MOHAN BABU UNIVERSITY

Sree Sainath Nagar, Tirupati – 517 102

SCHOOL OF COMPUTING

B.Tech. Information Technology

CURRICULUM AND SYLLABUS

(For 2022-23 Admitted Students)

FULLY FLEXIBLE CHOICE BASED CREDIT SYSTEM (FFCBCS)

MOHAN BABU UNIVERSITY

Vision

To be a globally respected institution with an innovative and entrepreneurial culture that offers transformative education to advance sustainability and societal good.

Mission

- Develop industry-focused professionals with a global perspective.
- Offer academic programs that provide transformative learning experience founded on the spirit of curiosity, innovation, and integrity.
- Create confluence of research, innovation, and ideation to bring about sustainable and socially relevant enterprises.
- Uphold high standards of professional ethics leading to harmonious relationship with environment and society.

SCHOOL OF COMPUTING

Vision

To lead the advancement of computer science research and education that has real-world impact and to push the frontiers of innovation in the field.

Mission

- Instil within our students fundamental computing knowledge, a broad set of skills, and an inquisitive attitude to create innovative solutions to serve industry and community.
- Provide an experience par excellence with our state-of-the-art research, innovation, and incubation ecosystem to realise our learners' fullest potential.
- Impart continued education and research support to working professionals in the computing domain to enhance their expertise in the cutting-edge technologies.
- Inculcate among the computing engineers of tomorrow with a spirit to solve societal challenges.

DEPARTMENT OF DATA SCIENCE

Vision

To become a nationally recognized quality education center in the domain of Computer Science and Information Technology through teaching, training, learning, research and consultancy.

Mission

- To impart quality education in Computer Science and Information Technology and emerging areas of IT industry by disseminating knowledge through contemporary curriculum, competent faculty and effective teaching-learning methodologies.
- Nurture research, innovation and entrepreneurial skills among faculty and students to contribute to the needs of industry and society.
- Inculcate professional attitude, ethical and social responsibilities for prospective and promising engineering profession.
- Encourage students to engage in life-long learning by creating awareness of the contemporary developments in Computer Science and Information Technology and its emerging areas.

B.Tech. Information Technology

PROGRAM EDUCATIONAL OBJECTIVES

After few years of graduation, the graduates of B.Tech. IT program will be:

PEO1: Demonstrated core competence of Computer Science and Information Technology to solve societal problems and pursue higher studies in the allied areas of computer science.

PEO2: Employed or becoming entrepreneurs by acquiring required professional skills in the domain of Computer Science and Information Technology.

PEO3: Able to adopt and exhibit technology advancements through life-long learning and follow ethical attitude in professional practice.

PROGRAM OUTCOMES

On successful completion of the Program, the graduates of B.Tech. IT with program will be able to:

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

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

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

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

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

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

PO7. Environment and Sustainability: Understand the impact of the professional engineering solutions in societal and environmental

contexts, and demonstrate the knowledge of, and need for sustainable development.

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

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

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

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

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

PROGRAM SPECIFIC OUTCOMES

On successful completion of the Program, the graduates of B.Tech. IT program will be able to:

PSO1: Design, develop and deploy software applications using programming concepts, tools, platforms, technologies and principles of software engineering as per user requirements.

PSO2: Apply databases concepts, analytic techniques and big data technologies for information management and design algorithms to provide effective solutions to real-time problems.

PSO3: Apply principles of system software, computing, networking and security to develop secure and reliable software systems.

PSO4: Build intelligent applications using Computer Vision and Artificial Intelligence for societal needs.

B.Tech. Information Technology

Basket Wise - Credit Distribution

(Regular – 4 Years Program)

S. No.	Basket	Credits (Min.- Max.)
1	SCHOOL CORE	50-54
2	PROGRAM CORE	45-61
3	PROGRAM ELECTIVE	24-36
4	SPECIALISATION ELECTIVE	12-18
5	UNIVERSITY ELECTIVE	9-12
	TOTAL CREDITS	**Min. 160**

Basket Wise - Credit Distribution

(Lateral Entry – 3 Years Program)

S. No.	Basket	Credits (Min.- Max.)
1	SCHOOL CORE	20-34
2	PROGRAM CORE	45-61
3	PROGRAM ELECTIVE	24-36
4	SPECIALIZATION ELECTIVE	12-18
5	UNIVERSITY ELECTIVE	9-12
	TOTAL CREDITS	**Min. 120**

School Core (50-54 Credits) - (Regular – 4 Years Program)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22MM102453	Physics for Computing	3	-	2	-	4	-
22EE102401	Basic Electrical and Electronics Engineering	3	-	2	-	4	-
22CS102001	Programming for Problem Solving	3	-	2	-	4	-
22AI105001	Design Thinking	-	1	2	-	2	-
22IT111001	Internship	-	-	-	-	2	-
22IT108001	Capstone Project	-	-	-	-	10	-
Language Basket (Min. 4 Credits to be earned)							
22LG102401	English for Professionals	2	-	2	-	3	-
22LG105402	Soft Skills	-	-	2	-	1	-
22LG101403	German Language	2	-	-	-	2	-
22LG101404	French Language	2	-	-	-	2	-
Mathematics Basket (Min. 12 Creditsto be earned)							
22MM101403	Calculus and Transformation Techniques	3	-	-	-	3	-
22MM101401	Matrix Theory and Linear Algebra	3	-	-	-	3	-
22MM101405	Numerical Methods, Probability and Statistics	3	-	-	-	3	-
22MM101407	Number Theory and Algebra	3	-	-	-	3	-
22MM101408	Statistics for Data Science	3	-	-	-	3	Numerical Methods, Probability and Statistics
Introduction to Computer Science (Min. 2 Creditsto be earned)							
22AI105002	Disruptive Technologies	-	1	2	-	2	-
22AI105003	Free and Open Source Software	-	1	2	-	2	Programming for Problem Solving
22CB105001	Computer Hardware and System Essentials	-	1	2	-	2	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
Programming Languages (Min. 5 Creditsto be earned)							
22AI104001	Object Oriented Programming through C++	3	-	2	4	5	Programming for Problem Solving
22AI104002	Object Oriented Programming through Java	3	-	2	4	5	Programming for Problem Solving
Management Basket (Min. 5 Creditsto be earned)							
22CM101401	Principles of Business Economics and Accountancy	3	-	-	-	3	-
22MG101401	Essentials of Leadership	2	-	-	-	2	-
22MG101402	Organizational Behaviour	2	-	-	-	2	-
22MG101403	Project Management	2	-	-	-	2	-
Mandatory Courses (Min. 8 Creditsto be earned - Earned Credits will not be considered for CGPA)							
22LG107601	Professional Ethics and Human Values	2	-	-	-	2	-
22CE107601	Environmental Science*	2	-	-	-	2	-
22CE107602	Disaster Mitigation and Management	2	-	-	-	2	-
22CE107603	Rural Technology	2	-	-	-	2	-
22LG107603	Spoken English	-	1	2	-	2	English for Professionals
22LG107602	Essential Life Skills for Holistic Development	2	-	-	-	2	-
22AB107601	NCC/NSS Activities	-	-	-	-	2	-
22AB107602	Yoga	-	-	-	-	2	-
22MG107401	Innovation, Incubation and Entrepreneurship	2	-	-	-	2	-
22EE107001	Intellectual Property Rights	2	-	-	-	2	-
22EE107002	Fundamentals of Research Methodology	2	-	-	-	2	-

* Compulsory Course

School Core (20-34 Credits) - (Lateral Entry – 3 Years Program)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22MM102453	Physics for Computing	3	-	2	-	4	-
22EE102401	Basic Electrical and Electronics Engineering	3	-	2	-	4	-
22CS102001	Programming for Problem Solving	3	-	2	-	4	-
22AI105001	Design Thinking	-	1	2	-	2	-
22CS111001	Internship	-	-	-	-	2	-
22CS108001	Capstone Project	-	-	-	-	10	-
22LG102401	English for Professionals	2	-	2	-	3	-
22LG105402	Soft Skills	-	-	2	-	1	-
22LG101403	German Language	2	-	-	-	2	-
22LG101404	French Language	2	-	-	-	2	-
22MM101403	Calculus and Transformation Techniques	3	-	-	-	3	-
22MM101401	Matrix Theory and Linear Algebra	3	-	-	-	3	-
22MM101405	Numerical Methods, Probability and Statistics	3	-	-	-	3	-
22MM101407	Number Theory and Algebra	3	-	-	-	3	-
22MM101408	Statistics for Engineers	3	-	-	-	3	-
22AI105002	Disruptive Technologies	-	1	2	-	2	-
22AI105003	Free and Open Source Software	-	1	2	-	2	-
22CB105001	Computer Hardware and System Essentials	-	1	2	-	2	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
22AI104001	Object Oriented Programming through C++	3	-	2	4	5	-
22AI104002	Object Oriented Programming through Java	3	-	2	4	5	-
22CM101401	Principles of Business Economics and Accountancy	3	-	-	-	3	-
22MG101401	Essentials of Leadership	2	-	-	-	2	-
22MG101402	Organizational Behaviour	2	-	-	-	2	-
22MG101403	Project Management	2	-	-	-	2	-
Mandatory Courses (Min. 6 Credits to be earned - Earned Credits will not be considered for CGPA)							
22LG107601	Professional Ethics and Human Values	2	-	-	-	2	-
22CE107601	Environmental Science*	2	-	-	-	2	-
22CE107602	Disaster Mitigation and Management	2	-	-	-	2	-
22CE107603	Rural Technology	2	-	-	-	2	-
22LG107603	Spoken English	-	1	2	-	2	-
22LG107602	Essential Life Skills for Holistic Development	2	-	-	-	2	-
22AB107601	NCC/NSS Activities	-	-	-	-	2	-
22AB107602	Yoga	-	-	-	-	2	-
22MG107401	Innovation, Incubation and Entrepreneurship	2	-	-	-	2	-
22EE107001	Intellectual Property Rights	2	-	-	-	2	-
22EE107002	Fundamentals of Research Methodology	2	-	-	-	2	-

* Compulsory Course

Program Core (45-61Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22CS102003	Data Structures	3	-	2	-	4	-
22CS102004	Design and Analysis of Algorithms	3	-	2	-	4	-
22AI101001	Discrete Mathematical Structures	3	-	-	-	3	-
22CS101001	Digital Logic Design	3	-	-	-	3	--
22CS101002	Computer Organization and Architecture	3	-	-	-	3	Digital Logic Design
22AI101019	Foundations of Operating Systems	3	-	-	-	3	-
22AI101002	Theory of Computation	3	-	-	-	3	-
22CS102006	Compiler Design	3	-	2	-	4	Theory of Computation
22CS102005	Database Management Systems	3	-	2	-	4	-
22AI101017	Data Mining	3	-	-	-	3	Database Management Systems
22IT101001	Software Engineering	3	-	-	-	3	
22IT102002	Computer Graphics and Multimedia	3	-	2	-	4	Programming for Problem Solving
22CB102002	Computer Networks	3	-	2	-	4	
22IT102003	Cloud Computing	3	-	2	-	4	Object Oriented Programming through Java, Operating Systems
22CS102002	Python Programming	3	-	2	-	4	
22IT104001	Web Technologies	3	-	2	4	5	Object Oriented Programming through Java
22CS104002	Mobile Application Development	3	-	2	4	5	Web Technologies

Program Elective (24 - 36 Credits)

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
22CB101003	Computer Networks	Mobile Computing	3	-	-	-	3	Computer Networks
22CB102006		Internet of Things	3	-	2	-	4	Computer Networks
22CB101018		Semantic Web and Social Networks	3	-	-	-	3	Computer Networks Web Technologies
22CB101017		Adhoc and Wireless Sensor Networks	3	-	-	-	3	Computer Networks
22CS101007	Software Development and Management	Software Project Management	3	-	-	-	3	Software Engineering
22CS102010		Software Testing and Quality Assurance	3	-	2	-	4	Software Engineering
22IT101002		Agile and Scrum Methodologies	3	-	-	-	3	Software Engineering
22IT101012		User Interface Design	3	-	-	-	3	Software Engineering
22IT102004		DevOps	3	-	2	-	4	Software Engineering
22AI102002	Intelligent Systems	Artificial Intelligence	3	-	2-	-	4	Python Programming
22AI102003		Machine Learning	3	-	2	-	4	-
22AI102006		Deep Learning	3	-	2	-	4	Machine Learning
22IT101016		Natural Language Processing	3	-	2	-	4	Python Programming
22AI102008		Computer Vision	3	-	2	-	4	-
22IT101017		Robotic Process Automation and Development	3	-	-	-	3	Artificial Intelligence
22IT101022		Evolutionary Computing	3	-	-	-	3	-
22CB102001	Cyber Security	Cryptography and Network	3	-	2	-	4	Number Theory and Algebra,

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
		Security						Computer Networks
22CB101001		Cyber Security Essentials	3	-	-	-	3	Computer Networks
22CB101009		Blockchain Technologies	3	-	-	-	3	Computer Networks
22IT101013	Programming Languages	Linux Programming	3	-	-	-	3	Operating Systems
22CS102011		Programming in C# and .NET Framework	3	-	2	-	4	-
22CS105001		R Programming	-	1	2	-	2	Object Oriented Programming through C++/Java
22DS102010		PYSPARK	3	-	2	-	4	Object Oriented Programming through C++/Java
22IT101020		Go Lang	3	-	-	-	3	
22IT101021	Platform based Development	Game Development	3	-	-	-	3	Programming in C# and .NET Framework
22IT104002		MERN Stack Development	3	-	2	4	5	Web Technologies
22IT106001		Advanced Web Development	-	1	2	4	3	Web Technologies
22IT102005		App Development with Flutter	3	-	2	-	4	Mobile Application Development
22IT105001		Dashboard Design Technologies	-	1	2	-	2	Database Management Systems
22AI101003	Graphics and Visualization	Digital Image Processing	3	-	-	-	3	-
22AI102010		Virtual Reality and Augmented Reality	3	-	2	-	4	Object Oriented Programming through C++/Java
22DS102002	Information	Big Data Technologies	3	-	2	-	4	-

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
22DS102003	Management	Data Visualization	3	-	2	-	4	Python Programming
22DS102006		Data Science	3	-	2	-	4	-
22CS101004	Computing	Advanced Computer Architecture	3	-	-	-	3	Computer Organization and Architecture
22CS101005		Distributed Systems	3	-	-	-	3	Operating Systems
22EC104017		Embedded Systems	3	-	2	-	4	Microcontroller and Interfacing
22CS101006		High Performance Computing	3	-	-	-	3	Object Oriented Programming through C++/Java

Specialization Elective (12 - 18 Credits)

