance practices to ensure the software design and development meets or exceeds applicable standards.

Programme 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.

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. Compare software development life cycle models to identify suitable models for different software applications.
2. Analyze software requirements and project metrics to support requirements specification and effort estimation.
3. Design software architectures and components using software design principles and patterns.
4. Apply software testing techniques and automation methods to validate software requirements.
5. Plan and estimate software projects using effort estimation models, scheduling methods, and risk management strategies.

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

UNIT I **9 Hours**

SOFTWARE PROCESS MODELS

Software Engineering Paradigm - Verification - Validation - Software Process Models: Waterfall model, Incremental model, Spiral model, WIN WIN Spiral model, Evolutionary Process Models, Prototyping model, Concurrent model, unified model - Agile process models

UNIT II **10 Hours**

REQUIREMENTS ANALYSIS AND SPECIFICATION

Requirements Analysis- Software Requirements: Functional and Non-Functional, User requirements, System requirements - Requirements Elicitation - Validation and management - Software prototyping - Rapid prototyping techniques - Analysis and modeling - Data, functional and behavioral models - Metrics in the Process and Project Domains - Software Measurements - Metrics for Software Quality - Software Project Estimation - Decomposition Techniques

UNIT III **8 Hours**

SOFTWARE DESIGN

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**

SOFTWARE TESTING METHODOLOGIES & AUTOMATION

Software testing fundamentals - Internal and external views of Testing - White box testing - Basis path testing - Control structure testing - Black box testing - Regression Testing - Unit Testing - Static testing vs Structural testing – Code functional testing - Integration Testing - Validation Testing - Acceptance testing – Performance testing – Regression Testing – Ad-hoc testing – Alpha, Beta Tests – Usability and Accessibility testing - Software Test Automation

UNIT V **9 Hours**

PROJECT MANAGEMENT

Software Project Management: Estimation - LOC, FP Based Estimation, Make/Buy Decision COCOMO I & II Model - Project Scheduling, Earned Value Analysis Planning - Project Plan, Planning Process - Risk Management-Risk Identification- Fundamentals of Agile: Agile Manifesto and Principles, Overview of Scrum, Extreme programming, Introduction to Kanban, Introduction to Agile Ceremonies and Sizing Techniques

Total: 45 Hours

Reference(s)

1. Sommerville, Software Engineering, 10th edition, Addison Wesley, 2016
2. Roger S Pressman, Software Engineering: A Practitioner Approach, Tata McGraw Hill, Eighth Edition, 2015.
3. James S Peters, Witold Pedrycz, Software Engineering an Engineering Approach, Wiley India Edition, 2011
4. Richard Fairley, Software Engineering Concepts, Tata McGraw Hill, 2008
5. Aditya P. Mathur, ―Foundations of Software Testing - Fundamental Algorithms and Techniques, Dorling Kindersley (India) Pvt. Ltd., Pearson Education, 2008.

21AI502 DEEP LEARNING 3 1 0 4

Course Objectives

- Understand the fundamental concepts of deep learning mechanisms to various learning problems.
- To present the mathematical, statistical and computational challenges of building neural networks.
- Enable the students to know deep learning techniques to support real time 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.

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.

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 neural network principles and learning mechanisms to model simple learning tasks.
2. Analyze feedforward and backpropagation algorithms used for training deep networks.
3. Implement convolutional neural networks for image recognition and classification tasks.
4. Evaluate deep learning architectures for modeling sequential and high-dimensional data.
5. Design deep learning solutions for real-world problems in vision and language domains.

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

UNIT I **9 Hours**

NEURAL NETWORKS

Basic concept of Neurons - Perceptron neural networks - Feed Forward and Back Propagation Networks- Activation Function (Sigmoid, Tanh, ReLu, Leaky ReLu)

UNIT II **9 Hours**

INTRODUCTION TO DEEP LEARNING

Feed Forward Neural Networks – Gradient Descent – Back Propagation Algorithm – Vanishing Gradient problem – Mitigation – ReLU Heuristics for Avoiding Bad Local Minima – Heuristics for Faster Training – Nestors Accelerated Gradient Descent – Regularization – Dropout.

UNIT III **9 Hours**

CONVOLUTIONAL NEURAL NETWORKS (CNN)

CNN Architecture - CNN Layers: Convolution – ReLu – Pooling – Fully Connected – Filters – Convolution Functions – Efficient convolution algorithms – Unsupervised features - Image Classification using Transfer Learning.

UNIT IV **9 Hours**

MORE DEEP LEARNING ARCHITECTURES

Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), Encoder/Decoder Architectures – Autoencoders – Standard- Sparse – Denoising – Contractive- Variational Autoencoders – Generative adversarial networks. – Autoencoder and DBM.

UNIT V **9 Hours**

APPLICATIONS OF DEEP LEARNING

Image Segmentation – Object Detection – Automatic Image Captioning – Image generation with Generative Adversarial Networks – Video to Text with LSTM Models – Attention Models for Computer Vision – Case Study: Named Entity Recognition

Total: 45+15=60 Hours

Reference(s)

1. Ian Good Fellow, Yoshua Bengio, Aaron Courville, “Deep Learning”, MIT Press, 2017.
2. Josh Patterson and Adam Gibson, “Deep learning: A practitioner's approach”, O'Reilly Media, First Edition, 2017
3. Francois Chollet, “Deep Learning with Python”, Manning Publications, 2018.
4. Simon Haykin, “Neural Networks and Learning Machines”, 3rd Edition, Pearson Prentice Hall.
5. Phil Kim, “Matlab Deep Learning: With Machine Learning, Neural Networks and Artificial Intelligence”, Apress, 2017.
6. Ragav Venkatesan, Baoxin Li, “Convolutional Neural Networks in Visual Computing”, CRC Press, 2018.
7. Navin Kumar Manaswi, “Deep Learning with Applications Using Python”, Apress, 2018.
8. Chao Pan, “Deep Learning Fundamentals: An Introduction for Beginners”, AI Sciences LLC, 2018.

21AI503 ANALYTICS IN CLOUD COMPUTING 3 0 0 3

Course Objectives

- Understand the protocols and mechanisms necessary to support cloud computing.
- Understand the architecture and features of different cloud models.
- Analyze the basic concepts of virtualization technology to derive the best practice model for deploying cloud-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.

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.

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. Analyze cloud deployment and service models for selecting appropriate cloud computing environments.
2. Design scalable cloud-based applications using virtualization and cloud service platforms.
3. Evaluate cloud storage architectures and load balancing techniques in cloud environments.
4. Apply cloud-based analytics platforms and web services for data-driven cloud applications.
5. Assess cloud security requirements, risks, and mitigation strategies for cloud-based systems.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO CLOUD COMPUTING

Defining Cloud Computing-Cloud Types: The NIST Model-The Cloud Cube Model -Deployment Models-Service Models-Essential Characteristics of Cloud Computing-Benefits of Cloud Computing- Measuring the Cloud's Value: Measuring Cloud Computing Costs

UNIT II **9 Hours**

CLOUD ENABLING TECHNOLOGIES

Service Oriented Architecture – REST and Systems of Systems – Web Services – Publish Subscribe Model – Basics of Virtualization – Types of Virtualization – Implementation Levels of Virtualization – Virtualization Structures – Tools and Mechanisms – Virtualization of CPU – Memory – I/O Devices – Virtualization Support and Disaster Recovery.

UNIT III **9 Hours**

CLOUD ARCHITECTURE, SERVICES AND STORAGE

Layered Cloud Architecture Design – NIST Cloud Computing Reference Architecture – Public, Private and Hybrid Clouds - laaS – PaaS – SaaS – Architectural Design Challenges – Cloud Storage – Storage-as-a-Service – Advantages of Cloud Storage – Cloud Storage Providers

UNIT IV **9 Hours**

ANALYTICS IN CLOUD APPLICATIONS AND WEB SERVICES

Introduction to Cloud Simulator, understanding CloudSim simulator, CloudSim Architecture (User code, CloudSim, GridSim, SimJava) Understanding Working platform for CloudSim, Introduction to GreenCloud -Cloud APIs-Working with Cloud- Cloud Computing Web Services: Google Web service - Surveying the Google application portfolio -Google toolkit -Amazon web services - Components and services - Microsoft cloud services –Windows azure platform - Microsoft Azure Fundamentals: Introduction to Azure-Different segments SaaS, PaaS, and IaaS

UNIT V **9 Hours**

ANALYTICS IN CLOUD SECURITY

Cloud Information Security Objectives-Cloud Security Services-Cloud Security Design Principles- Secure Cloud Software Requirements: Secure Development Practices-Approaches to Cloud Secure Software Requirements Engineering-Cloud Computing and Business Continuity Planning/Disaster Recovery – Cloud Analytics tool and its benefits - Case study with cloud analytics tools using IBM Cognos Analytics or Microsoft Power BI or Zoho Analytics.

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., CRC Press, 2017
2. Rittinghouse, John W., and James F. Ransome, ―Cloud Computing: Implementation, Management and Security, CRC Press, 2017.
3. Barrie Sosinsky, Cloud Computing Bible, Wiley-India, 2014.
4. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.

21AI504 PROGRAMMING FOR DATA SCIENCE 3 0 0 3

Course Objectives

- Understand the R Programming Language.
- Exposure on Solving Data science problems.
- Understand the statistical functions in R.

Programme 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.

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 fundamental R programming constructs including control structures, functions, and objects for basic data science computations.
2. Represent data using R data structures such as vectors, matrices, arrays, lists, and data frames for effective data manipulation.
3. Analyze datasets through data cleaning, transformation, and aggregation using R packages.
4. Create graphical visualizations using R libraries to interpret data patterns and trends.
5. Evaluate statistical models using regression techniques, probability distributions, and time series analysis in R.

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

UNIT I **9 Hours**

INTRODUCTION TO R

Installing R and RStudio, RStudio Overview, setting up working directory, working in the Console, Arithmetic Operators, Logical Operations, control structures, Loops, Functions, R Objects, Numbers and Attributes.

UNIT II **9 Hours**

R DATA STRUCTURES

Creating Variables, Numeric, Character and Logical Data, Vectors, Lists, Matrices, Arrays, Factors, Data Frames, Special Values, Loop functions, Strings, Operations on Dates and Times

UNIT III **9 Hours**

DATA MANAGEMENT

Installing and loading packages, Intro to tidy verse, fundamentals of data, Downloading and importing data, Tidy data, data wrangling, and simple data cleaning, Numerical and Categorical variables, aggregate functions in R with dplyr , Recoding, data transformation and joins, sampling data for modeling-test and training splits, creating sample groups, Data reduction

UNIT IV **9 Hours**

DATA VISUALIZATION

Visualization Packages, Pie Charts, Bar Charts, Histograms, Line Graphs, Boxplots, Box-and-Whisker Plots Together, Scatterplots, Area Chart, Heat Map, Using the ggplot2package to visualize data, applying themes from ggthemes to refine and customize charts and graphs, Building data graphics for dynamic reporting.

UNIT V **9 Hours**

R-STATISTICS

Measures of central tendency, Measures of variability, Linear Regression, Multiple Regression, Logistic Regression, Probability Distributions: Normal Distribution, Binomial Distribution, Poisson Regression, Analysis of Covariance, Goodness of Fit, Time series analysis.

Total: 45 Hours

Reference(s)

1. R for Data Science‖, Hadley Wickham and Garett Goleman, , O'Reilly, 2017
2. R Programming for Data Science, Roger D. Peng, Lean publishing, 2015
3. Practical Data Science with R, Nina Zumel and John Mount, Dreamtech/Manning, 2014
4. Maria Dolores Ugarte, Ana F. Militino, Alan T. Arnholt "Probability and Statistics with R" 2nd Edition on, CRC Press, 2016.
5. Michael Akritas, " Probability & Statistics with R for Engineers and Scientists", 2nd Edition on, CRC Press, 2016

21AI507 PROGRAMMING FOR DATA SCIENCE LABORATORY 0 0 4 2

Course Objectives

- Understand the R Programming Language.
- Exposure on solving data science problems.
- Understand the statistical functions in R.

Programme 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.

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

Course Outcomes (COs)

1. Implement R programs for data handling, transformation, and statistical computation.
2. Analyze datasets using exploratory data analysis and statistical techniques in R.
3. Create data visualizations using R to identify patterns, trends, and relationships.
4. Develop predictive and classification models using statistical and machine learning methods in R.
5. Evaluate data science solutions developed in R using appropriate performance measures.

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

EXPERIMENT 1 **2 Hours**

R AS CALCULATOR APPLICATION

a. Using with and without R objects on console
b. Using mathematical functions on console
c. Write an R script, to create R objects for calculator application and save in a specified location in disk.

EXPERIMENT 2 **4 Hours**
DESCRIPTIVE STATISTICS IN R

a. Write an R script to find basic descriptive statistics using summary, str, quartile function on mtcars & cars datasets.
b. Write an R script to find subset of dataset by using subset (), aggregate () functions on iris dataset.

READING AND WRITING DIFFERENT TYPES OF DATASETS

a. Reading different types of data sets (.txt, .csv) from Web and disk and writing in file in specific disk location.
b. Reading Excel data sheet in R.
c. Reading XML dataset in R.

EXPERIMENT 3 **4 Hours**
WORKING WITH MESSY DATA

a. Messy Data
b. Renaming Columns (Variable Names)
c. Attaching / Detaching
d. Tabulating Data: Constructing Simple Frequency Tables
e. Ordering Factor Variables

EXPERIMENT 4 **6 Hours**
VISUALIZATIONS

a. Find the data distributions using box and scatter plot.
b. Visualizing Measures of Central Tendency, Variation, and Shape.
c. Show the outliers using plot.
d. Plot the histogram, bar chart and pie chart on sample data.
e. Find the mean, media, standard deviation and quantiles of a set of observations.
f. Generate and Visualize Discrete and continuous distributions using the statistical environment.
g. Demonstration of CDF and PDF uniform and normal, binomial Poisson distributions.

EXPERIMENT 5 **4 Hours**
CORRELATION AND COVARIANCE

a. Find the correlation matrix.
b. Plot the correlation plot on dataset and visualize giving an overview of relationships among data on iris data.
c. Analysis of covariance: variance (ANOVA), if data have categorical variables on iris data

EXPERIMENT 6 **4 Hours**
ESTIMATING A LINEAR RELATIONSHIP

A Statistical Model for a Linear Relationship
Least Squares Estimates
The R Function lm
Scrutinizing the Residuals

EXPERIMENT 7 **2 Hours**
STATISTICAL FUNCTIONS IN R

Statistical inference, contingency tables, chi-square goodness of fit, regression, generalized linear models.

EXPERIMENT 7 **4 Hours**
REGRESSION MODEL

Import a data from web storage. Name the dataset and now do Logistic Regression to find out relation between variables that are affecting the admission of a student in an institute based on his or her GRE score, GPA obtained and rank of the student.
Also check the model is fit or not. Require (foreign), require (MASS).
Apply multiple regressions, if data have a continuous Independent variable. Apply on the above dataset.
Apply regression Model techniques to predict the data on the above dataset.

EXPERIMENT 8 **6 Hours**

CLASSIFICATION MODEL

a. Install relevant package for classification.
b. Choose classifier for classification problem.
c. Evaluate the performance of classifier.

CLUSTERING MODEL

a. Clustering algorithms for unsupervised classification.
b. Plot the cluster data using R visualizations.

EXPERIMENT 9 **6 Hours**

Develop a Data Science project using R code to build a recommendation system that recommends movies to the users.

EXPERIMENT 10 **6 Hours**

Develop a Data Science project using R to determine whether the consumer's attitude towards a particular product or topic is positive, negative, or neutral.

EXPERIMENT 11 **6 Hours**

Develop a Data Science project using R for Classifying Loan Applications using German Credit Dataset.

EXPERIMENT 12 **6 Hours**

Every Departmental store chain like Walmart wants to predict the store sales in the nearby future so that inventory planning can be done. Along with that, sales prediction helps to increase/decrease store staff based on the rush (More sales can mean more customers are coming to the stores). Also, it is always a good idea to do sales and revenue forecasting to better understand the company cash-flows and overall growth. In this problem, consider the sales data of more than 15 stores based on store, department and week.

Total: 60 Hours

Reference(s)

1. R for Data Science‖, Hadley Wickham and Garett Grolemund, , O'Reilly, 2017
2. R Programming for Data Science, Roger D. Peng, Lean publishing, 2015
3. Practical Data Science with R, Nina Zumel and John Mount, Dreamtech/Manning, 2014
4. Maria Dolores Ugarte, Ana F. Militino, Alan T. Arnholt "Probability and Statistics with R" 2nd Edition on, CRC Press, 2016.
5. Michael Akritas, " Probability & Statistics with R for Engineers and Scientists", 2nd Edition on, CRC Press, 2016

Web Reference(s)

1. http://www.r-bloggers.com/how-to-perform-a-logistic-regression-in-r/
2. http://www.ats.ucla.edu/stat/r/dae/rreg.htm
3. http://www.coastal.edu/kingw/statistics/R-tutorials/logistic.html
4. http://www.ats.ucla.edu/stat/r/data/binary.csv

21AI508 ANALYTICS IN CLOUD COMPUTING LABORATORY 0 0 4 2

Course Objectives

- Understand the basic networking fundamentals to use different devices to build network.
- To install, use, and manage virtual machines in Oracle VirtualBox.
- To develop web applications in cloud, design and development process involved in creating a cloud-based 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. Analyze networking and cloud infrastructure requirements for setting up cloud-based environments.
2. Configure virtual machines and networking components using virtualization platforms.
3. Simulate cloud environments using cloud simulators to evaluate scheduling and resource management strategies.
4. Analyze and visualize large-scale datasets using cloud-based analytics platforms.
5. Deploy web and data processing applications on commercial cloud platforms.

Articulation Matrix

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

EXPERIMENT 1 **4 Hours**

OS INSTALLATION

a. Install Ubuntu/Fedora/Redhat/Windows Operating System.
b. Create a directory while installing the Operating System.

EXPERIMENT 2 **4 Hours**
NETWORK SETUP

a. Design and configure a simple network setup for 10 computers using Packet Tracer
b. Restrict the IP address in the above designed network (CIDR calculation-subnet masking)

EXPERIMENT 3 **4 Hours**
VIRTUAL MACHINE SETUP

a. Install VirtualBox/VMware Workstation with different flavors of Linux or windows OS on top of windows7 or 8.
b. Create 2 machines which communicate with each other internally in the virtual environment.

