

# **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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### **VISION OF THE DEPARTMENT**

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

### **MISSION OF THE DEPARTMENT**

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

### **PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)**

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

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

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

### **PROGRAMME OUTCOMES (POs)**

1. **Engineering Knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem Analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/Development of Solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct Investigations of Complex Problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The Engineer and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and Team Work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long Learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

#### **PROGRAMME SPECIFIC OUTCOMES (PSOs)**

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

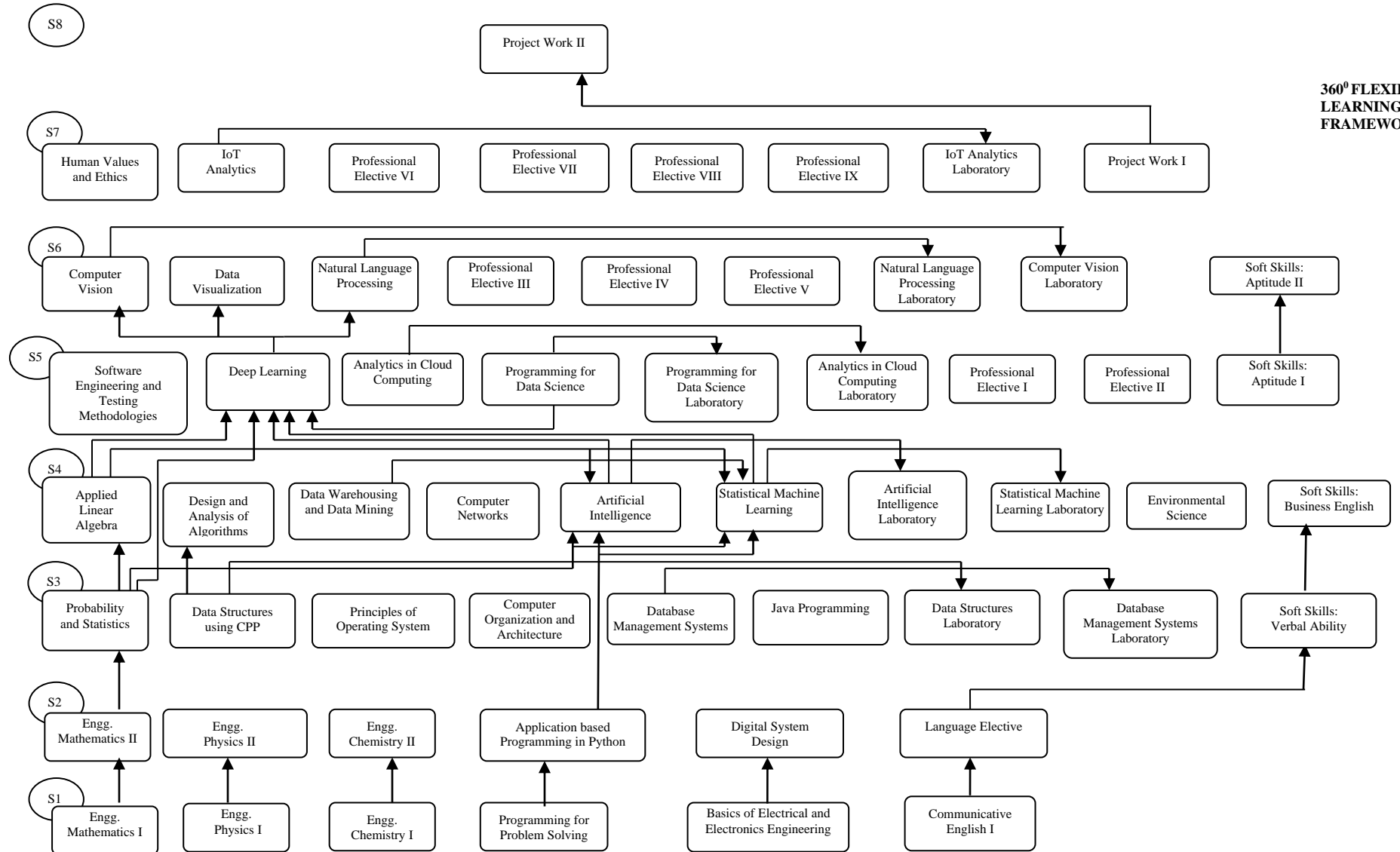
PSO2: Ability to identify and use appropriate analytical tools and techniques on massive datasets to extract information.

**MAPPING OF PEOs WITH POs AND PSOs**

<b>POs</b>	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>	<b>6</b>	<b>7</b>	<b>8</b>	<b>9</b>	<b>10</b>	<b>11</b>	<b>12</b>	<b>PSO1</b>	<b>PSO1</b>
<b>PEO 1</b>	X	X	X		X		X				X		X	X
<b>PEO 2</b>			X	X		X						X	X	X
<b>PEO 3</b>								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
<b>Total</b>		<b>12</b>	<b>1</b>	<b>10</b>	<b>18</b>	<b>23</b>				
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
<b>Total</b>		<b>13</b>	<b>1</b>	<b>8</b>	<b>20</b>	<b>25</b>				



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
<b>Total</b>		<b>17</b>	<b>1</b>	<b>12</b>	<b>23</b>	<b>30</b>				
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
<b>Total</b>		<b>19</b>	<b>1</b>	<b>12</b>	<b>23</b>	<b>32</b>				

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	
<b>Total</b>					<b>23</b>						
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	
<b>Total</b>					<b>23</b>						

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	100	0	100	PC
21AI708	PROJECT WORK I	0	0	6	3	6	50	50	100	EEC
<b>Total</b>					<b>22</b>					
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	50	50	100	EEC
<b>Total</b>		<b>0</b>	<b>0</b>	<b>18</b>	<b>9</b>	<b>18</b>				

<b>ELECTIVES</b>										
<b>LANGUAGE ELECTIVES</b>										
Code No.	Course	L	T	P	C	Hours/ Week	Maximum Marks			Category
							CA	ES	Total	
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
<b>DISCIPLINE ELECTIVES</b>										
<b>VERTICAL I – FULL STACK DEVELOPMENT</b>										
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
<b>VERTICAL II – CLOUD COMPUTING AND DATA CENTER TECHNOLOGIES</b>										
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
<b>VERTICAL III – CYBER SECURITY AND DATA PRIVACY</b>										
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
<b>VERTICAL IV – AI AND ROBOTICS</b>										
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
<b>VERTICAL V – COMPUTATIONAL INTELLIGENCE</b>										
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
<b>VERTICAL VI – DATA ANALYTICS</b>										
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
<b>DIVERSIFIED COURSES</b>										
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
<b>HONOURS</b>										
<b>VERTICAL I – FULL STACK DEVELOPMENT</b>										
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
<b>MINOR</b>										
<b>VERTICAL I – FULL STACK DEVELOPMENT</b>										
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
<b>OPEN ELECTIVES</b>										
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
21OEC04	PRINCIPLES OF COMPUTER COMMUNICATION AND NETWORKS	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.

**Course Outcomes (COs)**

1. Represent the different forms of coordinate system in complex plane and characteristics of linear systems by Eigenvalues and Eigenvectors.
2. Analyze various types of functions and their differentiation techniques involved in engineering fields.
3. Implement different methods of integration used in engineering problems.
4. Execute the suitable integration technique to calculate the area and volume of different surfaces.
5. Apply the concept of analytic function to estimate the integral in complex plane.

**Articulation Matrix**

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

**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.

**FOR FURTHER READING**

Applications of mass spring system in ordinary differential equations of higher order.

**Total: 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

**Course Outcomes (COs)**

1. Illustrate the Newtons three laws of motion and apply the same to solve the real-world problems involving elevator, atwood machine and acceleration of objects
2. Exemplify the physical characteristics of simple harmonic motion, wave motion and find the solutions for wave equations
3. Infer the fundamental laws, properties of electricity and magnetism and apply the same to electric and magnetic elements
4. Apply the principles of physical and geometrical optics in the mirrors, lenses, microscopes and diffraction gratings
5. Outline the importance of special theory of relativity, quantum physics and analyse the wave and particle nature of matter

**Articulation Matrix**

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

**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 -Davisson - Germer experiment

**1** **5 Hours**

**EXPERIMENT 1**

Determination of resultant of system of concurrent coplanar forces-Parallelogram law of forces

**2** **5 Hours**

**EXPERIMENT 2**

Determination of moment of inertia-Torsional pendulum

**3** **5 Hours**

**EXPERIMENT 3**

Determination of wavelength of mercury spectral lines-spectrometer

**4** **4 Hours**

**EXPERIMENT 4**

Determination of refractive index of solid and liquid-travelling microscope

**5** **3 Hours**

**EXPERIMENT 5**

Determination of wavelength of laser-diffraction grating

**6** **4 Hours**

**EXPERIMENT 6**

Determination of frequency of a tuning fork-Meldes apparatus

**7**

**4 Hours**

**EXPERIMENT 7**

Thickness of a thin wire using interference of light-Air wedge method

**Total: 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****2023****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

**Course Outcomes (COs)**

1. Compare the inorganic and organic materials used for smart screen fabrication
2. Demonstrate the fabrication of smart screen using conducting material
3. Analyse the type of materials for data storage in electronic devices
4. Identify various organic nanoscale materials in data storage
5. Select suitable materials for fabrication of microprocessor

**Articulation Matrix**

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

**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 [polythiophene]

**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

**FURTHER READING**

Applications of advanced data storage materials in electronic devices, conducting materials for smart screen Applications of smart material for microprocessor fabrication.

**1** **5 Hours**

**EXPERIMENT 1**

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

**2** **5 Hours**

**EXPERIMENT 2**

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

**3** **5 Hours**

**EXPERIMENT 3**

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

**4** **4 Hours**

**EXPERIMENT 4**

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

**5** **6 Hours**

**EXPERIMENT 5**

Electroless plating of copper on polymeric material used in IC fabrication

**6** **6 Hours**

**EXPERIMENT 6**

Electroless plating of nickel on polymeric material used in IC fabrication

**Total: 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**

**2023**

**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.

**Course Outcomes (COs)**

1. Explain the basic C programming concepts
2. Implement C programs using control statements
3. Implement the concepts of Arrays and strings in C
4. Implement the concepts of functions and pointers in C
5. Analyze the concepts of structures, unions and files in C

**Articulation Matrix**

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

**UNIT I**

**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

**1**

**4 Hours**

**EXPERIMENT 1**

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

**2**

**4 Hours**

**EXPERIMENT 2**

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

**3**

**2 Hours**

**EXPERIMENT 3**

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.