I. Artificial Intelligence and Machine Learning

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
22AI101004	Artificial Intelligence	Multi-Agent Systems	3	-	-	-	3	Artificial Intelligence
22AI101005		Markov Decision Processes	3	-	-	-	3	Numerical Analysis, Probability and Statistics, Artificial Intelligence
22AI101006		Knowledge Representation and Reasoning	3	-	-	-	3	Artificial Intelligence
22AI102013		Graph Algorithms	3	-	2	-	4	Machine Learning, Digital Image Processing
22AI101007		Information Theory	3	-	-	-	3	Mathematics Basket
22AI102014		Nature Inspired Algorithms	3	-	2	-	4	Optimization Techniques, Design and Analysis of Algorithms
22AI102015	Machine Learning	Feature Engineering for Machine Learning	3	-	2	-	4	Artificial Intelligence, Python Programming
22AI102016		Reinforcement Learning	3	-	2	-	4	Machine Learning
22AI102017		Approximation Algorithms	3	-	2	-	4	Design and Analysis of Algorithms
22AI102018		Deep Learning	3	-	2	-	4	Machine Learning
22AI101010		Generative Deep Learning	3	-	-	-	3	Deep Learning
22AI104003		MLOPs	3	-	2	4	5	Machine Learning
22AI101015	Applied Artificial Intelligence and Machine Learning	AI for Robotics	3	-	-	-	3	Artificial Intelligence
22AI102021		Machine Learning for Security	3	-	2	-	4	-
22AI101012		Social Network Analysis	3	-	-	-	3	Machine Learning

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
22AI101013		Image and Video Analytics	3	-	-	-	3	Digital Image Processing

II. Data Science

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
			L	T	P	S	C	
	Data Science							
22DS104001		Data Analytics	3	-	2	4	5	Data Mining
22DS101001		Text Analytics	3	-	-	-	3	Machine Learning
22DS102007		Web Analytics	3	-	-	-	3	Web Technologies
22DS101001		Decision Support and Intelligent systems	3	-	-	-	3	-
22DS101002		Predictive Analytics	3	-	-	-	3	Machine Learning
20DS102008		Business Intelligence Tools	3	-	2	-	4	-
20DS102009		Time Series Analysis	3	-	2	-	4	Machine Learning
22DS101003		Image and Video Analytics	3	-	-	-	3	-
22DS104002		Recommender System with Tensor flow	3	-	2	4	5	Machine Learning
22DS102010		PySpark	3	-	2	-	4	Big Data Technologies
22DS102011		Hadoop Application Architectures	3	-	2	-	4	Big Data Technologies
22DS101013		Generative AI	3	-	-	-	3	Python Programming

Course Code	Knowledge Area	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
22DS101014		Explainable AI	3	-	-	-	3	Machine Learning
22IT101023		VFX Animation	3	-	-	-	3	-
22CB101022		Quantum Computing	3	-	-	-	3	Matrix Theory and Linear Algebra

University Elective (9 - 12 Credits)

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22EC101701	AI in Healthcare	3	-	-	-	3	-
22CM101701	Banking and Insurance	3	-	-	-	3	-
22DS101701	Bioinformatics	3	-	-	-	3	-
22BS101701	Biology for Engineers	3	-	-	-	3	-
22LG101701	Business Communication and Career Skills	3	-	-	-	3	-
22CE101701	Civil Engineering and The Society	3	-	-	-	3	-
22SS101701	Constitution of India	3	-	-	-	3	-
22CM101702	Cost Accounting and Financial Management	3	-	-	-	3	-
22CB101701	Cyber Laws and Security	3	-	-	-	3	-
22EE101701	Electrical Safety and Safety Management	3	-	-	-	3	-
22MG101701	Entrepreneurship for Micro, Small and Medium Enterprises	3	-	-	-	3	-
22CE101702	Environmental Pollution and Control	3	-	-	-	3	-
22EC101702	Essentials of VLSI	3	-	-	-	3	-
22CB101702	Introduction to Ethical Hacking	3	-	-	-	3	-
22CB101703	Forensic Science	3	-	-	-	3	-
22SS101702	Gender and Environment	3	-	-	-	3	-
22ME101701	Global Strategy and Technology	3	-	-	-	3	-

Course Code	Title of the Course	Lecture	Tutorial	Practical	Project based Learning	Credits	Pre-requisite
		L	T	P	S	C	
22EE101704	Green Technologies	3	-	-	-	3	-
22ME101702	Human Resource Management	3	-	-	-	3	-
22SS101703	Indian Economy	3	-	-	-	3	-
22SS101704	Indian History	3	-	-	-	3	-
22SS101705	Indian Tradition and Culture	3	-	-	-	3	-
22EC101703	Instrumentation in Industries	3	-	-	-	3	-
22EC101704	Introduction to Nanotechnology	3	-	-	-	3	-
22AI101702	Introduction to Artificial Intelligence	3	-	-	-	3	-
22AI101703	Introduction to Data Science	3	-	-	-	3	-
22AI101704	Introduction to Machine Learning	3	-	-	-	3	-
22CS101701	Introduction to Python Programming	3	-	-	-	3	-
22CB101704	Introduction to Internet of Things	3	-	-	-	3	-
22ME101703	Management Science	3	-	-	-	3	-
22ME101704	Managing Innovation and Entrepreneurship	3	-	-	-	3	-
22ME101705	Material Science	3	-	-	-	3	-
22LG201701	Personality Development	3	-	-	-	3	-
22CE101703	Planning for Sustainable Development	3	-	-	-	3	-
22EC101705	Principles of Communication Engineering	3	-	-	-	3	-
22EE101702	Reliability and Safety Engineering	3	-	-	-	3	-
22CE101704	Remote Sensing, GIS and GPS	3	-	-	-	3	-
22CE101705	Smart Cities	3	-	-	-	3	-
22EC101706	Smart Sensors for Engineering Applications	3	-	-	-	3	-
22LG101703	Stress Management and Well Being	3	-	-	-	3	-
22EE101703	Sustainable Energy Systems	3	-	-	-	3	-
22CS101702	Web Design Fundamentals	3	-	-	-	3	-
22SS101706	Women Empowerment	3	-	-	-	3	-

Note:

1. If any student has chosen a course or equivalent course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s under University Elective.
2. The student can choose courses from other disciplines offered across the schools of MBU satisfying the pre-requisite other than the above list.

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM102453	**PHYSICS FOR COMPUTING**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on wave optics, Quantum mechanics and its applications, Semiconductor diodes, optoelectronic devices, and Fiber optics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply the concepts of light waves to interpret the concepts of Interference, Diffraction, and Polarization.

CO2. Demonstrate the basic knowledge of the quantum behaviour of matter in its microstate.

CO3. Analyze the band structure of solid materials using quantum physics.

CO4. Understand the basic concepts of semiconductors in the functioning of various optoelectronic devices.

CO5. Demonstrate the concepts of electromagnetic wave propagation in optical fibers.

CO6. Work independently and in teams to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	1	-	-	-	-	-
CO2	3	2	-	1	-	-	-	-	-	-	-	-
CO3	3	2	-	1	-	-	-	-	-	-	-	-
CO4	3	2	1	-	-	1	-	-	-	-	-	-
CO5	3	2	-	-	1	-	-	-	-	-	-	-
CO6	3	2	-	-	-	-	-	1	1	1	-	-
Course Correlation Mapping	3	2	1	1	1	1	1	1	1	1	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: WAVE OPTICS ***(10 Periods)***

Interference: Introduction - Interference in thin films (reflected light) - Newton's rings - Determination of wavelength.

Diffraction: Introduction - Fraunhofer diffraction - Single slit diffraction (qualitative) - Double slit diffraction (qualitative).

Polarization: Introduction - Polarization by reflection - and double refraction - Nicol's prism - Half wave and Quarter wave plate - Engineering applications of interference - diffraction and polarization.

Module 2: INTRODUCTION TO QUANTUM MECHANICS ***(08 Periods)***

***Principles of Quantum Mechanics*:** Introduction – de Broglie's hypothesis for matter waves - Davison and Germer's experiment - Schrödinger's one dimensional wave equation (time independent) - significance of wave function – Fermi Dirac distribution and effect of temperature (qualitative treatment).

Module 3: QUANTUM PHYSICS AND BAND THEORY OF SOLIDS: ***(08 Periods)***

Applications of Quantum Physics: Particle in a 1 D box (Eigen Value and Eigen Function) – 3 D Analysis (Qualitative) - Tunnelling Effect (Qualitative) - Kronig Penney model (qualitative treatment) - origin of energy bands formation in solids.

Module 4: SEMICONDUCTORS AND OPTOELECTRONIC DEVICES ***(11 Periods)***

Introduction - Intrinsic semiconductors - Density of electrons in intrinsic semiconductor - Intrinsic carrier concentration - Fermi energy - Electrical conductivity of intrinsic semiconductors - Extrinsic semiconductors - Density of charge carriers in Extrinsic semiconductors (qualitative) - Drift and Diffusion currents - Direct and Indirect band gap semiconductors - Hall effect - pn junction

Optoelectronic devices: Light Emitting Diode (LED) - Photodiode - Semiconductor diode laser

Module 5: FIBER OPTICS ***(08 Periods)***

Introduction to fiber optics - Total Internal Reflection - Critical angle of propagation - Acceptance angle - Numerical Aperture – V number (qualitative) - Classification of fibers based on Refractive index profile, modes - Applications of optical fibers – Fiber optic Sensors (temperature, displacement).

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS: (Minimum 10 experiments shall be conducted)

1 Estimation of the wavelength of the given laser by using a diffraction grating.

2. Predict the particle size using LASER by using the diffraction phenomenon.
3. Determine the thickness of thin wire using the wedge shape method.
4. Determination of the radius of curvature of the lens/wavelength of monochromatic source by using Newton's ring method
5. Find the numerical aperture of a given optical fiber and hence estimate its acceptance angle.
6. Calculate the number of charge carriers and Hall coefficients of a given semiconductor using the Hall Effect.
7. Find the forward and reverse resistance of a given p-n junction diode from its I-V characteristics curves.
8. Predict the energy gap of a semiconductor by varying the temperatures.
9. Estimation of threshold voltages of different LEDs.
10. Study the characteristics of Photodiode and determine its dark current.
11. Estimation of the magnetic field along the axis of a circular coil carrying current with Stewart Gee's method.
12. Determination of wavelength of light by plane diffraction grating using spectrometer by minimum deviation method.

RESOURCES

TEXTBOOKS:

1. M.N. Avadhanulu, P.G. Kshirsagar, and T.V.S Arun Murthy, *A Textbook of Engineering Physics*, S. Chand Publications, 11th edition, 2019.
2. R.K. Gaur and S.L. Gupta, *Engineering Physics*, Dhanpat Rai Publications (P) Ltd, 2015.
3. P.K. Palaniswamy,*Engineering Physics*, Scitech Publications India Private Limited, 2ndedition, 2009.
4. Serway and Jewett, *Physics for Scientists and Engineers with Modern Physics*, 6th Edition, Thomson Brooks, 2007.

REFERENCE BOOKS:

1. K. Thyagarajan, *Engineering Physics*, McGraw-Hill Education (India) Pvt. Ltd, 2016.
2. V. Rajendran*, Engineering Physics,* Tata McGraw Hill Publications Ltd, 7th Edition, New Delhi, 2014.
3. N.K. Verma, *Physics for Engineers,* PHI Pvt. Ltd., 2014.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/115102023
2. https://nptel.ac.in/courses/117102061
3. https://archive.nptel.ac.in/courses/122/107/122107035
4. https://nptel.ac.in/courses/115107095

Web Resources:

1. http://www.freepdfbook.com/engineering-physics-mcgraw-hill/
2. https://www.vedantu.com/revision-notes/cbse-class-12-physics-notes-chapter-10-wave-optics
3. https://salmanisaleh.files.wordpress.com/2019/02/physics-for-scientists-7th-ed.pdf
4. https://www.researchgate.net/publication/344758634_Short_Notes_on_Engineering_Physics

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EE102401	**BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**	3	-	2	-	4

Pre-Requisite -
Anti-Requisite Fundamentals of Electrical Technology.
Co-Requisite -

COURSE DESCRIPTION: This course is designed to provide an overview on the fundamentals of electrical and electrical engineering concepts and hands-on experience for non-electrical graduating students. The course address the fundamentals concepts of electrical circuits, operational aspects of motors, transformers and general electrical wiring systems. The course also emphasis on the illumination design, back-up supplies like UPS and Batteries, sensors and transducers, and principles of fundamental electronic devices and their applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the electrical circuits by applying the principles of electrical circuits.
CO2. Understand the operation of various motors used in domestic application, transformers and general wiring schemes.
CO3. Understand the operational aspects of UPS, batteries and design the appropriate lighting system for various industrial and domestic applications.
CO4. Understand the principle of various sensor and transducers to sense/measure various non-electrical parameters.
CO5. Understand the fundamentals of basic electronic devices, their characteristics and applications of electronic devices.
CO6. Work independently or in teams to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	2	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	1	-	-	-	-	-	-	-	-	3	-
CO3	3	2	2	-	-	1	1	-	-	-	-	-	-	-	3	-
CO4	3	1	-	-	-	1	-	-	-	-	-	-	-	-	3	-
CO5	3	1	-	1	2	-	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	3	-
Course Correlation Mapping	**3**	**2**	**1**	**1**	**2**	**1**	**1**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: FUNDAMENTALS OF ELECTRIC CIRCUITS (10 Periods)

Classification of network elements; Voltage-Current relations for passive elements; Kirchhoff's laws; Series-Parallel connection; Mesh and Nodal analysis (With DC Independent Sources only).
AC sources–Single loop generator, Phasor representation, Voltage, Current, Impedance, Power factor and Apparent power.

Module 2: ELECTRICAL SYSTEMS (09 Periods)

Motors: Types of motors, working principle and applications—DC motor, Three Phase Induction motor, Synchronous motor, Stepper motor.
Single Phase Transformer: Construction, principle of operation; EMF equation.
Electrical wiring: Methods of electrical wiring systems; Earthing procedure, Switch fuse unit (SFU), Operation of MCB and Relays.

Module 3: UTILIZATION OF ELECTRICAL SYSTEMS (09 Periods)

Illumination: Light sources, Terminologies, Laws of illumination; Types of lamps, Lighting calculations; Interior Lighting - Industrial lighting; Exterior lighting- Street lighting and Flood lighting.
Uninterruptible Power Supply (UPS) - Components in UPS, Functionality and Calculation of ratings for UPS components to a specific load.
Emergency supply: Batteries -Types of batteries, Elementary calculations for energy consumption for a specified application.

Module 4: SENSORS AND TRANSDUCERS (08 Periods)

Sensors- Light sensor, Voltage sensor, Temperature and Humidity sensor, Motion detection sensors, Wireless bluetooth sensors and Distance measurement with Ultrasound sensor.
Transducers -Basic requirements of transducers, Passive transducers - Strain gauge, Hall-Effect transducer, LVDT and Active transducers- Piezoelectric and Thermocouple, Data acquisition system (overview and concept only).

Module 5: FUNDAMENTALS OF ELECTRONICS ENGINEERING (09 Periods)

Half wave and full wave rectifier, Zener diode, characteristics, application – Regulator. BJT—operation; Introduction to Operational amplifier: Inverting and non-inverting amplifier. Application—Adder, Comparator, Integrator and Differentiator; Analog to Digital Convertors—Flash type and Successive approximation types; Digital to Analog converters—Weighed resistor and R-2R types.