EXPERIMENT 4 **4 Hours**
TIME SYNCHRONIZATION

a. Install and configure network time protocol for time synchronization in Ubuntu environment.

EXPERIMENT 5 **4 Hours**
DATABASE CREATION

a. Install and configure MySQL Server/MariaDB in the virtual machine
b. Access/Connect the database through SQLYOG

EXPERIMENT 6 **4 Hours**
ANALYZE AND VISUALIZE BIGQUERY DATASET WITH GOOGLE CLOUD DATALAB

a. Setting up Google Cloud and Big Query Environment
b. Creating a project on Google Cloud Platform's one of the Analytics services named as Big Query
c. Accessing publicly available sample datasets in Big Query

EXPERIMENT 7 **4 Hours**
WEBHOSTING

a. Install Google App Engine. Create hello world app and other simple web applications using python/java

EXPERIMENT 8 **4 Hours**
VIRTUAL MACHINE OF DIFFERENT CONFIGURATION

Find procedure to run the virtual machine of different configuration. Check how many virtual machines can be utilized at particular time.

EXPERIMENT 9 **4 Hours**
VIRTUAL BLOCK

Find procedure to attach virtual block to the virtual machine and check whether it holds the data even after the release of the virtual machine.

EXPERIMENT 10 **4 Hours**
EXECUTING PROGRAMS IN VIRTUAL MACHINE

Install a C compiler in the virtual machine and execute a sample program.
Show the virtual machine migration based on the certain condition from one node to the other.

EXPERIMENT 11 **4 Hours**
STORAGE CONTROLLER AND HADOOP
Find procedure to install storage controller and interact with it.
Find procedure to set up the one node Hadoop cluster.

EXPERIMENT 12 **4 Hours**
HADOOP AND FUSE
Mount the one node Hadoop cluster using FUSE.

EXPERIMENT 13 **4 Hours**
INTERACTION USING HADOOP API
Write a program to use the API of Hadoop to interact with it.

EXPERIMENT 14 **4 Hours**
MAP AND REDUCE TASKS
Write a word count program to demonstrate the use of Map and Reduce tasks.

EXPERIMENT 15 **4 Hours**
CLOUD SIM SIMULATION
Simulate a cloud scenario using Cloud Sim and run a scheduling algorithm that is not present in Cloud Sim.

Total: 60 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. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, ―Mastering Cloud Computing, Tata Mcgraw Hill, 2013.
4. Ronald L.Krutz and Russell Dean Vines, Cloud Security: A Comprehensive Guide to Secure Cloud Computing, Wiley-India, 2013.

Web Reference(s)

1. https://www.edureka.co/blog/hadoop-tutorial/
2. https://www.simplilearn.com/tutorials/hadoop-tutorial
3. https://www.pragimtech.com/blog/cloud/cloud-tutorial-for-beginners/

18GE501 SOFT SKILLS - APTITUDE I **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Course Outcomes (COs)

1. Apply number system concepts to solve quantitative aptitude problems involving percentages, averages, and ages.
2. Analyze profit–loss scenarios and ratio–proportion relationships in real-life problem contexts.
3. Apply quantitative techniques to solve problems related to time–work and speed–distance.
4. Analyze logical reasoning problems involving coding–decoding, sequences, data sufficiency, and critical reasoning.

1 **2 Hours**

NUMBER SYSTEMS

Introduction - Definition - Classification on Numbers- Power cycles and remainders - Short cut process-Concept of Highest Common Factor-Concept of Least Common Multiple- Divisibility- Number of zeros in an expression.

2 **2 Hours**

PERCENTAGE

Introduction - Definition and Utility of Percentage - Importance of base/denominator for percentage calculations-Concept of percentage values through additions-Fraction to percentage conversion table.

3 **3 Hours**

AVERAGES AND AGES

Introduction-Average of different groups-Addition or removal of items and change in average-Replacement of some of the items.

4 **3 Hours**

RATIO, PROPORTIONS AND VARIATION

Introduction- Ratio- Properties-Dividing a given number in the given ratio-Comparison of ratios-Proportions-Useful results on proportion- Continued proportion-Relation among the quantities more than two-Variation.

5 **2 Hours**

PROFIT AND LOSS

Gain/Loss and percentage gain or percentage loss-Multiplying equivalents to find sale price-Relation among cost price, sale price, gain/loss and percentage gain or percentage loss-An article sold at two different selling price-Two different articles sold at same selling price-Percentage gain or percentage loss on selling price-Percentage gain or percentage loss on whole property.

6 **2 Hours**

TIME AND WORK

Introduction-Basic concepts-Concepts on working with different efficiencies-Pipes and Cisterns-Work Equivalence (Man Days) -Alternative approach.

7 **2 Hours**

TIME, SPEED AND DISTANCE

Definition-Basics of Time, Speed and Distance - Relative speed-Problems based on Trains-Problems based on Boats and Streams-Problems based on Races-Time taken with two difference modes of transport-Time and distance between two moving bodies.

8 **3 Hours**

CODING AND DECODING

Introduction-Description of Coding method-Coding patterns - Concepts of Coding and Decoding-Problems involving Coding and Decoding methods.

9 **2 Hours**

SEQUENCE AND SERIES

Introduction-Sequences of real numbers - Number and Alphabet Series-Description of Number and Alphabet Series-Analogy-Odd Man Out-Power series.

10 **3 Hours**

DATA SUFFICIENCY

Introduction to Data Sufficiency - Overview of the wide variety of Data Sufficiency problems - Basic introduction on how to determine what information is sufficient to solve a given problem - Common pitfalls to avoid.

11 **3 Hours**

DIRECTION

Introduction to Direction - sense test - Overview of the wide variety of Direction Problems-Direction-Plotting diagrams.

12 **3 Hours**

CRITICAL REASONING

Introduction-Basic concept of critical reasoning- Weaken the Argument-Strengthen the Argument-Flaw in the argument-Evaluate the conclusion.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.

6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

21AI601 COMPUTER VISION 3 0 0 3

Course Objectives

- Introduce the computer vision algorithms and concepts to students, which will enable them to implement computer vision systems with emphasis on applications and problem solving.
- Aims to replace natural human vision recognition by training the computers through specific data processing algorithms.
- Explore and contribute to research and developments in the field of computer vision. Applications range from Biometrics, Medical Diagnosis, Document Processing, Mining of Visual Content etc.

Programme 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.

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

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

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 image formation models and low-level image processing techniques for image analysis.
2. Implement computer vision techniques for image feature extraction and segmentation.
3. Analyze computer vision algorithms for pattern recognition and classification tasks.
4. Evaluate motion estimation techniques for detecting and understanding motion in image sequences.
5. Design computer vision solutions for real-world vision-based 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	3	2		3							1	3	2
3	2	2	2		2							1	3	3
4	2	3	3		3			2				2	3	3
5	2	3	3	2	3	1				2	3	2	3	2

UNIT I **9 Hours**

DIGITAL IMAGE FORMATION AND LOW-LEVEL PROCESSING

Fundamentals of Image Formation, Transformation: Orthogonal, Euclidean, Affine, Projective; Fourier Transform, Convolution and Filtering, Image Enhancement, Restoration, Histogram Processing. Depth estimation and Multi camera views: Perspective, Binocular Stereopsis: Camera and Epipolar Geometry; Homography, Rectification, DLT, RANSAC, 3D reconstruction framework; Auto Calibration-Introduction on computer vision using Neural network.

UNIT II **9 Hours**

FEATURE EXTRACTION

Edges - Canny, LOG, DOG; Line detectors (Hough Transform), Corners - Harris and Hessian Affine, Orientation Histogram, SIFT, SURF, HOG, GLOH, Scale-Space Analysis- Image Pyramids and Gaussian derivative filters, Gabor Filters and DWT. Image Segmentation: Region Growing, Edge Based approaches to segmentation, Graph-Cut, Mean-Shift, MRFs, Texture Segmentation; Object detection.

UNIT III **9 Hours**

PATTERN ANALYSIS

Clustering: Mean-Shift**,** Density based Spatial, EM using Gaussians Mixture model, Classification: Discriminant Function, Supervised, Un-supervised, Semi-supervised; Classifiers: KNN, ANN models; Dimensionality Reduction: PCA, LDA, ICA; Non-parametric methods.

UNIT IV **9 Hours**

MOTION ANALYSIS

Background Subtraction and Modeling, Optical Flow, KLT, Spatio-Temporal Analysis, Dynamic Stereo, Motion parameter estimation. Shape from X: Light at Surfaces, Phong Model, Reflectance Map, Albedo estimation, Photometric Stereo, Use of Surface Smoothness Constraint, and Shape from Texture, color, motion and edges.

UNIT V **9 Hours**

APPLICATIONS

Emotion Recognition – Real Time Object Detection – Gesture Recognition – Face Detection- Biometrics- Augmented Reality- Stitching and document processing

Total: 45 Hours

Reference(s)

1. Forsyth, D. A. and Ponce, J., "Computer Vision: A Modern Approach", Prentice Hall, 2nd Ed.
2. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited 2011.
3. Richard Hartley and Andrew Zisserman, Multiple View Geometry in Computer Vision, Second Edition, Cambridge University Press, March 2004.
4. Fukunaga, K., Introduction to Statistical Pattern Recognition, Second Edition, Academic Press, Morgan Kaufmann, 1990.

21AI602 DATA VISUALIZATION 3 0 2 4

Course Objectives

- Understand the methodologies used to view large data sets
- Analyze the various process used in data visualization
- Explore the fundamentals settings of Interactive data visualization

Programme 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.

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. Interpret complex and voluminous datasets using appropriate data representation techniques.
2. Design effective visualizations using suitable data visualization methods and mappings.
3. Analyze data visualization processes and tools for transforming data into visual insights.
4. Implement principles of visual perception and graphical design for data analysis tasks.
5. Apply interactive data visualization techniques to derive and communicate meaningful inferences.

Articulation Matrix

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

UNIT II **9 Hours**

DATA VISUALIZATION METHODS

Mapping – Locations on a Map- 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- EDA using Python

UNIT III **9 Hours**

DATA VISUALIZATION PROCESS

Acquiring data, - Where to Find Data, Tools for Acquiring Data from the Internet, Locating Files for Use with Processing, Loading Text Data, Dealing with Files and Folders - Advanced Web Techniques. Parsing data - Levels of Effort, Tools for Gathering Clues, Text Is Best, Text Markup Languages, Regular Expressions (regexps), Grammars and BNF Notation, Compressed Data, Vectors and Geometry, Binary Data Formats, Advanced Detective Work.

UNIT IV **9 Hours**

PRINCIPLES FOR FIGURE DESIGNS

The Principle of Proportional ink – Handling Overlapping points - Common pitfalls of Color use – Redundant coding – Multipanel figures-Title, Captions and Tables- Balance the Data and Context – Use Larger Axis labels

UNIT V **9 Hours**

INTERACTIVE DATA VISUALIZATION

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

EXPERIMENT 1 **5 Hours**

Develop the Student Table and perform Data Preprocessing and Cleaning on Student Datasets.

EXPERIMENT 2 **6 Hours**

Create a Data Series for Weather Forecasting Application to display different categories.

EXPERIMENT 3 **6 Hours**

Create a Stock Prediction Dashboard to compare different predictions.

EXPERIMENT 4 **6 Hours**

Design a Website Traffic system to display various variability in website traffic and time-based trends.

EXPERIMENT 5 **7 Hours**

Develop the interactive dashboard maintenance system for COVID cases to display particular location.

Total: 45+30=75 Hours

Reference(s)

1. Ben Fry, "Visualizing data: Exploring and explaining data with the processing environment", O'Reilly, 2008
2. Claus O. Wilke, "Fundamentals of Data Visualization -A Primer on Making Informative and Compelling Figures", O'Reilly, April 2019
3. Scott Murray, "Interactive data visualization for the web", O'Reilly Media, Inc., Second Edition, 2017.
4. Stephen Few, "Information dashboard design: Displaying data for at-a-glance monitoring", second edition, Analytics Press, 2013
5. Storytelling with Data: "A Data Visualization Guide for Business Professionals", Wiley, 2015

21AI603 NATURAL LANGUAGE PROCESSING 3 0 0 3

Course Objectives

- Provide basic mathematical models and methods used in NLP applications to formulate computational solutions.
- Understand the syntax and semantics of natural languages. How they work and how machine can convert from one natural language to another.
- Acquire the knowledge on designing procedures for natural language resource annotation and the use of related tools for text analysis and hands-on experience of using such tools.

Programme 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.

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

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

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 fundamental concepts of natural language processing including linguistic structures, probability models, and language modeling techniques.
2. Evaluate sentiment classification and sequence labeling methods using probabilistic and neural network–based models.
3. Develop syntactic parsing models using context-free grammars and dependency parsing approaches.
4. Apply computational semantics and semantic parsing techniques for extracting meaning from natural language text.
5. Implement discourse analysis and coreference resolution methods for improving text understanding in NLP applications.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction - Mathematical Foundations - Elementary Probability Theory - Essential Information Theory – Linguistic Essentials- Parts of Speech and Morphology- Phrase Structure- Semantics and Pragmatics - Regular Expressions, Text Normalization, Edit Distance - N-gram Language Models

UNIT II **9 Hours**

SENTIMENT CLASSIFICATION AND LOGISTIC REGRESSION

Naive Bayes Classification and Sentiment - Logistic Regression- Vector Semantics -Neural Nets and Neural Language Models - Sequence Labeling for Parts of Speech- Deep Learning-Architectures for Sequence Processing

UNIT III **9 Hours**

SYNTACTIC PARSING

Context-Free Grammars, Grammar rules for English, Treebanks, Normal Forms for grammar – Dependency Grammar- Ambiguity – Cocke Kasami Younger (CKY) algorithm - Partial Parsing - Statistical Parsing- Dependency Parsing- Dependency Formalisms-Treebanks- Transition-Based Dependency Parsing- Graph-Based Dependency Parsing.

UNIT IV **9 Hours**

COMPUTATIONAL SEMANTICS AND SEMANTIC PARSING

Computational Desiderata for Representations- Model-Theoretic Semantics- First-Order Logic- Event and State Representations- Logics -Relation Extraction- Relation Extraction Algorithms- Word Senses- Relations between Senses- WordNet: A Database of Lexical Relations- Disambiguation- Alternate WSD algorithms and Tasks -Semantic Role Labeling.

UNIT V **9 Hours**

DISCOURSE COHERENCE AND COREFERENCE RESOLUTION

Lexicons for Sentiment, Affect, and Connotation, Discourse Coherence -Coherence Relations- Discourse Structure Parsing- Centering and Entity-Based Coherence- Representation learning models for local coherence- Co reference Resolution- Co reference Tasks and Datasets- Architectures for Co reference Algorithms- A neural mention-ranking algorithm

Total: 45 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, 2014.
2. Foundations of Statistical Natural Language Processing by Christopher D. Manning and Hinrich Schuetze, MIT Press, 2018
3. Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, O'Reilly Media; 1 edition, 2009
4. Breck Baldwin, ―Language processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
5. Richard M Reese, ―Natural Language Processing with Java‖, O'Reilly Media, 2015.
6. Nitin Indurkhya and Fred J. Damerau, ―Handbook of Natural Language Processing, Second Edition, Chapman and Hall/CRC Press, 2010.
7. Tanveer Siddiqui, U.S. Tiwary, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.

21AI607 NATURAL LANGUAGE PROCESSING LABORATORY 0 0 4 2

Course Objectives

- To understand the concepts of Natural Language Processing
- To enable students to work on various advanced techniques like word embeddings, deep learning attention, and more.
- To provide skills to work towards solution of real-life 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. Apply text preprocessing techniques such as tokenization, stemming, and normalization.
2. Implement sentiment analysis techniques using linguistic and statistical features.
3. Develop n-gram language models for sequence prediction tasks.
4. Implement syntactic and dependency parsing techniques for natural language analysis.
5. Analyze deep learning–based models used in natural language processing 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	1	2	2	2	2								2	2
3	2	2	2	2	2								3	3
4	2	2	2	2	2								3	3
5	2	2	2	2	2								3	3

EXPERIMENT 1 **10 Hours**

Develop a Language Translator Application using stemming and tokenization processes to get the root words in the given sentences.

EXPERIMENT 2 **10 Hours**

Create a New Chabot Application Use an n-gram language model to predict the next sequence of words or letters in a sentence.

EXPERIMENT 3 **10 Hours**

Create a Hospitality Industry Application applying machine language Translator Techniques.

EXPERIMENT 4 **10 Hours**

Design a Political Analyses Review Application using Sentiment Analysis.

EXPERIMENT 5 **10 Hours**

Create a Voice Activated- Virtual Assistance Application using Deep Learning Concepts.

EXPERIMENT 6 **10 Hours**

Develop a Game Prediction APP and Analyse the Winning Prediction using the Query Expansion for Information Retrieval Models Database.

Total: 60 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, 2014.
2. Foundations of Statistical Natural Language Processing by Christopher D. Manning and Hinrich Schuetze, MIT Press, 2018
3. Steven Bird, Ewan Klein and Edward Loper Natural Language Processing with Python, O'Reilly Media; 1 edition, 2009
4. Breck Baldwin, ―Language processing with Java and LingPipe Cookbook, Atlantic Publisher, 2015.
5. Richard M Reese, ―Natural Language Processing with Java‖, O'Reilly Media, 2015.

Web Reference(s)

1. https://www.kaggle.com/
2. https://towardsdatascience.com/gentle-start-to-natural-language-processing-using-python-e46c07addf3
3. https://github.com/alvations/awesome-community-curated-nlp

21AI608 COMPUTER VISION LABORATORY 0 0 4 2

Course Objectives

- Understand the major techniques in computer vision and image processing.
- Apply computer vision techniques to real-world challenges and 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. Implement image preprocessing techniques including noise removal, geometric transformation, and shape analysis.
2. Detect visual features such as edges, corners, and regions using computer vision algorithms.
3. Recognize objects in images and videos using object detection techniques.
4. Analyze object motion and activity using motion estimation and tracking algorithms.
5. Develop vision-based applications using OpenCV for real-world scenarios.