**4**

**2 Hours**

**EXPERIMENT 4**

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

**5**

**2 Hours**

**EXPERIMENT 5**

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
```

**6**

**4 Hours**

**EXPERIMENT 6**

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.

**7** **2 Hours**

**EXPERIMENT 7**

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

**8** **2 Hours**

**EXPERIMENT 8**

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

**9** **4 Hours**

**EXPERIMENT 9**

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:

**10** **4 Hours**

**EXPERIMENT 10**

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: 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**

2023

**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.

**Course Outcomes (COs)**

1. Understand the basic concepts of electric and magnetic circuits
2. Summarize the types of DC machines.
3. Classify the static and dynamic AC machines and explain their operation.
4. Interpret the operation of AC and DC drives
5. Illustrate the characteristics of semiconductor devices and communication systems.

**Articulation Matrix**

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

**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.

**FOR FURTHER READING**

Voltage Regulator - Stepper motor - Energy meter - SMPS, Satellite and Optical communication.

**1**

**4 Hours**

**EXPERIMENT 1**

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

**2**

**4 Hours**

**EXPERIMENT 2**

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

**3**

**4 Hours**

**EXPERIMENT 3**

Understand the concept of electromagnetic induction using copper coil.

**4**

**4 Hours**

**EXPERIMENT 4**

Understand the construction and working principle of DC machines.

**5**

**6 Hours**

**EXPERIMENT 5**

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

**6**

**4 Hours**

**EXPERIMENT 6**

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

**7**

**4 Hours**

**EXPERIMENT 7**

Lighting applications using logic gates principle.

**Total: 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.

**Course Outcomes (COs)**

1. Use appropriate grammar & vocabulary that is expected at the BEC Preliminary exam level.
2. Understand the general meaning of non-routine letters within own work area, and short reports of a predictable nature.
3. Write straightforward, routine letters of a factual nature, and make notes on routine matters, such as taking/placing orders.
4. Follow simple presentations/demonstrations.
5. Deal with predictable requests from a visitor, state routine requirements, and offer advice within own job area on simple matters.

**Articulation Matrix**

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

**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.

**Course Outcomes (COs)**

1. Illustrate the various parameters in partial differentiation and characterize the maxima and minima functions for signals and systems.
2. Apply multiple integral concepts to calculate the area and volume by appropriate vector integral theorems.
3. Analyse the convergence and divergence of sequences and series by various tests.
4. Construct first order differential equations from real time phenomena and solve it by suitable method.
5. Execute the appropriate method to solve the second order differential equations.

**Articulation Matrix**

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

**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.

**FOR FURTHER READING**

Applications of mass spring system in ordinary differential equations of higher order.

**Total: 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

**Course Outcomes (COs)**

1. Understand the principle, characteristics, different types of lasers and apply the same for optical data storage and retrieval techniques
2. Illustrate the propagation of light through different optical fibres, applications of optical fibres in communication and sensors
3. Identify the seven crystal systems, crystal planes and the stacking sequences in metallic crystal structures
4. Analyse the characteristics of semiconducting materials in terms of crystal lattice, charge carriers and energy band diagrams
5. Outline the properties of magnetic materials, domain theory of ferromagnetism and the applications for recording and readout process

**Articulation Matrix**

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

**UNIT I****7 Hours****LASER**

Principle - interaction of radiation with matter - characteristics of laser radiation - pumping mechanisms - types: CO<sub>2</sub> 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

**1** **2 Hours**

**EXPERIMENT 1**

Exposure to Engineering Physics Laboratory and precautionary measures

**2** **4 Hours**

**EXPERIMENT 2**

Determine the wavelength of given laser source by applying the principle of diffraction

**3** **4 Hours**

**EXPERIMENT 3**

Determination of acceptance angle and numerical aperture of a given fibre

**4** **4 Hours**

**EXPERIMENT 4**

Evaluation of band gap of given material using band gap kit.

**5** **4 Hours**

**EXPERIMENT 5**

Determine the V-I characteristics of a solar cell

**6** **4 Hours**

**EXPERIMENT 6**

Using Hall Effect, determine the nature of given material

**7** **4 Hours**

**EXPERIMENT 7**

Find the refractive index of a transparent solid with the aid of travelling microscope

**8**

**4 Hours**

**EXPERIMENT 8**

Determination of energy loss per cycle of a ferromagnetic material using hysteresis curve

**Total: 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****2023****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

**Course Outcomes (COs)**

1. Compare the metals and alloys used as thermal management materials in electronic devices
2. Interpret the advanced thermal management materials for microelectronics and optoelectronics
3. Analyze the importance of primary, secondary batteries and fuel cells used in energy storage devices in computers
4. Identify various organic nanoscale materials in data storage
5. Select a suitable technology to manage e-wastes from various electronic devices

**Articulation Matrix**

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

**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 [Al<sub>2</sub>O<sub>3</sub>, 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)

**1** **8 Hours**

**EXPERIMENT 1**

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

**2** **4 Hours**

**EXPERIMENT 2**

Determination of thermal stability of copper alloys using thermo gravimetric analysis

**3** **6 Hours**

**EXPERIMENT 3**

Determination of single electrode potential of zinc and copper electrodes

**4** **6 Hours**

**EXPERIMENT 4**

Preparation of cadmium nanoparticles and its characterization

**5** **6 Hours**

**EXPERIMENT 5**

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

**Total: 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

**Course Outcomes (COs)**

1. Explain the basic concepts of Python programming
2. Implement Python programs using control statement and functions
3. Develop Python programs for the data structures String, List and Set
4. Implement Python programs for tuples and dictionaries data structures
5. Develop Python programs for files, modules and packages

**Articulation Matrix**

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

**1** **2 Hours**

**EXPERIMENT 1**

Programs using expressions and input and output statements.

**2** **2 Hours**

**EXPERIMENT 2**

Programs using operators and built in functions.

**3** **2 Hours**

**EXPERIMENT 3**

Programs using conditional statements.

**4** **2 Hours**

**EXPERIMENT 4**

Programs performing all string operations.

**5** **2 Hours**

**EXPERIMENT 5**

Programs using functions

**6** **2 Hours**

**EXPERIMENT 6**

Programs to find square root, GCD, exponentiation, sum an array of numbers

**7** **2 Hours**

**EXPERIMENT 7**

Programs to perform linear search, binary search

**8** **2 Hours**

**EXPERIMENT 8**

Programs to perform operations on list

**9** **2 Hours**

**EXPERIMENT 9**

Programs using dictionary and set

<b>10</b> <b>EXPERIMENT 10</b> Programs to work with Tuples.	<b>2 Hours</b>
<b>11</b> <b>EXPERIMENT 11</b> Programs to sort elements (Selection, Insertion, Merge, Quick)	<b>2 Hours</b>
<b>12</b> <b>EXPERIMENT 12</b> Program to perform word count in file.	<b>2 Hours</b>
<b>13</b> <b>EXPERIMENT 13</b> Program to perform file operations	<b>2 Hours</b>
<b>14</b> <b>EXPERIMENT 14</b> Program to count the number of characters, words and lines in a text file	<b>2 Hours</b>
<b>15</b> <b>EXPERIMENT 15</b> Programs using modules and packages	<b>2 Hours</b>
	<b>Total: 75 Hours</b>

**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
- Analyse and design various combinational and sequential circuits

**Course Outcomes (COs)**

1. Understand the boolean algebra and logic gates
2. Design and analyze combinational circuits
3. Implement synchronous sequential logic
4. Understand the procedures in Asynchronous sequential logic
5. Implement the design with MSI devices

**Articulation Matrix**

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

**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.

**FOR FURTHER READING**

Design of a simple CPU - ASM charts - Hardware Description Language - RTL Design

**1**

**2 Hours**

**EXPERIMENT 1**

Implement Boolean Laws using Logic Gates

**2**

**4 Hours**

**EXPERIMENT 2**

Implement arithmetic circuits (Adder, Subtractor)

**3**

**2 Hours**

**EXPERIMENT 3**

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

**4**

**4 Hours**

**EXPERIMENT 4**

Construct Parity generator and parity checker

**5**

**2 Hours**

**EXPERIMENT 5**

Construct Magnitude comparator

**6**

**4 Hours**

**EXPERIMENT 6**

Demonstrate Multiplexer and Demultiplexers

**7**

**2 Hours**

**EXPERIMENT 7**

Function realization using multiplexers

**8**

**4 Hours**

**EXPERIMENT 8**

Demonstrate Encoder and Decoder

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

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

**Total: 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.

**Course Outcomes (COs)**

1. Demonstrate and apply the basic probability axioms and concepts in their core areas of random phenomena in their core areas.
2. Calculate the relationship of two-dimensional random variables using Correlation techniques and to study the properties of two-dimensional random variables.
3. Formulate the testing of hypothesis based on different types of hypothesis.
4. Implement one-way and two-way classifications.
5. Summarize the measurements for statistical quality control.

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	3	3	1										3	3
2	2	3											3	3
3	3	2		1									3	3
4	2	1	1	3									3	3
5	2	2	1	1									3	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 - 2<sup>2</sup> 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: 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.

**Course Outcomes (COs)**

1. Identify the features of object-oriented concepts in C++
2. Implement the operations and applications of Stack ADT, Queue ADT and List ADT
3. Classify the types of tree data structures and explain the tree traversal methods
4. Outline the features and applications of graph data structure
5. Design algorithms for searching and sorting techniques

**Articulation Matrix**

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

**FURTHER READING**

Set-Extensible Arrays - Associative Arrays - Reactive Data Structures - Distributed Data Structures - Custom Data Structures

**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, Data 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

**Course Outcomes (COs)**

1. Classify operating system components and system calls based on functionality
2. Analyze and evaluate CPU scheduling algorithms
3. Interpret the solutions for critical section problems and deadlock prevention
4. Analyze the memory management techniques in terms of fragmentation
5. Identify the various file organization and access methods

**Articulation Matrix**

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

**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

**Course Outcomes (COs)**

1. Apply the knowledge of performance metrics to find the performance of systems
2. Determine the technique to execute multiple instruction in single core and multi-core processor
3. Analyze how parallel processing and memory system can have significant impact on performance of a digital computer
4. Identify the different types of parallelism that can be exploited in a computer architecture
5. Understand the process of controlling and coordinating computer memory

**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											
3	2	2	2											
4	2	3	2											
5	2	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.

**FOR FURTHER READING**

Case Study: Memory Hierarchies in Intel Core i7 and ARM Cortex-A8, Dynamic Scheduling in Intel Core i7 and ARM Cortex-A8, Intel Skylake and IBM Power8 and Nvidia Maxwell.

**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 Varanasic 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.

**Course Outcomes (COs)**

1. Differentiate database systems from file system by understanding the features of database system and design an ER model for a database system.
2. Develop solutions to a broad range of query and data update problems using relational algebra, relational calculus and SQL.
3. Apply the normalization theory in relational databases for removing anomalies.
4. Compare database storage and access techniques for file organization, indexing methods and Query Processing.
5. Analyze the basic issues of transaction processing, concurrency control, deadlock and its recovery schemes

**Articulation Matrix**

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

**FOR FURTHER READING**

Introduction to Parallel, Distributed and Object-Oriented Databases- Introduction to MySQL and PHP

**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

**Course Outcomes (COs)**

1. To understand the elementary programming and object-oriented thinking of Java.
2. To develop a java application using three pillars of object-oriented programming concepts.
3. To define exceptions and use I/O streams and files in various roles.
4. To develop a java application with generics classes and multithreading concepts.
5. To design desktop-based java applications using Java Applet, AWT, Swing and its components.

**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	3		3									
3	3	3	3		3									
4	3	3	3		3									
5	3	3	3		3									

**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

**FOR FURTHER READING**

Java FX vs Swing and AWT, Java FX controls-Java Networking -Java Server faces

**1** **3 Hours**

**EXPERIMENT 1**

Program on Classes and Method

**2** **2 Hours**

**EXPERIMENT 2**

Implementation of Inheritance

**3** **3 Hours**

**EXPERIMENT 3**

Implementation of Interfaces and Packages

**4** **3 Hours**

**EXPERIMENT 4**

Implementation of Exception handling mechanisms

**5** **2 Hours**

**EXPERIMENT 5**

Develop a program to implement String Handling Methods

**6** **3 Hours**

**EXPERIMENT 6**

Implementation of I/O Streams

**7** **3 Hours**

**EXPERIMENT 7**

Implementation of Collections Interfaces and Classes

**8** **3 Hours**

**EXPERIMENT 8**

Implementation of Multithreaded Programming

<b>9</b> <b>EXPERIMENT 9</b> Implementation of Applet Programs	<b>2 Hours</b>
<b>10</b> <b>EXPERIMENT 10</b> Write a program to implement Event classes	<b>2 Hours</b>
<b>11</b> <b>EXPERIMENT 11</b> Implementation of Swing programs and layout managers	<b>2 Hours</b>
<b>12</b> <b>EXPERIMENT 12</b> Implementation of JDBC concepts	<b>2 Hours</b>
	<b>Total: 60 Hours</b>

**Reference(s)**

1. Herbert Schildt, Java: The Complete Reference, 11th Edition, McGraw Hill Education, 2018.
2. Y Daniel Liang, Introduction to Java Programming, 11th Edition, 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

**Course Outcomes (COs)**

1. Implement C++ programs to illustrate linear data structures
2. Implement C++ programs to illustrate non-linear data structures
3. Develop C++ programs to illustrate recursion, searching, sorting and hashing
4. Execute C++ programs using machine learning libraries

**Articulation Matrix**

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

**1** **2 Hours**  
**EXPERIMENT 1**  
 Implement Towers of Hanoi puzzle using recursion

**2** **4 Hours**  
**EXPERIMENT 2**  
 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

**3** **6 Hours**  
**EXPERIMENT 3**  
 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

**4** **8 Hours**

**EXPERIMENT 4**

- i. Design a web browser application using Stack that performs the 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 displays all the songs added to the queue in order

**5** **4 Hours**

**EXPERIMENT 5**

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

**6** **6 Hours**

**EXPERIMENT 6**

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

**7** **7 Hours**

**EXPERIMENT 7**

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

**8** **4 Hours**

**EXPERIMENT 8**

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

**9** **15 Hours**

**EXPERIMENT 9**

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.

**10** **4 Hours**

**EXPERIMENT 10**

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, Data 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.

**Course Outcomes (COs)**

1. Implement SQL commands like DDL, DML, TCL, and DCL
2. Implement stored procedures, functions, triggers and cursors.
3. Implement database connectivity 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								3	
2	2	2	3		3								3	
3	2	2	3		3								3	

<b>1</b>	<b>4 Hours</b>
<b>EXPERIMENT 1</b> Working with SQL commands like DDL, DML, TCL, and DCL	
<b>2</b>	<b>8 Hours</b>
<b>EXPERIMENT 2</b> Performing Single- row functions and group functions in SQL.	
<b>3</b>	<b>4 Hours</b>
<b>EXPERIMENT 3</b> Execute simple queries using joins and Integrity constraints.	
<b>4</b>	<b>8 Hours</b>
<b>EXPERIMENT 4</b> Creation and manipulation of database objects.	
<b>5</b>	<b>4 Hours</b>
<b>EXPERIMENT 5</b> Implementation of cursor in PL/SQL block.	
<b>6</b>	<b>8 Hours</b>
<b>EXPERIMENT 6</b> Generate trigger in PL/SQL block.	

**7** **8 Hours**

**EXPERIMENT 7**

Write PL/SQL block Programs using exception handling.

**8** **8 Hours**

**EXPERIMENT 8**

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