Total Periods: *45*

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Verification of Kirchhoff’s laws (Mesh and Nodal Analysis).
2. Performance evaluation by brake test on DC Shunt Motor.
3. Performance evaluation of a 1-Phase Transformer by Load test.
4. Practicing plate and pipe earthing system.
5. Operation and testing of Fuse, MCB and Relays.
6. Design and estimation of wiring for a typical house: One lamp controlled by one switch, Two lamp controlled by two switch and stair case wiring.
7. Calibration of LVDT for linear displacement measurement.
8. Analyze the characteristics of Resistance Temperature Detector (RTD) sensor.
9. Analyze the characteristics of piezoelectric sensor.
10. Investigate ripple factor and load regulations of rectifier with and without filters.
11. Design of inverting and non-inverting amplifiers using op-amp.

12. D-A converter (R-2R ladder) using Op-Amp 741 with required voltage levels.

TEXT BOOKS:

1. Ashfaq Hussain, Fundamentals of Electrical Engineering, Dhanpatrai& Co. (P) Ltd., 3rd Edition, New Delhi, 2009.
2. R. L. Boylestad and Louis Nashelsky, Electronics Devices and Circuits, PHI, 11th edition, 2009.

REFERENCE BOOKS:

1. Wadhwa, C. L. Basic Electric Engineering. 4th Edition, New Age International Private limited.
2. D. Patranabis, Sensors and Transducers, PHI Learning Private Limited, 2nd Edition, 2003.
3. A.K.Sawhney, A Course in Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai & Co., 19th Edition, 2015.
4. C.L. Wadhwa, Generation, Distribution and Utilization of Electrical Energy, New Age International Private Limited, 2015.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/108108076
2. https://nptel.ac.in/courses/108105061
3. https://nptel.ac.in/courses/108108147
4. https://nptel.ac.in/courses/108101091

WEB RESOURCES:

1. https://www.electrical4u.com/electric-circuit-or-electrical-network/
2. https://www.electronicshub.org/dc-circuits-basics/
3. https://www.electrical4u.com/working-of-electric-motor/
4. https://electricalbaba.com/what-is-ups-working-types-of-ups-explained/
5. https://www.lrc.rpi.edu/resources/publications/pdf/illuminationfund.pdf
6. https://www.sitsitamarhi.ac.in/wp-content/uploads/2020/04/file_5e8ef00b06190.pdf
7. https://www.electronics-tutorials.ws/io/io_1.html
8. https://www.homemade-circuits.com/making-ups-tutorial/
9. https://www.engineersgarage.com/introduction-to-uninterruptible-power-supply-ups-and-its-design-part-1-17/
10. https://www.dfliq.net/blog/the-basics-of-electrical-components/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CS102001	**PROGRAMMING FOR PROBLEM SOLVING**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on C Programming concepts, Operators and Expressions, Input and Output Functions, Control Structures, Problem Solving Aspects, Arrays and Strings, Functions, Pointers, Structures and Unions, and File Handling.

COURSE OUTCOMES: *After successful completion of the course, students will be able to*:

CO1. Demonstrate knowledge on C programming constructs to develop programs.
CO2. Design algorithms using problem-solving techniques for given problems.
CO3. Apply functions and Arrays to enhance reusability and data manipulation.
CO4. Develop programs using pointers for efficient memory management.
CO5. Apply structures, unions and file handling concepts to develop societal applications.
CO6. Work independently or in team to solve problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	3	2	3	-	-	-	-	-	-	-	-	-	3	-
CO3	3	2	3	-	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	3	-	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	2	3	3	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	3	-
Course Correlation Mapping	**3**	**2**	**3**	**2**	**3**	**3**	-	-	**3**	**3**	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO C PROGRAMMING ***(09 Periods)***

Basics of C Programming: Introduction, Structure of a C program, Concept of a variable, Data types in C, Program statement, Declaration, Storing the data in memory, Tokens,Operators and expressions, Lvalues and Rvalues, Type conversion in C.

Input and Output: Basic screen and keyboard I/O in C, Non-formatted input and output,formatted input and output functions.

Module 2: CONTROL STATEMENTS AND INTRODUCTION TO PROBLEM SOLVING ***(08 Periods)***

Control Statements: Specifying test condition for selection and iteration, Writing testexpression, Conditional execution and selection, Iteration and repetitive execution, gotostatement, Special control statements, Nested loops.

Introduction to Problem Solving: Algorithms, Flowcharts, Problem solving aspect, Top-down design, Implementation of algorithms, program verification and efficiency ofalgorithms.

Module 3: ARRAYS & STRINGS AND FUNCTIONS ***(10 Periods)***

Arrays and Strings: One-dimensional array – Declaration, Initialization, Accessing elements, operations; Multi-dimensional arrays – Declaration, Initialization, Working with 2D arrays; Strings – Declaration, Initialization, Printing strings, String input, Character manipulation, String manipulation; Arrays of strings – Initialization, manipulating string arrays.

Functions: Concept of function, Using functions, Call by value mechanism, working with functions, passing arrays to functions, Scope and extent, Storage classes, Recursion.

Module 4: POINTERS ***(08 Periods)***

Introduction to Pointers: Understanding memory addresses, Address operator (&), Pointer – declaration, Initialization, Indirection operator and dereferencing, Void and Null pointers, Use of pointers, Arrays and pointers, Pointers and strings, Pointer arithmetic, Pointers to pointers, Array of pointers, Pointers to an array, Two-dimensional arrays and pointers, Pointers to functions, Dynamic memory allocation.

Module 5: USER-DEFINED DATA TYPES AND FILES ***(10 Periods)***

User-Defined Data Types: Structures - Declaration, Accessing the members, Initialization,typedef and its use, Arrays of structures, Arrays within structure, Structures and pointers,Structures and functions; Unions, Enumeration types, Bitfields.

Files: Using files in C, Working with text and binary files, Direct File Input and Output,Files of records, Random access to files of records.

Total Periods: 45

EXPERIENTIAL LEARNING

1. a) Write a C program to perform the arithmetic operations on two integer numbers.
   b) Write a program to evaluate the following expressions by reading the necessary values from the keyboard.
      i. $(ax + b)/(ax - b)$ ii. $2.5 \log x + \text{Cos } 32^0 + | x^2 + y^2|$
      iii. $ax^5 + bx^3 + c$ iv. ae^{kt}
2. a) Write a C program to find the roots of a quadratic equation.
   b) In a town, the percentage of men is 52. The percentage of total literacy is 48 and the total percentage of literate men is 35 of the total population. Write a C program to find the total number of illiterate men and women if the population of the town is 7000.
3. a) Write a C Program to compute an electricity bill based on the following slab rates.

Consumption units	Rate (in Rupees/unit)
0-100	4.0
101-150	4.6
151-200	5.2
201-300	6.3
Above 300	8.0

(***Hint***: Take current and old meter readings from the user to get consumption

units)

b) An insurance company computes the premium amount based on the following;
   i. If a person's health is excellent and the person is between 25 and 35 years of age and lives in a city, and is a male then the premium is Rs.4 per thousand and the policy amount cannot exceed Rs.2 lakhs.
   ii. If a person satisfies all the above conditions and is female then the premium is Rs.3 per thousand and the policy amount cannot exceed Rs.1 lakh.
   iii. If a person's health is poor and the person is between 25 and 35 years of age and lives in a village and is a male then premium is Rs.6 per thousand and the policy cannot exceed Rs. 10000.
   iv. In all other cases the person is not insured.

   Write a C program to determine whether the person should be insured or not, his/her premium rate and maximum amount for which he/she can be insured.

c) Write a C Program to find the grade for a student using a Switch case. The user needs to enter a subject score (varies from 0 to 100)and then display the grade as described below.

Score	Grade	Score	Grade
> = 90	O	>=50 to< 60	D
>=80 to< 90	A	>=40 to< 50	E
>=70 to< 80	B	< 40	Fail
>=60 to< 70	C		

4. a) A Fibonacci sequence is defined as follows:
   The first and second terms in the sequence are 0 and 1. Sub-sequent terms are found by adding the preceding two terms in the sequence. Write a C program to generate the first *n* terms of the sequence.

   b) Write a C program to find the sum of individual digits of a positive integer.

   c) Write a C program to read two numbers *x* and *n*, and then compute the sum of the geometric progression: $1+x+x^2+x^3+\ldots\ldots\ldots+x^n$. Show appropriate error message for $n<0$. (*Example*: if *n* is 3 and *x* is 5, then the sum is: 1+5+25+125)

   d) Write a C program to print the following pattern.

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

5. a) Write a C program to find both the largest and smallest numbers in a list of integers.

   b) Write a C program that uses function to perform the following:
      i) Addition of Two Matrices ii) Multiplication of Two Matrices

6. a) Write a C program to insert a sub-string in to a main string at a given position.

   b) Write a C program to count the lines, words and characters in a given text.

7. a) Write a C program to generate all the prime numbers between 1 and *n*, where *n* is a value entered by the user. Define a separate function to generate prime numbers.

   b) Write C program that uses recursive function to find the following.
      i) Factorial of a given integer ii) GCD of two given integers

8. a) Write a C program to print the elements of an array in reverse order using pointers.

   b) Write a C program to count the number of vowels and consonants in a string using pointers.

   c) Write a C program to store *n* elements in an array and print the elements in sorted order using pointers.

9. a) Write a C program that performs the following operations:
   i. Reading a complex number ii. Writing a complex number
   iii. Addition of two complex numbers iv. Multiplication of two complex numbers
   (**Note:** Represent complex number using a structure.)

   b) Define a structure to store employee details include *Employee-Number, Employee-Name, Basic-pay, Date-of-Joining.* Write a C program for the following.
   i. A function to store 10 employee details.
   ii. A function to implement the following rules while revising the basic pay.
   If Basic-pay<=Rs.5000 then increase it by 15%.
   If Basic-pay> Rs.5000 and <=Rs.25000 then it increase by10%.
   If Basic-pay>Rs.25000 then there is no change in Basic-pay.
   iii. A function to print the details of employees whohave completed 20 years of service from the Date-of-Joining.

10 a) Write a C program to reverse the first *n* characters of a given text file.

   b) Write a C program to merge two files into a new file.

11 Develop a phone book application to save users contact information include name, mobile number and email id as well as to edit and delete contact details.

RESOURCES

TEXT BOOKS:

1. PradipDey and Manas Ghosh, *Programming in C*, Second Edition, Oxford University Press, New Delhi, 2013.
2. R. G. Dromey, *How to Solve it by Computer*, First Edition, Pearson Education, 2013.

REFERENCE BOOKS:

1. Byron S Gottfried and Jitender Kumar Chhabra, *Programming with C*, Fourth Edition, McGraw Hill Education, 2019.
2. YashavantKanetkar, *Let Us C*, Fifteenth Edition, BPB Publications, 2017.
3. E. Balagurusamy, *Programming in C*, Seventh Edition, McGraw Hill Education Pvt, Ltd, New Delhi, 2017.
4. Behrouz A. Forouzan and Richard F. Gilberg, *Computer Science: A Structured Programming Approach Using C*, Third Edition, Cengage Learning, 2008.

SOFTWARE/TOOLS:

1. Software: Turbo C++/Dev C++

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/106105171/L03.html
2. https://nptel.ac.in/courses/106104128

WEB RESOURCES:

1. Learn C Programming - https://www.programiz.com/c-programming
2. Learn C Programming - https://www.tutorialspoint.com/cprogramming/index.htm
3. C Programming Exercises, Practice, Solution - https://www.w3resource.com/c-programming-exercises/
4. Basic programming exercises and solutions in C - https://codeforwin.org/2015/05/ basic-programming-practice-problems.html
5. C Programming Exercises, Practice, Solution - https://www.w3resource.com/c-programming-exercises/
6. Basic programming exercises and solutions in C - https://codeforwin.org/2015/05/basic-programming-practice-problems.html

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22AI105001	**DESIGN THINKING**	-	1	2	-	2

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on design thinking process, evaluation of requirement specification and reflections on design experience. This course also focuses on demonstration of five phases of design thinking such as empathize, define, ideate, prototyping, testing and validation with design thinking tools and frameworks.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Investigate the requirements of a problem by conducting surveys.
CO2. Create meaningful and actionable problem statements for creative problem solving.
CO3. Construct blueprints to visualize user attitudes and behavior for gaining insights of customers.
CO4. Design prototypes of innovative products or services for a customer base.
CO5. Develop relevant products or services by choosing good design and applying empathy tools for experiencing user requirements.
CO6. Work independently and communicate effectively in oral and written forms.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	-	3	-	2	-	-	-	-	-	-	-	-	-	-	3	-
CO2	1	-	1	3	-	-	-	-	-	-	-	-	-	-	3	-
CO3	-	2		3	-	-	-	-	-	-	-	1	-	-	3	-
CO4	-	2	3	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5	-	3	-	1	1	-	1	2	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	-	3	3	2	-	-	-	3	-
Course Correlation Mapping	**1**	**3**	**2**	**3**	**1**	**-**	**1**	**2**	**3**	**3**	**2**	**1**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

EXPERIENTIAL LEARNING

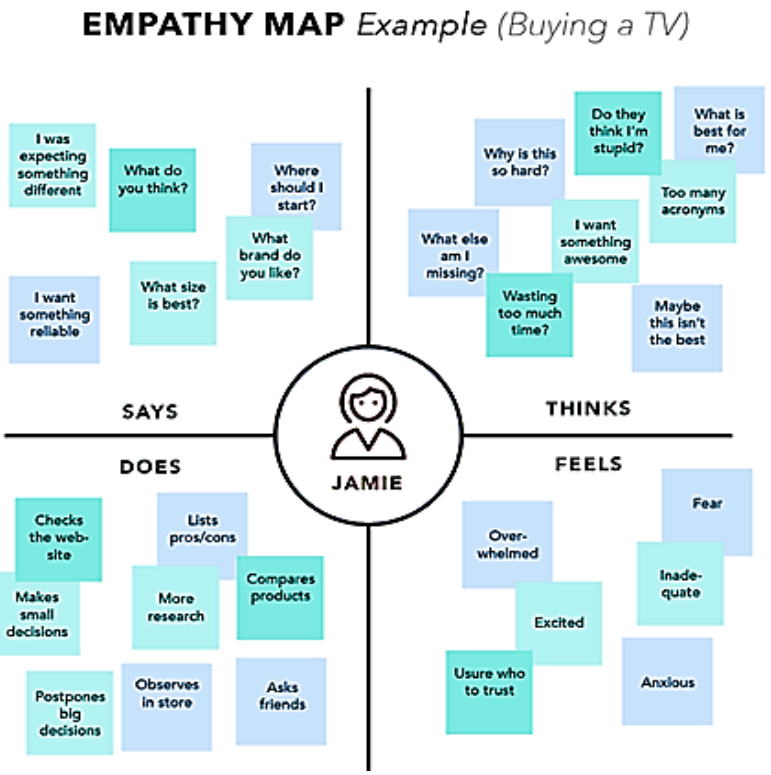
LIST OF EXERCISES:

Introduction to Design Thinking – Design thinking Process, Definition, Importance, Phases of Design Thinking, Canva Tool.

1. Conduct survey and identify the problem by either individual or group and frame a problem statement using AEIOU (Activities, Environment, Interactions, Objects, Users) framework.
2. Identify demographic or focus group for problem statement and create persona and explicitly define the characteristics of persona using Canva tool.

Emphathize - Role of empathy in design thinking, Purpose of Empathy Map, Empathy Tools – Customer Journey Map, Personas, Coggle Tool.