Articulation Matrix

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

EXPERIMENT 1 **8 Hours**

Detect the shape, label the shape and its colour, and highlight the edges and corners after removing the noise in the artistic image.

EXPERIMENT 2 **9 Hours**

Develop a personalized lane detection system employing Perspective Projection to guide traffic flow and indicate designated lanes for vehicle navigation.

EXPERIMENT 3 **8 Hours**

Detect the hand gestures in the home surveillance video

EXPERIMENT 4 **9 Hours**

Detect the presence of the human face, apply blur to facial regions and count the number of individuals passing through a designated area in the home surveillance video.

EXPERIMENT 5 **9 Hours**

Classify the vehicles on the road and calculate the total count of vehicles moving along the roadway in the traffic monitoring video.

EXPERIMENT 6 **8 Hours**

Apply image segmentation to identify and locate the people present in the Video Surveillance.

EXPERIMENT 7 **9 Hours**

Build a computer vision-based QR Code Scanner designed for seamless contactless transactions, ensuring the security and efficiency of mobile payments.

Total: 60 Hours

Reference(s)

1. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer International, 2011.
2. Reinhard Klette, "Concise Computer Vision: An Introduction into Theory and Algorithms", Springer, 2014.
3. E. R. Davies, "Computer and Machine Vision", Fourth Edition, Elsevier, 2012.

Web Reference(s)

1. https://www.pyimagesearch.com/start-here/
2. https://www.geeksforgeeks.org/opencv-python-tutorial/

18GE601 SOFT SKILLS-APTITUDE II **0 0 2 0**

Course Objectives

- Expose the undergraduate students to such methods and practices that help, develop and nurture qualities such as character, effective communication, aptitude and holding ethical values. It will provide a lot of activities and examples for a student to learn and develop these life skills.

Course Outcomes (COs)

1. Apply probability, set theory, permutation, and combination techniques to solve real-life quantitative problems.
2. Solve numerical problems involving logarithms, progressions, and interest calculations.
3. Analyze cube and cuboid-based problems to determine structural and color-based properties.
4. Interpret tabular and graphical data to compute ratios, percentages, and averages.
5. Apply logical reasoning strategies to solve age, relation, arrangement, and visual reasoning problems.

1 **2 Hours**

PERMUTATION AND COMBINATION
Definition-Fundamental rules-Theorems on Permutation-Theorems on Combination.

2 **2 Hours**

PROBABILITY
Concept and Importance of Probability-Underlying factors for real Life estimation of Probability-Basic facts about probability-Some important consideration while defining event.

3 **2 Hours**

SYLLOGISM AND VENN DIAGRAM
Concepts on Syllogisms-Venn diagram-Interpretation-Venn diagram-solving.

4 **4 Hours**

SIMPLE INTEREST AND COMPOUND INTEREST
Introduction-Definition - Effect of change of P, R, T on simple interest-Amount-Amount becomes N times the principle-Repayment of debt in equal installments-Rate and time are numerically equal-Compound Interest-Conversion period-Basic formula-Special cases-To find the principle / Time /Rate-Difference between Compound Interest and Simple Interest-Equal annual installment to pay the borrowed amount.

5 **2 Hours**

MIXTURES AND ALLIGATION
Definition-Alligation rule-Mean value (cost price) of the mixture-Some typical situations where allegation can be used.

6 **4 Hours**

CUBE AND LOGARITHM
Introduction-Basic Concepts of Cube and Cuboid-Problems involving cubes and cuboids of various dimensions-Problems involving coloured cubes and cuboids - Basic concepts of Logarithm-Laws of Logarithms including change of base-Common logarithm (base 10) - Properties of Logarithms to solve equations involving logarithmic expressions.

7 **2 Hours**

DATA INTERPRETATION

Introduction-Ratio-Percentage-Average-Tables - Graphs and Charts.

8 **2 Hours**

PROGRESSION AND LOGICAL REASONING

Arithmetic progression-Geometric progression-Harmonic progression-Theorems related with progressions.

9 **2 Hours**

PROBLEM ON AGES

Introduction-Basic concept-Usage of Percentage and Averages -Applications.

10 **2 Hours**

ANALYTICAL REASONING

Introduction-Basic concept-Non-verbal Analytical Reasoning -Arrangements.

11 **2 Hours**

BLOOD RELATION

Introduction-Basic concept-Kinds of relation-Tree diagram -Relations.

12 **2 Hours**

VISUAL REASONING

Introduction-Basic concepts-Odd man out-Next series-Mirror image and water image

13 **2 Hours**

SIMPLIFICATIONS

Introduction-Basic concepts-Arithmetic operations-Equation solving methods-Puzzles.

Total: 30 Hours

Reference(s)

1. Abhijit Guha, Quantitative Aptitude for Competitive Examinations, Fourth Edition, Mc Graw Hill Publications.
2. U. Mohan Rao, Quantitative Aptitude for Competitive Examinations, Scitech Publications Pvt Ltd, India.
3. Dinesh Khattar, The Pearson Guide to Quantitative Aptitude for Competitive Examinations, Third Edition, Pearson Education Pvt Ltd, India, 2016.
4. Dr. R S Aggarwal, A Modern Approach to Verbal and Non Verbal Reasoning, Revised Edition, S Chand Publications.
5. Arun Sharma, How to prepare for Logical Reasoning for CAT & other Management Exams, Fifth Edition, Mc Graw Hill Publications.
6. Jaikishan and Premkishan, How to Crack Test of Reasoning in all Competitive Examinations, Revised Edition, Arihant Publications.

21HS002 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)

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.

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. Examine human values and ethical principles using value frameworks to interpret personal attitudes and behavioral choices.
2. Apply ethical values and social responsibilities to demonstrate appropriate conduct in personal and professional interactions.
3. Analyze human aspirations and relationships to understand the role of harmony in individual, family, and societal well-being.
4. Examine societal and professional challenges using ethical reasoning to address issues in diverse socio-economic contexts.
5. Assess ecological and existential harmony using holistic perspectives to promote sustainable and responsible living.

Articulation Matrix

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

UNIT I **6 Hours**

COURSE INTRODUCTION - NEED, BASIC GUIDELINES AND ANALYSIS

1.Importance of Human Values & Ethics in 21st Century
2.Understanding the theory of basic human values and ethics
Openness to change
Self-enhancement
Conservation
Self-transcendence
3. 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. (2011). The Little Book of Ethics: A Human Values Approach. Australia: G.P. Martin.
2. Gupta, N. L. (2002). Human Values for The 21St Century. India: Anmol Publications Pvt. Limited.
3. Mishra, A. (2017). Happiness Is All We Want. India: Bloomsbury Publishing.
4. Universal Human Values. (2023). (n.p.): Books clinic Publishing.
5. A Textbook on Professional Ethics and Human Values. (2007). India: New Age International (P) Limited

21AI702 IOT ANALYTICS 3 0 0 3

Course Objectives

- Understand the challenges of IoT analytics systems development and deployment.
- To learn about data analytics and use cloud offerings related to IoT.
- Ability to understand the Searching and security requirements of IoT.
- Acquire the knowledge of Tools, Platform and Services for IoT Analytics.
- To Develop IoT infrastructure for real time scenario.

Programme 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.

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. Analyze IoT networking protocols and deployment challenges relevant to analytics-driven IoT systems.
2. Apply cloud-based IoT architectures and data analytics models for scalable IoT applications.
3. Evaluate security requirements and search mechanisms in Internet of Things environments.
4. Implement IoT analytics platforms, tools, and services to construct analytics-enabled solutions.
5. Assess real-time IoT analytics applications in smart environments using performance criteria.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION TO IoT ANALYTICS

Introduction – IoT Data and Big Data - Challenges of IoT Analytics - Applications - IoT Devices and Networking Protocols

UNIT II **9 Hours**

IoT CLOUD, WEB SERVICES AND DATA ANALYTICS

Cloud based IoT Platform - Iaas, Paas and Saas paradigms - Requirements of IoT in Big Data Analytics Platform - Functional Architecture - Web server: Web server for IoT applications

9 Hours

UNIT III

SEARCHING THE INTERNET THINGS AND IoT SECURITY

Introduction – A search architecture for social and physical sensors - Local Event Retrieval – Sensor Metadata – Venue Recommendation - Security Requirements in IoT - Security Concerns in IoT Applications - Security Architecture in the Internet of Things - Insufficient Authentication/Authorization - Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT

UNIT IV **9 Hours**

TOOLS AND SERVICE FOR IoT ANALYTICS

Architecture for IoT Analytics Applications – Nodes - Development Examples - Open source framework for IoT Analytics as a service - Sensing as a service Infrastructure Tools and Platforms

9 Hours

UNIT V

IoT ANALYTICS APPLICATIONS AND CASE STUDIES

Data Analytics and smart Building - Smart City - Data collection to deployment and operationalization using the vital platform

Total: 45 Hours

Reference(s)

1. John Soldatos, Building Blocks for IOT Analytics, River Publisher 2017

2. Andrew Minteer, Analytics for the Internet of Things, Packet Publishing Pvt. Ltd., Birmingham, 2017.
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.
4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things Key applications and Protocols, Wiley, 2012.
5. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van,2018.

Web Reference(s)

1. https://www.avsystem.com/blog/iot-protocols-and-standards/
2. https://www.fingent.com/blog/role-of-data-analytics-in-internet-of-things-iot/
3. https://geekflare.com/iot-platform-tools/

21AI707 IOT ANALYTICS LABORATORY 0 0 4 2

Course Objectives

- Understand the challenges of IOT analytics systems development and deployment.
- To learn about data analytics and use cloud offerings related to IOT.
- To develop IOT infrastructure for real time scenario

Programme 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.

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. Configure IoT controllers, sensors, and cloud platforms for data acquisition and device communication.
2. Develop real-time IoT applications for monitoring and control in smart environments.
3. Deploy IoT applications using standard communication protocols and cloud services.

Articulation Matrix

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

EXPERIMENT 1 **9 Hours**

Develop an application that indicates the operational of CNC machinery and monitoring the equipment condition status using LED signals

EXPERIMENT 2 **9 Hours**

Develop a program for Distance Measurement (between two objects) and Obstacle Detection Applications using Ultrasonic Sensors and LEDs.

EXPERIMENT 3 **9 Hours**

Create a program for Smart Home Application for controlling the Automatic Room Temperature and Lighting Control Systems.

EXPERIMENT 4 **9 Hours**

Develop a smart application for traffic signal control and motion detection using PIR(Passive Infrared) sensors in IoT

EXPERIMENT 5 **8 Hours**

Implement the IoT-based weather reporting system based on current and forecasted weather conditions.

EXPERIMENT 6 **8 Hours**

Implement the program for advanced Smart Home Solution using IoT for Password Door Lock Security for the Automated Appliance Control with smart waste management.

EXPERIMENT 7 **8 Hours**

Develop a mobile application for smart irrigation systems using IoT device management to monitor soil moisture levels and control water usage efficiently.

Total: 60 Hours

Reference(s)

1. John Soldatos, Building Blocks for IOT Analytics, River Publisher 2017
2. Andrew Minteer, Analytics for the Internet of Things, Packet Publishing Pvt. Ltd., Birmingham, 2017.
3. Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Avesand, Stamatis Karnouskos, David Boyle, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014. Christopher M.Bishop, Pattern Recognition and Machine Learning, Springer, 2006
4. Olivier Hersent, David Boswarthick, Omar Elloumi, The Internet of Things Key applications and Protocols, Wiley, 2012.
5. Practical Internet of Things Security (Kindle Edition) by Brian Russell, Drew Van,2018

Web Reference(s)

1. https://randomnerdtutorials.com/arduino-vs-raspberry-pi-vs-beaglebone-vs-pcduino/
2. https://www.intechopen.com/books/internet-of-things-iot-for-automated-and-smart-applications/ smart-home-systems-based-on-internet-of-things

21AI708 PROJECT WORK I 0 0 6 3

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- 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	3	2	3	3
4	2	2	3	3	3	3	3	3	3	3	3	2	3	3
5	2	2			2			3	3	3		2	3	3

21AI801 PROJECT WORK II **0 0 18 9**

Course Objectives

- Work in teams to propose, formulate, and solve a challenging open-ended design problem of significant scope, depth, and breadth.
- Understand and incorporate engineering standards and multiple realistic constraints, within realistic design time, budget, and performance objectives.
- Develop a prototype of the proposed design and demonstrate the prototype in accordance with the specifications.
- 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	3	2	3	3
4	2	2	3	3	3	3	3	3	3	3	3	2	3	3
5	2	2			2			3	3	3		2	3	3

LANGUAGE ELECTIVES

18HS201 COMMUNICATIVE ENGLISH II 1 0 2 2

Course Objectives

- Read and understand ideas of complex text on both concrete and abstract topics
- Listen and understand technical discussions in his/her field of specialization
- Produce clear, detailed text on a wide range of subjects and explain a viewpoint on a topical issue giving the advantages and disadvantages of various options
- Interact with a degree of fluency and spontaneity that makes regular interaction without strain

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. Use appropriate grammar and vocabulary that is expected at the BEC Vantage exam level.
2. Understand the general meaning of non-routine letters, and of a report of predictable / unpredictable topic
3. Write simple reports of factual nature and factual non-routine letters
4. Ask for factual information and understand the answer; and take/pass on workplace messages
5. Express opinions and present arguments to a limited extent; and give simple, prepared presentations on familiar topics

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

UNIT I **9 Hours**

GRAMMAR

Tenses - Future continuous, Future perfect, Future perfect continuous, Past perfect, Past perfect continuous - Adjectives and adverbs - Mixed conditionals - Modals - can't have, needn't have - Modals of deduction and speculation - Narrative tenses - Passives - Phrasal verbs, extended - Relative clauses - Reported speech - Will and going to, for prediction - Wish - Would expressing habits, in the past.

UNIT II **9 Hours**

READING

Scanning and reading for gist - Understanding text structure - Reading for gist and specific information - Vocabulary and structure - Understanding sentence structure and error identification

UNIT III **9 Hours**

WRITING

A message, memo or email, Giving instructions, explaining a development, asking for comments, requesting information, agreeing to requests - Business correspondence: explaining, apologising, reassuring, complaining, short report: describing, summarising - proposal: describing, summarising, recommending, persuading.

UNIT IV **9 Hours**

LISTENING

Listening for and noting specific information - Listening to identify topic, context, Function - Following the main points and retrieving specific information from the text.

UNIT V **9 Hours**

SPEAKING

Giving personal information: Talking about present circumstances, past experiences and future plans, expressing opinions, speculating - Organising a larger unit of discourse: Giving information and expressing and justifying opinions - Turn-taking: negotiating, collaborating, exchanging information, expressing and justifying opinions, agreeing/disagreeing, suggesting, speculating, comparing and contrasting, and decision- aking. 1.A Horse and Two Goats - R K Narayan 2.My Lord the Baby - Rabindranath Tagore 3.Twist in the Tale - Jeffery Archer.4.The Third and Final Continent - Jhumpa Lahiri 5.The Gift of the Magi - O Henry

Total: 45 Hours

Reference(s)

1. Guy Brook-Hart, "BEC Vantage: Business Benchmark Upper-Intermediate- Student's Books" 1st Edition, Cambridge University Press, New Delhi, 2006.
2. Ian Wood, Paul Sanderson, Anne Williams with Marjorie Rosenberg, "Pass Cambridge BEC Vantage- Student's Book" 2nd Edition, Cengage Learning, New Delhi, 2014
3. Michael Handford, Martin Lisboa, Almut Koester, Angela Pitt, "Business Advantage - Student's Book Upper-Intermediate" Cambridge University Press, New Delhi, 2014.
4. Cambridge Examinations Publishing, "Cambridge BEC VANTAGE - Self-study Edition", Cambridge University Press, UK, 2005.

18HSC01 CHINESE 1 0 2 2

Course Objectives

- To help students appear for HSK Level 1 Exam
- To help students acquire the basics of Chinese language
- To teach the students how to converse in Chinese in various 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.

Course Outcomes (COs)

1. Listen and identify individual sounds of Chinese
2. Use basic sounds and words while speaking
3. Read and understand short passages on familiar topics
4. Use basic sentence structures while writing
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**

Hello | 1. Initials and Finals of Chinese | b,p,m,f,d,,n,l,g,k,h,j,q,x | 2. Tones Four | 3. Chinese Syllables | 4.Tone S

UNIT II **9 Hours**

Thank you | Initials and Finals of Chinese | The Neutral Tone | Rules of Tone Marking and Abbreviation

UNIT III **9 Hours**

1. What's your name - In the school; -In the classroom; -In the school | The Interrogative Pronoun | 2 The Sentence | 3 Interrogative Sentences with

UNIT IV **9 Hours**

She is my Chinese teacher | In the library | The Interrogative Pronouns | The Structural Particle | The interrogative Particle

UNIT V **9 Hours**

Her daughter is 20 years old this year | 1. The Interrogative Pronoun | 2. Numbers below 100 | 3. Indicating a Change | The Interrogative Phrase

Total: 45 Hours

18HSF01 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. To 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 francaise, alphabets, les numeros, les jours, les mois.| Grammaire Les verbes s appeler,etre, avoir, les articles definis, indefinis | Communication - Saluer, s informer sur quelquun, demander de se presenter | Lexique - Les alphabets, les nationalites, 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, d ecrire son voisin, s informer sur un logement | Lexique - L habitat, les pieces, l equipement, la description physique

UNIT III **9 Hours**

VIVRE AU QUOTIDIEN

Grammaire - Articles contractes, verbes vouloir, pouvoir, devoir, adjective interrogative, 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 - OUVRIR -Ãƒ?Ã‚Â LA CULTURE

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait | Communication - Propose quelqu un de faire quelque chose, raconteur une sortie au passe parler un film | Lexique - Les sorties, la famille, 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 refuse rune invitation, donner des instructions, commander au restaurant | Lexique Les services et les commerces, les aliments, les ustensiles, argent

Total: 45 Hours

Reference(s)

1. Saison A1, Methode de francais
2. Hachette FLE

18HSG01 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 sounds and words while speaking
3. Read and understand short passages on familiar topics
4. Use basic sentence structures while writing
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**

Introduction to German language: Alphabet - Numbers - Greetings - Days and Seasons- Working with Dictionary.