**9** **8 Hours**

**EXPERIMENT 9**

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

**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										1				
2											2			
3								2						
4														
5														

**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.

**Course Outcomes (COs)**

1. Represent characteristics of matrices and determinants with their properties.
2. Analyze the characteristics of a linear system with Eigenvalues and Eigenvectors.
3. Implement the various matrix decomposition techniques to solve the given system.
4. Analyze the linear dependence and compute the basis and dimension of vector spaces.
5. Analyze the systems by Inner product space techniques.

**Articulation Matrix**

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

**FOR FURTHER READING**

Eigenvalues, Eigenvectors, Matrix Operation using MATLAB/Any Programming language of your choice.

**Total: 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.

**Course Outcomes (COs)**

1. Analyze the algorithm efficiency by means of mathematical notations.
2. Analyze the different sorting algorithms using algorithm design techniques.
3. Analyze the different techniques in the design of Graph algorithms.
4. Analyze the various backtracking and branch and bound algorithms.
5. Differentiate algorithms design techniques of NP complete with NP hard problem.

**Articulation Matrix**

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

**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: Prim's Algorithm, Kruskal's 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

**FOR FURTHER READING**

Sets and Dictionaries- Algorithm visualization- Exhaustive search- Knapsack problem and memory functions- Decision trees

**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**

**2023**

**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

**Course Outcomes (COs)**

1. Design data warehouse by applying principles of dimensional modelling and ETL concepts
2. Analyze various data pre-processing techniques for efficient data mining.
3. Apply association rule mining for finding hidden and interesting patterns in data.
4. Apply statistical procedure, machine learning and neural network-based classification algorithms for data prediction
5. Apply clustering algorithms for the application and generalizations for real time problems

**Articulation Matrix**

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

**1**

**3 Hours**

**EXPERIMENT 1**

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.

**2**

**2 Hours**

**EXPERIMENT 2**

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.

**3**

**1 Hour**

**EXPERIMENT 3**

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

**4**

**3 Hours**

**EXPERIMENT 4**

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.

**5**

**3 Hours**

**EXPERIMENT 5**

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,  $|D|=9$ .

**6**

**3 Hours**

**EXPERIMENT 6**

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  $a = (x_1, y_1)$  and  $b = (x_2, y_2)$  is defined as

$$P(a, b) = |x_2 - x_1| + |y_2 - y_1|$$

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: 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.

**Course Outcomes (COs)**

1. Examines the data communications and defines their components, the types of data exchanged, their standards.
2. Summarize the services provided by the data-link layer, its addressing mechanisms and help the delivery of data frame in the network layer.
3. Identify the network services, the routing protocols and apply the suitable addressing for their network.
4. Apply the necessary transport protocol based on the flow and error control services needed for their network.
5. Demonstrate how application programs use the services of all the layers in their network.

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

**UNIT I**

**9 Hours**

**DATA COMMUNICATIONS**

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

**FOR FURTHER READING**

WiMAX-Peer to Peer Networking-Internet 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

**Course Outcomes (COs)**

1. Compare AI with human intelligence and traditional information processing, and discuss its strengths and limitations and its application to complex and human-centered problems
2. Analyze the structures and algorithms selection in Artificial Intelligence techniques related to knowledge representation and reasoning.
3. Analyze the search strategies and its types
4. Apply and evaluate intelligent agents to given real time dataset
5. Understand the structures of Learning concepts and use of PROLOG in AI.

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

**FOR FURTHER READING**

Text Classification - Information Retrieval, Natural Language Processing

**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.

**Course Outcomes (COs)**

1. Identify applications suitable for different types of Machine Learning with suitable justification.
2. Implement supervised Learning algorithms for real time data sets for intelligent decision making.
3. Apply Machine Learning techniques to classification and clustering to unstructured data.
4. Apply reinforcement learning techniques for real life problems
5. Implement probabilistic discriminate and generative algorithms for an application and analyze the results.

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

**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).

**FOR FURTHER READING**

Dimensionality Reduction - Linear Discriminant Analysis - Principal Component Analysis - Factor Analysis - Independent Component Analysis - Locally Linear Embedding - Isomap - Least Squares Optimization - Evolutionary Learning - Genetic algorithms - Genetic Offspring

**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.

**Course Outcomes (COs)**

1. Analyze and specify software requirements.
2. Apply search techniques and knowledge representation schemes.
3. Apply AI techniques 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	1	1	2	2								3	
2	3	3	3	2									3	
3	3	3	3	2	2								3	

<p><b>1</b> <b>EXPERIMENT 1</b> Installation and working on various AI tools viz Scikit Learn, Tensorflow, Keras, CNTK</p>	<b>6 Hours</b>
<p><b>2</b> <b>EXPERIMENT 2</b> Data pre-processing and annotation and creation of datasets.</p>	<b>6 Hours</b>
<p><b>3</b> <b>EXPERIMENT 3</b> Implementation of Breadth First searching techniques.</p>	<b>4 Hours</b>
<p><b>4</b> <b>EXPERIMENT 4</b> Implementation of Depth First searching techniques.</p>	<b>4 Hours</b>
<p><b>5</b> <b>EXPERIMENT 5</b> Implementation of Hill climbing algorithm</p>	<b>4 Hours</b>
<p><b>6</b> <b>EXPERIMENT 6</b> Implementation of A* Algorithm</p>	<b>4 Hours</b>

<b>7</b> <b>EXPERIMENT 7</b> Designing a Chat bot application.	<b>8 Hours</b>
<b>8</b> <b>EXPERIMENT 8</b> Implementation of Knowledge base system	<b>4 Hours</b>
<b>9</b> <b>EXPERIMENT 9</b> Implementation of Inference system.	<b>4 Hours</b>
<b>10</b> <b>EXPERIMENT 10</b> Write a program to solve 4-Queen problem.	<b>4 Hours</b>
<b>11</b> <b>EXPERIMENT 11</b> Write a program to solve traveling salesman problem.	<b>4 Hours</b>
<b>12</b> <b>EXPERIMENT 12</b> Implementation of Tic-Tac-Toe game	<b>4 Hours</b>
<b>13</b> <b>EXPERIMENT 13</b> Implementation of snake game in python	<b>4 Hours</b>
	<b>Total: 60 Hours</b>

**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.

**Course Outcomes (COs)**

1. Implement supervised Learning algorithms for real time data sets for intelligent decision making.
2. Apply Machine Learning techniques to classification and clustering to unstructured data.
3. Apply reinforcement learning techniques for real life 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								3	
2	3	3	3	2	2								3	
3	3	3	3	2	2								3	

**1** **6 Hours**  
**EXPERIMENT 1**

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

**2** **6 Hours**  
**EXPERIMENT 2**

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

**3** **6 Hours**  
**EXPERIMENT 3**

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.

**4** **6 Hours**  
**EXPERIMENT 4**

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

**5** **6 Hours**  
**EXPERIMENT 5**

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

**6** **6 Hours**  
**EXPERIMENT 6**

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

**7** **6 Hours**  
**EXPERIMENT 7**

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.

**8** **6 Hours**  
**EXPERIMENT 8**

Implement Q Learning with Linear Function Approximation.

**9** **6 Hours**  
**EXPERIMENT 9**

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

**10** **6 Hours**  
**EXPERIMENT 10**

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 patten 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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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)

**FOR FURTHER READING**

Human rights: Biomedical waste -Identification of adulterants in food materials

**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

**Course Outcomes (COs)**

1. Listen, Read, Speak, and Write Business English at the level of independent users
2. Appear for the Business English Certificate (BEC) Vantage level examination conducted by the Cambridge Assessment English

**Articulation Matrix**

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

**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.

**Course Outcomes (COs)**

1. Analyze and identify a suitable software development life cycle model for an application.
2. Develop software requirements specification and cost estimation for an application.
3. Analyze the software design concepts and principles to develop high quality software.
4. Characterize various software testing methodologies and analyze the given software requirements to determine appropriate testing techniques in commercial software environments.
5. Obtain adequate knowledge about software process models, software effort estimation techniques and risk management principles.

**Articulation Matrix**

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

**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.

**Course Outcomes (COs)**

1. Understand the fundamental techniques and principles of Neural Networks.
2. Understand the Feed Forward and Back Forward Propagation algorithms
3. Implement the Convolutional Neural Network to recognize and classify the image.
4. Understand the deep learning architecture to model the data.
5. Apply the deep learning techniques for solving real-life problems.

**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	
2	3	2	3	2	3								3	
3	3	3	3	3	3								3	
4	3	3	3	3	3								3	
5	3	3	3	2	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: 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.

**Course Outcomes (COs)**

1. Understand the different types of cloud models and services for building an efficient cloud computing environment.
2. Design and develop highly scalable cloud-based applications by creating and configuring virtual machines on the cloud.
3. Analyze the key concepts of cloud storage for load balancing in cloud architecture.
4. Understand the concept web services in cloud applications.
5. Explore the cloud security concerns and examine the risks involved in cloud security.

**Articulation Matrix**

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

**FOR FURTHER READING**

Cloud evolution- Data center requirements- vmware virtualization- Google Infrastructure- Google Cloud Security, Case study on Amazon, Google and IBM cloud services

**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.

**Course Outcomes (COs)**

1. Install and use R for simple programming tasks.
2. Extend the functionality of R by using add-on packages.
3. Conduct exploratory data analysis using R.
4. Create insightful visualizations to identify patterns from data.
5. Apply statistical estimates to make meaningful predictions from data. Code statistical functions in R.

**Articulation Matrix**

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

**UNITII**

**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.

**FOR FURTHER READING**

Data querying: SQL and R, RMarkdown

**Total: 45 Hours**

**Reference(s)**

1. R for Data Science, Hadley Wickham and Garrett 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.

**Course Outcomes (COs)**

1. Install and use R for simple programming tasks.
2. Extend the functionality of R by using add-on packages.
3. Conduct exploratory data analysis using R.
4. Create insightful visualizations to identify patterns from data.
5. Apply statistical estimates to make meaningful predictions from data. Code statistical functions in R.

**Articulation Matrix**

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

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.

**Course Outcomes (COs)**

1. Understand the fundamental concepts of cloud computing and analyze the networking components for communication.
2. Configure various virtualization tools such as Virtual Box, VMware workstation.
3. Learn how to simulate a cloud environment to implement new schedulers.
4. Analyze and visualize the big query dataset with Google cloud.
5. Use commercial cloud to deploy web applications.

**Articulation Matrix**

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

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. Explain various concepts of number systems and their techniques in solving the percentage, average and age problems.
2. Analyse the profit and loss of real time situations and the relation between ratio, proportion and variation.
3. Apply different techniques to find the distance, speed and time of various moving objects.
4. Understand the concepts of coding, sequences and series, data interpretation and critical reasoning to solve real time logical reasoning problems.

**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.

**Course Outcomes**

1. Understand the detailed models of image formation and processing.
2. Apply the computer vision techniques for image feature extraction and segmentation.
3. Analyze the computer vision algorithms for recognizing and classifying the pattern.
4. Analyze the computer vision techniques for motion detection.
5. Implement the computer vision techniques in real time problems.

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

**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

**Course Outcomes (COs)**

1. Understand the representation of complex and voluminous data
2. Design and use various methodologies present in data visualization
3. Analyze the various process and tools used in data visualization
4. Implement the principle of visual perception for various data analysis tasks
5. Apply the interactive data visualization to make inferences.

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

**FOR FURTHER READING**

Security Data Visualization – Attacking and Defending Visualization, Data Visualization for Web.

**EXPERIMENT 1**

**3 Hours**

**DATA PREPROCESSING AND CLEANING METHODS ON STUDENT DATASETS**

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

**EXPERIMENT 2**

**3 Hours**

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

**EXPERIMENT 3**

**3 Hours**

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

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

**EXPERIMENT 4**

**3 Hours**

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

**EXPERIMENT 5**

**3 Hours**

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

**EXPERIMENT 6**

**3 Hours**

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

**EXPERIMENT 7**

**3 Hours**

Using the Website traffic data set

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

**EXPERIMENT 8**

**3 Hours**

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

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

**EXPERIMENT 9**

**3 Hours**

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

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

**EXPERIMENT 10**

**3 Hours**

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

**Total: 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.

**Course Outcomes**

1. Understand the fundamental mathematical models and algorithms in the field of NLP.
2. Apply the mathematical models and algorithms in the applications of software.
3. Implement a rule-based system to tackle morphology/syntax of a language.
4. Analyze the design and implementation issues in various NLP applications such as information retrieval and information extraction.
5. Apply the principles of language resource annotation and its use in machine learning applications

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

**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 Javal, O'Reilly Media, 2015.
6. Nitin Indurkha 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.

**Course Outcomes**

1. Apply techniques such as tokenization, stemming in Text processing.
2. Implementation of sentiment classification using parts of speech.
3. Apply n-gram language model for predicting the sequence
4. Implement of various parsing techniques
5. Analyze various deep learning models used in NLP.

**Articulation Matrix**

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

**EXPERIMENT 1**

**3 Hours**

Use stemming and tokenization process to get the root words in the given sentences.

**EXPERIMENT 2**

**4 Hours**

Split the words and display both splitted words and count of the words in the given sentence using tokenizer function.

**EXPERIMENT 3**

**4 Hours**

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

**EXPERIMENT 4**

**3 Hours**

Remove Stop words and identify parts of speech in the given sentence.

**EXPERIMENT 5**

**4 Hours**

Use n-gram language model to predict the next sequence of word or letter in sentence.

**EXPERIMENT 6**

**4 Hours**

Construct a parse tree that satisfies the given rule for the sentence using chunk parsing.

<b>EXPERIMENT 7</b> Find the probability of given sentence using PCF Parsing.	<b>4 Hours</b>
<b>EXPERIMENT 8</b> Implement a program that processes a word and discovers synonym, definition and example.	<b>4 Hours</b>
<b>EXPERIMENT 9</b> Apply sentiment analysis and categorizing opinions expressed in a piece of text.	<b>6 Hours</b>
<b>EXPERIMENT 10</b> Use deep learning concepts RNN's, LSTM's and GRU's to solve NLP problems.	<b>6 Hours</b>
<b>EXPERIMENT 11</b> Implement a simple part-of-speech tagger.	<b>6 Hours</b>
<b>EXPERIMENT 12</b> Implement Cricket Game Prediction using deep learning model.	<b>6 Hours</b>