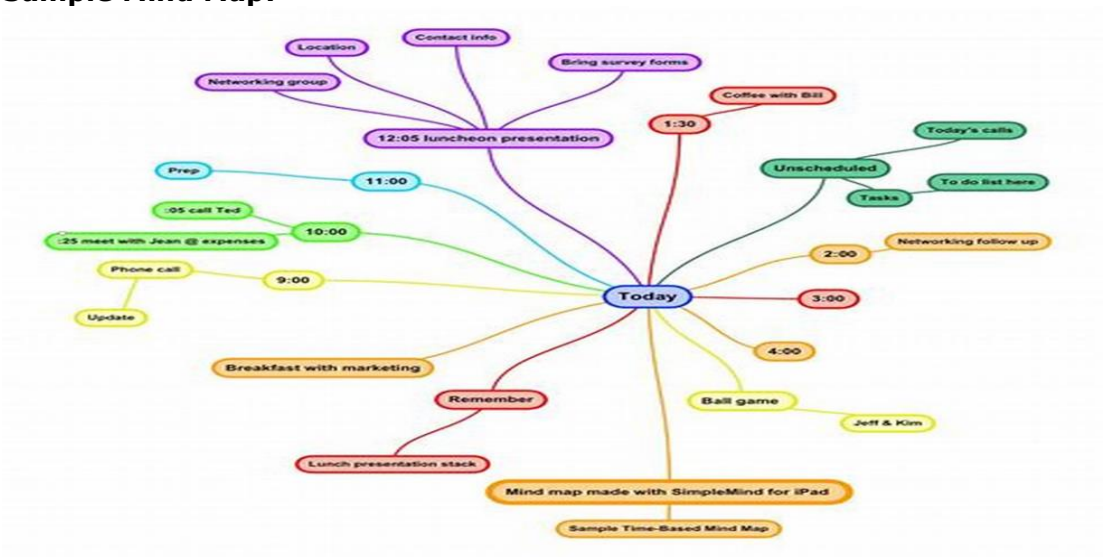
3. Build a Customer Journey Map (CJM-Before-During-After) and identify touch points for any mock scenario or persona created during last experiment and frame 2-3 questions using HMW (How Might We).
4. Create an Empathy Map using Coggle design thinking tool.
   Sample Empathy Map:



Ideation - Importance of visualizing and empathizing before ideating, Applying the method**,** Ideation Tools - Story board, Brainstorming, Mind Map, SCAMPER.

5. **Story boarding design ideas:** Consider a mock scenario and create user stories and storyboards to transform information about user needs into design concepts using any story board tool.

6. Create Mind Map for your problem statement using Coggle.
Sample Mind Map:



7. Perform Brain Storming Session with your team and record using the SCAMPER framework and finalize the best three innovative ideas.

Prototyping and Testing – Definition, Prototype examples, Need for Prototyping, Fidelity for prototypes, Process of prototyping, Introduction to Marvel POP Software**,** Testing prototypes with users.

8. Create an application prototype for product recommendation using **Marvel POP Software**.
9. Create a **low-fidelity paper prototype** by sketching out the product design and adding relevant functionality.
10. Test the prototype created in Exercise 9 by interacting with each member of the team, walking them through the design and gathering feedback. Use feedback grid with the following quadrants: what worked, what could be improved, questions, and ideas.

What worked?	**What could be improved?**
Questions	**Ideas**

RESOURCES

REFERENCES:

1. Michael G. Luchs, Scott Swan , Abbie Griffin, ”Design Thinking – New Product Essentials from PDMA”,Wiley,2015.
2. Vijay Kumar, “101 Design Methods: A Structured Approach for Driving Innovation in Your Organization”, 2012.
3. Kathryn McElroy,”Prototyping for Designers: Developing the best Digital and Physical Products”,O’Reilly,2017.
4. S.Salivahanan, S.Suresh Kumar, D.Praveen Sam, ”Introduction to Design Thinking”,Tata Mc Graw Hill, First Edition,2019.

SOFTWARE/TOOLS:

1. Canva (https://www.canva.com/)
2. Coggle (https://coggle.it/)
3. Marvel POP

VIDEO LECTURES:

1. https://nptel.ac.in/courses/109/104/109104109/
2. https://nptel.ac.in/courses/110106124/
3. https://www.youtube.com/watch?v=q654-kmF3Pc&t=0s
4. https://www.youtube.com/watch?v=TNAdanuvwtc
5. https://www.youtube.com/watch?v=U-hzefHdAMk
6. https://www.youtube.com/watch?v=zbLxs6te5to

WEB RESOURCES:

1. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process
2. https://www.ibm.com/design/thinking/page/toolkit
3. https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge-by-creating-your-point-of-view-and-ask-how-might-we
4. https://www.culturepartnership.eu/en/article/ten-tools-for-design-thinking
5. https://www.mindtools.com/pages/article/newCT_02.htm

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG102401	**ENGLISH FOR PROFESSIONALS**	2	-	2	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with listening strategies, reading comprehension, grammar, vocabulary, pronunciation, Written, Verbal and Non-verbal communication, Channels of communication, Barriers to communication, Modes of technology-based communication, and Technical Communication.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basics of Reading, Writing, Listening, and Speaking skills.

CO2. Analyzethe rules of English grammar in speaking and writing.

CO3. Demonstrate knowledge of English pronunciationin speaking.

CO4. Apply the knowledge of reading strategies and vocabulary in communication.

CO5. Apply the strategies of writing in preparing a report.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	3	-	2
CO2	-	3	2	-	-	-	-	-	-	3	-	2
CO3	3	2	-	-	-	-	-	-	-	3	-	2
CO4	-	-	-	-	3	-	-	-	-	3	-	2
CO5	-	-	-	-	3	-	-	-	-	3	-	2
Course Correlation Mapping	**3**	**2**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**3**	**-**	**2**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: SUPER HEROES – THE SCIENCE BEHIND SUPER HEROES ***(06 Periods)***
Reading for Comprehension, Grammar, Speaking, Listening, Vocabulary, Writing, Verbal and Non-verbal communication.

Module 2: ALIENS – THE CYLINDER OPENS ***(06 Periods)***
Reading for comprehension, Grammar, Vocabulary, Writing, Listening, and Channels of communication.

Module 3: INVENTORS – THE RAMAN EFFECT ***(06 Periods)***
Reading comprehension, Listening, Writing, Grammar, Speaking, Pronunciation, and communication barriers.

Module 4: HEALTH AND NUTRITION – WHAT SHOULD YOU BE EATING ***(06 Periods)***
Reading comprehension, Listening, Speaking, Grammar,Writing, Pronunciation, and Modes of technology-based communication.

Module 5: NEW-AGE ENTREPRENEURS – HOW A CHINESE BILLIONAIRE BUILT HER FORTUNE ***(06 Periods)***
Reading comprehension, Vocabulary, Listening, Grammar, Writing, and Technical Communication

Total Periods: 30

EXPERIENTIAL LEARNING

PART-A
Any six modules among the following:

1. Conversation starters and role play
2. Reading comprehension
3. Listening comprehension
4. Vocabulary Building (business and job-related vocabulary)
5. Describing people, places, objects, and Events
6. Phonetics - Accent/ Rhythm/ Intonation
7. Tenses
8. Proposal Writing

PART-B

Any four modules among the following:

1. Communicating effectively is important to become successful in any business. Prepare a Case study of successful business personnel regarding communication competence.
2. Prepare a PowerPoint presentation on an orator and analyze the voice dynamics.
3. People face situations to convince or agree with the points they have. The college arranges a 5-day tour program to Goa. Prepare a video on persuasive talk and convince parents to get permission.
4. Write an article on the famous clichés of our time.
5. Prepare a poster on the effects of social media on youth.
6. Give a short talk on the importance of inventors and their role in present socio, political and economic changes.
7. Prepare a collage of entrepreneurs' pictures and their achievements.
8. NASA released recent photos of the universe with the help of the James Webs Space Telescope. Write down the expected impact on the existing theory on planets and the universe.
9. Obesity is the most common problem for people. List out the reasons for the problem and prepare food habits to overcome.
10. Epics of India deals with superheroes of those days. Compare the weapons used in the battles of Mahabharata with modern weapons.
11. Write a report on your recently invented product so that it should be sold as a hot cake in the market.
12. Illustrate the essential rules for good precis writing.

RESOURCES

TEXTBOOK:

1. N.P. Sudharshana & C.Savitha, *English for Technical Communication*, Cambridge University Press, 2016.

REFERENCE BOOKS:

1. Kline J. A., *Speaking effectively: Achieving excellence in presentations. Upper Saddle River,* NJ: Pearson/Prentice Hall, 2004.
2. Kuiper,*S. Contemporary business report writing* Cincinnati, OH: Thomson/South, Western, 3rd Edition, 2007.
3. Locker, K. O. & Kaczmarek, *S. K. Business communication*: *Building critical skills,* McGraw Hill, 3rd Edition, 2007.
4. Mascull, *B. Business vocabulary in use: Advanced. Cambridge,*Cambridge University Press, 2004.
5. Matthews, C. B. & Matthews, and M. *Quicksteps to winning business presentations: Make the most of your PowerPoint presentations*, McGraw Hill, 2007.
6. Marsh, C. *Strategic writing: Multimedia writing for public relations, advertising, sales and marketing, and business communication*, Pearson, 2005.
7. Munter, M. & Russell, L. *Guide to presentations*, Pearson, 2nd Edition, 2008.
8. Reardon, K. K. *The skilled negotiator: Mastering the language of engagement*, Jossey,Bass, 2004.
9. Stiff, J. B. *Persuasive communication*, Jossey, Bass, 2nd Edition 2003.

VIDEO LECTURES:

1. https://learnenglish.britishcouncil.org/general,english/video,zone/the,day,elizabeth,became,queen
2. https://www.youtube.com/watch?v=CscHc8qSn1A

Web Resources:

1. https://galgotiacollege.edu/assets/pdfs/study,material/Notes,english.pdf
2. https://lecturenotes.in/subject/183
3. https://www.fluentu.com/blog/english/professional,english/
4. https://learnenglish.britishcouncil.org/business,english

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG105402	**SOFT SKILLS**	-	-	2	-	1

Pre-Requisite -
Anti-Requisite -
Co - Requisite -

COURSE DESCRIPTION: This course deals with an understanding of the fundamental soft skills and their practical social and workplace usage. It helps participants to communicate effectively and to carry themselves confidently and in harmony with their surroundings. They also learn how to identify and overcome the barriers in interpersonal relationships, and to employ oral and written communication, teamwork, leadership, problem-solving, and decision-making skills, to gain the best results.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of career skills by analyzing the strategies of Goal Setting, Thinking Skills, interpersonal skills, and etiquette.

CO2. Analyze various situations by applying Assertive communication and Non-verbal forms in developing Interpersonal Skills.

CO3. Apply appropriate managerial strategies by analyzing the conflicts in various situations.

CO4. Demonstrate various communication styles by analyzing and applying Thinking Skills in diverse teams as an individual and a team member and during Interviews and Group Discussions.

CO5. Analyze and apply appropriate strategies of emotional intelligence and adaptability skills for personal and professional success.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	2	-	2	-	2	-	-	-	-	2
CO2	3	3	2	-	2	-	2	-	-	2	-	2
CO3	2	2	2	-	3	-	2	-	-	-	-	2
CO4	3	2	2	-	2	-	2	-	3	2	3	2
CO5	2	2	2	-	3	-	3	-	-	2	-	3
Course Correlation Mapping	**3**	**2**	**2**	**-**	**3**	**-**	**2**	**-**	**3**	**2**	**3**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

***Anytenmodules are mandatory among the following:**

Module 1: BODY LANGUAGE
Body language basics, Types of Body Language, Facial Expressions and their messages, Eye Contact Insights, Body Posture, Hand gestures, and finger movements

Module 2: ASSERTIVENESS

Communication Styles,Benefits, Asserting yourself, Tips, and Role Play

Module 3: GOALSETTING
Seven Steps of Goal Setting,Self-Motivation, Personal Goal Setting,and Setting Career Goals

Module 4: THINKING SKILLS
Positive Thinking, Creative Thinking, Lateral Thinking, Logical Thinking,and Intuitive Thinking

Module 5: TEAM BUILDING
Learning Activities, Management Essentials,and Team Building Scenarios

Module 6: CONFLICT MANAGEMENT
Ways of Resolving Conflict, Personality Types and Conflict, Conflict Resolution Process, and Team Conflict

Module 7: EMOTIONAL INTELLIGENCE
Definition, understanding emotions, Identifying emotional intelligence, and self-assessment

Module 8: ADAPTABILITY SKILLS
Understanding organizational communication, Identifying adaptability skills, and self-assessment.

Module 9: GROUP DISCUSSIONS
Types of GD, Dos, and Don'ts, Dynamics of GD ,Intervention, and Summarization Techniques

Module 10: INTERVIEW SKILLS
Planning, Opening Strategies, Answering Strategies, Teleconferencing, Videoconferencing, Practice questions, and Dress code

Module 11: INTERPERSONAL SKILLS
Starting a Conversation, Responding to a Conversation, Conversation Examples, Body Language, and Role Play

Module 12: ETIQUETTE
Basic Social Etiquette, Telephone Etiquette, Dining Etiquette, Conference Etiquette, and Email Etiquette

RESOURCES

REFERENCES:

1. Soft Skills-Lab Manual, SVEC.
2. Dr. K. Alex, *Soft Skills*, S. Chand & Company LTD, Latest Edition, New Delhi, 2018.
3. R. C. Sharma & Krishna Mohan, *Business Correspondence and Report Writing*, Tata Mc Graw, Hill Publishing Company Limited, 3rd Edition, New Delhi, 2012.
4. S.P. Dhanavel, English and Soft Skills, Orient Black Swan Private Limited, 2010.

SOFTWARE/TOOLS:

1. K-VAN Solutions.
2. Learning to Speak English 8.1, The Learning Company, 4 CDs.
3. English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
4. Language in Use 1, 2 & 3.
5. Cambridge Advanced Learner's Dictionary, 3rd Edition.
6. Let's Talk English, Regional Institute of English South India

VIDEO LECTURES:

1. http://nptel.ac.in/courses/106102064
2. http://nptel.ac.in/courses/106106127/

WEB RESOURCES:

1. http://psydilab.univer.kharkov.ua/resources/ucheba/softskills/Chapter_1_Introduction.PDF
2. https://learning.tcsionhub.in/courses/tcs,ion/introduction,to,soft,skills/
3. https://goo.gl/laEHOY (dealing with complaints)
4. http://www.adm.uwaterloo.ca/infocecs/CRC/manual/resumes.html
5. https://goo.gl/FEMGXS
6. http://www.career.vt.edu/interviewing/TelephoneInterviews.html
7. http://job,search,search.com/interviewing/behavioral_interviews
8. https://www.thebalancecareers.com/what,are,soft,skills,2060852

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG101403	**GERMAN LANGUAGE**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Oral communication; Basic grammar; Basic writing; Berufsdeutcsch (Business German)

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate basic knowledge of the German language and verb conjugation.

CO2. Comprehend and apply the knowledge of vocabulary and phrases in day-to- day real-life conversation.

CO3. Apply the various sentence structures by examining the rules of grammar in speaking and writing.