UNIT II **9 Hours**

Nouns - articles - Speaking about one self - Listening to CD supplied with the books, paying special attention to pronunciation

UNIT III **9 Hours**

Regular & Irregular verbs - Personal pronouns - family - Introduction to types of sentences

UNIT IV **9 Hours**

Question words-Types of Questions - Nominative case- Verb Conjugation - country - nationalities

UNIT V **9 Hours**

Verbs - to be & to have - conjugation - Hobbys - 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.

18HSH01 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 acquire the ability to 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. Appear for 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				

UNIT I **9 Hours**

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

UNIT II **9 Hours**

Nouns: Genders (Masculine & Feminine Nouns long vowels and short vowels - -Masculine & Feminine - Reading Exercises.

UNIT III **9 Hours**

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

UNIT V **9 Hours**

Speaking: Model Sentences and Rhymes - Speaking practice for various occasions.

Total: 45 Hours

Reference(s)

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

18HSJ01 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 etiquettes

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**

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. N1 wa N2 desu - N1 wa N2 ja arimasen - S ka N1 mo - N1 no N2 - san - Kore - Sore - Are - Kono N - Sono N - Ano N - Sou desu - Sou ja Arimasen - S1 ka - S2 ka - N1 no N2 - Sou desu ka - Koko - Soko - Asoko - Kochira - Sochira Achira - N1 wa N2 (place) desu - Doko - Dochira - N1 no N2 - Ko - So - A - Do (Demonstrative words) - O kuni Kanji10 - Technical Japanese Vocabulary (30 Numbers)

UNIT II **9 Hours**

Introduction to time - Ji - Fun - Pun - Introduction of verbs - V Masu - V Masen - V Mashita - V Masendeshita N (Time) Ni V - N1 Kara - N2 Made - N1 to N2 - S Ne - N (Place) e Ikimasu - Kimasu - Kaerimasu - Doko (e) Mo Ikimasen - Ikimasendeshita - N (Vechile) de Ikimasu - Kimasu - Kaerimasu - N (Person / Animal) to V - Itsu - S Yo N o (transitive) - N o Shimasu - Nani o Shimasuka - Nan and Nani - N (place) de V - V Masenka - V Mashou - o - Kanji 10 - Technical Japanese Vocabulary (30 Numbers) .

UNIT III **9 Hours**

N (tool/means) de V - Word/Sentence wa Go de Nani desu ka - N (person) Ni Agemasu, etc - N (person) Ni Moraimasu etc - Mou V Mashita - Introduction to Adjectives - N wa Na adj (Na) desu - N wa II adj (II) desu - Na adj Na n - II adj (II) N - Totemo - Amari - N wa Dou desuka - N1 wa Donna N2 desuka - S1 Ga S2 - Dore N ga Arimasu - Wakarimasu - N Ga Sukidesu - Kiraidesu - Jozu desu - Heta desu - Donna N - Yoku - Daitai - Takusan - Sukoshi - Amari - Zenzen - S1 kara S2 - Doushite - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT IV **9 Hours**

N ga Arimasu - Imasu - N1 (place) Ni N2 ga Arimasu - Imasu - N1 (thing/person/place) no N2 (position) - N1 ya N2 - Word (s) desuka - Chirisosu wa Arimasuka - Saying numbers - Quantifier (period) Ni kai V - Quantifier Dake - N dake - Past tense of Noun sentences and Na adjective sentences - Past tense of ii adjective sentences - N1 wa N2 yori adjective desu - N1 to N2 to dochira ga adjective desu ka - N1/N2 no houga adjective desu - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

UNIT V **9 Hours**

N ga hoshi desu - V masu form tai desu - N (place) e V masu form - N Ni - ikimasu - kimasu - kaerimasu N ni V - N o V - dou ko ka - nani ka - go chuu mon - Verb conjugation - Verb groups - Verb te form - V te form kudasai - V te form imasu - V masu from mashouka - S1 ga S2 - N ga V - V te form mo ii desu - V te form wa ikemasen - V te form imasu Shrimasen - Kanji 10 - Technical Japanese Vocabulary (30 Numbers)

Total: 45 Hours

Text Book

1. Japanese for Everyone: Elementary Main Textbook 1-2, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

Reference

1. Japanese for Everyone: Elementary Main Textbook1-1, Goyal Publishers and Distributors Pvt. Ltd., Delhi, 2007.

PROFESSIONAL ELECTIVES

21AI001 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.

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

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

PSO1: 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 agile principles, values, and methodologies used in modern software development environments.
2. Examine agile process frameworks such as Scrum, Extreme Programming, Kanban, and Feature Driven Development for iterative software development.
3. Assess knowledge management practices that support information sharing and decision making in agile software projects.
4. Apply agile requirements engineering techniques for managing evolving software requirements.
5. Evaluate agile quality assurance practices including test-driven development, pair programming, and agile metrics for improving software quality.

Articulation Matrix

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

UNIT I **9 Hours**

AGILE METHODOLOGY

Theories for Agile management – agile software development – traditional model vs. agile model - classification of agile methods – agile manifesto and principles – agile project management – agile team interactions – ethics in agile teams - agility in design, testing – agile documentations – agile drivers, capabilities and values.

UNIT II **9 Hours**

AGILE PROCESSES

Extreme Programming: Method overview – lifecycle – work products, roles and practices- Lean production - SCRUM, Crystal, Feature Driven Development, Adaptive SoftwareDevelopment, Kanban model.

UNIT III **9 Hours**

AGILITY AND KNOWLEDGE MANAGEMENT

Agile information systems – agile decision making - Earls schools of KM – institutionalknowledge 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 – agilerequirements 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.

21AI002 UI AND UX DESIGN **3 0 0 3**

Course Objectives

- Study about designing web pages and understand the difference between UI and UX Design.
- To understand the concept of UX design and how it has evolved Able o to understand UX design process and methodology.
- Learning the Importance and scope of Interaction design, User centered design.

Programme Outcomes (POs)

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

PO2: Problem Analysis: Identify, formulate, review research literature, and 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.

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. Analyze user research data to derive personas and customer journey maps for user-centered design..
2. Construct interaction flows and information architectures that support intuitive user navigation in digital products.
3. Develop low-fidelity and high-fidelity wireframes using modern interface design tools and techniques.
4. Apply visual design elements and UI principles to create effective interactive interface prototypes.
5. Evaluate digital interface designs through usability testing methods and interpret user feedback.

Articulation Matrix

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

Principles of Sketching - Core Responsive Design - Wireframing vs Wireflows - Click through Wireframing Prototyping - Wireflow Creation - Work with different tools – Figma - Low-High Fidelity Design: Inclusive Design and Designing for Accessibility - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Designing animations and interactions

UNIT IV **9 Hours**

UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING

Building a Design System – Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration - Use of grids in UI design - Design animations and interaction patterns for key UI elements

UNIT V **9 Hours**

USABILITY EVALUATION AND PRODUCT DESIGN

Type of usability evaluation – Qualitative & Quantitative evaluation - Guerilla testing, A/B Testing, Unmoderated remote usability testing, Card sorting, Session recording, think aloud - Think aloud – Introduction and advantages - Designing evaluation protocol - Conducting usability evaluation study - Conduct Usability Test explicit - Synthesize Test Findings - practices in corporate World - 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: Toward the 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.

21AI003 WEB FRAMEWORKS 3 0 0 3

Course Objectives

- Understand the architecture behind an Angular application and how to use it
- To understand the significance of using MongoDB as a database system
- To understand the role of React in designing front-end components
- Build a Web Server in Node and understand how it really works
- Develop a web application and API using web frameworks

Programme Outcomes (POs)

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

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

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

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

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. Develop dynamic web pages using Angular modules, components, routing, and animations.
2. Implement CRUD-based web applications by integrating web frameworks with MongoDB.
3. Design Progressive Web Applications using Angular features such as service workers and server-side rendering.
4. Design single-page applications with reusable UI components using React and modern CSS frameworks.
5. Build server-side applications and RESTful services using Node.js and Express.js.

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

UNIT I **9 Hours**

ANGULAR FRONT-END FRAMEWORK

Introduction - Setup - Architecture: Modules, Components, Services and DI fundamentals - Components and Templates – Configuration- Forms - Observables & RxJS - Boot Strapping - Ng Modules - Dependency Injection - Http Client - Routing and Navigation – Animations

UNIT II **9 Hours**
FRAMEWORKS WITH DATABASES
MongoDB - MongoDB Basics - Documents - Collections - Query Language - Installation - The mongo Shell - Schema Initialization - MongoDB Node.js Driver - Reading from MongoDB - Writing to MongoDB - CRUD operations - projections - Indexing - Aggregation - Replication - Sharding - Creating backup – Deployment

UNIT III **9 Hours**
ANGULAR TECHNIQUES
Service workers & PWA - Server-side rendering - Angular Libraries - Schematics - CLI Builders - Angular Ivy - Web Workers

UNIT IV **9 Hours**
REACT
React Introduction - React ES6 - React Render HTML - React JSX - Components -React Classes - Composing Components - Passing Data - Dynamic Composition - React state - setting State - Async State Initialization - Event Handling Communicating from Child to Parent - Stateless Components - Designing components- React Forms - React CSS - React SaaS

UNIT V **9 Hours**
NODE JS BACK-END FRAMEWORK
Node.js basics - Local and Export Modules - Node Package Manager - Node.js web server - Node.js File system - Node Inspector - Node.js 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

21AI004 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.

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

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

PSO1: 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 mobile application programming concepts and platform-specific constraints in comparison with other computing platforms.
2. Analyze the architecture, components, and lifecycle of Android applications.
3. Develop Android applications using rapid prototyping techniques and Android APIs.
4. Implement mobile user interface components and data persistence techniques in mobile applications using platform-specific frameworks.
5. Design cross-platform mobile applications using Flutter for deployment and 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	1	1
2	1	2	2		3				1			1	1	1
3	1		2		3				2			2	1	1
4	1	1	2		3				2			2	1	1
5	1	2	2		3				2			2	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 **2 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 **4 Hours**

Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.

EXPERIMENT 7 **4 Hours**

Implement UI elements like Text Fields, Label, Toolbar, Status bar, Tabbar.

EXPERIMENT 8 **4 Hours**

Implement any type of App using Flutter.

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.

21AI005 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. Analyze the role of software testing in ensuring software quality throughout the software development lifecycle.
2. Compare test case design strategies to select appropriate techniques for different testing scenarios.
3. Analyze various levels and types of software testing to ensure functional and non-functional quality requirements.
4. Apply test management practices and testing roles for effective planning, execution, and reporting of testing activities.
5. Apply software test automation techniques and tools to design and execute automated test suites.

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 CodeLogic – 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.

21AI006 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.

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

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

PSO1: 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 version control operations using Git to manage source code and track changes in software projects.
2. Apply continuous integration, testing, and deployment pipelines using Jenkins with Maven and Gradle.
3. Implement continuous integration pipelines using Jenkins for automated build, testing, and integration of software applications.
4. Apply configuration management techniques using Ansible to automate infrastructure provisioning.
5. Use cloud-based DevOps tools to build and manage CI/CD pipelines in a cloud environment.

Articulation Matrix

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

21AI007 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.

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.

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. Examine the role, evolution, and necessity of virtualization in cloud computing environments.
2. Apply virtualization techniques and hypervisor architectures to support cloud infrastructure.
3. Design virtualized computing environments using appropriate virtualization technologies.
4. Configure and manage virtual machines by installing operating systems and allocating CPU, storage, and network resources.
5. Assess availability, performance, and application deployment capabilities in virtualized environments.

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	3	2		1							1	1	2
3	2	2	3	2	2							1	1	2
4	1	2	2	3	3							1	1	2
5	1	2		3	2	1							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 & CONFIGURATIONS

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

UNIT V **9 Hours**

AVAILABILITY & APPLICATIONS IN A VIRTUAL MACHINE

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

Total: 45 Hours

Reference(s)

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

21AI008 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.

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. Evaluate the performance of virtual machines and cloud-deployed applications using cloud reference architectures.
2. Examine cloud service and delivery models with respect to cost, scalability, and deployment trade-offs.
3. Apply Infrastructure-as-a-Service (IaaS) architectures to real-world computing scenarios.
4. Assess Platform-as-a-Service (PaaS) concepts and architectures for application development needs.
5. Analyze Software-as-a-Service (SaaS) delivery models for business and enterprise use cases.

Articulation Matrix

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

9 Hours

UNIT II

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

21AI009 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 cloud storage architectures and service models used in modern cloud infrastructure.
2. Apply intelligent storage systems and RAID techniques to improve performance and fault tolerance.
3. Evaluate storage networking architectures and virtualization technologies used in cloud environments.
4. Assess backup, replication, and disaster recovery strategies for ensuring data availability.
5. Apply storage security mechanisms to protect data and storage infrastructure in cloud systems.

Articulation Matrix

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

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

UNIT V **9 Hours**

SECURING STORAGE INFRASTRUCTURE

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

Total: 45 Hours

Reference(s)

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

21AI010 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 using infrastructure-as-code tools such as Terraform and AWS services.
2. Apply virtual machine provisioning and migration techniques in cloud environments.
3. Analyze cloud automation and configuration management strategies for scalable deployments.
4. Apply load balancing and auto-scaling mechanisms to manage dynamic cloud workloads.
5. Evaluate AWS CloudFormation use cases for automated cloud infrastructure deployment.

Articulation Matrix

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

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

Total: 45 Hours

Reference(s)

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

21AI011 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.

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 need for Software Defined Networking and its impact on traditional network architectures.
2. Analyze the roles and interactions of the SDN data plane and control plane.
3. Develop network applications using SDN controllers and northbound interfaces.
4. Develop SDN applications to support network services such as traffic engineering, monitoring, and data center networking.
5. Evaluate SDN and NFV use cases for data center and service provider networks.

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

UNIT I **6 Hours**

SDN: INTRODUCTION

History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Date Planes.

UNIT II **6 Hours**

SDN DATA PLANE AND CONTROL PLANE

Data Plane functions and protocols - OpenFlow Protocol - Packet Processing and Performance Optimization – Flow Table - Control Plane Functions - Southbound Interface, Northbound Interface – SDN Controllers - Ryu, Open Daylight, ONOS - Distributed Controllers.

UNIT III **6 Hours**

VIRTUALMACHINES SDN APPLICATIONS

SDN Application Plane Architecture – Network Services Abstraction Layer – Traffic Engineering – Measurement and Monitoring – Security – Data Center Networking – Wide Area Networks (WAN) – Service Provider Networks – Internet Service Providers (ISPs).

UNIT IV **6 Hours**

NETWORK FUNCTION VIRTUALIZATION

Network Virtualization - NFV Architecture – Virtual LANs – OpenFlow VLAN Support – NFV Standards and Frameworks – NFV Concepts – Benefits and Requirements – Reference Architecture.

UNIT V **6 Hours**

NFV FUNCTIONALITY

NFV Infrastructure – Virtualized Network Functions – NFV Management and Orchestration – NFV Use Cases: Virtual Customer Premises Equipment, Virtual Evolved Packet Core, Virtualized Network Monitoring and Traffic Analysis, Network Slicing, Edge Computing and NFV.

EXPERIMENT 1 **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.

21AI012 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.

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.

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 fundamental cloud security concepts and cryptographic mechanisms used to ensure confidentiality, integrity, authentication, and non-repudiation.
2. Evaluate cloud security architectures and protection strategies to mitigate threats in cloud environments.
3. Apply identity management and access control mechanisms for securing cloud infrastructure and services.
4. Implement cloud security design patterns for protecting cloud resources and interfaces.
5. Assess monitoring, auditing, and incident response mechanisms for secure management of cloud systems.

Articulation Matrix

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

UNIT I **8 Hours**

FUNDAMENTALS OF CLOUD SECURITY CONCEPTS

Overview of Cloud Security- Security Services - Confidentiality, Integrity, Authentication, Non-repudiation, Access Control - Basic of Cryptography - Conventional and Public-key cryptography, Hash Functions, Authentication and Digital Signatures.

UNIT II **11 Hours**

SECURITY DESIGN AND ARCHITECTURE FOR CLOUD

Security Design Principles for Cloud Computing - Comprehensive Data Protection - End-to-end access control - Common Attack Vectors and threats - Network and Storage - Secure Isolation Strategies - Virtualization strategies - Inter-tenant network segmentation strategies - Data Protection strategies: Data Redaction, Tokenization, Obfuscation, PKI and Key

UNIT III **9 Hours**

ACCESS CONTROL AND IDENTITY MANAGEMENT

Access Control Requirements for Cloud infrastructure - User Identification - Authentication and Authorization - Roles-based Access Control - Multi-factor authentication - Single Sign-on, Identity Federation - Identity providers and service consumers - Storage and network access control options - OS Hardening and minimization – Verified and measured boot - Intruder Detection

UNIT IV **8 Hours**

CLOUD SECURITY DESIGN PATTERNS

Introduction to Design Patterns, Cloud Bursting, Geo-tagging, Secure Cloud Interfaces, Cloud Resource Access Control, Secure On-Premise Internet Access, Secure External Cloud

UNIT V **9 Hours**

MONITORING, AUDITING AND MANAGEMENT

Proactive Activity Monitoring – Incident Response, Monitoring for Unauthorized Access, Malicious Traffic, Abuse of System Privileges – Events and Alerts – Auditing – Record generation, Reporting and Management, Tamper-Proofing Audit logs, Quality of Services, Secure Management, User Management, Identity Management, Security Information and Event Management

Total: 45 Hours

Reference(s)

1. Dave Shackleford, Virtualization Security, SYBEX a Wiley Brand, 2013
2. Mark C. Chu-Carroll, Code in the Cloud, CRC Press, 2011.
3. Mather, Kumaraswamy and Latif, Cloud Security and Privacy, Oreilly, 2011.
4. Rajkumar Buyya, Christian Vecchiola, S. ThamaraiSelvi, Mastering Cloud Computing Foundations and Applications Programming, 2013.
5. Raj Kumar Buyya, James Broberg, Andrzej Goscinski, Cloud Computing, Wiley 2013.

21AI013 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.

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.