<b>EXPERIMENT 13</b> Implement Query Expansion for Information Retrieval.	<b>6 Hours</b>

**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 References

1. <https://www.kaggle.com/>
2. <https://towardsdatascience.com/gentle-start-to-natural-language-processing-using-python-6e46c07addf3>
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.

**Course Outcomes (COs)**

1. Implement noise removal, Perspective projection and shape detection.
2. Detect the edges and corners using edge and corner detection algorithm.
3. Recognize the object using object detection algorithm.
4. Implement the objects and its motion using motion analysis algorithm.
5. Implementation of face detection using OpenCV.

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

**EXPERIMENT 1:**

**3 Hours**

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

**EXPERIMENT 2:**

**3 Hours**

Remove the noise in image using noise removal algorithms.

**EXPERIMENT 3:**

**4 Hours**

Detect the edges of an object using Edge detection algorithm.

**EXPERIMENT 4:**

**6 Hours**

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

**EXPERIMENT 5:**

**4 Hours**

Detect the corners of an object using corner detection algorithm.

**EXPERIMENT 6:**

**4 Hours**

Detect the particular color from the image.

<b>EXPERIMENT 7:</b> Recognize the hand gestures in video streams.	<b>6 Hours</b>
<b>EXPERIMENT 8:</b> Detect if this is a Face or not and further recognize whose face is it.	<b>6 Hours</b>
<b>EXPERIMENT 9:</b> Classify the vehicles on the road and count the number of vehicles that travel through a road.	<b>6 Hours</b>
<b>EXPERIMENT 10:</b> Count the number of people passing through a specific scene.	<b>4 Hours</b>
<b>EXPERIMENT 11:</b> Build QR Code Scanner utilizing Computer vision for image analysis.	<b>6 Hours</b>
<b>EXPERIMENT 12:</b> Detect the face region of the person and use it to blur the image	<b>4 Hours</b>
<b>EXPERIMENT 13:</b> Image Segmentation: Divide the image into multiple segments for object detection.	<b>4 Hours</b>

**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 References

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 the concepts of probability, Sets, Permutation and Combinations in estimating data for real time problems.
2. Understand the concept of logarithms, progressions and Simple and Compound interest to solve various practical problems.
3. Analyse objects involving cubes and cuboids in determining the number of sides colored.
4. Interpret various data from graphs and tables to determine ratio, percentage and averages.
5. Apply the logical reasoning skills for identifying age, relations, visual relations and puzzles.

**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

2002

**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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**Course Outcomes (COs)**

1. Identify the networking protocols for connecting devices and challenges of IoT Analytics.
2. Understand the cloud based IoT and IoT in Data Analytics.
3. Explain the concepts of Security requirements and Searching the IoT.
4. Apply the different tools and services for IoT Analytics platform.
5. Analyze applications of IoT Analytics in real time scenario.

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

**UNIT III**

**9 Hours**

**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

**UNIT V**

**9 Hours**

**IoT ANALYTICS APPLICATIONS AND CASE STUDIES**

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

**FOR FURTHER READING**

Data Science for IoT Analytics – Economics of IoT Analytics, IoT Enabled Technologies

**Total: 45 Hours**

**Reference(s)**

1. John Soldatos, Building Blocks for IOT Analytics, River Publisher 2017
2. Andrew Minter, 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 References**

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

**Course Outcomes (COs)**

1. Understand the IoT controllers and the process of cloud configuration.
2. Implement the real time applications using IoT.
3. Deploy the application using HTTP, MQTT.

**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								2	
4														
5														

**EXPERIMENT 1**

**3 Hours**

Familiarization with the concept of IoT controller with necessary software installation.

**EXPERIMENT 2**

**3 Hours**

Understand the connectivity and configuration of IoT Controller circuit with basic peripherals, LEDs. Understand the GPIO and the process of cloud configuration.

**EXPERIMENT 3**

**3 Hours**

Create an application to measure the distance using Ultrasonic Sensor and Make Led Blink.

**EXPERIMENT 4**

**3 Hours**

Develop an application for Automatic Room Temperature Controller.

**EXPERIMENT 5**

**3 Hours**

Create an application to detect the movements using PIR Sensor.

**EXPERIMENT 6**

**3 Hours**

Develop the IOT based Weather Reporting System.

**EXPERIMENT 7**

**4 Hours**

Implement the IoT based Smart Dustbin.

**EXPERIMENT 8**

**3 Hours**

Develop an application to detect obstacles and notify users with LEDs.

<b>EXPERIMENT 9</b> Create an application for Automatic Room Lighting system.	<b>4 Hours</b>
<b>EXPERIMENT 10</b> Create an application using IoT Controller to control the operation of a hardware simulated traffic signal.	<b>5 Hours</b>
<b>EXPERIMENT 11</b> Develop an application for password door lock security system.	<b>5 Hours</b>
<b>EXPERIMENT 12</b> Develop a smart home application with following requirements: When user enters into the house, the required appliances like fan, light should be switched ON.	<b>7 Hours</b>
<b>EXPERIMENT 13</b> Develop an application to monitor an IoT device using IoT platform cloud.	<b>7 Hours</b>
<b>EXPERIMENT 14</b> Develop a Smartphone application to control an IoT device using the IoT Platform cloud.	<b>7 Hours</b>

**Total: 60 Hours**

#### **Reference(s)**

1. John Soldatos, Building Blocks for IOT Analytics, River Publisher 2017
2. Andrew Minter, 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 References**

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>

## **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

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

**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-making. 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

**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

**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 française, alphabets, les numeros, les jours, les mois. | Grammaire Les verbes s'appeler, être, avoir, les articles définis, indéfinis | Communication - Saluer, s'informer sur quelqu'un, demander de se présenter | Lexique - Les alphabets, les nationalités, âge, les pays, les couleurs, les jours de la semaine, les mois de l'année, les professions

**UNIT II****9 Hours****PARTAGER SON LIEU DE VIE**

Les français et leur habitat, des habitations insolites | Grammaire - Verbes - Conjugaison : Présent (Avoir / être / ER, IR, RE : Régulier et Irrégulier) - Adjectifs les propositions de lieu | Communication - Chercher un logement, écrire son voisin, s'informer sur un logement | Lexique - L'habitat, les pièces, l'équipement, la description physique

**UNIT III****9 Hours****VIVRE AU QUOTIDIEN**

Grammaire - Articles contractés, verbes vouloir, pouvoir, devoir, adjectif interrogative, future proche | Communication - Exprimer ses goûts, parler de ses loisirs, justifier un choix, exprimer une envie | Lexique - le temps libre et les loisirs, les saisons, les activités quotidiennes, le temps (le matin, le soir, la nuit)

**UNIT IV**

**9 Hours**

**COMPRENDRE SON ENVIRONNEMENT - OUVRIRE LA CULTURE**

Grammaire - Verbes - Finir, Sortir, les adjectifs demonstratifs, le passe compose, l imparfait |  
Communication - Propose quelque 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 une 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

**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 München, 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

**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

**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 (Vehicle) 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 form 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(s)**

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

**Reference(s)**

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

## **DISCIPLINE 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 quality assurance.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**AGILE METHODOLOGY**

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

**UNIT II**

**9 Hours**

**AGILE PROCESSES**

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

**UNIT III**

**9 Hours**

**AGILITY AND KNOWLEDGE MANAGEMENT**

Agile information systems – agile decision making - Earls schools of KM – institutional knowledge evolution cycle – development, acquisition, refinement, distribution, deployment, leveraging – KM in software engineering – managing software knowledge – challenges of migrating to agile methodologies – agile knowledge sharing – role of story-cards – Story-card Maturity Model (SMM).

**UNIT IV**

**9 Hours**

**AGILITY AND REQUIREMENTS ENGINEERING**

Impact of agile processes in RE – current agile practices – variance – overview of RE using agile– managing unstable requirements – requirements elicitation – agile requirements abstraction model – requirements management in agile environment, agile requirements prioritization – agile requirements modeling and generation – concurrency in agile requirements generation

**UNIT V**

**9 Hours**

**AGILITY AND QUALITY ASSURANCE**

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

**Total: 45 Hours**

**Reference(s)**

1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), —Agile Software Development, Current Research and Future Directions, Springer-Verlag Berlin Heidelberg, 2010
2. David J. Anderson; Eli Schragenheim, —Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003
3. Hazza & Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, VIII edition, 2009
4. Craig Larman, —Agile and Iterative Development: A 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 designprocess and methodology.
- Learning the Importance and scope of Interaction design, User centered design

**Course Outcomes (COs)**

1. Understand to do user research, persona mapping, customer journey mapping
2. Design of interactive products Methods of interaction design Tools for interaction design
3. Design wireframes on paper and translate paper concepts into digital wireframes.
4. Apply and practice the techniques involved in designing digital wireframes using various UI elements.
5. Implement the process of conducting usability tests Learning steps for digital products.

**Articulation Matrix**

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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, and Node, Vasam 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

**Course Outcomes (COs)**

1. Identify fundamental concepts of mobile programming that make it unique from programming for other platforms
2. Analyze the essential of Android Application with their anatomy and terminologies
3. Apply rapid prototyping techniques to design, develop and deploy the Android Applications
4. Analyze the essentials of User Interface Design in IoS with SQLite Database
5. Design the flutter applications on the Android marketplace for distribution.

**Articulation Matrix**

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

**UNIT I**

**6 Hours**

**INTRODUCTION TO ANDROID**

The Android Platform, Android SDK, Eclipse Installation, Android Installation, building your First Android application, Understanding the Android Manifest file.

**UNIT II**

**6 Hours**

**ANDROID APPLICATION DESIGN ESSENTIALS**

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Using Intent Filter, Permissions.

**UNIT III**

**6 Hours**

**COMMON ANDROID APIs**

Testing Android applications, Publishing Android applications, Using Android Data and Storage APIs, managing data using Sqlite, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Applications to the World.

**UNIT IV**

**6 Hours**

**IoS USER INTERFACE DESIGN ESSENTIALS**

IoS features, UI implementation, Touch frameworks, Data persistence using Core Data and SQLite, Integrating calendar and address book with social media application, Using Wifi, 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.

- 1** **2 Hours**  
**EXPERIMENT 1**  
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.
- 2** **4 Hours**  
**EXPERIMENT 2**  
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.
- 3** **4 Hours**  
**EXPERIMENT 3**  
Create a SIGNUP activity with Username and Password. Validation of password should happen based on the following rules:
- Password should contain uppercase and lowercase letters.
  - Password should contain letters and numbers.
  - Password should contain special characters.
  - Minimum length of the password (the default value is 8).
  - On successful SIGN UP proceed to the next Login activity. Here the user should SIGNIN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying “Successful Login” or else display a toast message saying “Login Failed”. The user is given only two attempts and after that display a toast message saying “Failed Login Attempts” and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.
- 4** **4 Hours**  
**EXPERIMENT 4**  
Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.
- 5** **4 Hours**  
**EXPERIMENT 5**  
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.
- 6** **4 Hours**  
**EXPERIMENT 6**  
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.
- 7** **4 Hours**  
**EXPERIMENT 7**  
Implement UI elements like Text Fields, Label, Toolbar, Status bar, Tabbar.

8

4 Hours

**EXPERIMENT 8**

Implement any type of App using Flutter.

**Total: 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 for any device” ISBN-13 9780141044804.
5. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS6 Development: 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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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 and Test Design – Defect Examples- Developer/Tester Support of Developing a Defect Repository.

**UNIT II**

**9 Hours**

**TEST CASE DESIGN STRATEGIES**

Test Scenarios - Test Cases - Test case Design Strategies - Black Box Approach to Test Case Design - Using White Box Approach to Test design – Test Adequacy Criteria – Static testing vs. Structural testing – Code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – Code complexity testing – Additional White box testing approaches - Test Coverage

**UNIT III**

**9 Hours**

**LEVELS OF TESTING**

Types of testing - manual and automation - Introduction to testing methods - White-box, Black- box and Grey-box - Functional testing - Non-functional testing - Introduction to levels of testing– Unit Testing, Integration Testing, System Testing, User Acceptance Testing - Introduction to types of testing – Regression Testing, Smoke Testing, Database Testing, Usability Testing, Load Testing, Stress Testing, Performance Testing, Compatibility Testing, Security Testing, Internationalization Testing, Localization Testing



**UNIT IV**

**9 Hours**

**TEST MANAGEMENT**

People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group- The Structure of Testing Group - The Technical Training Program.

**UNIT V**

**9 Hours**

**TEST AUTOMATION**

Software test automation – Design and Architecture for Automation - Automation testing - Automation Tools - Selenium Web Driver - Create Selenese Commands - TestNG - TestNG Annotations - Jmeter - Assertions in JMeter - Junit

**Total: 45 Hours**

**Text Books**

1. Srinivasan Desikan and Gopaldaswamy Ramesh, “Software Testing – Principles and Practices”, 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, New York, 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

**Course Outcomes (COs)**

1. Understand different actions performed through Version control tools like Git.
2. Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
3. Ability to Perform Automated Continuous Deployment.
4. Ability to do configuration management using Ansible.
5. Understand to leverage Cloud-based DevOps tools using Azure DevOps.

**Articulation Matrix**

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

itory- 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: Cidc 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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**HYPERVERSORS**

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.aspx>
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.

**Course Outcomes (COs)**

1. Evaluate the performance of the virtual machines and deployed applications. Apply Cloud Computing reference architecture for developing clouds
2. Analyze the different forms of cloud service models
3. Apply the characteristics and architecture of IaaS using various real-world applications.
4. Evaluate PaaS concepts and architectures with real-world examples.
5. Analyze, and synthesize concepts related to the SaaS delivery model.

**Articulation Matrix**

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

**UNIT I****9 Hours****CLOUD COMPUTING REFERENCE ARCHITECTURE (CCRA)**

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

**UNIT II****9 Hours****INTRODUCTION OF DELIVERY MODELS IN CLOUD COMPUTING**

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

**UNIT III****9 Hours****INFRASTRUCTURE AS A SERVICE (IaaS)**

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

**UNIT IV**

**9 Hours**

**PLATFORM AS A SERVICE (PaaS)**

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

**UNIT V**

**9 Hours**

**SOFTWARE AS A SERVICE (SaaS)**

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

**Total: 45 Hours**

**Reference(s)**

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

**Course Outcomes (COs)**

1. Analyze the fundamentals of information storage management and various models of Cloud infrastructure services and deployment.
2. Apply the usage of advanced intelligent storage systems and RAID.
3. Evaluate various storage networking architectures - SAN, including storage subsystems and virtualization.
4. Execute the different roles in providing disaster recovery and remote replication technologies.
5. Implement the security needs and security measures to be employed in information storage management.

**Articulation Matrix**

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

**UNIT I**

**8 Hours**

**STORAGE SYSTEMS**

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