CO4. Analyze the various verb structure of English and German languages effectively in professional writing

CO5. Apply the various verb structure of English and German languages effectively in professional writing

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	2	-	-	-	-
CO2	3	-	-	-	-	-	-	2	-	-	-	-
CO3	3	-	-	-	-	-	-	2	-	-	-	-
CO4	3	-	-	-	-	-	-	2	-	-	-	-
CO5	3	-	-	-	-	-	-	2	-	-	-	-
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION ***(06 Periods)***

Introduction - German alphabet, numbers, days in a week, names of months, seasons. Grammar: Nouns –(i)Nominative case and (ii) Nominative personal pronouns, simple sentence, Verb Conjugation 1st and 2nd type, verb Conjugation 3rd type, 'Wh' questions (simple sentences) Nominative (definite and indefinite) Articles.

Module 2: CITY AND FOOD ***(06 Periods)***

In the city: naming places and buildings, means of transport, basic directions. Food: drink, groceries and meals. Apartments: rooms, furniture, colours.
Grammar: Nouns-articles negation–(kein and nicht); imperative and the accusative case; Nominative Possessive Pronouns.

Module 3: DAY-TO-DAY CONVERSATIONS ***(06 Periods)***

Everyday life, telling time, making appointments, leisure activities, and celebrations. Different types of professions, Health and the body, holidays and weather, Clothes and Dresses.

Module 4: BASIC GRAMMAR ***(06 Periods)***

Grammar: Possessive articles, Prepositions (am, um, von. bis); Modal verbs, Separable verbs, accusative, past tense of 'to have' and 'to be', imperative sentences, dative case, perfect tense.

Module 5: BASIC WRITING ***(06 Periods)***

Translation from English to German and German to English, Contacts, Writing letters and Email Writing.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a report on the importance of the German language in India
2. Why is German taught in Indian schools?

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXTBOOKS:

1. Stefanie Dengler, Paul Rusch, Helen Schmitz, Tana Sieber, *Netzwerk Deutsch als Fremdsprache, Arbeitsbuch A1*, Goyal Publishers and Distributors Pvt. Ltd. 2015.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=o4GvYa-3BmY
2. https://www.youtube.com/watch?v=mrF9BizWmgk
3. https://www.youtube.com/watch?v=mojirClzQEs
4. https://www.youtube.com/watch?v=0osSyX0MmCM
5. https://www.youtube.com/watch?v=mMDOtG5ucHA

Web Resources:

1. https://learngerman.dw.com/en/beginners/c-36519789
2. https://storylearning.com/learn/german/german-tips/basic-german-phrases
3. https://study.com/academy/lesson/how-to-write-a-letter-in-german.html

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG101404	**FRENCH LANGUAGE**	2	-	-	-	2

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Oral communication; Basic writing; Basic grammar

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate basic knowledge of the French language.
CO2. Comprehend and apply the knowledge of the alphabet in day-to-day real-life conversation.
CO3. Apply the various styles of greetings in speaking and writing.
CO4. Analyze the various conversations in French languages
CO5. Apply the French words for date and time.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	2	-	-	-	-
CO2	3	-	-	-	-	-	-	2	-	-	-	-
CO3	3	-	-	-	-	-	-	2	-	-	-	-
CO4	3	-	-	-	-	-	-	2	-	-	-	-
CO5	3	-	-	-	-	-	-	2	-	-	-	-
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**

Correlation Levels: 3:High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION ***(06Periods)***

Introduction –Introduction, History of the French Language, Extent of the French Language, Reasons To Learn French, Book Organization, Learning French, Advice on Studying French

Module 2: THE ALPHABET ***(06 Periods)***

Letters,Punctuation,Acute Accent, Grave Accent,Tonic Accent, Stres

Module 3: GREETINGS ***(06 Periods)***

Greetings,Good-byes, Names, Vous vs. tu, Courtesy, Formal Speech Titles, Asking For One's Name

Module 4: CONVERSATIONS & NUMBERS ***(06 Periods)***

How are you?, Asking How One Is Doing, Cardinal Numbers and Ordinal Numbers

Module 5: THE DATE& TIME ***(06 Periods)***

Numbers 01-31, Seasons, Days of the week, Months of the Year, Numbers 30-60, Times of Day, Asking for the time.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare a report on the importance of the French language in India
2. Why is French taught in Indian schools?

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXTBOOKS:

1. The current, editable version of this book is available in Wikibooks, the open-content textbooks collection, at http://en.wikibooks.org/wiki/French

VIDEO LECTURES:

1. https://www.bing.com/videos/riverview/relatedvideo?&q=video+lecture+on+THE+ALPHABET+in+french&qpvt=video+lecture+on+THE+ALPHABET+in+french&mid=D123409C16604E0FDE26D123409C16604E0FDE26&&FORM=VRDGAR
2. https://www.youtube.com/watch?v=hd0_GZHHWeE

WEB RESOURCES:

1. https://vdocument.in/french-lecture-notespdf.html?page=2

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM101403	**CALCULUS AND TRANSFORMATION TECHNIQUES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite Transformation Techniques and Linear Algebra

Co-Requisite -

COURSE DESCRIPTION: This course consists of topics in Calculus and Transformation Techniques with applications to various engineering problems. It covers the topics, Mean Value Theorems, Taylor's and Maclaurin's Theorems. It includes functions of two or more variables together with their applications. This course is designed to train students with the basic integral transform techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Make use of mean value theorems to solve engineering problems.

CO2. Identify the maxima and minima of multivariable functions.

CO3. Determine Laplace transform of different functions arising in engineering problems.

CO4. Apply Laplace transform and its inverse to solve initial and boundary value problems.

CO5. Determine the Fourier series and Fourier transforms of various functions.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	-	1	1	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	1	1	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	2	1	-	-	-	-	-	-	-	-	2	-	-
CO4	3	3	-	3	1	-	-	-	-	-	-	-	-	2	-	-
CO5	3	3	-	3	1	-	-	-	-	-	-	-	-	2	-	-
Course Correlation Mapping	**3**	**3**	**-**	**2**	**1**	**-**	**-**	**-**	-	**-**	**-**	**-**	**-**	**2**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SINGLE VARIABLE CALCULUS ***(08 Periods)***

Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin's theorems with remainders (without proof) related problems.

Module 2: MULTIVARIABLE CALCULUS ***(07 Periods)***

Introduction to function of several variables, Jacobian and its properties, Functional dependence, Maxima and minima of functions with two variables, Lagrange's multiplier method.

Module 3: LAPLACE TRANSFORMS ***(10 Periods)***

Definition of Laplace transform, Existence conditions, Laplace transforms of standard functions, Linearity property, First and second shifting theorems, Change of scale property, Laplace transforms of derivatives and integrals, Multiplication by t^n, Division by t, Laplace transform of periodic functions (without proofs), Laplace transforms of unit step function and unit impulse function.

Module 4: INVERSE LAPLACE TRANSFORMS ***(10 Periods)***

Definition of inverse Laplace transform, Linearity property, First and second shifting theorems, Change of scale property, Inverse Laplace transforms of derivatives and integrals, Multiplication by s, Division by s, Convolution theorem (without proofs), Applications of Laplace transforms to ordinary differential equations of first and second order with constant coefficients.

Module 5: FOURIER SERIES AND FOURIER TRANSFORMS ***(10 Periods)***

Fourier series: Determination of Fourier coefficients, Euler's formulae, Convergence of Fourier series (Dirichlet's conditions), Fourier series in $(-\pi, \pi)$, Half range sine and cosine expansions, Parseval's identity in $(0, \pi)$.

Fourier Transforms: Complex Fourier transform, Fourier sine and cosine transforms, Inverse Fourier transforms.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Obtain the Taylor series of any Single variable function (Algebraic or Transcendental) and then plot the graph of the function given using MAPLESOFT or MATLAB.
2. A 100-gm mass is suspended from a spring with constant 50 N/m. It is set into motion by raising it 10 cm above its equilibrium position and giving it a velocity of 1 m/s downward. During the subsequent motion a damping force acts on the mass and the magnitude of this force is twice the velocity of the mass. If an impulse force of magnitude 2 N is applied vertically upward to the mass at t = 3 s, find the position of the mass for all time**.**
3. Differentiate the Fourier and Laplace transforms of any time domain function with an example**.**

(It's an indicative one. The course instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44th edition, 2017.
2. Erwin kreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 10th edition, 2011.

REFERENCE BOOKS:

1. B. V. Ramana, *Higher Engineering Mathematics*, Tata McGraw hill, 1st edition, 2017.
2. N.P. Bali and Manish Goyal, "A Text Book of Engineering Mathematics", Laxmi Publications, Reprint, 2008.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/111105121(Calculus)
2. https://nptel.ac.in/111106139/ (Laplace Transform)
3. https://nptel.ac.in/courses/111106111/ (Fourier Series and Fourier Transforms)

WEB RESOURCES:

1. http://www.efunda.com/math/math_home/math.cfm
2. http://www.sosmath.com/
3. http://www.mathworld.wolfram.com/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM101401	**MATRIX THEORY AND LINEAR ALGEBRA**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a discussion on matrix factorizations, linear systems, Eigenvalues and Eigenvectors, vector spaces, linear transformations, and orthogonality.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Demonstrate the concepts of matrix factorizations and solutions of the linear system.
CO2. Determine the Eigenvalues and Eigenvectors of the matrix and implement the concept of Eigen values and decompositions of a matrix in intelligent systems.
CO3. Apply the concepts of vector spaces and linear transformation on problems of computational systems.
CO4. Use the inner product spaces for the study of orthogonality and to construct orthonormal basis.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3		3	2	-	-	-	-	-	-	-	-	2	-	-
CO2	2	3		2	2	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	2	1	-	-	-	-	-	-	-	-	2	-	-
CO4	2	3		3	2	-	-	-	-	-	-	-	-	2	-	-
Course Correlation Mapping	**3**	**3**	-	**3**	**2**	**-**	**-**	**-**	-	**-**	-	-	-	**2**	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: MATRICES AND LINEAR SYSTEM OF EQUATIONS ***(10 Periods)***
Elementary Row-operations, Elementary Matrices, Echelon form, Rank of a matrix by row-reduction, Solutions of system of linear equations by row reduction, Matrix Factorization, LU factorization, LDU factorization.

Module 2: EIGEN VALUES, EIGEN VECTORS AND DIAGONALIZATION ***(09 Periods)***

Characteristic equation of a matrix, Eigenvalues and Eigenvectors of matrices, Similarity of matrices, Diagonalization by using Eigenvalues, Cayley-Hamilton Theorem (Without Proof), Evaluation of matrix powers.

Module 3: VECTOR SPACES ***(10 Periods)***

Vector spaces, Sub-spaces, Four fundamental subspaces of a matrix, Span, Linearly independent and dependent, Basis, construction of Basis, dimensions, Finite dimensional vector space.

Module 4: LINEAR TRANSFORMATION ***(08 Periods)***

Linear transformation, Kernal and range of linear transformation, Basic properties, Invertible linear transformation, Matrix of linear transformation.

Module 5: INNER PRODUCT SPACES ***(08 Periods)***

Inner product, Norm, Distance, Inner product space, Orthogonal and orthonormal basis, Gram-Schmidt orthogonalization, Singlular Value Decomposition for square matrices.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Let Breakfast consists of orange juice, cereal, and eggs with the following nutritional information:

	OJ	Cereal	Eggs
Protein	0%	10%	20%
Vitamin C	20%	15%	0%
Calories	100	120	100

   If you must have 30% protein, 30% Vitamin C and 300 calories for your breakfast, How many servings of OJ, Cereal, and Eggs should you have?
2. Solve for the Eigen values and Eigen vectors of 2x2 matrix on paper and larger matrices using MATLAB.
3. Check that the complex numbers $\square = \{x + iy / i^2 = -1, x, y \in \Re\}$, satisfy all of the conditions in the definition of vector space over $\square$. Make sure you state carefully what your rules for vector addition and scalar multiplication.

(It's an indicative one. The course instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Peter Selinger, Matrix theory and linear algebra, 1st Edition, creative commons license, 2018.
2. Stephen H. Friedberg, Arnold J. Insel and Lawrence E. Spence, Linear Algebra, Pearson Education, 5th Edition, 2022.

REFERENCE BOOKS:

1. Kuladeep Sing, Linear Algebra step by step, 1st edition, Oxford University press, 2014.
2. David Poole, *Linear Algebra: A Modern Introduction*, Brooks/Cole, 2nd edition, 2005.
3. Edgar G. Goodaire, Linear Algebra, Cambridge University Press, 1st Edition, 2014.
4. M. Thamban Nair and Arindama Singh, Linear Algebra, Springer, 1st Edition, 2019.
5. Hans Schneider and George Phillip Barker, Matrices and Linear Algebra, Dover Publications, 2nd Edition, 1989.
6. Jim Defranza, Daniel Gagliardi,Introduction to Linear algebra with applications, Mc GrawHill, 2009.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/111106051
2. https://nptel.ac.in/courses/111106135

WEB RESOURCES:

1. https://catalogimages.wiley.com/images/db/pdf/9781119570271.excerpt.pdf
2. https://web.northeastern.edu/dummit/docs/linalgprac_5_eigenvalues_and_diagonalization.pdf
3. https://web.auburn.edu/holmerr/2660/Textbook/vectorspace-print.pdf
4. https://textbooks.math.gatech.edu/ila/linear-transformations.html
5. https://linear.axler.net/InnerProduct.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM101405	**NUMERICAL METHODS, PROBABILITY AND STATISTICS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course contains various numerical methods to solve algebraic and transcendental equations and differential equations. This course also contains probability distributions and interpretation of hypothesis test for large and small samples.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Determine the approximate root of an equation and apply different methods to compute the value of interpolating polynomial at given point.

CO2 Evaluate integrals making use of quadrature formulae and solve ordinary differential equations numerically.

CO3 Use discrete and continuous distribution models to calculate probabilities for appropriate random variables.

CO4 Demonstrate and apply the basic concepts of inferences concerning means and proportions to the decision making process.

CO5 Interpret hypotheses test for small samples.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	3	2	-	-	-	-	-	-	-
CO2	3	3	-	3	2	-	-	-	-	-	-	-
CO3	3	3	-	3	2	-	-	-	-	-	-	-
CO4	3	3	-	3	2	-	-	-	-	-	-	-
CO5	3	3	-	3	2							
Course Correlation Mapping	**3**	**3**	**-**	**3**	**2**	**-**	**-**	**-**	-	**-**	**-**	**-**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1 ALGEBRAIC AND TRANSCENDENTAL EQUATONS, INTERPOLATION ***(09 Periods)***

Solution of algebraic and transcendental equations: Bisection method and Newton-Raphson's method. Finite differences, relation between operators, interpolation using Newton's forward and backward difference formulae. Interpolation with unequal intervals: Lagrange's formula.

Module 2 NUMERICAL DIFFERENTIATION AND INTEGRATION ***(10 Periods)***

Numerical Differentiation- Newton's forward and backward difference formulae, numerical integration- trapezoidal rule, Simpson's 1/ 3^{rd} and 3/ 8^{th} rules.

Module 3 RANDOM VARIABLE AND DISTRIBUTIONS ***(09 Periods)***

Random variables (discrete and continuous), probability density functions, probability distribution: Binomial - Poisson - normal distribution and their properties (mathematical expectation and variance).