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 cyber security principles, cybercrimes, and the role of security mechanisms in protecting information systems.
2. Examine various cyber-attacks, vulnerabilities, and countermeasures used to mitigate security threats.
3. Apply reconnaissance and scanning techniques to gather security-related information about systems and networks.
4. Evaluate intrusion detection mechanisms and cyber laws for identifying and responding to cyber threats.
5. Implement firewall and intrusion prevention mechanisms to protect systems and networks from cyber-attacks.

Articulation Matrix

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

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

9 Hours

UNIT II

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.

21AI014 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.

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.

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 fundamental principles of symmetric and asymmetric cryptography, hardness assumptions, and semantic security models.
2. Examine cryptographic attack models including chosen plaintext and chosen ciphertext attacks used to evaluate encryption schemes.
3. Interpret pseudorandom generators, pseudorandom functions, and one-way functions used in provably secure cryptographic constructions.
4. Construct pseudorandom permutations and block cipher structures using cryptographic design techniques.
5. Evaluate message authentication codes, digital signature schemes, and cryptographic protocols for secure communication.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

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

UNIT II **9 Hours**

FORMAL NOTIONS OF ATTACKS

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

UNIT III **9 Hours**

RANDOM ORACLES

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

UNIT IV **9 Hours**

BUILDING A PSEUDORANDOM PERMUTATION

The 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.

21AI015 **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.

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.

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 digital forensics principles, legal requirements, and evidence handling procedures in investigations.
2. Utilize forensic tools to acquire, preserve, and manage digital evidence effectively.
3. Analyze forensic data from systems and networks to identify unauthorized activities.
4. Assess firewall configurations and security controls to identify system vulnerabilities.
5. Evaluate hacking techniques to test system robustness and recommend corrective measures.

Articulation Matrix

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

UNIT I **8 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 **10 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 & 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.

21AI016 **ETHICAL HACKING** **3 0 0 3**

Course Objectives

- To learn about the importance of information security.
- To learn different scanning and enumeration methodologies and tools.
- To understand various hacking techniques and attacks.
- To be exposed to programming languages for security professionals.
- To understand the different phases in penetration testing

Programme Outcomes (POs)

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

PO2: Problem Analysis: Identify, formulate, review research literature, and 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.

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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.

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 ethical hacking principles, legal constraints, and penetration testing methodologies.
2. Perform scanning and enumeration using standard penetration testing tools.
3. Analyze security vulnerabilities in Windows and Linux operating systems.
4. Execute controlled attacks on web servers and applications to identify security flaws.
5. Assess firewall, intrusion detection, and prevention mechanisms for network protection.

Articulation Matrix

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

21AI017 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.

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

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 blockchain architecture and cryptographic concepts in distributed ledger systems.
2. Analyze consensus algorithms and security challenges in cryptocurrency networks.
3. Examine blockchain protocols to identify gaps between theoretical models and real-world deployment.
4. Implement blockchain applications using Hyperledger Fabric and Ethereum platforms.
5. Evaluate blockchain applications across finance, supply chain, and emerging digital domains.

Articulation Matrix

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

21AI018 **MALWARE ANALYSIS** **3 0 0 3**

Course Objectives

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

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature, and 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.
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.
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 malware types, characteristics, and basic static and dynamic analysis techniques used to identify malicious programs.
2. Interpret advanced static analysis techniques including disassembly and executable file structures for malware investigation.
3. Examine advanced dynamic analysis methods to monitor malware behavior through system calls, API tracing, and network analysis.
4. Evaluate malware functionality and persistence mechanisms used to compromise system security.
5. Apply static and dynamic analysis techniques to investigate Android malware applications and security threats.

Articulation Matrix

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

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.
6. Windows Malware Analysis Essentials by Victor Marak, Packt Publishing, 2015.

21AI019 ROBOTIC PROCESS AUTOMATION 3 0 0 3

Course Objectives

- Understand the basic concepts, methodologies and tools in RPA.
- Understand the UiPath building blocks in the RPA.
- 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.

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.

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

Course Outcomes (COs)

1. Analyze RPA concepts, process methodologies, and automation suitability across business workflows.
2. Identify UiPath components and orchestration features required for software robot development.
3. Develop automated workflows using RPA techniques for structured and semi-structured applications.
4. Integrate exception handling, logging, and control mechanisms within RPA bots.
5. Evaluate RPA solutions for real-time operational problems with performance and scalability considerations.

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

21AI020 REINFORCEMENT LEARNING 3 0 0 3

Course Objectives

- Understand the core principles behind the RL, including policies, value functions, deriving Bellman equations.
- Acquire the knowledge to define Markov Decision Processes with its properties.
- 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. Analyze reinforcement learning components and decision-making mechanisms in agent-based systems.
2. Formulate Markov Decision Processes for sequential decision problems.
3. Derive optimal value functions and policies using Bellman equations.
4. Apply dynamic programming techniques to compute optimal control strategies.
5. Implement Monte Carlo methods to solve real-world reinforcement learning 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										2	
3	2	3	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 & 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

21AI021 **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.

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 edge computing architectures, communication models, and deployment scenarios.
2. Implement data analytics techniques for real-time processing at the network edge.
3. Apply security mechanisms to ensure confidentiality, authentication, and secure storage in edge environments.
4. Formulate optimization models to enhance performance in edge and fog computing systems.
5. Deploy edge computing solutions using Raspberry Pi for industrial and commercial applications.

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		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.

21AI022 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.

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

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

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

PSO1: 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 fundamental concepts, classifications, and design considerations of robotic systems and their applications.
2. Examine the working principles and characteristics of actuators and sensors used in robotic systems.
3. Interpret the architecture, components, and aerodynamic principles involved in unmanned aerial vehicles.
4. Implement drone control mechanisms using controllers, GPS modules, and embedded platforms.
5. Evaluate drone maintenance procedures and intelligent techniques applied in drone-based systems.

Articulation Matrix

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

UNIT I **9 Hours**

ROBOTS INTRODUCTION

Introduction – History & 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 & 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.

21AI023 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.

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.

Course Outcome (COs)

1. Analyze transportation system components and associated security challenges.
2. Classify functional blocks of intelligent transportation systems.
3. Design data collection methodologies for traffic monitoring and control.
4. Compare communication technologies used in intelligent transportation networks.
5. Evaluate TIS implementations under Indian operational and infrastructural 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							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.
5. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010.
6. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.
7. Turban E.,”Decision Support and Export Systems Management Support Systems", Maxwell Macmillan, 1998.
8. ITS Hand Book 2000: Recommendations for World Road Association (PIARC) by Kan Paul Chen, John Miles.

21AI024 **EXPERT SYSTEMS** **3 0 0 3**

Course Objectives

- Understand the concepts of intelligent agents, searching, knowledge and reasoning, planning and learning in expert systems.
- Illustrate the knowledge representation and acquisition in expert systems.
- 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.

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 architectures, tools, limitations, and applications of expert systems.
2. Construct expert systems using suitable development methodologies.
3. Evaluate knowledge acquisition techniques and modelling approaches used in expert system development.
4. Implement knowledge representation schemes such as logic, semantic networks, frames, and scripts in expert systems.
5. Apply fuzzy logic concepts to develop fuzzy expert systems.

Articulation Matrix

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

21AI025 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. Analyze the role of knowledge engineering in developing intelligent systems.
2. Examine knowledge representation structures and reasoning mechanisms for problem solving.
3. Apply uncertainty handling and reasoning techniques in intelligent system design.
4. Design ontologies using structured development methodologies and representation principles.
5. Evaluate learning and rule induction methods for knowledge-based applications.

Articulation Matrix

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

UNIT IV **9 Hours**
ONTOLOGIES – DESIGN AND DEVELOPMENT
Concepts and Instances – Generalization Hierarchies – Object Features – Defining Features – Representation – Transitivity – Inheritance – Concepts as Feature Values – Ontology Matching. Design and Development Methodologies – Steps in Ontology Development

UNIT V **9 Hours**
LEARNING AND RULE LEARNING
Machine Learning – Concepts – Generalization and Specialization Rules – Types of Generalization and Specialization – Formal definition of Generalization. Modelling, Learning and Problem Solving

Total: 45 Hours

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.

21AI026 TEXT AND SPEECH ANALYSIS 2 0 2 3

Course Objectives

- Understand natural language processing basics
- Apply classification algorithms to text documents
- Build question-answering and dialogue systems
- Develop a speech recognition system
- Develop a speech synthesizer

Programme 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 (COs)

1. Apply text preprocessing and feature representation techniques such as tokenization, stemming, and TF-IDF for NLP tasks.
2. Develop text classification models using word embeddings and deep learning architectures.
3. Design question answering and dialogue systems using retrieval and language models.
4. Construct speech recognition and text-to-speech systems using neural architectures.
5. Evaluate discourse-level phenomena such as coreference, coherence, and sentiment in text.

Articulation Matrix

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

UNIT I **6 Hours**
NATURAL LANGUAGE BASICS
Foundations of natural language processing – Language Syntax and Structure- Text Preprocessing and Wrangling – Text tokenization – Stemming – Lemmatization – Removing stopwords – Feature Engineering for Text representation – Bag of Words model- Bag of N-Grams model – TF-IDF model

UNIT II **6 Hours**
TEXT CLASSIFICATION
Vector Semantics and Embeddings -Word Embeddings - Word2Vec model – Glove model – FastText model – Deep Learning models for text classification– Recurrent Neural Networks (RNN) – Transformers –Text summarization and Topic Models

UNIT III **6 Hours**
QUESTION ANSWERING AND DIALOGUE SYSTEMS
Information retrieval – IR-based question answering – knowledge-based question answering – language models for QA – classic QA models – chatbots – Design of dialogue systems -– evaluating dialogue systems

UNIT IV **6 Hours**
TEXT-TO-SPEECH SYNTHESIS
Text normalization - Letter-to-sound conversion -Prosody – Evaluation -Signal processing - Concatenative and parametric approaches - WaveNet and other deep learning-based TTS systems

UNIT V **6 Hours**
AUTOMATIC SPEECH RECOGNITION
Named Entity Recognition (NER)-Coreference resolution-Text coherence and cohesion-Advanced sentiment analysis-Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems

EXPERIMENT 1 **3 Hours**
Create Regular expressions in Python for detecting word patterns and tokenizing text

EXPERIMENT 2 **3 Hours**
Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams

EXPERIMENT 3 **3 Hours**
Accessing Text Corpora using NLTK in Python

EXPERIMENT 4 **3 Hours**
Write a function that finds the 50 most frequently occurring words of a text that are not stop words

EXPERIMENT 5 **3 Hours**
Implement the Word2Vec model

EXPERIMENT 6 **3 Hours**
Use a transformer for implementing classification

EXPERIMENT 7 **5 Hours**
Design a chatbot with a simple dialog system

EXPERIMENT 8 **3 Hours**
Convert text to speech and find accuracy

EXPERIMENT 9 **4 Hours**

Design a speech recognition system and find the error rate

Total: 30+30=60 Hours

Textbook

1. Daniel Jurafsky and James H. Martin, "Speech and Language Processing: An Introduction to Natural Language Processing, Computational Linguistics, and Speech Recognition", Third Edition, 2022.

Reference(s)

1. Dipanjan Sarkar, "Text Analytics with Python: A Practical Real-World approach to Gaining Actionable insights from your data", APress,2018.
2. Tanveer Siddiqui, Tiwary U S, "Natural Language Processing and Information Retrieval", Oxford University Press, 2008.
3. Lawrence Rabiner, Biing-Hwang Juang, B. Yegnanarayana, "Fundamentals of Speech Recognition" 1st Edition, Pearson, 2009.
4. Steven Bird, Ewan Klein, and Edward Loper, "Natural language processing with Python", O'REILLY.

21AI027 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. Formulate linear programming models and obtain optimal solutions using analytical methods.
2. Analyze integer programming and transportation problems using exact optimization techniques.
3. Apply dynamic programming and simulation techniques to sequential decision problems.
4. Construct project scheduling networks using CPM and PERT methodologies.
5. Optimize constrained and unconstrained systems using classical optimization and queuing models.

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, VikasPublishing House Pvt.Ltd. New Delhi, 1994.
6. Ravindran A., Philip D.T., and Solberg J.J., Operations Research, John Wiley, 2nd Edition, 2007.

21AI028 BIG DATA ANALYTICS 3 0 0 3

Course Objectives

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

Programme Outcomes (POs)

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

PO2: Problem Analysis: Identify, formulate, review research literature, and 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 (COs)

1. Apply big data concepts and technologies to interpret large-scale unstructured data trends and applications.
2. Analyze NoSQL data models and distributed data management techniques to support scalable big data storage solutions.
3. Implement MapReduce programming and job scheduling mechanisms to process large datasets in Hadoop environments.
4. Analyze Hadoop Distributed File System (HDFS) architecture and data flow mechanisms to enable efficient big data processing.
5. Apply Hadoop ecosystem tools such as Hive, Pig, and HBase to perform large-scale data analytics.

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

21AI029 QUANTUM COMPUTING 3 0 0 3

Course Objectives

- Understand the background of classical computing and quantum computing.
- Acquire the knowledge about the hardware and mathematical models of quantum computation.
- 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.

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.

Course Outcomes (COs)

1. Analyze quantum information processing tasks using quantum mechanical principles.
2. Apply quantum gate operations and circuit models to perform quantum computation tasks.
3. Examine quantum algorithms implemented using the circuit computation model.
4. Evaluate computation models used in quantum information theory.
5. Assess quantum cryptographic protocols for secure information exchange.

Articulation Matrix

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

21AI030 COGNITIVE SCIENCE 3 0 0 3

Course Objectives

- Understand the fundamentals of Cognitive Science
- To apply advanced analytics to cognitive science functions
- Explore how cognitive science used in healthcare system.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply 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. Analyze cognitive processes using interdisciplinary theoretical frameworks.
2. Model cognitive components computationally using artificial intelligence techniques.
3. Apply probabilistic programming constructs to represent cognitive reasoning mechanisms.
4. Examine inference models for explaining perception, decision-making, and learning.
5. Evaluate cognitive science applications in healthcare and intelligent decision 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
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

21AI031 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.

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 biomedical image characteristics and acquisition artifacts relevant to clinical diagnosis.
2. Apply enhancement and filtering techniques to improve biomedical image quality.
3. Extract shape, texture, and oriented pattern features from biomedical images.
4. Evaluate pattern classification techniques for biomedical decision-making systems.
5. Develop computational models for automated biomedical image analysis applications.

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	1
2	3	3	2	1	3								2	1
3	2	2	2	1	2								3	3
4	2	2	2	1	2								3	3
5	2	2	2	1	3								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, AddisonWesley, 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

21AI032 RECOMMENDER SYSTEMS 3 0 0 3

Course Objectives

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

Programme 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.

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 fundamental concepts and dimensionality reduction to recommender models.
2. Implement machine learning techniques to build content-based models.
3. Analyze collaborative filtering methods to assess recommendation accuracy.
4. Evaluate attack-resistant techniques and robustness of recommendation algorithms.
5. Evaluate performance using online and offline evaluation metrics.

Articulation Matrix

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

UNIT IV **9 Hours**

ATTACK-RESISTANT RECOMMENDER SYSTEMS

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

UNIT V **9 Hours**

EVALUATING RECOMMENDER SYSTEMS

Evaluating Paradigms – User Studies – Online and Offline evaluation – Goals of evaluation design – Design Issues – Accuracy metrics – Limitations of Evaluation measures Sharing Scheme. Formally Analyzing Cryptographic Protocols. Zero Knowledge Proofs andProtocols.

Total: 45 Hours

Reference(s)

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

21AI033 **VIDEO ANALYTICS** **3 0 0 3**

Course Objectives

- Understand the need for video Analytics.
- Understand the basic configuration of video analytics.
- Understand the functional blocks of a video analytic system.
- Get exposed to the various applications of video 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.

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 video data characteristics and preprocessing techniques for analytics systems.
2. Apply foreground extraction and tracking algorithms for multi-camera environments.
3. Implement classification models for activity recognition in video streams.
4. Evaluate deep learning architectures for large-scale video analytics.
5. Develop application-specific video analytics solutions for security and business intelligence.

Articulation Matrix

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

VIDEO ANALYTIC COMPONENTS

Need for Video Analytics-Overview of video Analytics- Foreground extraction- Feature extraction - classifier -Pre-processing- edge detection- smoothing- Feature space-PCA-FLD-SIFT features.

UNIT II **9 Hours**

FOREGROUND EXTRACTION

Background estimation – Averaging - Gaussian Mixture Model - Optical Flow based – Image Segmentation -Region growing - Region splitting - Morphological operations - erosion-Dilation -Tracking in a multiple camera environment.

UNIT III **9 Hours**

CLASSIFIERS

Neural networks (back propagation) - Deep learning networks - Fuzzy Classifier - Bayesian classifier - HMM based classifier.

UNIT IV **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.

UNIT V **9 Hours**

VIDEO ANALYTICS APPLICATIONS

Customer behavior analysis - people counting- Traffic rule violation detection- traffic congestion identification for route planning- driver assistance- lane change warning.

Total: 45 Hours

Reference(s)

1. Graeme A. Jones (Editor), Nikos Paragios (Editor), Carlo S. Regazzoni (Editor) Video- Based SurveillanceSystems: Computer Vision and Distributed Processing, Kluwer academic publisher, 2001.
2. Nilanjan Dey (Editor), Amira Ashour (Editor) and Suvojit Acharjee (Editor), Applied Video Processing in Surveillance and Monitoring Systems (IGI global) 2016.
3. Zhihao Chen (Author), Ye Yang (Author), The Next Generation of Video Surveillance and Video Analytics:The Unified Intelligent Video Analytics Suite, Create Space Independent Publishing Platform,2014
4. Caifeng Shan (Editor), Fatih Porikli (Editor), Tao Xiang (Editor), Shaogang Gong (Editor) Video Analytics forBusiness Intelligence, Springer, 2012.

21AI034 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. Analyze cyber attack patterns and adversary behaviors in enterprise environments.
2. Classify cyber threats and intrusion techniques using structured attack models.
3. Evaluate network and system security using threat intelligence indicators.
4. Analyze threat intelligence data, logs, and reports for incident investigation.
5. Develop response strategies for detecting, containing, and mitigating cyber 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.