**UNIT II**

**9 Hours**

**INTELLIGENT STORAGE SYSTEMS AND RAID**

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

**UNIT III**

**10 Hours**

**STORAGE NETWORKING TECHNOLOGIES AND VIRTUALIZATION**

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



**UNIT IV**

**9 Hours**

**BACKUP, ARCHIVE AND REPLICATION**

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) I, 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 ComputingI, Tata Mcgraw Hill, 2013.
4. Rittinghouse, John W., and James F. Ransome, —Cloud Computing: Implementation, Management and SecurityI, CRC Press, 2017.
5. Toby Velte, Anthony Velte, Robert Elsenpeter, "Cloud Computing - A Practical ApproachI, 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

**Course Outcomes (COs)**

1. Implement cloud native applications on AWS, Terraform etc.
2. Apply VM provisioning and migration in the cloud.
3. Analyze cloud automation and configuration.
4. Apply balance load and auto scaling in the cloud.
5. Analyze the AWS cloud formation use-case.

**Articulation Matrix**

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

**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****2023****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.

**Course Outcomes (COs)**

1. Apply the motivation behind SDN
2. Analyze the functions of the data plane and control plane
3. Evaluate and develop network applications using SDN
4. Execute network services using NFV
5. Implement various use cases of SDN and NFV

**Articulation Matrix**

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

**UNIT I****6 Hours****SDN: INTRODUCTION**

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

<b>UNIT V</b>	<b>6 Hours</b>
<b>NFV FUNCTIONALITY</b>	
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.	
<b>1</b>	<b>6 Hours</b>
<b>EXPERIMENT 1</b>	
Setup your own virtual SDN lab	
i) Virtual box/Mininet Environment for SDN - <a href="http://mininet.org">http://mininet.org</a>	
ii) <a href="https://www.kathara.org">https://www.kathara.org</a>	
iii) GNS3	
<b>2</b>	<b>6 Hours</b>
<b>EXPERIMENT 2</b>	
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.	
<b>3</b>	<b>6 Hours</b>
<b>EXPERIMENT 3</b>	
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.	
<b>4</b>	<b>6 Hours</b>
<b>EXPERIMENT 4</b>	
Create a simple end-to-end network service with two VNFs using vim-emu <a href="https://github.com/containernet/vim-emu">https://github.com/containernet/vim-emu</a>	
<b>5</b>	<b>6 Hours</b>
<b>EXPERIMENT 5</b>	
Install OSM and onboard and orchestrate network service.	

**Total: 60 Hours**

**Reference(s)**

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

**Course Outcomes (COs)**

1. Understand the cloud security concepts and fundamentals.
2. Explain the security challenges in the cloud.
3. Analyze the cloud policy, identity and Access Management.
4. Delivers various risks, audit and monitoring mechanisms in the cloud.
5. Applying the various architectural and design considerations for security in the cloud.

**Articulation Matrix**

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

**UNIT I****8 Hours****FUNDAMENTALS OF CLOUD SECURITY CONCEPTS**

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

**UNIT II****11 Hours****SECURITY DESIGN AND ARCHITECTURE FOR CLOUD**

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

**UNIT III****9 Hours****ACCESS CONTROL AND IDENTITY MANAGEMENT**

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

**UNIT IV**

**8 Hours**

**CLOUD SECURITY DESIGN PATTERNS**

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

**UNIT V**

**9 Hours**

**MONITORING, AUDITING AND MANAGEMENT**

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

**Total: 45 Hours**

**Reference(s)**

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

**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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**INTRODUCTION**

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

**UNIT II**

**9 Hours**

**ATTACKS AND COUNTER MEASURES**

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



**UNIT III**

**9 Hours**

**RECONNAISSANCE**

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

**UNIT IV**

**9 Hours**

**INTRUSION DETECTION**

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

**UNIT V**

**9 Hours**

**INTRUSION PREVENTION**

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

**Total: 45 Hours**

**TEXTBOOKS**

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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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”, Cengage Learning, 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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**INTRODUCTION**

Ethical Hacking Overview - Role of Security and Penetration Testers - Penetration-Testing Methodologies- Laws of the Land - Overview of TCP/IP- The Application Layer - The Transport Layer - The Internet Layer - IP Addressing - Network and Computer Attacks - Malware - Protecting Against Malware Attacks- Intruder Attacks - Addressing Physical Security

**UNIT II**

**9 Hours**

**SCANNING AND ENUMERATION**

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

**UNIT III**

**9 Hours**

**SYSTEM HACKING**

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

**UNIT IV**

**9 Hours**

**PROGRAMMING FOR SECURITY PROFESSIONALS**

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

**UNIT V**

**9 Hours**

**NETWORK PROTECTION SYSTEMS**

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

**Total: 45 Hours**

**Reference(s)**

1. EC-Council, “Ethical Hacking and Countermeasures: Attack Phases”, Cengage Learning,2010.
2. Jon Erickson, “Hacking, 2nd Edition: The Art of Exploitation”, No Starch Press Inc.,2008.
3. Michael T. Simpson, Kent Backman, James E. Corley, “Hands-On Ethical Hacking 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**

**2023**

**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.

**Course Outcomes (COs)**

1. Understand emerging abstract models for Blockchain Technology.
2. Identify major research challenges and technical gaps existing between theory and practice in the crypto currency domain.
3. Develop conceptual understanding of the function of Blockchain as a method of securing distributed ledgers, how consensus on their contents is achieved, and the new applications that they enable.
4. Apply Hyperledger Fabric and Ethereum platform to implement the Block chain Application.
5. Analyze the real-life applications of Blockchain Technologies.

**Articulation Matrix**

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

**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.

**1** **5 Hours**

**EXPERIMENT 1**

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.

**2** **5 Hours**

**EXPERIMENT 2**

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.

**3** **5 Hours**

**EXPERIMENT 3**

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

**4** **5 Hours**

**EXPERIMENT 4**

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

**5** **5 Hours**

**EXPERIMENT 5**

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

6

5 Hours

### EXPERIMENT 6

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: 60 Hours**

#### Text Books

1. Bashir and Imran, Mastering Blockchain: Deeper insights into decentralization, cryptography, Bitcoin, and popular Blockchain frameworks, 2017.
2. Andreas Antonopoulos, "Mastering Bitcoin: Unlocking Digital Cryptocurrencies", O'Reilly, 2014.

#### Reference(s)

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

**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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**INTRODUCTION AND BASIC ANALYSIS**

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

**UNIT II**

**10 Hours**

**ADVANCED STATIC ANALYSIS**

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

**UNIT III**

**10 Hours**

**ADVANCED DYNAMIC ANALYSIS**

Live malware analysis - dead malware analysis - analyzing traces of malware - system calls - api calls – registries - network activities. Anti-dynamic analysis techniques - VM detection techniques- Evasion techniques - Malware Sandbox - Monitoring with Process Monitor - Packet Sniffing with Wireshark - Kernel vs. User-Mode Debugging – OllyDbg – Breakpoints – Tracing - Exception Handling – Patching

**UNIT IV**

**8 Hours**

**MALWARE FUNCTIONALITY**

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

**UNIT V**

**8 Hours**

**ANDROID MALWARE ANALYSIS**

Android Malware Analysis: Android architecture - App development cycle – APKTool- APKInspector - Dex2Jar - JD-GUI - Static and Dynamic Analysis - Case Study: Smartphone (Apps) Security

**Total: 45 Hours**

**TEXT BOOKS:**

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.

**REFERENCES:**

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

**21AI019 ROBOTIC PROCESS AUTOMATION****3 0 0 3****Course Objectives**

- Understand the basic concepts, methodologies and tools in RPA.
- Implement the exception handling and automation techniques using RPA.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I****9 Hours****RPA AND PROCESS METHODOLOGIES**

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

**UNIT II****9 Hours****UiPath ESSENTIALS**

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

**UNIT III****9 Hours****ADVANCED RPA TECHNIQUES**

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

**UNIT IV****9 Hours****HANDLING EXCEPTIONS AND USER EVENTS**

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

**UNIT V**

**9 Hours**

**DEPLOYMENT AND MAINTENANCE OF BOT**

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

**Total: 45 Hours**

**Reference(s)**

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

**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.

**Course Outcomes (COs)**

1. Interpret the importance of Reinforcement Learning primitives.
2. Infer the RL Framework and Markov Decision Process.
3. Illustrate the value functions for optimal decision-making.
4. Implement dynamic programming to solve complex problems.
5. Apply the Monte Carlo methods to solve the real-world problems.

**Articulation Matrix**

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

**UNIT I****10 Hours****REINFORCEMENT LEARNING PRIMITIVES**

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

**UNIT II****10 Hours****MARKOV DECISION PROCESS**

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

**UNIT III****9 Hours****VALUE FUNCTIONS & 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: Policies -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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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. Niranjnamurthy · 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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**ROBOTS INTRODUCTION**

Introduction – History & 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 Intelligencel, McGraw Hill, 2015.
2. Pratihari.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.

**Course Outcome (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**INTRODUCTION TO INTELLIGENT TRANSPORT SYSTEM**

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

**UNIT II**

**9 Hours**

**TECHNOLOGY BUILDING BLOCKS OF ITS**

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

**UNIT III**

**9 Hours**

**DATA COLLECTION METHODS FOR ITS**

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

**UNIT IV**

**9 Hours**

**TRANSPORT MANAGEMENT SYSTEM**

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

**UNIT V**

**9 Hours**

**TRAVELLER AND INFORMATION SYSTEM**

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

**Total: 45 Hours**

**Reference(s)**

1. Sarkar, Pradip Kumar, Amit Kumar Jain, Intelligent Transport Systems, PHI Learning, 2018.
2. Rodolfo I. Meneguette, Robson E. De Grande, Intelligent Transport System in Smart Cities: Aspects and Challenges of vehicular networks and cloud, Springer, 2018.
3. R.P Roess, E.S. Prassas, W.R. McShane. Traffic Engineering, Pearson Educational International, Fifth Edition, 2019.
4. Sussman, J.M. Perspectives on Intelligent Transportation Systems, Springer, Berlin, 2010.
5. Intelligent Transport Systems, Intelligent Transportation Primer, Washington, US, 2001.
6. Turban E., "Decision Support and Expert Systems Management Support Systems", Maxwell Macmillan, 1998.
7. 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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I****9 Hours****INTRODUCTION TO EXPERT SYSTEMS**

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

**UNIT II****9 Hours****BUILDING AN EXPERT SYSTEMS**

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

**UNIT III****9 Hours****KNOWLEDGE ACQUISITION IN EXPERT SYSTEMS**

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

**UNIT IV****9 Hours****KNOWLEDGE REPRESENTATION IN EXPERT SYSTEMS**

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

**UNIT V**

**9 Hours**

**FUZZY EXPERT SYSTEMS**

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

**Total: 45 Hours**

**Reference(s)**

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



**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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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**

**Text Books**

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, MorganKaufmann, 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**

**2023**

**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

**Course Outcomes (COs)**

1. Understand the foundations of natural language processing and speech analysis
2. Apply classification algorithms to text documents
3. Build question-answering and dialogue systems
4. Apply deep learning models for building speech recognition and text-to-speech systems
5. Infer coreference and coherence for text processing

**Articulation Matrix**

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

**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

<b>UNIT V</b>	<b>6 Hours</b>
<b>AUTOMATIC SPEECH RECOGNITION</b>	
Named Entity Recognition (NER)-Coreference resolution-Text coherence and cohesion-Advanced sentiment analysis-Speech recognition: Acoustic modelling – Feature Extraction - HMM, HMM-DNN systems	
<b>1</b>	<b>3 Hours</b>
<b>EXPERIMENT 1</b>	
Create Regular expressions in Python for detecting word patterns and tokenizing text	
<b>2</b>	<b>3 Hours</b>
<b>EXPERIMENT 2</b>	
Getting started with Python and NLTK - Searching Text, Counting Vocabulary, Frequency Distribution, Collocations, Bigrams	
<b>3</b>	<b>3 Hours</b>
<b>EXPERIMENT 3</b>	
Accessing Text Corpora using NLTK in Python	
<b>4</b>	<b>3 Hours</b>
<b>EXPERIMENT 4</b>	
Write a function that finds the 50 most frequently occurring words of a text that are not stop words	
<b>5</b>	<b>3 Hours</b>
<b>EXPERIMENT 5</b>	
Implement the Word2Vec model	
<b>6</b>	<b>3 Hours</b>
<b>EXPERIMENT 6</b>	
Use a transformer for implementing classification	
<b>7</b>	<b>5 Hours</b>
<b>EXPERIMENT 7</b>	
Design a chatbot with a simple dialog system	
<b>8</b>	<b>3 Hours</b>
<b>EXPERIMENT 8</b>	
Convert text to speech and find accuracy	
<b>9</b>	<b>4 Hours</b>
<b>EXPERIMENT 9</b>	
Design a speech recognition system and find the error rate	

**Total: 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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**Course Outcomes (COs)**

1. Understand the basics of information processing tasks that can be accomplished using quantum mechanical systems.
2. Understand the background of Quantum Mechanics that allows the calculation of properties of physical systems.
3. Analyze the Quantum algorithms which is used in circuit model.
4. Analyze the computation models used in quantum information theory.
5. Interpret quantum security in order to ensure that any attempt to intercept.

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**QUANTUM COMPUTING BASIC CONCEPTS**

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

**UNIT II**

**9 Hours**

**QUANTUM GATES AND CIRCUITS**

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

**UNIT III**

**9 Hours**

**QUANTUM ALGORITHMS**

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

**UNIT IV**

**9 Hours**

**QUANTUM INFORMATION THEORY**

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

**UNIT V**

**9 Hours**

**QUANTUM CRYPTOGRAPHY**

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**INTRODUCTION TO COGNITIVE SCIENCE**

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**

**2023**

**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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**6 Hours**

**THE NATURE OF BIOMEDICAL IMAGES**

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

**UNIT II**

**6 Hours**

**REMOVAL OF ARTIFACTS**

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

**UNIT III**

**6 Hours**

**ANALYSIS OF SHAPE**

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

<b>UNIT IV</b>	<b>6 Hours</b>
<b>ANALYSIS OF ORIENTED PATTERNS</b> Analysis of Oriented Patterns: Oriented Patterns in Images - Measures of Directional Distribution- Directional Filtering - Gabor Filters - Directional Analysis via Multiscale Edge Detection	
<b>UNIT V</b>	<b>6 Hours</b>
<b>PATTERNS ANALYSIS DECISION</b> 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.	
<b>1</b>	<b>6 Hours</b>
<b>EXPERIMENT 1</b> <b>Cell Counting and Nucleus Detection in Microscopy Images:</b> 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.	
<b>2</b>	<b>6 Hours</b>
<b>EXPERIMENT 2</b> <b>Automated Detection of Diabetic Retinopathy in Fundus Images</b> 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.	
<b>3</b>	<b>6 Hours</b>
<b>EXPERIMENT 3</b> <b>Segmentation and Characterization of Tumor Regions in Breast MRI</b> 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.	
<b>4</b>	<b>6 Hours</b>
<b>EXPERIMENT 4</b> <b>Analysis of White Matter Tracts in Diffusion Tensor Imaging (DTI)</b> 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.	
<b>5</b>	<b>6 Hours</b>
<b>EXPERIMENT 5</b> <b>Quantification of Cardiac Function using Echocardiography</b> 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.	
	<b>Total: 60 Hours</b>

**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 Practical Approach 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.
- To learn collaborative filtering.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**INTRODUCTION**

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