Module 4 TEST OF SIGNIFICANCE FOR LARGE SAMPLES ***(09Periods)***

Formulation of null hypothesis, critical regions, level of significance. Large sample tests: Test for single proportion, difference of proportions, test for single mean and difference of means.

Module 5 TEST OF SIGNIFICANCE FOR SMALL SAMPLES ***(08 Periods)***

Student's t-distribution (single mean, two means and paired t-test), Testing of equality of variances (F-test). Chi-square test for goodness of fit.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a Python program to solve algebraic equation by bisection method.
2. Write a Pseudo code on numerical integration using Simpson1/3 method.
3. What is the importance of probability distribution in computer science engineering?
4. If you draw from a normal distribution with known values of parameters, how do you generate draws in a uniform distribution?

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. B.S. Grewal, *Higher Engineering Mathematics*, Khanna Publishers, 44/e, 2019.
2. S.S. Sastry,*Introductory Methods of Numerical Analysis*,Prentice Hall of India, 5^{th} Edition, 2012.
3. Miller and Freund's, *Probability and Statistics for Engineers*, Prentice Hall of India, 8^{th} Edition,2011.

REFERENCE BOOKS:

1. Erwin Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 9^{th} Edition, 2006.
2. T.K.V.Iyenger, Krishna Gandhi and others, *Probability & Statistics*, S.Chand.
3. S. C. Gupta and V. K. Kapoor, *Fundamentals of Mathematical Statistics*, Sultan Chand and Sons Publications, 11^{th} Edition, 2012.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/127106019
2. https://nptel.ac.in/courses/111106112
3. https://nptel.ac.in/courses/111105041
4. https://nptel.ac.in/courses/111106112

WEB RESOURCES:

1. https://www.pdfdrive.com/introductory-methods-of-numerical-analysis-by-ss-sastry-d148704487.html
2. https://faculty.ksu.edu.sa/sites/default/files/probability_and_statistics_for_engineering_and_the_sciences.pdf
3. http://brharnetc.edu.in/br/wp-content/uploads/2018/11/21.pdf
4. http://www.mi.sanu.ac.rs/~gvm/Teze/Numerical%20methods%20In%20Computational%20Engineering.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM101407	**NUMBER THEORY AND ALGEBRA**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: The course contains various topics related to Number theory and its applications, Rings, ideals, polynomial rings and finite fields. In particular this contains the topics related to arithmetic functions and congruences which are helpful to the students in cryptography and Network security related topics in computer sciences.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Demonstrate the knowledge on the concepts of Basic number theory and their applications in computer sciences.

CO2 Apply knowledge congruences in the computer programming involved in network security issues

CO3 Evaluating and analyze the results and concepts in cryptography through the knowledge of Arithmetic functions and their properties.

CO4 Apply the techniques of abstract algebra in evaluation of the problems in network security.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	2	1	-	-	-	-	-	-	-
CO2	3	3	-	2	2	-	-	-	-	-	-	-
CO3	3	3	-	2	1	-	-	-	-	-	-	-
CO4	3	3	-	2	1	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**-**	**2**	**2**	**-**	**-**	**-**	-	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 BASIC NUMBER THEORY ***(09 Periods)***

Divisibility of integers, GCD and LCM of integers and their properties, Prime numbers and their properties, Euclidean algorithm.

Module 2 CONGRUENCES ***(09 Periods)***

Congruences and their elementary properties, Complete and reduced residue systems, Linear congruences, Chinese Remainder theorem, Fermat's theorem, Wilson's theorem,

Applications.

Module 3 ARITHMETIC FUNCTIONS ***(09 Periods)***

Arithmetic functions, multiplicative and totally multiplicative functions, Euler's totient function, Divisor function, Sum of divisors (The function σ), Mobius function ($\mu(n)$), Elementary properties of arithmetic functions.

Module 3 RINGS AND IDEALS ***(09 Periods)***

Rings, examples of Rings. Basic properties, Integral domain, Field and Ideals, Ring homomorphism and isomorphism.

Module 4 POLYNOMIAL RINGS AND FINITE FIELDS ***(09Periods)***

Polynomial ring in one variable, Irreducible polynomials over finite fields, Factorization polynomial over finite fields, properties of finite fields, Primitive roots.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Exhibit the complete residue system modulo 17 composed entirely of multiples of 3.
2. Analyse the numbers and prove every square number is of the form 5k-1, 5k, 5k+1, where n is some positive integer.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Nadiya Gubareni, *Introduction to Modern Algebra and its applications*, CRC Press, 2019.
2. K.C. Chowdhury, *A first course in Number Theory*, Asian Books, First edition, 2004.
3. Hiram Paley, Paul M. Weichsel, *First course in Abstract Algebra*, Holt, Rinehart and Winston, First Edition, 1966.
4. Joseph Silverman, *A Friendly introduction to Number Theory*, Pearson Publishers, 5th Edition, 2019.
5. Edwin Weiss, *First course in Algebra and Number Theory*, Academic Press, 1971.

REFERENCE BOOKS:

1. Papantonopoulou, Algebra, *Pure and Applied Mathematics*, Prentice Hall, 2002.
2. Arkadii slinko, *Algebra fir applications*, Springer Publications, 2015.
3. Abhijit Das, *Computational Number Theory*, CRC Press, 2013.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=yHwneN6zJmU
2. https://www.youtube.com/watch?v=6DfXcNv6as4
3. https://www.youtube.com/watch?v=MNj_e-t9tIs&list=PLLtQL9wSL16htZdyMm99giCaam049Od4x
4. https://www.youtube.com/playlist?list=PLU6SqdYcYsfLyL330UDwLrRvNvWbto7DR

Web Resources:

1. https://math.libretexts.org/Courses/Mount_Royal_University/MATH_2150%3A_Higher_Arithmetic/4%3A_Greatest_Common_Divisor_least_common_multiple_and_Euclidean_Algorithm
2. https://ocw.mit.edu/courses/18-781-theory-of-numbers-spring-2012/de23a8d881a615303f6d4fa665669dc9_MIT18_781S12_lec4.pdf
3. https://crypto.stanford.edu/pbc/notes/numbertheory/mult.html
4. https://sites.math.washington.edu/~bviray/teaching/RingHomomorphismsAndIsomorphisms.pdf
5. https://www.birs.ca/workshops/2006/06w5021/report06w5021.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MM101408	STATISTICS FOR ENGINEERS	3	-	-	-	3

Pre-Requisite - Numerical Methods, Probability and Statistics

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on different sample collection methods, correlation and regression, ANOVA, non parametric tests and statistical quality control and also real-time applications of all these different types' statistical techniques. This course also gives ability to implement features of ANOVA and experimental design and to perform the data analysis by using non parametric tests.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Identity different sample collection methods, probability theorems, interpretation and presentation techniques for decision making.

CO2 Analyse correlation and regression to measure the relationship between two variables.

CO3 Apply ANOVA concepts to make a confident and reliable decision.

CO4 Perform data analysis using non- parametric tests.

CO5 Apply statistical quality control to design charts for monitoring the process performance of a continuous data.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	3	-	-	-	-	-	-	-	-	-	-
CO5	2	3	2	1	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	2	-	-	-	-	-	-	-	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: DESCRIPTIVE STATISTICS AND PROBABILITY ***(10 Periods)***

Descriptive Statistics: Collection of data, Classification and Tabulation of data, Diagrammatic and Graphic representation of data, Measures of Central value - Mean, Median, Mode; Measures of Dispersion- Quartile deviation, Mean deviation, Standard deviation;

Probability: Definition of probability, Addition theorem, Multiplication theorem, Bayes'

theorem.

Module 2: CORRELATION ANALYSIS & REGRESSION ANALYSIS ***(09 Periods)***

Correlation Analysis: Introduction to Correlation, Types of Correlation, Methods of Studying Correlation, Karl Pearson's Coefficient of Correlation, Rank Correlation Coefficient, Partial Correlation, Multiple Correlation.

Regression Analysis: Introduction anduses of Regression Analysis, Difference between Correlation and regression analysis, Regression lines*, Regression equations.*

Module 3 ANOVA & EXPERIMENTAL DESIGN ***(10 Periods)***

ANOVA: Introduction to ANOVA , Assumptions of ANOVA, Techniques of ANOVA, , ANOVA in One way and Two-Way Classification Model,

Experimental Design: Randomized Block Design, Latin Squares, Randomized Blocks Vs Latin Square.

Module 4 NON-PARAMETRIC TESTS ***(08 Periods)***

Introduction to Non-Parametric tests, Advantagesof Non-Parametric Tests, The Sign Test, A Rank Sum Test: The Mann-Whitney U-Test, The One Sample Runs Test, The Kruskal-Wallis Or H-Test.

Module 5 STATISTICAL QUALITY CONTROL ***(08 Periods)***

Introduction to SQC, Advantages and limitations of SQC, Control Charts, $\bar{X}$ Chart, R Chart, Control Chart for C, Control Chart for P.

Total Periods: 45

EXPERIENTIAL LEARNING:

1. Let's say you golfed nine holes. Each number below represents the number of swings it took you to sink the ball in the hole. If you're lucky and you have some golf skills, your score is the following:
   8, 4, 10, 4, 4, 5, 4, 5, 6
   You go back into the clubhouse and are quite pleased with your score. Your friend says that his mean score was 6, his median was 7 and his mode was 6. Did you score better than your friend?
2. A Company organizes meetings often. Find the efficiency of the meetings using correlation analysis by considering two values. Namely, time spent for the meetings and positive ideas came out of the meeting. Draw a graph to analyse the efficiency the meeting conducted in a year.
3. A large scale farm is interested in understanding which of three different fertilizers leads to the highest crop yield. They sprinkle each fertilizer on ten different fields and measure the total yield at the end of the growing season. To understand whether there is a statistically significant difference in the mean yield that results from these three fertilizers, conduct ANOVA using "type of fertilizer" as the factor and "crop yield" as the response.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOK(S):

5. S.P. Gupta and Sultan, *Statistical Methods*, Chand & Sons Publication, 44th Edition, 2017.

REFERENCE BOOK(S):

1. Jay L.Devore, *Probability and Statistics for Engineering and Sciences*, Cengage Learning, 2015.
2. Ronals E.Walpole, Raymond H.Mayers, Sharon L.Myers, Keying E.Ye, *Probability and Statistics for Engineers and Scientists*, Pearson Publication, 9th Edition, 2014.
3. Shankar Rao, *Probability and Statistics for Science and Engineering*, University Press, 2015

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/102/106/102106051/
2. https://archive.nptel.ac.in/courses/110/107/110107114/
3. https://archive.nptel.ac.in/courses/102/101/102101056/
4. https://archive.nptel.ac.in/courses/111/104/111104120/
5. (164) Statistics 101: ANOVA, A Visual Introduction - YouTube
6. https://www.youtube.com/watch?v=qb3mvJ1gb9g

WEB RESOURCES:

1. https://intranet.missouriwestern.edu/cas/wp-content/uploads/sites/17/2020/05/Measures-of-Central-Tendency-2014.pdf
2. http://www.uop.edu.pk/ocontents/Chatper%202.pdf
3. https://rcub.ac.in/econtent/ug/bcom/sem4/Business%20Statistics%20Unit%204%20Correlation%20and%20Regression.pdf
4. https://www.stats.ox.ac.uk/pub/bdr/IAUL/ModellingLecture4.pdf
5. https://web.lemoyne.edu/courseinformation/MTH%20112/RINAMAN/instman/CH14.PDF
6. http://ndl.ethernet.edu.et/bitstream/123456789/78721/2/Lecture%20Note%20Statistical%20Quality%20Control%20.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22AI105002	**DISRUPTIVE TECHNOLOGIES**	-	1	2	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Google AI tools for speech recognition, language detection and Python API to build Machine Learning Models. This course also focuses on demonstration of Cloud Services and tools, Internet of Things with Arduino and simulation of robots using robotics development platform.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Use Google AI tools for speech recognition and language detection.
CO2. Construct Machine Learning Modelsusing Python API to solve Classification problems.
CO3. Use Cloud Services and tools for effective collaboration and data sharing
CO4. Design an interface to embedded systems using real time sensors with Arduino.
CO5. Design and simulate robot using robotic simulation platforms for societal applications.
CO6. Work independently and communicate effectively in oral and written forms.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	3	3	2	-	-	-	-	-	-	-	3	-	-
CO2	2	3	3	3	3	2	-	-	-	-	-	-	-	3	-	-
CO3	2	-	-	-	3		-	-	-	-	-	-	-	3	-	-
CO4	2	-	3	-	2	2	2	-	-	-	-	-	-	3	-	-
CO5	2	-	3	-	-	2	-	-	-	-	-	-	-	3	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	3	-	-
Course Correlation Mapping	**2**	**3**	**3**	**3**	**3**	**2**	**2**	**-**	**3**	**3**	**-**	**-**	**-**	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

Artificial Intelligence – Introduction, Applications, Trends, Technologies, Relevant Libraries/API; Machine Learning – Introduction, Applications, Python Libraries/API.

1. Speech Recognition: Read an audio file with Python and use the Google Speech Recognition API to perform conversion of Speech to Text.
2. Language Detection: Detect the language of the text using Language Detection Library (langdetect) ported from Google's languagedetection.
3. Object Detection: Detect multiple objects present in an image using Detection-Facebook's API.
4. Build a classification model using Decision Tree learning algorithm. Use Iris dataset and scikit-learn python library to build the model.

Cloud Computing – Introduction, Applications, Services - PaaS, IaaS, SaaS, Virtualization, Application Deployment.

1. Create Windows virtual machine using VMware workstation under IaaS.
2. Create online survey forms, questionnaires and analyse the result of survey using Zoho under SaaS.
3. Develop a web application and deploy the same on Amazon Simple Storage Service.

Internet of Things - Introduction, Applications, Arduino IDE, Servo Motor, Sensors, ECG System.

4. Design and simulate Servo motor interfacing with Arduino.
5. Design and simulate Flame Sensor interfacing with Arduino.
6. Design and implement an IoT ECG (Electrocardiogram) System to recordhearts electrical activity.

Robotics - Introduction, Applications, understanding robotics development platform to model, Program and Simulate robots.

7. Design a Two Wheel line following robot integrated with infrared sensors.
8. Design a collision avoidance robot in multi obstacle based environment.

RESOURCES

REFERENCES:

1. Sebastian Raschka, Vahid Mirjalili, Python Machine Learning, Packt Publishing, 3rd Edition, 2019.
2. Simon Monk, Programming Arduino, Second Edition, McGraw-Hill Education,2016.

SOFTWARE/TOOLS:

1. Python – Google SpeechRecognition API,Google langdetect API, Scikit-learn
2. Virtual Box and Virtual PC Software
3. Arduino Kit, Python/C
4. CoppeliaSim

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=lKra6E_tp5U
2. https://onlinecourses.nptel.ac.in/noc21_cs14/preview
3. https://www.youtube.com/watch?v=H_ustCy4Ks8
4. https://onlinecourses.nptel.ac.in/noc21_cs17/preview
5. https://www.youtube.com/watch?v=xq_JKhbYWKk
6. https://www.youtube.com/watch?v=uBLcAz7obwA

WEB RESOURCES:

1. https://gsuite.google.com/learning-center/products/#!/
2. https://pypi.org/project/langdetect/
3. https://cloud.google.com/translate/docs
4. https://scikit-learn.org/stable/modules/generated/sklearn.tree.DecisionTreeClassifier.html
5. Understanding Amazon Web Services, https://aws.amazon.com/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22AI105003	**FREE AND OPEN SOURCE SOFTWARE**	-	1	2	-	2

Pre-Requisite Programming for Problem Solving

Anti-Requisite -

Co-Requisite Object Oriented Programming through Java

COURSE DESCRIPTION: This course covers the basic programming constructs of Go language. It emphasizes the concepts including string handling and implementation of HTTP protocols in Go language. The course also provides hands on training on application development using MIT app inventor and GIT commands related to repositories.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Create source code repositories using GitHub.