21AI035 BUSINESS ANALYTICS 3 0 0 3

Course Objectives

- Comprehend the process of acquiring Business Intelligence.
- Understand various types of analytics for Business Forecasting.
- Apply analytics for different functions of a business.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature, and 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. Analyze real-world business problems and formulate analytics-driven solutions.
2. Examine business processes to extract actionable business intelligence.
3. Apply predictive analytics models for business forecasting applications.
4. Evaluate analytics techniques for supply chain and logistics decision-making.
5. Apply analytics frameworks to marketing and sales performance optimization.

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 & 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 & 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.

21AI036 DIGITAL MARKETING AND TECHNIQUES 3 0 0 3

Course Objectives

- Understand the Digital marketing platforms.
- Understand the theoretical aspects of creating a website.
- Understand the role of digital marketing in business administration.
- Familiarize with search engine optimization.
- Understand MISC tools.

Programme 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 (COs)

1. Analyze digital marketing platforms and managerial roles in online business environments.
2. Examine digital business models and digital customer behavior in online marketing environments.
3. Apply marketing automation and analytics tools for campaign execution.
4. Evaluate customer lifecycle management using CRM and marketing automation techniques.
5. Assess emerging digital marketing techniques for business growth and engagement.

Articulation Matrix

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

21AI037 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. Analyze time series components using visualization and exploratory techniques.
2. Examine stochastic processes governing temporal data behavior.
3. Classify stationary and non-stationary models for time series representation.
4. Apply regression and econometric models for time series forecasting.
5. Evaluate statistical, state-space, and machine learning methods for forecasting accuracy.

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.

21AI038 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.

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

Course Outcomes (COs)

1. Analyze human cognitive factors and interaction principles in interface design.
2. Design accessible user interfaces addressing usability and inclusivity requirements.
3. Evaluate HCI implications in multimedia, e-commerce, and e-learning systems.
4. Develop mobile application frameworks using HCI design tools and models.
5. Construct web interfaces following usability guidelines and interaction patterns.

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 & 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 of Mobile 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.

21AI039 PATTERN RECOGNITION 3 0 0 3

Course Objectives

- To provide the basic knowledge about the pattern recognition and its applications.
- Implement the supervised and unsupervised algorithms for pattern classification.
- 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.

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 pattern recognition frameworks and probabilistic decision models.
2. Apply supervised classification algorithms to labeled datasets.
3. Implement clustering techniques for unsupervised pattern discovery.
4. Evaluate feature extraction and selection techniques for dimensionality reduction.
5. Analyze fuzzy and neural approaches for complex pattern classification tasks.

Articulation Matrix

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

UNIT I 9 Hours

INTRODUCTION TO PATTERN RECOGNITION

Importance of Pattern Recognition – Features - Feature Vectors and Classifiers - Supervised, Unsupervised and Semi-supervised learning - Introduction to Bayes Decision Theory - Discriminant Functions and Decision Surfaces - Gaussian PDF and Bayesian Classification for Normal Distributions.

UNIT II **9 Hours**

CLASSIFIERS

Estimation of Unknown Probability Density Functions - Maximum Likelihood Parameter Estimation - Maximum Entropy Estimation - The Naive-Bayes Classifier - Linear Classifiers - Perceptron Algorithm - Least Square Methods - Support Vector Machines for Classification.

UNIT III **9 Hours**

CLUSTERING

Clustering for Unsupervised Learning and Classification - C-means Algorithm - Hierarchical Clustering Procedures - Validity of Clustering Solutions.

UNIT IV **9 Hours**

FEATURE EXTRACTION AND SELECTION

Introduction - Basis Vectors and Images - Entropy Minimization – Karhunenloeve Transformation – Feature Selection through Functions Approximation – Binary Feature Selection – K-NN.

UNIT V **9 Hours**

RECENT ADVANCES

Fuzzy Classification: Fuzzy Set Theory - Fuzzy and Crisp Classification - Elementary Neural Network for Pattern Recognition – Hebbnet – ADALINE - Case Study: Virtual search, Face recognition and Image pattern recognition.

Total: 45 Hours

Reference(s)

1. Richard O. Duda, Peter E. Hart, David G. Stork, "Pattern Recognition", John Wiley & Sons, 2021.
2. M. Narasimha Murthy, V. Susheela Devi, "Pattern Recognition", Springer, 2011.
3. Pattern Recognition: Sergios Theodoridis, Konstantinos Koutroumbas, Elsevier India Pvt. Ltd (Paper Back), 4th edition.
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.

21AI040 **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.

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.

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 ethical principles and societal impacts of artificial intelligence technologies.
2. Examine global ethical initiatives and AI case studies to identify potential ethical risks in AI applications.
3. Assess AI standards and regulatory frameworks to ensure transparency, privacy, and fairness in AI systems.
4. Interpret roboethics principles and moral theories to guide responsible development and use of intelligent technologies.
5. Evaluate societal challenges and opportunities of AI to support responsible decision-making in AI deployment.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

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

UNIT II **9 Hours**

ETHICAL INITIATIVES IN AI

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

UNIT III **9 Hours**

AI STANDARDS AND REGULATION

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

UNIT IV **9 Hours**

ROBOETHICS: SOCIAL AND ETHICAL IMPLICATION OF ROBOTICS

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

UNIT V **9 Hours**

AI AND ETHICS- CHALLENGES AND OPPORTUNITIES

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

Total: 45 Hours

Reference(s)

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

21AI041 AUGMENTED REALITY/VIRTUAL REALITY 3 0 0 3

Course Objectives

- To impart the fundamental concepts and applications of Virtual Reality.
- Describe how Augmented Reality systems work and list the applications of Augmented Reality.
- Use computer vision concepts for Augmented Reality 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.

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 input and output devices used in virtual reality environments.
2. Apply geometric and physical modeling techniques for immersive visualization.
3. Develop virtual reality applications using Unity development platform.
4. Evaluate tracking, display, and sensor technologies used in augmented reality systems.
5. Implement computer vision techniques for augmented reality applications.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Introduction to Virtual Reality and Augmented Reality – Definition – Introduction to Trajectories and Hybrid Space-Three I's of Virtual Reality – Virtual Reality Vs 3D Computer Graphics – Benefits of Virtual Reality – Components of VR System – Introduction to AR-AR Technologies-Input 144 Devices – 3D Position Trackers – Types of Trackers – Navigation and Manipulation Interfaces – Gesture Interfaces – Types of Gesture Input Devices – Output Devices – Graphics Display – Human Visual System – Personal Graphics Displays – Large Volume Displays – Sound Displays – Human Auditory System

UNIT II **10 Hours**

GEOMETRIC MODELLING

Geometric Modeling: Virtual Object Shape- Object Visual Appearance- Kinematics Modeling: Homogeneous Transformation Matrices- Object Position- Transformation Invariants- Object Hierarchies Viewing the Three-Dimensional World- Physical Modeling: Collision Detection- Surface Deformation-Force Computation Force Smoothing and Mapping- Haptic Texturing - Behavior Modeling: Model Management Level-of-Detail Management- Cell Segmentation.

UNIT III **7 Hours**

UNITY AND VR APPLICATIONS

Introduction to Unity – 3D Space - Unity User Interface - Navigating in Unity - Creating Objects in Unity-Positioning, Scaling, and Transforming Primitives in Unity - Keyframe Animation in Unity - Medical Applications of VR – Education, Arts and Entertainment – Military VR Applications – VR Applications in Manufacturing – Applications of VR in Robotics.

UNIT IV **9 Hours**

AUGMENTED REALITY

Introduction to Augmented Reality – Displays: Multimodal Displays - Visual Perception - Spatial Display Model - Visual Displays -Tracking: Tracking, Calibration, and Registration -Coordinate Systems - Characteristics of Tracking Technology - Stationary Tracking Systems - Mobile Sensors - Optical Tracking – Sensor Fusion-Interaction-Modelling and Annotation-Navigation-Wearable devices.

UNIT V **10 Hours**

COMPUTER VISION FOR AUGMENTED REALITY & CALIBRATION

Computer Vision for Augmented Reality: Marker Tracking - Multiple-Camera Infrared Tracking - Natural Feature Tracking by Detection - Incremental Tracking - Simultaneous Localization and Mapping - Outdoor Tracking - Calibration and Registration: Camera Calibration - Display Calibration – Registration - Visual Coherence – Visualization – Interaction.

Total: 45 Hours

Reference(s)

1. C. Burdea & Philippe Coiffet, "Virtual Reality Technology", Second Edition, Gregory, John Wiley & Sons, Inc., 2016.
2. Augmented Reality: Principles and Practice (Usability) by Dieter Schmalstieg and Tobias Hollerer, Pearson Education (US), Addison-Wesley Educational Publishers Inc, New Jersey, United States, 2016. ISBN: 9780321883575
3. Jason Jerald. 2015. The VR Book: Human-Centred Design for Virtual Reality. Association for Computing Machinery and Morgan & Claypool, New York, NY, USA.
4. Practical Augmented Reality: A Guide to the Technologies, Applications, and Human Factors for AR and VR (Usability), Steve Aukstakalnis, Addison-Wesley Professional; 1 edition, 2016.
5. Augmented Reality: Principles & Practice by Schmalstieg / Hollerer, Pearson Education India; First edition (12 October 2016), ISBN-10: 9332578494.

21AI042 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.

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. Analyze software project planning and evaluation techniques for effective project initiation.
2. Apply software process models and estimation techniques to determine project effort and cost.
3. Develop project schedules and risk management plans using network planning techniques.
4. Assess project monitoring and control techniques to ensure effective project execution.
5. Evaluate staffing strategies and team management practices for successful software project delivery.

Articulation Matrix

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

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

HONOURS

[FULL STACK DEVELOPMENT]

21AIH01 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.

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

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

PSO1: 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 agile principles, values, and methodologies used in modern software development environments.
2. Examine agile process frameworks such as Scrum, Extreme Programming, Kanban, and Feature Driven Development for iterative software development.
3. Assess knowledge management practices that support information sharing and decision making in agile software projects.
4. Apply agile requirements engineering techniques for managing evolving software requirements.
5. Evaluate agile quality assurance practices including test-driven development, pair programming, and agile metrics for improving software quality.

Articulation Matrix

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

UNIT I **9 Hours**

AGILE METHODOLOGY

Theories for Agile management – agile software development – traditional model vs. agile model - classification of agile methods – agile manifesto and principles – agile project management – agile team interactions – ethics in agile teams - agility in design, testing – agile documentations – agile drivers, capabilities and values.

UNIT II **9 Hours**

AGILE PROCESSES

Extreme Programming: Method overview – lifecycle – work products, roles and practices- Lean production - SCRUM, Crystal, Feature Driven Development, Adaptive 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 – agilerequirements 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.

21AIH02 UI AND UX DESIGN 3 0 0 3

Course Objectives

- Study about designing web pages and understand the difference between UI and UX Design.
- To understand the concept of UX design and how it has evolved Able o to understand UX design process and methodology.
- Learning the Importance and scope of Interaction design, User centered design

Programme Outcomes (POs)

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

PO2: Problem Analysis: Identify, formulate, review research literature, and 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.

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. Analyze user research data to derive personas and customer journey maps for user-centered design.
2. Construct interaction flows and information architectures that support intuitive user navigation in digital products.
3. Develop low-fidelity and high-fidelity wireframes using modern interface design tools and techniques.
4. Apply visual design elements and UI principles to create effective interactive interface prototypes.
5. Evaluate digital interface designs through usability testing methods and interpret user feedback.

Articulation Matrix

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

Principles of Sketching - Core Responsive Design - Wireframing vs Wireflows - Click through Wireframing Prototyping - Wireflow Creation - Work with different tools – Figma - Low-High Fidelity Design: Inclusive Design and Designing for Accessibility - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Designing animations and interactions

UNIT IV **9 Hours**

UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING

Building a Design System – Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration - Use of grids in UI design - Design animations and interaction patterns for key UI elements

UNIT V **9 Hours**

USABILITY EVALUATION AND PRODUCT DESIGN

Type of usability evaluation – Qualitative & Quantitative evaluation - Guerilla testing, A/B Testing, Unmoderated remote usability testing, Card sorting, Session recording, think aloud - Think aloud – Introduction and advantages - Designing evaluation protocol - Conducting usability evaluation study - Conduct Usability Test explicit - Synthesize Test Findings - practices in corporate World - 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: Toward the 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.

21AIH03 WEB FRAMEWORKS 3 0 0 3

Course Objectives

- Understand the architecture behind an Angular application and how to use it
- To understand the significance of using MongoDB as a database system
- To understand the role of React in designing front-end components
- Build a Web Server in Node and understand how it really works
- Develop a web application and API using web frameworks

Programme Outcomes (POs)

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

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

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

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

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. Develop dynamic web pages using Angular modules, components, routing, and animations.
2. Implement CRUD-based web applications by integrating web frameworks with MongoDB.
3. Design Progressive Web Applications using Angular features such as service workers and server-side rendering.
4. Design single-page applications with reusable UI components using React and modern CSS frameworks.
5. Build server-side applications and RESTful services using Node.js and Express.js.

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

UNIT I 9 Hours

ANGULAR FRONT-END FRAMEWORK

Introduction - Setup - Architecture: Modules, Components, Services and DI fundamentals - Components and Templates – Configuration- Forms - Observables & RxJS - Boot Strapping - NgModules - Dependency Injection - Http Client - Routing and Navigation - Animations

UNIT II **9 Hours**
FRAMEWORKS WITH DATABASES
MongoDB - MongoDB Basics - Documents - Collections - Query Language - Installation - The mongo Shell - Schema Initialization - MongoDB Node.js Driver - Reading from MongoDB - Writing to MongoDB - CRUD operations - projections - Indexing - Aggregation - Replication - Sharding - Creating backup – Deployment

UNIT III **9 Hours**
ANGULAR TECHNIQUES
Service workers & PWA - Server-side rendering - Angular Libraries - Schematics - CLI Builders - Angular Ivy - Web Workers

UNIT IV **9 Hours**
REACT
React Introduction - React ES6 - React Render HTML - React JSX - Components -React Classes - Composing Components - Passing Data - Dynamic Composition - React state - setting State - Async State Initialization - Event Handling Communicating from Child to Parent - Stateless Components - Designing components- React Forms - React CSS - React SaaS

UNIT V **9 Hours**
NODE JS BACK-END FRAMEWORK
Node.js basics - Local and Export Modules - Node Package Manager - Node.js web server - Node.js File system - Node Inspector - Node.js 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

21AIH04 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.

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

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

PSO1: 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 mobile application programming concepts and platform-specific constraints in comparison with other computing platforms.
2. Analyze the architecture, components, and lifecycle of Android applications.
3. Develop Android applications using rapid prototyping techniques and Android APIs.
4. Implement mobile user interface components and data persistence techniques in mobile applications using platform-specific frameworks.
5. Design cross-platform mobile applications using Flutter for deployment and 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	1	1
2	1	2	2		3				1			1	1	1
3	1		2		3				2			2	1	1
4	1	1	2		3				2			2	1	1
5	1	2	2		3				2			2	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 **2 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 **4 Hours**

Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.

EXPERIMENT 7 **4 Hours**

Implement UI elements like Text Fields, Label, Toolbar, Status bar, Tabbar.

EXPERIMENT 8 **4 Hours**

Implement any type of App using Flutter.

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.

21AIH05 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. Analyze the role of software testing in ensuring software quality throughout the software development lifecycle.
2. Compare test case design strategies to select appropriate techniques for different testing scenarios.
3. Analyze various levels and types of software testing to ensure functional and non-functional quality requirements.
4. Apply test management practices and testing roles for effective planning, execution, and reporting of testing activities.
5. Apply software test automation techniques and tools to design and execute automated test suites.

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.

21AIH06 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.

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

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

PSO1: 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 version control operations using Git to manage source code and track changes in software projects.
2. Apply continuous integration, testing, and deployment pipelines using Jenkins with Maven and Gradle.
3. Implement continuous integration pipelines using Jenkins for automated build, testing, and integration of software applications.
4. Apply configuration management techniques using Ansible to automate infrastructure provisioning.
5. Use cloud-based DevOps tools to build and manage CI/CD pipelines in a cloud environment.

Articulation Matrix

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

MINOR

[FULL STACK DEVELOPMENT]

21AIM01 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.

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

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

PSO1: 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 agile principles, values, and methodologies used in modern software development environments.
2. Examine agile process frameworks such as Scrum, Extreme Programming, Kanban, and Feature Driven Development for iterative software development.
3. Assess knowledge management practices that support information sharing and decision making in agile software projects.
4. Apply agile requirements engineering techniques for managing evolving software requirements.
5. Evaluate agile quality assurance practices including test-driven development, pair programming, and agile metrics for improving software quality.

Articulation Matrix

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

UNIT I **9 Hours**

AGILE METHODOLOGY

Theories for Agile management – agile software development – traditional model vs. agile model - classification of agile methods – agile manifesto and principles – agile project management – agile team interactions – ethics in agile teams - agility in design, testing – agile documentations – agile drivers, capabilities and values.

UNIT II **9 Hours**

AGILE PROCESSES

Extreme Programming: Method overview – lifecycle – work products, roles and practices- Lean production - SCRUM, Crystal, Feature Driven Development, Adaptive 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 – agilerequirements 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.

21AIM02 **UI AND UX DESIGN** **3 0 0 3**

Course Objectives

- Study about designing web pages and understand the difference between UI and UX Design.
- To understand the concept of UX design and how it has evolved Able o to understand UX design process and methodology.
- Learning the Importance and scope of Interaction design, User centered design

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature, and 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.
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. Analyze user research data to derive personas and customer journey maps for user-centered design..
2. Construct interaction flows and information architectures that support intuitive user navigation in digital products.
3. Develop low-fidelity and high-fidelity wireframes using modern interface design tools and techniques.
4. Apply visual design elements and UI principles to create effective interactive interface prototypes.
5. Evaluate digital interface designs through usability testing methods and interpret user feedback.