**UNIT II**

**9 Hours**

**CONTENT-BASED RECOMMENDATION SYSTEMS**

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

**UNIT III**

**9 Hours**

**COLLABORATIVE FILTERING**

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

**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, 3<sup>rd</sup> 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.

**Course Outcomes (COs)**

1. Design video analytic algorithms for security applications.
2. Design video analytic algorithms for business intelligence.
3. Design custom made video analytics systems for the given target application.
4. Understand the algorithms available for performing analysis on video data and address the challenges.
5. Understand the algorithms available for searching and matching in video content.

**Articulation Matrix**

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

**LEAD MANAGEMENT & DIGITAL MARKETING**

Web to lead forms - Web to case forms - Lead generation techniques - Leads are everywhere- social media and lead gen Inbuilt tools for Digital Marketing - Ip Tracker - CPC reduction (in case of paid ads) Group posting on Social Media platforms.

**UNIT V**

**9 Hours**

**VIDEO ANALYTICS FOR BUSINESS INTELLIGENCE**

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 Surveillance Systems: 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 for Business Intelligence, Springer, 2012.

**21AI034 CYBER THREAT ANALYTICS**

**3 0 0 3**

**Course Objectives**

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

CO No	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
1	2	2	2										3	
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 an Effective Response to Incidents, 2018, Packt publisher.
2. Arun E Thomas, Security Operations Center - SIEM Use Cases and Cyber Threat Intelligence, 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, Wiley Publisher.
4. Eoghan Casey, Digital Evidence and Computer Crime: Forensic Science, Computers, and the Internet, Elsevier.
5. John Sammons, The Basics of Digital Forensics: The Primer for Getting Started in Digital 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.

**Course Outcomes (COs)**

1. Infer the real-world business problems and model with analytical solutions.
2. Interpret the business processes for extracting Business Intelligence
3. Apply predictive analytics for business fore-casting
4. Apply analytics for supply chain and logistics management
5. Apply analytics for marketing and sales

**Articulation Matrix**

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

**Total: 45 Hours**

**Reference(s)**

1. R. Evans James, Business Analytics, 2017
2. R N Prasad, Seema Acharya, Fundamentals of Business Analytics, 2016
3. Philip Kotler and Kevin Keller, Marketing Management, 15th edition, PHI, 2016
4. VSP RAO, Human Resource Management, 3rd Edition, Excel Books, 2010.
5. Mahadevan B, “Operations Management -Theory and Practice”,3rd Edition, Pearson Education,2018.



**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.

**Course Outcomes (COs)**

1. Explain the concept of digital marketing and the role of a digital manager
2. Administer the website and identifies the search engines
3. Discuss the various MISC tools
4. Describe the concepts of lead management and digital marketing
5. Explain the various trending digital marketing skills

**Articulation Matrix**

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

**UNIT I****9 Hours****INTRODUCTION TO DIGITAL MARKETING**

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

**UNIT II****9 Hours****DIGITAL MODEL AND DIGITAL CUSTOMER**

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

**UNIT III****9 Hours****SOCIAL MEDIA MARKETING AND SEARCH ENGINE**

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

**UNIT IV**

**9 Hours**

**CUSTOMER LIFECYCLE MANAGEMENT**

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

**UNIT V**

**9 Hours**

**DIGITAL MARKETING PLAN AND MANAGEMENT**

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

**Total: 45 Hours**

**Reference(s)**

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

**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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I****9 Hours****FOUNDATIONS OF HCI**

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

**UNIT II****9 Hours****DESIGN & 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.

**Course Outcomes (COs)**

1. Illustrate the basic concepts of pattern recognition.
2. Apply supervised learning models for assigning class label to the input pattern.
3. Implement unsupervised algorithms to group similar patterns into clusters.
4. Apply feature selection algorithms to select the features.
5. Analyze the various fuzzy techniques used in pattern classification.

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**INTRODUCTION TO PATTERN RECOGNITION**

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

**UNIT II**

**9 Hours**

**CLASSIFIERS**

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

**UNIT III**

**9 Hours**

**CLUSTERING**

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

**UNIT IV**

**9 Hours**

**FEATURE EXTRACTION AND SELECTION**

Introduction - Basis Vectors and Images - Entropy Minimization – 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. Copey, “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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I****9 Hours****INTRODUCTION**

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

**UNIT II****9 Hours****ETHICAL INITIATIVES IN AI**

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

**UNIT III****9 Hours****AI STANDARDS AND REGULATION**

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

**UNIT IV****9 Hours****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.

**FOR FURTHER READING**

Information Retrieval - Information Extraction - Data security and privacy.

**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 Parliament 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.

**Course Outcomes (COs)**

- Analyze the various input and output devices used for virtual reality
- Apply the different geometric modelling to visual virtualization
- Implement the Virtual Reality applications using Unity
- Analyze the working principle of Virtual Reality related to display, Tracking and sensors
- Implement the computer vision concepts for augmented reality applications

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

**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.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**PROJECT EVALUATION AND PROJECT PLANNING**

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

**UNIT II**

**9 Hours**

**PROJECT LIFE CYCLE AND EFFORT ESTIMATION**

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

**UNIT III**

**9 Hours**

**ACTIVITY PLANNING AND RISK MANAGEMENT**

Objectives of Activity planning – Project schedules – Activities – Sequencing and scheduling – Network Planning models – Formulating Network Model – Forward Pass & Backward Pass techniques – Critical

path (CRM) method – Risk identification – Assessment – Risk Planning – Risk Management – – PERT technique – Monte Carlo simulation – Resource Allocation – Creation of critical paths – Cost schedules.

**UNIT IV**

**9 Hours**

**PROJECT MANAGEMENT AND CONTROL**

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

**UNIT V**

**9 Hours**

**STAFFING IN SOFTWARE PROJECTS**

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

**Total: 45 Hours**

**Reference(s)**

1. Bob Hughes, Mike Cotterell and Rajib Mall: Software Project Management – Fifth Edition, Tata McGraw Hill, New Delhi, 2012.
2. Robert K. Wysocki “Effective Software Project Management” – Wiley Publication, 2011.
3. Walker Royce: “Software Project Management”- Addison-Wesley, 1998.
4. Gopalswamy 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 quality assurance.

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**AGILE METHODOLOGY**

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

**UNIT II**

**9 Hours**

**AGILE PROCESSES**

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

**UNIT III**

**9 Hours**

**AGILITY AND KNOWLEDGE MANAGEMENT**

Agile information systems – agile decision making - Earls schools of KM – institutional knowledge evolution cycle – development, acquisition, refinement, distribution, deployment, leveraging – KM in software engineering – managing software knowledge – challenges of migrating to agile methodologies – agile knowledge sharing – role of story-cards – Story-card Maturity Model (SMM).

**UNIT IV**

**9 Hours**

**AGILITY AND REQUIREMENTS ENGINEERING**

Impact of agile processes in RE – current agile practices – variance – overview of RE using agile – managing unstable requirements – requirements elicitation – agile requirements abstraction model – requirements management in agile environment, agile requirements prioritization – agile requirements modeling and generation – concurrency in agile requirements generation



**UNIT V**

**9 Hours**

**AGILITY AND QUALITY ASSURANCE**

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

**Total: 45 Hours**

**Reference(s)**

1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), —Agile Software Development, Current Research and Future Directions, Springer-Verlag Berlin Heidelberg, 2010
2. David J. Anderson; Eli Schragenheim, —Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003
3. Hazza & Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, VIII edition, 2009
4. Craig Larman, —Agile and Iterative Development: A 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 designprocess and methodology.
- Learning the Importance and scope of Interaction design, User centered design

**Course Outcomes (COs)**

1. Understand to do user research, persona mapping, customer journey mapping
2. Design of interactive products Methods of interaction design Tools for interaction design
3. Design wireframes on paper and translate paper concepts into digital wireframes.
4. Apply and practice the techniques involved in designing digital wireframes using various UI elements.
5. Implement the process of conducting usability tests Learning steps for digital products.

**Articulation Matrix**

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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, and Node, Vasam 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**

**2023**

**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

**Course Outcomes (COs)**

1. Identify fundamental concepts of mobile programming that make it unique from programming for other platforms
2. Analyze the essential of Android Application with their anatomy and terminologies
3. Apply rapid prototyping techniques to design, develop and deploy the Android Applications
4. Analyze the essentials of User Interface Design in IoS with SQLite Database
5. Design the flutter applications on the Android marketplace for distribution.

**Articulation Matrix**

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

**UNIT I**

**6 Hours**

**INTRODUCTION TO ANDROID**

The Android Platform, Android SDK, Eclipse Installation, Android Installation, building your First Android application, Understanding the Android Manifest file.

**UNIT II**

**6 Hours**

**ANDROID APPLICATION DESIGN ESSENTIALS**

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Using Intent Filter, Permissions.

**UNIT III**

**6 Hours**

**COMMON ANDROID APIs**

Testing Android applications, Publishing Android applications, Using Android Data and Storage APIs, managing data using Sqlite, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Applications to the World.

**UNIT IV**

**6 Hours**

**IoS USER INTERFACE DESIGN ESSENTIALS**

IoS features, UI implementation, Touch frameworks, Data persistence using Core Data and SQLite, Integrating calendar and address book with social media application, Using Wifi, 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.

**1** **2 Hours**

**EXPERIMENT 1**

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.

**2** **4 Hours**

**EXPERIMENT 2**

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.

**3** **4 Hours**

**EXPERIMENT 3**

Create a SIGNUP activity with Username and Password. Validation of password should happen based on the following rules:

- Password should contain uppercase and lowercase letters.
- Password should contain letters and numbers.
- Password should contain special characters.
- Minimum length of the password (the default value is 8).
- On successful SIGN UP proceed to the next Login activity. Here the user should SIGNIN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying “Successful Login” or else display a toast message saying “Login Failed”. The user is given only two attempts and after that display a toast message saying “Failed Login Attempts” and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.

**4** **4 Hours**

**EXPERIMENT 4**

Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

**5** **4 Hours**

**EXPERIMENT 5**

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.

**6** **4 Hours**

**EXPERIMENT 6**

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.

**7** **4 Hours**

**EXPERIMENT 7**

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

8

4 Hours

**EXPERIMENT 8**

Implement any type of App using Flutter.

**Total: 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 for any device” ISBN-13 9780141044804.
5. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS6 Development: 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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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 and Test Design – Defect Examples- Developer/Tester Support of Developing a Defect Repository.

**UNIT II**

**9 Hours**

**TEST CASE DESIGN STRATEGIES**

Test Scenarios - Test Cases - Test case Design Strategies - Black Box Approach to Test Case Design - Using White Box Approach to Test design – Test Adequacy Criteria – Static testing vs. Structural testing – Code functional testing – Coverage and Control Flow Graphs – Covering Code Logic – Paths – Code complexity testing – Additional White box testing approaches - Test Coverage

**UNIT III**

**9 Hours**

**LEVELS OF TESTING**

Types of testing - manual and automation - Introduction to testing methods - White-box, Black- box and Grey-box - Functional testing - Non-functional testing - Introduction to levels of testing– Unit Testing, Integration Testing, System Testing, User Acceptance Testing - Introduction to types of testing – Regression Testing, Smoke Testing, Database Testing, Usability Testing, Load Testing, Stress Testing, Performance Testing, Compatibility Testing, Security Testing, Internationalization Testing, Localization Testing

**UNIT IV**

**9 Hours**

**TEST MANAGEMENT**

People and organizational issues in testing – Organization structures for testing teams – testing services – Test Planning – Test Plan Components – Test Plan Attachments – Locating Test Items – test management – test process – Reporting Test Results – Introducing the test specialist – Skills needed by a test specialist – Building a Testing Group- The Structure of Testing Group - The Technical Training Program.

**UNIT V**

**9 Hours**

**TEST AUTOMATION**

Software test automation – Design and Architecture for Automation - Automation testing - Automation Tools - Selenium Web Driver - Create Selenese Commands - TestNG - TestNG Annotations - Jmeter - Assertions in JMeter - Junit

**Total: 45 Hours**

**Text Books**

1. Srinivasan Desikan and Gopaldaswamy Ramesh, “Software Testing – Principles and Practices”, 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, New York, 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

**Course Outcomes (COs)**

1. Understand different actions performed through Version control tools like Git.
2. Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
3. Ability to Perform Automated Continuous Deployment.
4. Ability to do configuration management using Ansible.
5. Understand to leverage Cloud-based DevOps tools using Azure DevOps.

**Articulation Matrix**

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**AGILE METHODOLOGY**

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

**UNIT II**

**9 Hours**

**AGILE PROCESSES**

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

**UNIT III**

**9 Hours**

**AGILITY AND KNOWLEDGE MANAGEMENT**

Agile information systems – agile decision making - Earls schools of KM – institutional knowledge evolution cycle – development, acquisition, refinement, distribution, deployment, leveraging – KM in software engineering – managing software knowledge – challenges of migrating to agile methodologies – agile knowledge sharing – role of story-cards – Story-card Maturity Model (SMM).

**UNIT IV**

**9 Hours**

**AGILITY AND REQUIREMENTS ENGINEERING**

Impact of agile processes in RE – current agile practices – variance – overview of RE using agile – managing unstable requirements – requirements elicitation – agile requirements abstraction model – requirements management in agile environment, agile requirements prioritization – agile requirements modeling and generation – concurrency in agile requirements generation

**UNIT V**

**9 Hours**

**AGILITY AND QUALITY ASSURANCE**

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

**Total: 45 Hours**

**Reference(s)**

1. Dingsoyr, Torgeir, Dyba, Tore, Moe, Nils Brede (Eds.), —Agile Software Development, Current Research and Future Directions, Springer-Verlag Berlin Heidelberg, 2010
2. David J. Anderson; Eli Schragenheim, —Agile Management for Software Engineering: Applying the Theory of Constraints for Business Results, Prentice Hall, 2003
3. Hazza & Dubinsky, —Agile Software Engineering, Series: Undergraduate Topics in Computer Science, Springer, VIII edition, 2009
4. Craig Larman, —Agile and Iterative Development: A 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 designprocess and methodology.
- Learning the Importance and scope of Interaction design, User centered design

**Course Outcomes (COs)**

1. Understand to do user research, persona mapping, customer journey mapping
2. Design of interactive products Methods of interaction design Tools for interaction design
3. Design wireframes on paper and translate paper concepts into digital wireframes.
4. Apply and practice the techniques involved in designing digital wireframes using various UI elements.
5. Implement the process of conducting usability tests Learning steps for digital products.