CO2. Create communication between client to server and develop interactive software applications using GO language.

CO3. Develop basic mobile applications using MIT App inventor.

CO4. Work independently and communicate effectively in oral and written Forms.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	3	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	3	3	-	3	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	-	3	-	3	-	3	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**2**	**2**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	-

Correlation Levels: 3: High; 2: Medium;1: Low

EXPERIENTIAL LEARNING

List of Experiments:
GIT HUB

Theory Topics: Git Basics, Git repositories, local repositories, remote repositories, Secure shell encryption algorithm.

1. Configuration of Git using gitconfig, gitlog and gitaliases commands.
2. Initializing the local repositories using Git commands: add, commit and status.
3. Moving the local repository to the Git hub using the commands remote, push and pull.
4. Creation of remote access to Github using SSH key.
5. I/O management system with Github using branch and merge techniques.

Go Programming Language
Theory Topics: Variables, Data types, Conditional statements, Looping statements, strings.

1. Peano numbers are a simple way of representing the natural numbers using only a zero value and a successor function. Ex. 0->1->2->3->5…. Write a GO program to generate Peano integers.
2. Write a GO program to check if two trees are equivalent if they both have the same topology and if the objects contained in corresponding nodes are equal.
3. Hypertext Transfer Protocol (HTTP) is an application-layer protocol for transmitting hypermedia documents. It was designed for communication between web client and web servers. Write a program to configure HTTP server for establishing a simple client – server communication.
4. Code the solutions to a few string-related hacker rank problems.
   Ex: Prints the text of each line that appears more than once in the standard input, preceded by its count.

Build Apps with MIT App Inventor

Theory Topics: Frames, Blocks, embedding audio & video

1. Develop the Hello Codi App by using MIT App Inventor with the components: Blocks Editor, audio, video, clock timer.
2. Develop a Digital Doodle Application using MIT App Inventor.

RESOURCES

REFERENCES

GIT Hub

1. Scott chacon, Ben Straub, *Pro Git*, Second Edition, APress open, 2014.

Go Programming Language

1. Alan A. A. Donovan, Brain W. Kernighan, *The Go Programming Language,*First Edition, Addison-Wesley, New York, 2005.
2. https://gophercises.com/.

MIT App Inventor

1. http://appinventor.mit.edu/

SOFTWARES/TOOLS used:

1. System Software: Git hub, Go Compiler & MIT App Inventer.

VIDEO LECTURES:

1. https://onlinecourses.swayam2.ac.in/aic20_sp37/preview
2. https://www.coursera.org/courses?query=github
3. https://www.youtube.com/c/Freecodecamp
4. https://www.simplilearn.com/tutorials/git-tutorial/git-tutorial-for-beginner

WEB RESOURCES:

1. https://docs.github.com/en
2. https://go.dev/doc/tutorial/getting-started
3. https://appinventor.mit.edu/explore/ai2/tutorials

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CB105001	**COMPUTER HARDWARE AND SYSTEM ESSENTIALS**	-	1	2	-	2

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on internal components of a computer, assemble a computer system, install an operating system, and troubleshoot using system tools and diagnostic software. Students will also be able to understand various network cables, connectors and TCP/IP networks, and work group.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Identify different hardware components on personal computer and peripheral devices.
CO2. Create network architecture using TCP and UDP protocols for data transmission.
CO3. Devise the solutions for the problems occurred in personal computer in Operating Systems.
CO4. Implement the functionalities of different peripheral devices and networks by configuring multi-functional devices.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	1	1	-	-	-	-	-	-	-	-	-	-	3
CO2	3	-	3		1	-	-	-	-	-	-	-	-	-	-	3
CO3	3	-	3	1	2	-	-	-	-	-	-	-	-	-	-	3
CO4	3	2	3	1		-	-	-	-	-	-	-	-	-	-	3
Course Correlation Mapping	**3**	**3**	**3**	**1**	**1**	**-**	**-**	**-**	-	**-**	**-**	**-**	**-**	**-**	**-**	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

HARDWARE CONFIGURATION

Peripherals of the computer

1. Implement the following activities:
   a) Configure settings using BIOS/UEFI tools on a PC.
   b) Identify different components of mother board
   c) Analyze various RAM types, PC extensions cards and storage devices
2. Implement the following activities:
   a) Identify various CPU's, cooling methods and PC connection interfaces

b) Identification of various power supply, display devices and common PC Connectors

c) Install and configure common peripheral devices and SOHO multi-function device

PC Networking using Packet Tracer

Network Types and Components, Topologies, Wired and Wireless Transmission, Protocols.

1. a) Identify various types of network cables and connectors and characteristics
   b) Implement the following characteristics of TCP/IP
   i)IPv4 and IPv6 ii)Client side DNS Settings
2. a) Identify following TCP and UDP Ports
   i)21-FTP ii)443-HTTPS iii)80-HTTP iv)Telnet
   b) Analyze the following TCP and UDP protocols
   i)SMD ii)SNMP iii)DHCP
3. a) Configure the following network types
   i) LAN ii) WAN iii) WLAN
   b) Configure network architecture using the following
   i) HUB ii) Switch iii) Router

OPERATING SYSTEMS

Introduction to Operating System, Characteristics of Operating System, Types of Operating System and its components

1. Installation of Windows Operating System
2. Installation of Application and Device Drivers management

TROUBLESHOOTING

Introduction to trouble shooting, Hardware and Software Trouble shooting

1. a) Study the common problems related to the following
   i) Mother Board ii) RAM iii) CPU iV) Power
   b) Troubleshoot the following failures
   i) Read/Write Failure ii) Slow Performance iii) Failure to boot
2. Trouble Shoot the following symptoms of Video, projector and display issues
   i) VGA Mode ii) No Image of Screen iii) Dead Pixels iv) Color patterns
3. Trouble shoot the following issues of wired, wireless and mobile devices
   i) No Connectivity ii) IP conflict iii) Ghost Cursor iv) Stiking Keys

RESOURCES

REFERENCES:

1. David Anfinson, Allan Johnson and Kathleen Czurda, *IT Essentials v7 Companion Guide*, CISCO Press, 2020
2. Brian W. Kernighan, *Understanding the Digital World: What You Need to Know about Computers, the Internet, Privacy, and Security*, Second Edition, Princeton University Press, 2021
3. Kavin Wilson, *Exploring Computer Systems: The Illustrated Guide to Understanding Computer Systems, Hardware &Networks*, Elluminent Press, 2019

SOFTWARE/TOOLS:

1. Windows 8/10 operating systems
2. Cisco Packet Tracer

VIDEO LECTURES:

1. https://www.edx.org/course/computer-hardware-and-operating-systems
2. https://www.coursera.org/learn/computer-hardware-software

WEB RESOURCES:

1. https://www.cisco.com/c/en/us/td/docs/ios-xml/ios/interface/configuration/15-s/ir-15-s-book.pdf
2. https://www.certexams.com/comptia/a+/cert-notes-aplus-networking.htm
3. https://www.rcboe.org/cms/lib/GA01903614/Centricity/Domain/4399/Network%20n10-007.pdf
4. https://www.tutorialsweb.com/CertNotes/CompTIA-cert/A+/aplus-prac-10.htm

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22AI104001	**OBJECT ORIENTED PROGRAMMING THROUGH C++**	**3**	**-**	**2**	**4**	**5**

Pre-Requisite Programming for Problem solving

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on basic characteristics of Object Oriented Programming through C++. It covers basic Object Oriented Programming paradigms like Classes and Objects in custom application development. The OOP concepts types of overloading and inheritance are also covered. It provides hands-on experience inimplementation of OOP features and other programming concepts like handling pointers, file and exceptions.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the concepts of Object oriented programming.

CO2. Apply function and operator overloading techniques for code optimization.

CO3. Apply inheritance and virtual functions to implement dynamic binding.

CO4. Develop robust applications using exception handling mechanism and file I/O.

CO5. Develop reliable applications to solve real world problems using Object oriented programming constructs.

CO6. Work independently or in team to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	2	3	2	-	-	-	-	-	-	-	-	-	3	-
CO3	3	2	2	3	2	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	3	3	2	-	1	-	-	-	-	-	-	-	3	-
CO5	3	2	3	3	2	-	1	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	3	-
Course Correlation Mapping	**3**	**2**	**2.6**	**2.6**	**2**	-	**1**	-	3	**3**	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1: C++ FUNDAMENTALS ***(10 Periods)***

Need of Object-Oriented Programming - Comparison of procedural programming and Object-Oriented Programming - Characteristics of Object-Oriented Languages - C++ Programming Basics: Basic Program Construction - Data Types, Variables, Constants - Type Conversion, Operators, Library Functions - Loops and Decisions, Structures - Functions : Simple Functions, Passing arguments, Returning values, Reference Arguments. - Recursion, Inline Functions, Default Arguments - Storage Classes - Arrays, Strings.

Module 2: OOP FUNDAMENTALS ***(09 Periods)***

Classes and Objects: Classes, Friend functions, Friend classes, Inline functions, Parameterized constructors, Static Class Members, The Scope resolution operator, nested and local classes, Passing Objects to functions, returning objects, object assignment. Arrays, Pointers, References: Array of Objects, Pointers to objects, the This pointer.

Module 3 FUNCTION AND OPERATOR OVERLOADING ***(09 Periods)***

Function Overloading: Copy Constructors, and Default Arguments: Function Overloading, Overloading Constructors, Copy constructors, Default Function Arguments.

Operator Overloading: Creating a member operator function, operator overloading using a friend function, overloading new and delete, overloading some special operators, and comma operator.

Module 4 INHERITANCE AND VIRTUAL FUNCTIONS ***(09 Periods)***

Inheritance: Base Class Access Control, Inheritance and protected members, inheriting multiple base classes, constructors, destructors, and inheritance, granting access, virtual base classes.

Virtual Functions: Pointers to objects, Pointers to derived classes, Virtual Functions, Pure Virtual Functions.

Module 5 FILE I/O AND EXCEPTIONS ***(08 Periods)***

Files: File Pointers - Error handling in File I/O - File I/O with member Functions - Overloading the extraction and Insertion Operators - Multi File Programs

Exceptions: Need of Exceptions, keywords, Simple and Multiple Exceptions - Re-throwing Exception and Exception Specifications, Custom Exception

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

OOPS & C++ Fundamentals

1. a. Write a C++ program to identify appropriate data types and variables to find the size of various datatypes. Display the variables along with their size.

   b. Write a C++ program to take name, address as character array, age as int, salary as float and contains inline functions to set the values and display it.

2. a. Write a C++ program to display names, roll no and grades of 3 students whohave appeared in examination. Declare the class of name, roll no and grade. Create an array of class objects, read and display the contents of array.

   b. Create a class TIME with members hours, minutes, seconds. Take input, add two time objects passing objects to function and display the resultant time in hours,

minutes &seconds.

3. Given that an EMPLOYEE class contains following members: data members: Employee number, Employee name, Basic, DA, IT, Net Salary and print data members.Write a C++ program to read the data of N employee and compute Net salary of eachemployee (DA=52% of Basic and Income Tax (IT) =30% of the gross salary).

POLYMORPHISM

4. a. Create a base class basic_info with data members name ,roll no, sex and two member functions getdata and display. Derive a class physical_fit from basic_info which has data members height and weight and member functions getdata and display. Display all the information using object of derived class.

   b. Consider two complex number in the form a+bi and c+dj, Write a program overload binary + operator to perform addition of the complex numbers.

INHERITANCE

5 a. Write a C++ Program to calculate the area and perimeter of rectangles using concept of Hierarchical inheritance. Area class is derived from base class Rectangle. Perimeter class is also derived from base class Rectangle.

   b. Write a C++ program to create Employee and Student inheriting from Person using Hierarchical Inheritance. The Person class should contain the common attributes of Employee and Student class.

6. Design three classes STUDENT, EXAM and RESULT. The STUDENT class has data members such as rollno, name. Create a class EXAM by inheriting the STUDENT class. The EXAM class adds data members representing the marks scored in six subjects. Derive the RESULT from the EXAM class and has its own data members such as total marks. Write a C++ program to model this relationship.

7. Create a base class called SHAPE. Use this class to store two double type values. Derive two specific classes called TRIANGLE and RECTANGLE from the base class. Add to the base class, a member function getdata() to initialize base class data members and another member function display to compute and display the area of figures. Make display a virtual function and redefine this function in the derived classes to suit their requirements. Using these three classes design a program that will accept driven of a TRIANGLE or RECTANGLE interactively and display the area.

FILE I/O

8. a. Write a C++ program named store_temps.cpp that creates a file named raw_temps.txt with temperature data. Fill thefile with at least 50 temperature readings.

   b. Assuming that a text file named FIRST.TXT contains some text written into it, write a function named copyupper() in C++, that reads the file FIRST.TXT and creates a new file named SECOND.TXT contains all words from the file FIRST.TXT in uppercase.

9. Write a C++ program that accepts two file names and produces a new file that is thecontents of the first file followed by the contents of the second; that is, the

programconcatenates the two files.

EXCEPTION HANDLING

10. Add an exception handler (try/catch/throw) to the class that throws an error message (e.g. "value out of range") in the getValue function that is caught and handled in the main program. Implement two version of the program. In version1, throw the error in getValue, catch the error in the main, display an error message in the main, and then allow the program to terminate. In the second version, perform the same basic actions (throw and catch) but keep re-invoking the getValue function from the main program until the user enters a valid value.

PROJECT BASED LEARNING:

Faculty shall provide Projects relevant to the contents of the course.

Sample Projects:

1. **Bookshop inventory system**
   The project is to build the bookshop inventory system in C++ that helps to keep track of all the book records in a shop. Below are the features to be implemented:
   - Add new book and the details of the book are:
     - Book ID
     - Name of book
     - Name of Author
     - Number of books
   - Delete a book
   - Update anexistingbook detail
   - Display summary of all the books
   - Search a book

2. **Online Examination Management System**
   The project is to build the online examination management system in C++ that helps to conduct online proctored examinations. Below are the features to be implemented:
   - Add New Students
   - Student Login
     - Registration for examination
     - Attempting the questions
   - Faculty Login
     - Uploading the questions
   - Proctor Login
     - Online monitoring of students
   - Admin View
     - Consolidation of marks
     - Release of results

RESOURCES

TEXT BOOKS:

1. Herbert Schildt,"C++ - The Complete Reference", 4th edition, Tata McGraw Hill, 2018.
2. E.Balaguruswamy "Object Oriented Programming with C++", 6th edition, Tata McGraw Hill

Education, 2015.