Articulation Matrix

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

Principles of Sketching - Core Responsive Design - Wireframing vs Wireflows - Click through Wireframing Prototyping - Wireflow Creation - Work with different tools – Figma - Low-High Fidelity Design: Inclusive Design and Designing for Accessibility - Building High-Fidelity Mockups - Designing Efficiently with Tools - Interaction Patterns - Designing animations and interactions

UNIT IV **9 Hours**

UNDERSTAND STYLE GUIDES, ELEMENTS, PROTOTYPING

Building a Design System – Style guides, color palette, fonts, grid, iconography, UI elements, photography or imagery, and illustration - Use of grids in UI design - Design animations and interaction patterns for key UI elements

UNIT V **9 Hours**

USABILITY EVALUATION AND PRODUCT DESIGN

Type of usability evaluation – Qualitative & Quantitative evaluation - Guerilla testing, A/B Testing, Unmoderated remote usability testing, Card sorting, Session recording, think aloud - Think aloud – Introduction and advantages - Designing evaluation protocol - Conducting usability evaluation study - Conduct Usability Test explicit - Synthesize Test Findings - practices in corporate World - 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: Toward the 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.

21AIM03 WEB FRAMEWORKS 3 0 0 3

Course Objectives

- Understand the architecture behind an Angular application and how to use it
- To understand the significance of using MongoDB as a database system
- To understand the role of React in designing front-end components
- Build a Web Server in Node and understand how it really works
- Develop a web application and API using web frameworks

Programme Outcomes (POs)

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

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

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

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

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. Develop dynamic web pages using Angular modules, components, routing, and animations.
2. Implement CRUD-based web applications by integrating web frameworks with MongoDB.
3. Design Progressive Web Applications using Angular features such as service workers and server-side rendering.
4. Design single-page applications with reusable UI components using React and modern CSS frameworks.
5. Build server-side applications and RESTful services using Node.js and Express.js.

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

UNIT I 9 Hours

ANGULAR FRONT-END FRAMEWORK

Introduction - Setup - Architecture: Modules, Components, Services and DI fundamentals - Components and Templates – Configuration- Forms - Observables & RxJS - Boot Strapping - NgModules - Dependency Injection - Http Client - Routing and Navigation – Animations

UNIT II **9 Hours**
FRAMEWORKS WITH DATABASES
MongoDB - MongoDB Basics - Documents - Collections - Query Language - Installation - The mongo Shell - Schema Initialization - MongoDB Node.js Driver - Reading from MongoDB - Writing to MongoDB - CRUD operations - projections - Indexing - Aggregation - Replication - Sharding - Creating backup – Deployment

UNIT III **9 Hours**
ANGULAR TECHNIQUES
Service workers & PWA - Server-side rendering - Angular Libraries - Schematics - CLI Builders - Angular Ivy - Web Workers

UNIT IV **9 Hours**
REACT
React Introduction - React ES6 - React Render HTML - React JSX - Components -React Classes - Composing Components - Passing Data - Dynamic Composition - React state - setting State - Async State Initialization - Event Handling Communicating from Child to Parent - Stateless Components - Designing components- React Forms - React CSS - React SaaS

UNIT V **9 Hours**
NODE JS BACK-END FRAMEWORK
Node.js basics - Local and Export Modules - Node Package Manager - Node.js web server - Node.js File system - Node Inspector - Node.js 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

21AIM04 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.

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

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

PSO1: 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 mobile application programming concepts and platform-specific constraints in comparison with other computing platforms.
2. Analyze the architecture, components, and lifecycle of Android applications.
3. Develop Android applications using rapid prototyping techniques and Android APIs.
4. Implement mobile user interface components and data persistence techniques in mobile applications using platform-specific frameworks.
5. Design cross-platform mobile applications using Flutter for deployment and 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	1	1
2	1	2	2		3				1			1	1	1
3	1		2		3				2			2	1	1
4	1	1	2		3				2			2	1	1
5	1	2	2		3				2			2	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 **2 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 **4 Hours**

Create an activity like a phone dialer with CALL and SAVE buttons. On pressing the CALL button, it must call the phone number and on pressing the SAVE button it must save the number to the phone contacts.

EXPERIMENT 7 **4 Hours**

Implement UI elements like Text Fields, Label, Toolbar, Status bar, Tabbar.

EXPERIMENT 8 **4 Hours**

Implement any type of App using Flutter.

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.

21AIM05 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. Analyze the role of software testing in ensuring software quality throughout the software development lifecycle.
2. Compare test case design strategies to select appropriate techniques for different testing scenarios.
3. Analyze various levels and types of software testing to ensure functional and non-functional quality requirements.
4. Apply test management practices and testing roles for effective planning, execution, and reporting of testing activities.
5. Apply software test automation techniques and tools to design and execute automated test suites.

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 CodeLogic – 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.

21AIM06 **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.

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

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

PSO1: 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 version control operations using Git to manage source code and track changes in software projects.
2. Apply continuous integration, testing, and deployment pipelines using Jenkins with Maven and Gradle.
3. Implement continuous integration pipelines using Jenkins for automated build, testing, and integration of software applications.
4. Apply configuration management techniques using Ansible to automate infrastructure provisioning.
5. Use cloud-based DevOps tools to build and manage CI/CD pipelines in a cloud environment.

Articulation Matrix

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

OPEN ELECTIVES

21OCE01 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.

21OEC01 BASICS OF ANALOG AND DIGITAL ELECTRONICS — 3 0 0 3

Course Objectives

- Understand the working of diodes and transistors in electronic circuits.
- Understand the analog operational amplifier and its applications.
- Understand the implementation of combinational and sequential circuits in digital systems.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply 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. Apply the diodes and transistors in regulators and amplifiers and analyze their characteristics.
2. Illustrate the working of analog IC with different configurations and its applications.
3. Simplification of Boolean expressions using K-map and implementation of combinational circuits.
4. Analyze the Flip flops and memory configurations in digital circuits.
5. Classify and analyze A/D and D/A converters with its parameters.

Articulation Matrix

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

UNIT I **9 Hours**

SEMICONDUCTORS DEVICES

Conductor, Semiconductors & Insulators, Semiconductors: intrinsic & extrinsic, energy band diagram - Mobility - Electrons and holes - The P-N junction diode - Zener diode - Avalanche effect- Rectifier Circuits Half wave, Full wave circuits, Efficiency, PIV, Ripple factor and AC and DC current and voltage in rectifier. PNP and NPN Bipolar junction Transistors - H parameters equivalent circuit - Common emitter amplifier - DC behavior: the load slope and the Q point - AC behavior - Emitter follower amplifier - Field effect transistors: JFET and MOSFET.

UNIT II **9 Hours**

OPERATIONAL AMPLIFIERS: DC PERFORMANCE
The operational amplifier - Input resistance, Output resistance, Open loop gain - Bias currents - Offset currents - Offset voltage - Differential mode gain - Common mode gain - Common mode rejection ratio - Negative feedback - Open loop gain and closed loop gain - Inverter amplifier - Non-inverter amplifier - The voltage follower - Transimpedance amplifier (Current to voltage converter) - Differential amplifier. Adders, Subtractors, Comparator, Integrator and Differentiator.

UNIT III **9 Hours**

DIGITAL TECHNIQUES: COMBINATIONAL CIRCUITS
Numbering systems - Binary, octal and hexadecimal numbers - Boole algebra - Conversion and operations - AND gate- OR gate - Inverter - NAND gate - NOR gate - Exclusive OR gate. Morgans laws. Combinational Circuits: Truth tables, logic expressions, Logic simplification using K- map, half and full adder/subtractor, multiplexers, demultiplexers, Logic families: TTL and CMOS.

UNIT IV **9 Hours**

DIGITAL TECHNIQUES: SEQUENTIAL CIRCUITS
Gated Latches & Flip Flops- Level triggered and Edge triggered Flip-Flops, Flop (FF) types: RS type. JK FF. JK FF Master slave. D FF. T FF. Flip Flop Conversion. Shift registers, Counters. Memories Structure: address and data bus. ROM, PROM, EPROM and flash RAM. Volatiles Memories: RAM, SRAM, DRAM. Addressing modes.

UNIT V **9 Hours**

DIGITAL TO ANALOG CONVERTERS AND ANALOG TO DIGITAL CONVERTERS
DIGITAL TO ANALOG CONVERTERS: Input latch. Binary Weighted Resistor Network. R-2R Ladder Resistor Network. Pulse Width Modulation. Resolution. Accuracy. Linearity. Zero Offset. Settling Time. Glitches. ANALOG TO DIGITAL CONVERTERS: Sampling. Real time sampling and equivalent time sampling. Sampling frequency. Sampling theorem (Nyquist). Anti-aliasing filtering. Sampling and holding. Conversion.

Total: 45 Hours

Reference(s)

1. L Robert Boylestead, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson Education,2012.
2. J Millman, C. Halkias & Satyabrata Jit, Electronic Devices and Circuits, Tata McGraw- Hill,2010.
3. Ramakant A.Gayakwad, OP-AMP and Linear IC"s , Prentice Hall of India, 2002.
4. D.RoyChoudhry, Shail Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
5. Thomas L.Floyd, Digital Fundamentals, Prentice Hall, 11th Edition, 2015.
6. M.Morris Mano, Michael D Ciletti Digital Design 4th edition Pearson, 2011.

21OEC02 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.

21OEC03 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.

21OEI01 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.

21OEI02 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.

21OEI03 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.

21OEI04 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.

21OME01 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, Modeling methods - Wire frame modelling, Surface modelling, Solid modelling - Constructive Solid Geometry and Boundary Representation Techniques. CAD/CAM data exchange - IGES, STEP. Product Life cycle management (PLM).

UNIT II **10 Hours**

AUTOMATION AND CNC MACHINES

Introduction to Automation - Definition, types, reasons for automating. CNC Machines - Principles, types, features, advantages, applications. CNC Machine structure - Linear motion bearings, Recirculating ball bearings, drive system, and control system. CNC Lathe and Milling programming - Linear and circular interpolation, threading and drilling programs.

UNIT III **7 Hours**

ADDITIVE MANUFACTURING

Introduction - Impact of Additive Manufacturing (AM) and Tooling on Product Development - Distinction between AM and CNC Machining - The Generalized AM Process chain - CAD Model - Input file formats - Generation and Conversion of STL file - File Verification and Repair - Build File Creation - Part Construction - Part Cleaning and finishing - AM Benefits - Classification of AM process

UNIT IV **8 Hours**

LIQUID AND SOLID MATERIAL BASED SYSTEMS

Stereo lithography Apparatus (SLA), Digital Light Processing (DLP), Fused Deposition Modelling (FDM) and Laminated Object Manufacturing (LOM) - Working Principle, Construction, Process, Materials and Applications

UNIT V **11 Hours**

POWDER BASED PROCESSES AND APPLICATIONS OF ADDITIVE MANUFACTURING

Selective Laser Sintering (SLS), Color Jet Printing (CJP), Electron Beam Melting (EBM) and Laser Engineered Net Shaping (LENS) - Working Principle, Construction, Process Variables, Materials and Applications. Reverse Engineering using 3D scanner. Application of Additive Manufacturing in Medical field, Manufacturing, Automotive industries, Aerospace and Electronics and Retail industries.

Total: 45 Hours

Reference(s)

1. Ibrahim Zeid, R.Sivasubramania, CAD/CAM Theory and Practice, Tata McGraw Hill, 2010.
2. M. Aditan, B.S. Pabala, CNC Machines, New age International, 2012.
3. C. K. Chua, K. F. Leong and C. S. Lim, Rapid prototyping: Principles and applications, Cambridge University Press, 2010.
4. D. T.Pham, S. S.Dimov, Rapid manufacturing, Springer-Verlag, London, 2001.
5. I. Gibson, D. W. Rosen, and B. Stucker, Additive Manufacturing Technologies 3D Printing, Rapid Prototyping and Direct Digital Manufacturing, Springer, 2015 http://www.springer.com/978-1-4939-2112-6

21OME02 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

21OME03 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 centre performance reporting.

Total: 45 Hours

Reference(s)

1. Srivastava S.K, Maintenance Engineering, S Chand and Company, 2010.
2. Mishra R.C, Pathak K, Maintenance Engineering and Management, second edition, Prentice Hall India Learning Pvt. Ltd., 2012.
3. Keith Mobley R, Lindley R. Higgins and Darrin J. Wikoff, Maintenance Engineering Handbook, Seventh edition, McGraw-Hill Professional, 2008.
4. Davies A, Handbook of Condition Monitoring: Techniques and Methodology, Springer, 2012.
5. Otegui Jose Luis, Failure Analysis, Fundamentals and Applications in Mechanical Components, Nineteenth edition, Springer, 2014.

21OME04 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.

21OBT01 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, purification of 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

21OFD01 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.

21OFD02 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.

21OFD03 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.

21OFD04 CEREAL, PULSES AND OIL SEED 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**

OIL SEEDS 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.

21OFT01 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

21OFT02 INTERIOR DESIGN IN FASHION 3 0 0 3

Course Objectives

- To impart knowledge on interior design.
- To improve the design skills, sustainable with socially-conscious designs

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO5: Modern Tool Usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO6: The Engineer and Society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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

21OFT03 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

21OPH01 NANOMATERIALS SCIENCE 3 0 0 3

Course Objectives

- Impart knowledge on Nanoscience
- Explore different techniques of producing nanomaterials
- Create expertise on the applications of nanomaterials in various fields

Programme Outcomes (POs)

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

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

Course Outcomes (COs)

1. Summarize the origin and advance of nanomaterials and its classification
2. Compare the different types of methods adopted for synthesizing nanomaterials
3. Analyze the characterization techniques for analyzing nanomaterials
4. Explain the physical properties exhibited by nanomaterials
5. Organize the nanomaterials developed for advanced technological applications

Articulation Matrix

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

UNIT I **9 Hours**

NANO SCALE MATERIALS

Introduction-Feynman's vision-national nanotechnology initiative (NNI) - past, present, future -classification of nanostructures, nanoscale architecture - effects of the nanometer length scale - changes to the system total energy, and the system structures- effect of nanoscale dimensions on various properties -differences between bulk and nanomaterials and their physical properties.

UNIT II **9 Hours**

NANOMATERIALS SYNTHESIS METHODS

Top-down processes - mechanical milling, nanolithography and types based on radiations - Bottom-up process physical method: physical vapour deposition, RF sputtering, CVD- chemical method: colloidal and sol-gel methods - template based growth of nanomaterials - ordering of nano systems, self-assembly and self-organization.

UNIT III **9 Hours**

CHARACTERIZATION TECHNIQUES

General classification of characterization methods - analytical and imaging techniques - microscopy techniques - electron microscopy, scanning electron microscopy, transmission electron microscopy, atomic force microscopy - diffraction techniques - X-ray spectroscopy - thermogravimetric analysis of nanomaterials.

UNIT IV **9 Hours**

SEMICONDUCTOR NANOSTRUCTURES

Quantum confinement in semiconductor nanostructures - quantum wells, quantum wires, quantum dots, super lattices-epitaxial growth of nanostructures-MBE, metal organic VPE, LPE - carbon nano tubes- structure, synthesis and electrical properties -applications- quantum well laser- quantum efficiency of semiconductor nanomaterials

9 Hours

UNIT V

NANOMACHINES AND NANODEVICES

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- single electron transistor - - organic photovoltaic cells- spintronics

Total: 45 Hours

Reference(s)

1. Willam A. Goddard, Donald W.Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, AuliceScibioh M, "Fuel cells: Principles and Applications", University Press, 2009.

21OPH02 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.

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

9 Hours

UNIT II

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

21OPH03 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.

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

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

21OPH04 BIO-PHOTONICS 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.
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. 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	2												
2	3	2												
3	3	2							3					
4	3	2							3					
5	3	2												

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.

21OPH05 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

9 Hours

UNIT II

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. 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.

21OCH01 CORROSION SCIENCE AND ENGINEERING 3 0 0 3

Course Objectives

- Analyse the loss incurred due to corrosion in different sectors and terminologies related to corrosion
- Identify forms and types of corrosion with suitable mechanism
- Apply various methods of corrosion control, corrosion testing and monitoring

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2: Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development

Course Outcomes (COs)

1. Explain if corrosion can occur under specific operating conditions in a given equipment or construction and indicate regions of immunity, corrosion and passivity of a metal
2. Compare different corrosion types on metals when exposed to air, water and at high temperatures (> 100 C)
3. Identify the corrosion mechanism on steel, iron, zinc and copper metal surfaces
4. Calculate the rate of corrosion on metals using electrochemical methods of testing
5. Propose the correct materials, design and operation conditions to reduce the likelihood of corrosion in new equipment and constructions

Articulation Matrix

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

UNIT I **9 Hours**

CORROSION

Importance of corrosion - spontaneity of corrosion - units of corrosion rate (mdd and mpy) - direct and indirect damage by corrosion - importance of corrosion prevention in industries - Pilling Bedworth ratio and its significance - passivation - area relationship in both active and passive states of metals - Pourbaix digrams of Mg, Al and Fe and their advantages and disadvantages

UNIT II **7 Hours**

TYPES OF CORROSION

Eight forms of corrosion: uniform, galvanic, crevice corrosion, pitting, intergranular corrosion, selective leaching, erosion corrosion and stress corrosion-Catastrophic oxidation corrosion

UNIT III **9 Hours**

MECHANISM OF CORROSION

Hydrogen embrittlement - corrosion fatigue - filiform corrosion - fretting damage and microbes induced corrosion. Corrosion mechanism on steel, iron, zinc and copper metal surfaces.