**Articulation Matrix**

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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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, and Node, Vasam 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**

**2023**

**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

**Course Outcomes (COs)**

1. Identify fundamental concepts of mobile programming that make it unique from programming for other platforms
2. Analyze the essential of Android Application with their anatomy and terminologies
3. Apply rapid prototyping techniques to design, develop and deploy the Android Applications
4. Analyze the essentials of User Interface Design in IoS with SQLite Database
5. Design the flutter applications on the Android marketplace for distribution.

**Articulation Matrix**

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

**UNIT I**

**6 Hours**

**INTRODUCTION TO ANDROID**

The Android Platform, Android SDK, Eclipse Installation, Android Installation, building your First Android application, Understanding the Android Manifest file.

**UNIT II**

**6 Hours**

**ANDROID APPLICATION DESIGN ESSENTIALS**

Anatomy of Android applications, Android terminologies, Application Context, Activities, Services, Intents, Receiving and Broadcasting Intents, Using Intent Filter, Permissions.

**UNIT III**

**6 Hours**

**COMMON ANDROID APIs**

Testing Android applications, Publishing Android applications, Using Android Data and Storage APIs, managing data using Sqlite, Using Android Web APIs, Using Android Telephony APIs, Deploying Android Applications to the World.

**UNIT IV**

**6 Hours**

**IoS USER INTERFACE DESIGN ESSENTIALS**

IoS features, UI implementation, Touch frameworks, Data persistence using Core Data and SQLite, Integrating calendar and address book with social media application, Using Wifi, 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.

**1** **2 Hours**

**EXPERIMENT 1**

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.

**2** **4 Hours**

**EXPERIMENT 2**

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.

**3** **4 Hours**

**EXPERIMENT 3**

Create a SIGNUP activity with Username and Password. Validation of password should happen based on the following rules:

- Password should contain uppercase and lowercase letters.
- Password should contain letters and numbers.
- Password should contain special characters.
- Minimum length of the password (the default value is 8).
- On successful SIGN UP proceed to the next Login activity. Here the user should SIGNIN using the Username and Password created during signup activity. If the Username and Password are matched then navigate to the next activity which displays a message saying “Successful Login” or else display a toast message saying “Login Failed”. The user is given only two attempts and after that display a toast message saying “Failed Login Attempts” and disable the SIGN IN button. Use Bundle to transfer information from one activity to another.

**4** **4 Hours**

**EXPERIMENT 4**

Write a program to enter Medicine Name, Date and Time of the Day as input from the user and store it in the SQLite database. Input for Time of the Day should be either Morning or Afternoon or Evening or Night. Trigger an alarm based on the Date and Time of the Day and display the Medicine Name.

**5** **4 Hours**

**EXPERIMENT 5**

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.

**6** **4 Hours**

**EXPERIMENT 6**

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.

**7** **4 Hours**

**EXPERIMENT 7**

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

8

4 Hours

**EXPERIMENT 8**

Implement any type of App using Flutter.

**Total: 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 for any device” ISBN-13 9780141044804.
5. David Mark, Jack Nutting, Jeff LaMarche and Frederic Olsson, “Beginning iOS6 Development: 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

**Course Outcomes (COs)**

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

**Articulation Matrix**

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

**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 and Test Design – Defect Examples- Developer/Tester Support of Developing a Defect Repository.

**UNIT II**

**9 Hours**

**TEST CASE DESIGN STRATEGIES**

Test Scenarios - Test Cases - Test case Design Strategies - Black Box Approach to Test Case Design - Using White Box Approach to Test design – Test Adequacy Criteria – Static testing vs. Structural testing – Code functional testing – Coverage and Control Flow Graphs – Covering 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 – Skills needed by a test specialist – Building a Testing Group- The Structure of Testing Group - The Technical Training Program.

**UNIT V**

**9 Hours**

**TEST AUTOMATION**

Software test automation – Design and Architecture for Automation - Automation testing - Automation Tools - Selenium Web Driver - Create Selenese Commands - TestNG - TestNG Annotations - Jmeter - Assertions in JMeter - Junit

**Total: 45 Hours**

**Text Books**

1. Srinivasan Desikan and Gopaldaswamy Ramesh, “Software Testing – Principles and Practices”, 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, New York, 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

**Course Outcomes (COs)**

1. Understand different actions performed through Version control tools like Git.
2. Perform Continuous Integration and Continuous Testing and Continuous Deployment using Jenkins by building and automating test cases using Maven & Gradle.
3. Ability to Perform Automated Continuous Deployment.
4. Ability to do configuration management using Ansible.
5. Understand to leverage Cloud-based DevOps tools using Azure DevOps.

**Articulation Matrix**

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

**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
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.energymanagertraining.com](http://www.energymanagertraining.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.

**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
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.

**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
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.

**FOR FURTHER READING**

Introduction- Architecture- Registers- Memory- Instruction set- Addressing Modes- I/O Pins- Timers- Counters- Interrupts.

**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

**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
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 and PM waveforms, phase deviation and modulation index, frequency deviation and percent modulation, Frequency analysis of angle modulated waves. Bandwidth requirements for Angle modulated waves

**UNIT II**

**9 Hours**

**DIGITAL COMMUNICATION**

Introduction, Shannon limit for information capacity, Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) Minimum Shift Keying (MSK), Phase Shift Keying (PSK), BPSK, QPSK, 8 PSK Quadrature Amplitude Modulation (QAM), Bandwidth Efficiency, Comparison of various Digital Communication System (ASK - FSK - PSK - QAM).

**UNIT III**

**9 Hours**

**DIGITAL TRANSMISSION**

Introduction, Pulse modulation, PCM, PCM sampling, sampling rate, signal to quantization noise rate, companding, delta modulation, adaptive delta modulation, differential pulse code modulation, pulse transmission, Intersymbol interference, eye patterns.

**UNIT IV**

**9 Hours**

**SPREAD SPECTRUM AND MULTIPLE ACCESS TECHNIQUES**

Introduction, Pseudo-noise sequence, DS spread spectrum with coherent binary PSK, processing gain, FH spread spectrum, multiple access techniques, wireless communication, TDMA and CDMA in wireless communication systems, source coding of speech for wireless communications.

**UNIT V**

**9 Hours**

**SATELLITE AND OPTICAL COMMUNICATION**

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

**21OEC04 PRINCIPLES OF COMPUTER COMMUNICATION AND NETWORKS**

**3 0 0 3**

**Course Objectives**

- To understand the concept of data communication and networking models.
- To study the various networking Components and Networks.
- To explore the routing, addressing and security and management aspects of computer networks.

**Course Outcomes (COs)**

1. Classify the types of computer networks and analyze the seven layers of OSI model.
2. Analyze the basic operations of Routing Algorithms and Routing devices
3. Analyze the local and wide area networking technologies.
4. Apply the ISDN and ATM interface connections in broadband networks.
5. Analyze the security and management techniques related with networks.

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**NETWORK FUNDAMENTALS**

Types of Computer Networks: by Area, by Topology; Communication Services: Serial and Parallel, Synchronous and Asynchronous, Simplex and Duplex, Analog and Digital; Speed and Capacity; Multiplexing and Switching; Network Architecture: OSI Seven-Layer Network model.

**UNIT II**

**9 Hours**

**INTERNETWORKING AND COMPONENTS**

Routing Concepts: Routing Algorithms, RIP, RIP-2, OSPF and other routing Protocols; Switches and Hubs: Store and Forward Switch, Cut-Through Switch,Hybrid Switch, Performance of Switches ; Repeaters; Repeater Vs Hubs; Bridges: Standards, Bridges Vs Repeaters; Routers and Gateways.

**UNIT III**

**9 Hours**

**LOCAL AND WIDE AREA NETWORKING TECHNOLOGIES**

LAN Components and Topologies; Access Techniques; Transmission Protocols and Media; Ethernet and IEEE 802.3 Networks: History, 10-MBPS Ethernet, Switched Ethernet, 100-MBPS Ethernet, Gigabit Ethernet.

**UNIT IV**

**9 Hours**

**BROADBAND NETWORKS**

ISDN: Evolution, ISDN Channel and Interface Structures; Broadband ISDN: Basics, Principles and General Architecture; Asynchronous Transfer Mode (ATM): Introduction, Concepts, Components, Connection Supported by ATM network and Concept of Virtual Channel and Virtual Path, Traffic control and Congestion Control, Operation and Maintenance aspects.

**UNIT V**

**9 Hours**

**NETWORK SECURITY AND MANAGEMENT**

Security: Need of Security, Security Threats, Vulnerabilities, Methods, tools and Techniques for Attacks; Network Security: Levels of Security, Cryptosystems; Data Encryption Standard (DES), Public Key Cryptography, Firewalls; Network Management: Functions and Elements, Distribution of Management; Simple Network Management Protocol (SNMP), Remote Network Management Services.

**Total: 45 Hours**

**Reference(s)**

1. Michael A.Gallo, William M. Hancock, Computer Communications and Networking Technologies, 1 Ed, Thomson Learning, 2002.
2. Kenneth C. Mansfield, Jr. James L. Antonakos, An Introduction to Computer Networking, 1Ed, Prentice Hall of India, 2002
3. A Shanmugam, S Rajeev, Computer Communication Networks, 1Ed, ISTE Learning Materials Centre, 2001
4. Discrete-Time Signal Processing by Alan V. Oppenheim and Ronald W. Schaffer, 3rd edition, 2010, Prentice Hall
5. Digital Signal Processing by Sanjit Mitra, 4th edition, 2011, McGraw-Hill, New York, NY

**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

**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

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

**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.

**210EI03 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.

**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.

**210EI04 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

**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.

**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	PSO3
1	2	2	2		2								1	2	
2	2	2	2		2								1	2	
3	2	2	2		2								1	2	
4	2	2	2		2								1	3	
5	2	2	2		2								1	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.Pharm, 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>

**210ME02 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

**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	PSO3
1	2	3	1		1									2	
2	3	3	1		2						2			2	
3	1	3	3		2									2	
4	2	3	1		2									2	
5	2	3	1		2									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.

**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	PSO3
1	2	2												2	
2	2	2												2	
3					2	2	1							2	
4	1	2	1		2	2	2							2	
5	2	2	2		1	1	1							2	

**UNIT I**

**9 Hours**

**PRINCIPLES OF MAINTENANCE PLANNING**

Basic principles of maintenance planning - Objectives and principles of planned maintenance activity - Importance and benefits of sound maintenance systems - Maintenance organization - Maintenance economics.

**UNIT II**

**9 Hours**

**MAINTENANCE CATEGORIES AND LUBRICATION**

Maintenance categories - Comparative merits of each category - Preventive maintenance, Maintenance schedules, Repair cycle - Total Productive Maintenance - Principles and methods of lubrication.

**UNIT III**

**9 Hours**

**CONDITION MONITORING**

Condition based maintenance - Cost comparison with and without Condition Monitoring - Methods and instruments for condition monitoring - Noise, vibration, wear and temperature measurement.

**UNIT IV**

**9 Hours**

**FAILURE ANALYSIS AND REPAIR METHODS**

Failure analysis - Failures and their development - Role of Non-Destructive Testing in failure analysis - Repair methods for bearings, cylinder block, fuel pump, shaft.

**UNIT V**

**9 Hours**

**COMPUTER AIDED MAINTENANCE MANAGEMENT**

Approach towards Computerization in maintenance - computer-aided maintenance management system (CAMMS) - Advantages of CAMMS - spare parts and inventory centre performance reporting.

**FURTHER READING**

Retrofitting, objectives, classification of retrofitting, cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features and selection for retrofitting.

**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.

**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	PSO3
1					2	1		1						2	2
2					1			3					2	1	
3	2											3	1		2
4	2	3							2				2		1
5					2					3				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

**FOR FURTHER READING**

Case Studies- Major accidents at Flixborough, UK, Seveso, Italy, Victoria Dock, India, Bhopal, India.

**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 sustainable development
- To give way to the bolster green technology and incline towards more ecofriendly options.

**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	PSO3
1	1		2				3								1
2	2						1								3
3	1						3								2
4	2						3								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.

**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 TRADITIONAL 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

**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 residues - 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

**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

**Course Outcomes (COs)**

1. Identify the specific processing technologies employed for cereals
2. Analyse the composition of millets and their nutritional importance
3. Relate the compositional changes and processing methods of pulses and legumes
4. Create the competence in processing of oilseeds technology
5. Relate the storage processing of food grains with quality aspects

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**CEREALS**

Cereal Grains- Basic agricultural aspects, structure and composition; Storage, Insect control; Processing: Wheat- milling, (Atta and maida), quality aspects of flour, wheat proteins and their function, rheology of flour; wheat based baked products - Bread, Biscuit, Cakes, Extruded products, Pizza, Chapatis, malting and malt products; Rice-Milling, Parboiling, Quick cooking rice, Traditional Indian Products- Puffed Rice, flaked rice, Idli/Dosa/vada mixes and other savouries; Corn- Wet and dry milling, Corn Products - Corn flakes, Corn starch, canned corn products, puffed product; Oats-Milling, Oat Products - Steel cut, rolled oats, quick cooking; Traditional and Fermented cereal products.

**UNIT II**

**9 Hours**

**OTHER CEREALS AND MILLETS**

Sorghum, Pearl Millet, Finger millet, Foxtail Kodo Millet - Basic agricultural millet, aspects, structure and composition; storage, insect control; processing - pearling, Milling, Malting, Malt based foods, flaked and fermented products; Traditional and Nutritional products based on finger millet.

**UNIT III**

**9 Hours**

**PULSES AND LEGUMES**

Basic agricultural aspects, structure, composition, storage, insect control, processing Milling/splitting, dhal milling, products - puffed, flakes, flour, legume-based traditional products, flour based Indian sweets and savouries, soya milk, soy protein Isolate, soya paneer

#### **UNIT IV**

**9 Hours**

##### **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 Hosney., 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.

**Course Outcomes (COs)**

1. Outline the classification, techniques and criteria for selecting raw materials for making various handicraft materials and produce textile-based handicrafts. Produce various decorative and appealing products
2. Design and construct various wall hangings and fashion accessories.
3. Design and construct toys and accessories
4. Design and construct head accessories, home furnishings and paintings
5. Design and construct various decorative and appealing products for interiors

**Articulation Matrix**

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

**UNIT I****9 Hours****TECHNIQUES OF HANDICRAFT MATERIALS**

Definition of Handicraft, Classification: Reusable, Non reusable, Raw materials used in various craft materials: printed, embroidered, stitched and handmade, Criteria for selection of raw materials: material types and end uses.

**UNIT II****9 Hours****DECORATIVE AND APPEALING PRODUCTS - INTERIORS**

Designing and Construction procedures for following various decorative and appealing products: Wall hangings - String Art on plywood, Pressed Flower Art frames.

**UNIT III****9 Hours****DECORATIVE AND APPEALING PRODUCTS - ACCESSORIES**

Designing and Construction procedures for following various decorative and appealing products: Handbags, Hats, footwear.

**UNIT IV****9 Hours****DECORATIVE AND APPEALING PRODUCTS - ORNAMENTS**



Designing and Construction procedures for following various decorative and appealing products: Stone necklace using Macrame Technique, Tribal Jewellery using woollen threads, Floral Jewellery using Resin Technique, Fabric Jewellery using Tie and Dye Technique.

**UNIT V**

**9 Hours**

**DECORATIVE AND APPEALING PRODUCTS - FANCY ITEMS**

Designing and Construction procedures for following various decorative and appealing products: Jewellery Box, Utility Holder, Gift items. Lampshade decors from cardboard, Driftwood Frames for pictures and Mirrors.

**Total: 45 Hours**

**Reference(s)**

1. Handmade in India: A Geographic Encyclopaedia of India Handicrafts. Abbeville press; 1 edition (October 20,2009)
2. Encyclopaedia of Card making Techniques (Crafts), Search Press Ltd, illustrated edition, 2007
3. All about Techniques in Illustration, Barron Educational Series, 2001
4. Printing by Hand: A Modern Guide to printing with Handmade stamps, Stencils and Silk Screens, STC Craft/A Melanie Falick Book, 2008
5. Materials & Techniques in the Decorative Arts: An Illustrated Dictionary, University of Chicago Press, 2000
6. <https://www.marthastewart.com/274411/fashion-crafts>

**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

**Course Outcomes (COs)**

1. Interpret the elements of interior design concepts and resolve the personality requirements
2. Develop graphical representations of interior design concepts
3. Resolve the space planning requirements of residential home as per CPWD guidelines
4. Determine the aesthetic requirements of interior design components.
5. Appraise the roles and responsibilities of interior designer.

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**INTRODUCTION**

Interior designing - definition, importance, requirements and types - Structural design, Decorative Design - Designing interiors, Good taste; Design themes, types and application. Personality of the Home - Art elements - Line: types, characteristics and importance; form: size and shape, characteristics; Colour - sources, qualities, emotional effects, colour wheel and schemes.

**UNIT II**

**9 Hours**

**GRAPHICAL PRESENTATIONS**

3D composition; Isometric and Axonometric- Still life- Furniture Sketching- Object Drawing with color rendering - Interior elements, Lighting, plants. Perspective, Axonometric Isometric drawing. Orthographic Projection - Lifts and escalators.

**UNIT III**

**9 Hours**

**SPACE PLANNING**

Space planning concepts- interiors, circulation. Definition, application of ergonomic principals in interiors. Residential house space planning case study- CPWD guidelines. Lighting for different locations and activities, measurement, ventilation and indoor air quality, noise control methods.

**UNIT IV**

**9 Hours**

**INTERIOR COMPONENTS**

Application of colour in interiors; Texture - types and significance; Pattern: types and effects; Light - importance. Importance of Furniture Design for Interiors- Ancient Age / Middle Age / Contemporary. Doors,

Windows, Staircase designs, False Ceiling, Partitions, Wall Panelling, Comics, Mosaic, Cladding- Flooring and Wall Cladding

**UNIT V**

**9 Hours**

**ROLES AND RESPONSIBILITIES OF INTERIOR DESIGNER**

Role of an Interior Designer- Responsibility towards society and need of an Interior Designer to better the environment- Ethics and Code of Conduct- Responsibility towards client, contractor and supplier, Estimation. Professional Fees- Work of an Interior Designer- Making of portfolio, JD Annual Design Awards.

**Total: 45 Hours**

**Reference(s)**

1. Joanna Gaines, Homebody: A guide to creating spaces you never want to leave, Harper design, 2018.
2. Erin gates, Elements of Style: Designing a Home and a life, Simon and Schuster, 2014.
3. Simon Dodsworth, The Fundamentals of Interior Design, AVA publishing, 2009.
4. V. Mary. Knackstedt, The Interior Design Business Handbook: A Complete Guide to Profitability, Wiley, New Jersey; 2006.
5. M. G. Shah, C. M. Kale, and S.Y. Patki, Building Drawing with an Integrated Approach to Build Environment, Tata McGraw Hill, 2002.
6. <https://eclectictrends.com>

**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

**Course Outcomes (COs)**

1. Analyze the raw material requirements for surface ornamentation and its application
2. Implement hand embroidery stitches on fabric and show the stitch development procedure in diagrammatic representations
3. Apply the machine and computerized embroidery stitches
4. Analyze the surface embellishment techniques and its application
5. Assess the quality maintenance parameters of all embroidered products and analyze the 6 traditional embroidery techniques

**Articulation Matrix**

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

**UNIT I**

**9 Hours**

**INTRODUCTION TO SURFACE ORNAMENTATION**

Introduction, Definition, Need, Types, Raw materials, Importance of surface ornamentation, Selection of needle, thread and fabric for hand embroidery and machine embroidery. various methods of surface embellishment- embroidery and surface ornamentation.

**UNIT II**

**9 Hours**

**HAND EMBROIDERY**

General rules for hand embroidery. Types of hand embroidery stitches-Running, Couching, Button hole, Satin, Long & Short, Wheat, Chain, Stem, Herringbone, Cross stitch, Knotted stitches, Fish bone, Fly stitch, Braids, Back, Hem, Seed, Needle weaving, Whip stitches.

**UNIT III**

**9 Hours**

**MACHINE EMBROIDERY**

General rules for machine embroidery. Types of frames and methods of transferring the designs. Attachments to sewing machines for embroidery, Types of machine embroidery stitches- Eyelet work, Cut work, patch work, Mirror work, Applique, Shaded embroidery, Shadow work, Bead and Sequins work, Vermicelli, Zigzag, Granite stitch. Computerized embroidery machine- Concept of design and development, software used in embroidery machines, process of designing, method and types of stitch application, punching and digitizing.

**UNIT IV**

**9 Hours**

**EMBELLISHMENT TECHNIQUES**

Materials used and Applications. Types of embellishment techniques- fabric painting-hand, Stencil-dabbing and Spraying. Dyeing and printing-advanced tie and dye techniques, batik and block printing. Trimmings and decorations-Laces, Pompons, Fringes, Tassels, Tucks, Show buttons, Crocheting.

**UNIT V**

**9 Hours**

**TRADITIONAL EMBROIDERIES OF INDIA AND CARE**

Care and maintenance of embroidered articles-care and maintenance methods for embroidered apparel, pressing. Traditional Embroideries of India-Phulkari, Kasuti, Kashmiri embroidery, Kutch work, Chikkankari, Kantha.

**Total: 45 Hours**

**Reference(s)**

1. Ruth Chandler, Modern Hand Stitching-Dozens of stitches with creative free-form variations,2014
2. Sophie Long, Mastering the Art of Embroidery: Traditional Techniques and Contemporary Applications for Hand and Machine Embroidery, Heritage Publishers, London, 2013
3. Christen Brown, Embroidered & Embellished, C&T Publishing, 2013
4. Sheila Paine, Embroidered Textiles, Thames and Hudson Publisher, UK, 1990.
5. Gail Lawther, Inspirational Ideas for Embroidery on Clothes & Accessories, Search Press Ltd, UK, 1993.
6. <http://www.needlenthread.com/tag/hand-embroidery-stitches>

**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

**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

### **UNIT V**

**9 Hours**

#### **NANOMACHINES AND NANODEVICES**

Microelectromechanical systems (MEMS) and Nanoelectromechanical systems (NEMS)-fabrication, actuators-organic FET- principle, description, requirements, integrated circuits- single electron transistor - - organic photovoltaic cells- spintronics

**Total: 45 Hours**

#### **Reference(s)**

1. Willam A. Goddard, Donald W. Brenner, "Handbook of Nanoscience, Engineering, and Technology", CRC Press, 2012
2. Charles P. Poole Jr and. Frank J. Owens, "Introduction to Nanotechnology", Wiley Interscience, 2007
3. Guozhong Cao, Y. Wang, "Nanostructures and Nanomaterials-Synthesis, Properties & Applications", Imperials College Press, 2011.
4. T. Pradeep, "NANO: The Essentials Understanding Nanoscience and Nanotechnology", McGraw - Hill Education (India) Ltd, 2012
5. Robert W. Kelsall, Ian W. Hamley, Mark Geoghegan, "Nanoscale Science and Technology", John Wiley and Sons Ltd, 2006
6. Viswanathan B, Aulice Scibioh 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

**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

**UNIT II**

**9 Hours**

**P-N JUNCTION**

Basic structure and fabrication process of p-n junction - current - voltage characteristics - energy band diagram - equilibrium Fermi levels - depletion region - junction breakdown phenomena - zener - avalanche breakdown.

**UNIT III**

**9 Hours**

**BIPOLAR JUNCTION TRANSISTOR**

The basic transistor action - operation in the active mode - current gain - static characteristics - carrier distribution in emitter, base and collector region - modes of operation - current - voltage characteristics of common base and emitter configuration - frequency response and switching of bipolar transistor



**UNIT IV**

**9 Hours**

**MOSFET**

The ideal MOS diode - basic fundamentals and characteristics - types - CMOS and BiCMOS - CMOS inverter - MOSFET on insulator - thin film transistor (TFT) - silicon on insulators (SOI) devices - MOS Memory structures - DRAM and SRAM

**UNIT V**

**9 Hours**

**PHOTONIC DEVICES**

Radiative transitions and optical absorption-light emitting diodes-organic LED - infrared LED - semiconductor laser - temperature effect - photo detector - photo diode - silicon and compound semiconductor solar cells - efficiency

**Total: 45 Hours**

**Reference(s)**

1. Donald A Neamen, "Semiconductor Physics and Devices", Tata McGraw Hill, 2012
2. S. M. Sze and M. K. Lee, "Semiconductor Devices, Physics and Technology", John-Wiley & Sons, 2015
3. Ben. G. Streetman and S. K. Banerjee, "Solid State Electronic Devices", Pearson Education Ltd, 2015
4. C. Kittel, "Introduction to Solid State Physics", John-Wiley & Sons, 2012
5. J. Millman and C. Halkias, "Electronic Devices and Circuits", Tata McGraw Hill, 2010
6. Hagen Klauk, "Organic Electronics: Materials, Manufacturing and Applications", Wiley-VCH, 2006

**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

**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.

**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

**Course Outcomes (COs)**

1. Identify the salient features of soft matter and hard matter
2. Exemplify the fundamental interactions and stability of colloids and gels
3. Illustrate the structure and properties of liquid crystals
4. Outline the aggregation and phase behavior of surfactants, polymers, copolymers and block copolymers
5. Analyze the soft matter behavior of nucleic acids, proteins, polysaccharides and membranes

**Articulation Matrix**

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

**UNIT I****9 Hours****CONDENSED MATTER**

Intermolecular forces-Condensation and freezing-mechanical response: Hookean solid-Newtonian liquid-viscoelasticity. Glasses: relaxation time-viscosity- glass forming liquids. Soft matter: length scales-fluctuations and Brownian motion

**UNIT II****9 Hours****COLLOIDAL DISPERSIONS & GELS**

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

**UNIT III** **9 Hours**

**LIQUID CRYSTALS**

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

**UNIT IV** **9 Hours**

**SUPRAMOLECULAR SELF ASSEMBLY**

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

**UNIT V** **9 Hours**

**SOFT MATTER IN NATURE**

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

**Total: 45 Hours**

**REFERENCES**

1. Richard A L Jones, Soft Condensd Matter, Oxford University Press, UK, 2002
2. Masao Doi, Soft Matter Physics, Oxford University Press, UK, 2013.
3. Ian W. Hamley, Introduction to Soft Matter, John Wiley & Sons, 2007
4. A. Fernandez-Nieves, A M Puertas, Fluids, Colloids and Soft materials: An Introduction to Soft Matter Physics, John Wiley & Sons, 2016
5. Maurice Kleman, Oleg D. Lavrentovich, Soft Matter Physics: An Introduction, Springer-Verlag, New York, 2003.

**210CH01 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

**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 diagrams 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

**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 - calendaring. 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.

**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.

**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	PSO3
1	1	2													
2	1	3													
3	2	3													
4	2	3													
5	3	3													

**UNIT I**

**9 Hours**

**INTRODUCTION**

Graphs - Introduction - Isomorphism - Sub graphs - Walks, Paths, Circuits - Connectedness - Components - Euler graphs - Hamiltonian paths and circuits - Trees - Properties of trees - Distance and centers in tree - Rooted and binary trees.

**UNIT II**

**9 Hours**

**TREES, CONNECTIVITY**

Spanning trees - Fundamental circuits - Spanning trees in a weighted graph - cut sets - Properties of cut set - All cut sets - Fundamental circuits and cut sets - Connectivity and separability - Network flows - 1- Isomorphism - 2-Isomorphism - Combinational and geometric graphs - Planer graphs - Different representation of a planer graph.

**UNIT III**

**9 Hours**

**MATRICES, COLOURING AND DIRECTED GRAPH**

Chromatic number - Chromatic partitioning - Chromatic polynomial - Matching - Covering - Four color problem - Directed graphs - Types of directed graphs - Digraphs and binary relations - Directed paths and connectedness - Euler graphs.

**UNIT IV**

**9 Hours**

**PERMUTATIONS**

Fundamental principles of counting - Permutations and combinations - Binomial theorem - combinations with repetition - Combinatorial numbers - Principle of inclusion and exclusion - Derangements - Arrangements with forbidden positions.

**UNIT V**

**9 Hours**

**GENERATING FUNCTIONS**

Generating functions - Partitions of integers - Exponential generating function - Summation operator - Recurrence relations - First order and second order - non-homogeneous recurrence relations - Method of generating functions.

**Total: 45 Hours**

**Reference(s)**

1. 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.

**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	PSO3
1									2		3				
2									2		2				
3									2		2				
4									3		2				
5									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.

**FURTHER READING**

Retrofitting, objectives, classification of retrofitting, cost effectiveness through retrofitting (economical aspects), circumstances leading to retrofitting, features and selection for retrofitting.

**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

**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	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	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

**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	PSO3
1						1	2		2						
2						1	2		2						
3						1	2		2						
4						1	2		2						
5						1	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 tax (Cases). Indirect taxation, Excise duty, Customs, Sales and Service tax, VAT, Octroi, GST (Cases)

**UNIT IV**

**9 Hours**

**GOVERNMENT SUPPORT**

Industrial policy of Central and State Government, National Institute-NIESBUD, IIE, EDI. State Level Institutions-TIIC, CED, MSME, Financial Institutions

**UNIT V**

**9 Hours**

**BUSINESS PLAN PREPARATION**

Purpose of writing a business plan, Capital outlay, Technical feasibility, Production plan, HR plan, Market survey and Marketing plan, Financial plan and Viability, Government approvals, SWOT analysis.

**Total: 45 Hours**

**Reference(s)**

1. Hisrich, Entrepreneurship, Tata McGraw Hill, New Delhi: 2005
2. Philip Kotler., Marketing Management, Prentice Hall of India, New Delhi: 2003
3. Aswathappa K, Human Resource and Personnel Management - Text and Cases, Tata McGraw Hill:2007.
4. Jain P C., Handbook for New Entrepreneurs, EDII, Oxford University Press, New Delhi: 2002.
5. Akhileshwar Pathak, Legal Aspects of Business, Tata McGraw Hill: 2006.
6. <http://niesbud.nic.in/agencies.html>

**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

**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	PSO3
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 – coping 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**

Introduction to Digital Signal Processors- Basic Classification-Features TMS320C6713 Architecture-Functional Unit-Pipelining- Addressing Modes -Instruction set Simple Assembly Language Program.

**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.

**Course Outcomes (COs)**

1. Implement deep learning models in TensorFlow and Keras
2. Apply the optimization technique to improve the model performance

**Articulation Matrix**

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

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 Learning 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`Reilly.
2. [https://www.tensorflow.org/api\\_docs](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.

**Course Outcomes (COs)**

1. Create data visualizations and dashboards using Tableau
2. Apply data visualizations to gain insights

**Articulation Matrix**

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

Introduction to 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.

**Course Outcomes (COs)**

1. Develop the real-world application using TypeScript
2. Apply Jest Testing Framework to ensure correctness of the JavaScript

**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	3	3		3									

**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.

**Course Outcomes (COs)**

1. Develop the real-world applications using ReactJS.
2. Design interactive user interfaces and web applications using ReactJS

**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	3	3		3									

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.

**Course Outcomes (COs)**

1. Implement Qt Widgets for creating user interface applications.
2. Implement Qt Programs.

**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	3	3		3									

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.

**Course Outcomes (COs)**

1. Apply the Blockchain technology in real world problems.
2. Implement the smart contracts in Ethereum framework.

**Articulation Matrix**

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

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.

**Course Outcomes (COs)**

1. Implement Docker to build, test, and deploy applications quickly
2. Build Docker images, configure containerized environments and deploy applications using Kubernetes

**Articulation Matrix**

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

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.

**Course Outcomes (COs)**

1. Implement Apache Spark to process data
2. Implement Apache Spark to build machine learning models

**Articulation Matrix**

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

Introduction to 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>