UNIT IV **10 Hours**

CORROSION RATE AND ITS ESTIMATION

Rate of corrosion: Factors affecting corrosion. Electrochemical methods of polarization: Tafel extrapolation polarization and linear polarization. Weight loss method - testing for intergranular susceptibility and stress corrosion. Non-Destructive testing methods: Visual testing - liquid penetrant testing - magnetic particle testing - Ultrasonic monitoring, and eddy current testing

UNIT V **10 Hours**

CORROSION CONTROL METHODS

Fundamentals of cathodic protection - types of cathodic protection (sacrificial anodic and impressed current cathodic protection). Stray current corrosion, problems and its prevention. Protective coatings: Metal coatings: Hot dipping (galvanizing, tinning and metal cladding) - natural inhibitors. Selection of suitable design for corrosion control

Total: 45 Hours

Reference(s)

1. Mouafak A. Zaher, "Introduction to Corrosion Engineering", CreateSpace Independent Publishing Platform, 2016.
2. E.McCafferty, "Introduction to Corrosion Science", Springer; 2010 Edition, January 2010.
3. R. Winstone Revie and Herbert H. Uhlig, "Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering", 4th Edition, John Wiley & Science, 2008.
4. Mars G. Fontana, "Corrosion Engineering", Tata McGraw Hill, Singapore, 2008
5. David E.J. Talbot (Author), James D.R. Talbot, "Corrosion Science and Technology", Second Edition (Materials Science & Technology), CRC Press; 2nd Edition, 2007.
6. http://corrosion-doctors.org/Corrosion-History/Eight.html

21OCH02 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. F. W. Billmeyer,"Text Book of Polymer Science", John Wiley & Sons, New York, 2008
4. Barbara H. Stuart, "Polymer Analysis", John Wiley & Sons, New York, 2008
5. George Odian , "Principles of Polymerization", John Wiley & Sons, New York, 2004
6. R. J. Young and P. A. Lovell, "Introduction to Polymers", CRC Press, New York, 2011
7. Common Biocompatible Polymeric Materials for Tissue Engineering and Regenerative Medicine (2019), Materials Chemistry and Physics https://doi.org/10.1016/j.

21OCH03 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
PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

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. N. Eliaz, E. Gileadi, Physical Electrochemistry, Fundamentals, Techniques and Applications, Wiley, 2019.
2. J. Garche, K. Brandt, Electrochemical Power sources: Fundamentals Systems and Applications, Elsevier, 2018
3. S.P. Jiang, Q. Li, Introduction to Fuel Cells, Springer, 2021.
4. A. Iulianelli, A. Basile, Advances in Hydrogen Production, Storage and Distribution, Elsevier, 2016.
5. M.M. Eboch, The Future of Energy, From Solar Cells to Flying Wind Farms, Capstone, 2020.

21OMA01 GRAPH THEORY AND COMBINATORICS 3 0 0 3

Course Objectives

- This course comprehends the graphs as a modeling and analysis tool in computer science & Engineering
- It introduces the structures such as graphs & trees and techniques of counting and combinations, which are needed in number theory-based computing and network security studies in Computer Science.

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply 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. Recognize the basic ideas of Graph and its characteristics.
2. Assess the characteristics of trees and its properties.
3. Predict the coloring of graphs and its applications in the respective areas of engineering.
4. Compute the permutations and combinations in the engineering field.
5. Demonstrate the types of generating functions and their applications in engineering.

Articulation Matrix

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

UNIT I **9 Hours**

INTRODUCTION

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

UNIT II **9 Hours**

TREES, CONNECTIVITY

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1-Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

UNIT III **9 Hours**

MATRICES, COLOURING AND DIRECTED GRAPH

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

UNIT IV **9 Hours**

PERMUTATIONS

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

UNIT V **9 Hours**

GENERATING FUNCTIONS

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - non-homogeneous recurrence relations - Method of generating functions.

Total: 45 Hours

Reference(s)

1. Narsingh Deo, Graph Theory: With Application to Engineering and Computer Science, Prentice Hall of India, 2003
2. Grimaldi R.P., Discrete and Combinatorial Mathematics: An Applied Introduction, Addison Wesley, 1994.
3. Rosen K.H., Discrete Mathematics and Its Applications, McGraw Hil, 2007
4. Clark J. & Holton D.A., A First Look at Graph Theory, Allied Publishers, 1995.
5. Mott J.L., Kandel A. & Baker T.P., Discrete Mathematics for Computer Scientists and Mathematicians, Prentice Hall of India, 1996.
6. Liu C.L., Elements of Discrete Mathematics, McGraw Hill, 1985.

21OGE01 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		2	2
2									2		2		2	2
3									2		2		2	2
4									3		2		2	2
5									2		2		2	2

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.

21OGE02 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. Analyse the different modes of operation management.

Articulation Matrix

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

UNIT I **9 Hours**

BASICS OF ENTREPRENEURSHIP

Nature, scope and types of Entrepreneurship, Entrepreneur Personality Characteristics, Entrepreneurship process. Role of entrepreneurship in economic development.

UNIT II **9 Hours**

GENERATION OF IDEAS

Creativity and Innovation, Lateral Thinking, Generation of Alternatives, Fractional, Reversal Method, Brain Storming, Analogies

UNIT III **9 Hours**

LEGAL ASPECTS OF BUSINESS

Contract act-Indian contract act, Essential elements of valid contract, classification of contracts, sale of goods act- Formation of contract of sale, negotiable instruments- promissory note, bills and cheques, partnership, limited liability partnership (LLP), companies act-kinds, formation, memorandum of association, articles of association.

UNIT IV **9 Hours**

BUSINESS FINANCE

Project evaluation and investment criteria (cases), sources of finance, financial statements, break even analysis, cash flow analysis.

UNIT V **9 Hours**

OPERATIONS MANAGEMENT

Importance- functions-deciding on the production system- facility decisions: plant location, plant layout (cases), capacity requirement planning- inventory management (cases)-lean manufacturing, Six sigma.

Total: 45 Hours

Reference(s)

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Prasanna Chandra, Projects Planning, Analysis, Selection, Implementation and Reviews, Tata McGraw-Hill Publishing Company Limited, New Delhi: 2000.
3. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006

21OGE03 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. Analyse the cases involved in human resource management.
3. Classify the direct and indirect taxes in business.
4. Analyze the supports given by government for improving the business.
5. Examine the various steps involved in preparing the business plan.

Articulation Matrix

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

UNIT I **9 Hours**

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 LevelInstitutions-TIIC, CED, MSME, Financial Institutions

UNIT V **9 Hours**

BUSINESS PLAN PREPARATION

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, 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

21OGE04 NATION BUILDING: LEADERSHIP AND SOCIAL RESPONSIBILITY 3 0 0 3

Course Objectives

- To understand the importance of National Integration, Patriotism and Communal Harmony
- To outline the basic awareness about the significance of soft skills in professional and inter-personal communications and facilitate an all-round development of personality
- To analyze the different types of responsibility role of play for the improvement of society

Programme Outcomes (POs)

PO1: Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO3: Design/Development of Solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
PO7: Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development
PO12: Life-long Learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Course Outcomes (COs)

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

UNIT I **9 Hours**

NATIONAL INTEGRATION

Importance & Necessity, Factors Affecting National Integration, Unity in Diversity. Threats to National Security. Water Conservation and Rain Harvesting, Waste Management and Energy Conservation. Leadership Capsule-Traits-Indicators-Motivation-Moral Values-Honor Code-Case Studies: Shivaji, Jhansiki Rani, Case Studies–APJ Abdul kalam, Deepa Malik, Maharana Pratap, N Narayan Murthy Ratan Tata Rabindra Nath Tagore, role of NCC cadets in 1965 war.

UNIT II **9 Hours**

PERSONALITY DEVELOPMENT AND LEADERSHIP

Intra & Interpersonal skills - Self-Awareness- &Analysis, Empathy, Critical & creative thinking, Decision making and problem solving, Communication skills, Group Discussion – copping with stress and emotions, changing mindset, Public Speaking, Time Management, Social skills, Career counseling, SSB procedure and Interview skills.

UNIT III **9 Hours**

SOCIAL SERVICE, COMMUNITY DEVELOPMENT AND ENVIRONMENTAL AWARENESS

Basics of social service and its need, Types of social service activities, Objectives of rural development programs and its importance, NGO's and their contribution in social welfare, contribution of youth and NCC in Social welfare. Protection of children & women safety, Road/ Rail Travel Safety, New initiatives, Cyber and mobile security awareness. Disaster management Capsule-Organization-Types of Disasters-Essential Services-Assistance-Civil Defence Organization

UNIT IV **9 Hours**

HEALTH, HYGIENE AND COMMUNICATION

Sanitation, First Aid in Common Medical Emergencies. Health, Treatment and Care of Wounds. Yoga-Introduction, Definition, Purpose, Benefits. Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasanaetc. Obstacle Training Contact: Obstacle training - Intro, Safety measures, Benefits, Straight balance, Clear Jump, Gate Vault, ZigZagBalance, High Wall etc. COMMUNICATION: Basic Radio Telephony (RT) Procedure-Introduction, Advantages, Disadvantages, Need for standard- Procedures-Types of Radio Telephony Communication-Radio telephony procedure, Documentation.

UNIT V **9 Hours**

ARMED FORCES AND NCC GENERAL

Army, navy, Air force and Central armed policed forces- Modes of entry into army, police and CAPF-Naval expeditions & campaigns. History, Geography of Border / Coastal areas. EEZ maritime security & ICG. Modes of Entries in armed forces. Security challenges & role of cadets in Border management. Aims, Objectives and org of NCC- Incentives- Duties of NCC cadets- NCC Camps: types and conduct.

Total: 45 Hours

Reference(s)

1. 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/

ONE CREDIT COURSES

20AI0XA TENSORFLOW 1 0 0 1

Course Objectives

- Understand the fundamental concepts of TensorFlow Framework and Keras.
- Implementation of deep learning concepts in 2D data using TensorFlow.

Programme 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.

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

Course Outcomes (COs)

1. Develop deep learning models using TensorFlow and Keras for structured and image data.
2. Apply optimization techniques and evaluate model performance using appropriate metrics.

Articulation Matrix

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

Need for AI in Industry- Introduction to ML and DL- Introduction to TensorFlow – Basic Components of TensorFlow –Architecture of Tensor Flow- Deep Learning Fundamentals – Introduction to Keras – Application of Keras on Deep Lea rning Problems– Optimizers – Case study on Prediction analysis on 2-Dimensional data- Case study on Prediction analysis on Image analytics.

Total: 15 Hours

Reference(s)

1. Hands-on machine learning with Scikit-learn Keras and TensorFlow by Aurelion Geron published by O` Reilley.
2. https://www.tensorflow.org/api_docs
3. https://www.kaggle.com/learn/intro-to-deep-learning.

20AI0XB TABLEAU 1 0 0 1

Course Objectives

- Learn how to organize data, build visualizations, and design dashboards to empower more meaningful business decisions.

Programme 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.

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

Course Outcomes (COs)

1. Design interactive data visualizations and dashboards using Tableau tools.
2. Analyze data through visual representations to support decision making.

Articulation Matrix

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

Introduction to Tableau - Different Products by Tableau - Advantages of Tableau- Introduction to Data Visualization- Applications of Tableau- Companies using Tableau- Features of Tableau- Tableau Terminologies- Tableau Navigations- Tableau Design Flow- How to Connect to a File Source- Understanding of Different Data Sources- Data Source Filters- Data Types - Tableau Operators- String Functions in Tableau- Date Functions - Logical Statements - Aggregate Functions- Joins- Data Blending- Field Operator-Filter- Changing Data Type of a Field from Data Pane-Formatting- Worksheet- Line Chart- Bar Chart- Histogram- Scatter Plot- Pie Chart- Bubble chart- Tableau Forecasting- Tableau Dashboard.

Total: 15 Hours

Reference(s)

1. https://help.tableau.com/current/guides/get-started-tutorial/en-us/get-started-tutorial-home.htm

20AI0XC TYPESCRIPT WITH JEST TESTING FRAMEWORK 1 0 0 1

Course Objectives

- Understand the fundamental concepts of TypeScript and use JEST framework to test the JavaScript code.

Programme 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.

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

Course Outcomes (COs)

1. Develop web-based applications using TypeScript with structured programming concepts.
2. Apply testing techniques using Jest to verify functionality and correctness of applications.

Articulation Matrix

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

TypeScript 10 Hours

Introduction to JavaScript – Difference between JavaScript and TypeScript – Why do we need to prefer TypeScript over JavaScript – Introduction to TypeScript – Features of TypeScript – Access Modifiers – Data Types – Keywords – Flow Control – Interface, Class, Objects – Practical Session on writing TypeScript Code

Jest Testing Framework 5 Hours

Introduction to Jest Testing – Features of Jest – Writing unit tests – Testing the code written in Typescript – Practical Session on Jest Testing Frame work

Total: 15 Hours

Reference(s)

1. https://www.udemy.com/course/typescript-for-beginners-u/

20AI0XD REACT JS 1 0 0 1

Course Objectives

- Understand the fundamental concepts of ReactJS to develop web 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.

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 (COs)

1. Develop web-based applications using TypeScript with structured programming concepts.
2. Apply testing techniques using Jest to verify functionality and correctness of applications.

Articulation Matrix

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

Introduction to React - React vs. Angular vs. Vue - Installing Node.js and npm - Creating a new React project using Create React App - Familiarizing with the React project structure - React Components: class components and functional components - Creating a simple functional component - Using JSX to write HTML - like code in JavaScript - Rendering the component in the browser - Props and State-Modifying state in component - Creating a form in React - Handling form submission -Validating form input-React Router - Setting up React Router in a React project - Event Handling - Redux

Total: 15 Hours

Reference(s)

1. https://www.udemy.com/course/react-redux/

20AI0XE BUILDING WIDGETS APPLICATIONS 1 0 0 1

Course Objectives

- Apply the knowledge of the Qt for developing the 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.

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 (COs)

1. Develop dynamic web applications using React components and state management.
2. Design responsive user interfaces using React and modern web technologies.

Articulation Matrix

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

Introduction to QT framework-Qt Build Mechanism-Qt Cross platform details-Widgets-Dialogs-Buttons-Layouts -Input Widgets components- QObject System-Views, Items-containers -Q_PROPERTY details-QtQuick Classes/Module -Signals and Slots-Threads-Positioner, Anchors and Layouts-Memory Management - Event Handling -Menus – Dialogs - Models: Qstring List Models, QFile Models-Extracting data from models-Working File Systems: QFile, QBuffer, QDataStreams

Total: 15 Hours

Reference(s)

1. Learn Qt 5: Build modern, responsive cross-platform desktop applications with Qt, C++, and QMLby Nicholas Sherriff (Nick)-2018
2. Mastering Qt 5: Create stunning cross-platform applications using C++ with Qt Widgets and QML with Qt Quick, 2nd Edition 2nd Revised edition by Guillaume Lazar, Robin Penea-2018

3. Getting Started with Qt 5: Introduction to programming Qt 5 for cross-platform application development by Benjamin Baka – 2019
4. https://www.qt.io/

20AI0XF BLOCKCHAIN PROGRAMMING AND SMART CONTRACTS **1 0 0 1**

Course Objectives

- Understand the Blockchain technology and how it can be used to process cryptocurrency transactions across the distributed ledger.
- Develop blockchain based solutions and create smart contract using solidity.

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

Course Outcomes (COs)

1. Develop user interface applications using Qt widgets and layout mechanisms.
2. Apply Qt programming concepts for handling events, data models, and application logic.

Articulation Matrix

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

Introduction to Blockchain - Elements of a blockchain - Features of Blockchain - Types of Blockchain - DLT - DLT vs. Blockchain - CAP theorem - Byzantine Generals Problem - Consensus Mechanism - Introduction to Ethereum - Ethereum Wallets - Working with MetaMask - EOA and Contracts Transaction: Structure of Transaction - Transaction Nonce -Transaction GAS – Recipient - Values and Data - Transmitting Values to EOA and Contracts -Basic of Solidity and Web 3 - Life cycle of Smart contract - Smart Contract programming using solidity - MetaMask (Ethereum Wallet) -Setting up development environment - Use cases of Smart Contract -Smart Contracts: Opportunities and Risk.

Total: 15 Hours

Reference(s)

1. "Mastering Blockchain: Distributed Ledger Technology, Decentralization, and Smart Contracts Explained" by Imran Bashir.
2. "Blockchain Basics: A Non-Technical Introduction in 25 Steps" by Daniel Drescher.
3. "Solidity Programming Essentials: A Beginner's Guide to Build Smart Contracts for Ethereum and Blockchain" by Ritesh Modi.

20AI0XG CONTAINERS ORCHESTRATION TECHNIQUES 1 0 0 1

Course Objectives

- Understand the basics of Docker and container orchestration.
- Implement the Container Orchestration with Kubernetes.

Programme 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.

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

Course Outcomes (COs)

1. Apply blockchain concepts to model decentralized applications and transactions.
2. Develop smart contracts using Solidity for Ethereum-based applications.

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	2
2	3	2	3		3							2	3	3

Overview of containerization and its advantages - Introduction to Docker and its architecture - Docker installation and setup - Building and running containers with Docker -Creating Docker images - Managing Docker containers - Container networking - communication - Docker volumes - data persistence - Introduction to Docker Compose - Defining multi-container applications with Docker Compose - Managing application lifecycle with Docker Compose - Introduction to container orchestration and its benefits - Understanding Kubernetes architecture and components - Deploying Kubernetes cluster - Managing and scaling applications with Kubernetes - Kubernetes pods, services, and deployments

Total: 15 Hours

Reference(s)

1. https://www.docker.com/101-tutorial/

20AI0XH REAL TIME BIG DATA ANALYTICS 1 0 0 1

Course Objectives

- Understand the different components of Apache Spark and how to use Apache Spark to process data and build 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.
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 containerization concepts using Docker for application deployment.
2. Deploy and manage applications using Kubernetes orchestration techniques.

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	2
2	3	2	3		3							2	3	3

Introduction to Big Data - Types and challenges - Introduction to Apache Spark - Different components of Apache Spark - Installation of Apache Spark - Data Processing with Apache Spark: How to read data from different sources - How to write data to different sources - How to process data with Apache Spark - Machine Learning with Apache Spark: Build machine learning models with Apache Spark - Evaluate machine learning models - Advanced Data Processing with Apache Spark: Spark SQL - Spark Streaming- Spark MLlib - Advanced Machine Learning with Apache Spark - Spark ML Pipelines

Total: 15 Hours

Reference(s)

1. Learning Spark by Bill Chambers, Matei Zaharia, Andy Konwinski, Ilya Sukharevsky, Matei Zaharia
2. Spark: The Definitive Guide by Bill Chambers, Matei Zaharia, Andy Konwinski, Ilya Sukharevsky, Matei Zaharia
3. https://www.oracle.com/big-data/what-is-big-data/
4. https://spark.apache.org/docs/latest/
5. https://spark.apache.org/downloads.html
6. https://spark.apache.org/docs/latest/api/python/index.html
7. https://spark.apache.org/docs/latest/ml-guide.html
8. https://spark.apache.org/docs/latest/sql-programming-guide.html
9. https://spark.apache.org/docs/latest/streaming-programming-guide.html