REFERENCE BOOKS:

1. Cohoon and Davidson, "C++ Program Design: An introduction to Programming and object – Oriented Design", 3rd Edition, Tata McGraw Hill, 2003.
2. Robert Lafore, "Object-Oriented Programmig in C++", 4th edition, Pearson Education, 2008.
3. Walter Savitch,"Problem Solving with C++", 9th edition, Pearson Education, 2015.

SOFTWARE/TOOLS:

1. Software: Dev C++

VIDEO LECTURES:

1. https://www.coursera.org/learn/c-plus-plus-a#syllabus
2. https://www.udemy.com/free-learn-c-tutorial-beginners/
3. https://onlinecourses.nptel.ac.in/noc21_cs02/preview

WEB RESOURCES:

1. http://www.cplusplus.com/files/tutorial.pdf
2. http://mazonka.com/shared/Straustrup4th.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22AI104002	**OBJECT ORIENTED PROGRAMMING THROUGH JAVA**	3	-	2	4	5

Pre-Requisite Programming for Problem Solving

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is emphasize on the fundamentals structure design with classes including development, testing, implementation and documentation. This course also focuses on understanding and practical mastery of object oriented concepts such as classes, objects, data abstraction, methods, method overloading, inheritance and polymorphism. By end of the course, students will acquire the basic knowledge and skills necessary to implement object-oriented programming techniques in software development using Java.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply object oriented programming constructs to solve computational problems.

CO2. Use Exception handling and multithreading mechanisms to create efficient software applications.

CO3. Create Web based applications using collections frameworks to solve real world problems.

CO4. Design and develop GUI using applets and swings for internet and system based applications.

CO5. Work independently or in team to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	3	-	-	-	2	-	-	-	-	2	3	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	2	-	3	-	-	-
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	1	3	2	3	1	-	1	2	3	3	2	1	3	-	-	

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1: OOPS FUNDAMENTALS ***(09Periods)***

Introduction: History of Java, Byte code, JVM, Java buzzwords, OOP principles, Data types, Variables, Scope and life time of variables, Operators, Control statements, Type conversion and casting, Arrays.

Concepts Of Classes And Objects: Introducing methods, Method overloading, Constructors, Constructor overloading, Usage of static with data and method, Access control, this key word, Garbage collection, String class, StringTokenizer.

Module 2: INHERITANCE, INTERFACE AND PACKAGES ***(09Periods)***

Inheritance basics, Types of inheritance, Member access rules, Usage of super key word, Method overriding, Usage of final, Abstract classes, Interfaces - differences between abstract classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces; Packages - defining, creating and accessing a package, importing packages, access control in packages.

Module 3 EXCEPTION HANDLING AND MULTITHREADING ***(10 Periods)***

Exception Handling: Concepts of exception handling, Types of exceptions, Usage of try, catch, throw, throws and finally keywords, Built-in exceptions, Creating user defined exception;

Multithreading: Concepts of multithreading, Differences between process and thread, Thread life cycle, Creating multiple threads using Thread class and Runnable interface, Synchronization, Thread priorities, Inter thread communication.

Module 4 COLLECTION FRAMEWORK ***(08 Periods)***

Collection Framework: Collections Overview, Collection Interfaces - List, Set, Map, List - ArrayList, Linked List, Vector, Set - HashSet, TreeSet, Map - HashTable, HashMap, Accessing a collection via an Iterator, comparator, comparable.

Module 5 GUI PROGRAMMING ***(09 Periods)***

GUI Programming With Applets: Applets - Applet Class, Applet skeleton, Simple Applet; Delegation event model - Events, Event sources, Event Listeners, Event classes, handling mouse and keyboard events.

Exploring Swing Controls:JLabel and Image Icon, JText Field, JButton, JCheckBox, JRadioButton, JTabbed Pane, JList, JCombo Box.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

OOPS Fundamentals

1. a) Develop a Java application for generating Electricity bill.
   Create a class with the following members: Consumer no., consumer name, previous month reading, current month reading, type of EB connection (i.e domestic or commercial). Compute the bill amount using the following tariff. If the type of the EB connection is domestic, calculate the amount to be paid as follows:
   - First 100 units - Rs. 1 per unit
   - 101-200 units - Rs. 2.50 per unit

- 201 -500 units - Rs. 4 per unit
- >501 units - Rs. 6 per unit

If the type of the EB connection is commercial, calculate the amount to be paid as follows:

- First 100 units - Rs. 2 per unit
- 101-200 units - Rs. 4.50 per unit
- 201 -500 units - Rs. 6 per unit
- > 501 units - Rs. 7 per unit

b) Design a class to represent a Student details include the Student ID, Name of the Student, Branch, year, location and college. Assign initial values using Constructor. Calculate average of marks of 6 subjects and calculate attendance percentage.

2. a) Create a class Student which has data members as name, branch, roll no, age, sex, marks in five subjects. Display the name of the student and his percentage who has more than 70%.Use array of objects.

b) Write a program to perform addition of two complex numbers using constructor overloading. The first constructor which takes no argument is used to create objects which are not initialized, second which takes one argument is used to initialize real and imaginary parts to equal values and third which takes two argument is used to initialized real and imaginary to two different values.

Inheritance

3 a) Create a base class basic_info with data members name, roll no, sex and two member functions getdata and display. Derive a class physical_fit from basic_info which has data members height and weight and member functions getdata and display. Display all the information using object of derived class.

b) Create class first with data members book no, book name and member function getdata and putdata. Create a class second with data members author name, publisher and members getdata and showdata. Derive a class third from first and second with data member no of pages and year of publication. Display all these information using array of objects of third class.

4 A High School application has two classes: The Person superclass (Name, age, Gender) and the Student subclass (RegNo, Dept, CGPA).Using inheritance, create two new classes, Teacher and College Student. Teacher will be like Person but will have additional properties such as salary (the amount the teacher earns) and subject (e.g., "Computer Science", "Chemistry", "English", "Other"). The College Student class will extend the Student class by adding a year (current level in college) and major (e.g., "Electrical Engineering", "Communications", "Undeclared"). Create objects and test the functionality of all the methods.

5 Develop a java application for generating pay slip on different category of employees using the concept of inheritance.

Exception Handling and Multithreading

6 Consider two integers x and y as inputand compute the value of x/y.
Implement a class which raise an exception if x and y are not signed integers or if y is zero.

7 a) Write a java program that implements a multi-thread application that has three threads. First thread generates random integer every 1 second and if the value is even, second thread computes the square of the number and prints. If the value is odd, the third thread will print the value of cube of the

number

b) Write a program that creates three threads. First thread displays "Good Morning" every one second, the second thread displays "Hello" every two seconds and the third thread displays "Welcome" every three seconds.

Collection Framework

8 Write a Java program that works as a simple calculator. Use a grid layout to arrange buttons for the digits and for the +, -,*, % operations. Add a text field to display the result. Handle any possible exceptions like divide by zero.

GUI Programming

9 a) Write a java program that simulates a traffic light. The program lets the user select one of three lights: Red, Yellow or Green with radio buttons. On selecting a button an appropriate message with "STOP" or "READY" or "GO" should appear above the buttons in selected color. Initially, there is no message shown.

b) Write an Applet that computes the payment of a loan on the amount of the loan, the interest rate and the number of months. It takes one parameter from the browser. Monthly; if true, the interest rate is per month, otherwise the interest rate is annual.

c) Write a java programs to find factorial of a number. User is allowed to enter a number into the text field whose factorial is to be determined. On pressing the button the value of the text field is firstly converted into integer and then processed to find its factorial. The result will get displayed in another text field. (Hint: use swings).

PROJECT BASED LEARNING:

Faculty shall provide Projects relevant to the contents of the course.

Sample Projects:

1. CALENDER APPLICATION
   Develop a calendar application that uses many windows properties to make it colorful, for example, to indicate the vacation, it uses the red foreground color. The calendar can be used for two purposes. First to see the date and month as usual calendars and second to find out the day corresponding to given date. Some of the salient features of the project are
   1. It uses various windows properties to make the program colorful although it has lack of graphics.
   2. It entirely uses java code which is written in simple manner with lots of comments and important notes can be added.
   3. The date with such notes appears different than others with red background color
   4. The months can be navigated using arrow keys.

2. TICKET RESERVATION SYSTEM
   Develop Ticket reservation system to manage details of seats, passenger, trains, Bookings and stations. The features required to be implemented are as follows

1. Provides searching facility based on factors such as seats, trains, booking and stations
2. Manage the information of passengers
3. Shows the information of the seats and trains
4. Provide filter on train, booking, time and station
5. Information Management of booking
6. Export excel report for trains, passengers and station
7. Export pdf for booking details

RESOURCES

TEXT BOOKS:

1. Herbert Schildt, "Java the complete reference", 11th edition, McGraw Hill, Education,2018.
2. C. Thomas Wu, "An Introduction to Object-Oriented Programming with Java 5th edition", McGraw-Hill Higher Education 2010.

REFERENCE BOOKS:

1. J. Nino and F.A. Hosch,"An Introduction to programming and OOPS design using Java", 3rd edition, John Wiley & sons, 2008.
2. P. Radha Krishna,"Object Oriented Programming through Java", 1st edition, Universities Press, 2007.

SOFTWARE/TOOLS:

1. Software: Eclipse / Net beans / JDK 1.7
2. Java compatible web browser

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106105191
2. https://www.udemy.com/course/java-tutorial/

WEB RESOURCES:

1. https://www.tutorialspoint.com/java/java_tutorial.pdf
2. https://www.guru99.com/java-tutorial.html

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CM101401	**PRINCIPLES OF BUSINESS ECONOMICS AND ACCOUNTANCY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

Business economics and demand analysis; theory of production and cost analysis; markets and pricing; principles of accounting and capital; final accounts and tally ERP9.0.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the principles of Business Economics and theories of Demand.

CO2. Apply the theories of Production and Cost to the managerial decision-making of an organization.

CO3. Determine the Price and Output relation in the different Market structures.

CO4. Demonstrate the principles of Accountancy and sources of Capital

CO5. Analyze the profitability and soundness of an organization.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	1	-	3	-	2
CO2	3	2	-	-	-	-	-	1	-	3	-	2
CO3	3	2	-	-	-	-	-	1	-	3	-	2
CO4	3	2	1	-	-	-	-	1	-	3	-	2
CO5	3	2	1	-	-	-	-	1	-	3	-	2
Course Correlation Mapping	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**3**	**-**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BUSINESS ECONOMICS AND DEMAND ANALYSIS ***(09 Periods)***

Definition - Nature and Scope of Business Economics - Demand: Determinants of demand – Demand function - Law of demand, assumptions, and exceptions - Elasticity of demand – Types of elasticity of demand-Demand forecasting and methods of demand forecasting.

Module 2 THEORY OF PRODUCTION AND COST ANALYSIS (09 *Periods)*

Production Function: Input-output relationship-Law of Variable proportion-Isoquants and Isocosts

Cost Concepts: Total, Average and Marginal Cost **-** Fixed vs. Variable costs – Opportunity Costs Vs Outlay Costs– Separable Costs Vs Joint Costs, Urgent Costs Vs Postponable Costs-Avoidable Costs Vs Unavoidable Costs

Break Even Analysis (BEA)–Assumptions, Merits and demerits- Determination of Break-Even Point (Simple problems).

Module 3: MARKETS AND PRICING ***(09Periods)***

Market Structure: Types of Markets - Features of perfect competition - Monopoly and monopolistic competition - Price and Output determination in perfect competition, monopoly and monopolistic Markets.

Pricing: Objectives and policies of pricing – Sealed bid pricing - Marginal cost pricing – Cost plus pricing - Going rate pricing – penetration Pricing – skimming Pricing - Block pricing –Peakl oad pricing – Cross subsidization.

Module 4 : **PRINCIPLES O FACCOUNTING & CAPITAL** ***(09Periods)***

Accountancy: Introduction – Concepts – Conventions – Double Entry Book Keeping– Journal – Ledger - Trial Balance (Simple problems)

Capital: Significance- Types of capital – Sources of Capital.

Module 5: **FINAL ACCOUNTS & TALLY ERP9.0** ***(09Periods)***

Introduction to Final Accounts – Trading account - Profit and Loss account and Balance Sheet with simple adjustments (Simple problems)

Tally ERP 9.0: Introduction – Create a company – Create ledger – Posting vouchers – Advantages of Tally.

TotalPeriods:45

EXPERIENTIALLEARNING

1. Prepare the Journal Entries by the students with practical examples.
2. Conduct an event about the market structure.
3. Do the problems on Financial Statements with practical examples.
4. Prepare are port regarding the demand and supply of electric vehicles in the Indian market.
5. From the following balances of Mr. Aravind as at 31.12.2016, prepare Trading, Profit and Loss Account for the year ended and Balance Sheet as at that date after making the necessary adjustments.

Debit Balances	Amount(Rs.)	Credit Balances	Amount(Rs.)
Drawing Account	6,000	Capital	80,000
Plant and Machinery	25,000	Sundry Creditors	10,000
Stock(opening)	15,000	Sales	1,20,000
Purchases	82,000	Returns outwards	1,000
Return Inwards	2,000	R.B.D.D.	400
Sundry Debtors	20,600	Discounts	800
Furniture & Fixtures	5,000	Rent of Premises sublet	1,200
Freight and Duty	2,000	Reserve Fund	5,000
Carriage outwards	500		
Rent, Rates & Taxes	4,600		
Printing & Stationery	800		
Trade Expenses	400		
Postage and Telegrams	800		
Insurance charges	700		
Salaries and Wages	21,300		
Cash in Hand	6,200		
Cash at Bank	25,500		
	2,18,400		2,18,400

Adjustments:

- Stock on 31.12.2006 was Rs.14,600.
- Write off Rs.600 as bad debts and provide 5% for R.B.D.D.
- Provide for depreciation on furniture 5% & Plant & Machinery at 20%.
- Insurance prepaid was Rs.100.
- Outstanding salaries Rs.700
- A fire occurred on 25th December 2006 and stock worth Rs.5,000 was destroyed and the insurance company admitted a claim for Rs.4500 only.

RESOURCES:

TEXT BOOKS:

1. H L Ahuja, *Business Economics*, S Chand Publishing, Thirteenth Edition, 2016.
2. S. P. Jainand, K.L. Narang, *Financial Accounting*, Kalyani Publishers, Twelth Edition, 2018.

REFERENCE BOOKS:

1. Joseph G. Nellis and David Parker, *Principles of Business Economics*, Pearson Education Canada, Second Edition, 2016.
2. Larry M. Walther, *Financial Accounting*, Create Space Independent Publishing Platform, 2017.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=xWKfKCnQqAE
2. https://www.youtube.com/watch?v=daYPYHbJ6Xc

WEB RESOURCES:

1. https://leverageedu.com/blog/scope-of-business-economics/
2. https://www.economicsdiscussion.net/break-even-analysis/break-even-point-of-a-firm-meaning-determination-and-types/21785

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG101401	**ESSENTIALS OF LEADERSHIP**	2	-	-	-	2

Pre-Requisite

Anti-Requisite

Co-Requisite -

COURSE DESCRIPTION: This course is designed for learners who desire to improve their leadership, communications, and workplace skills.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Differentiate between leadership and management

CO2. Identify the values common among great leaders.

CO3. Discuss the power of positive expectations and how to apply it as a leader

CO4. Assess what, how, and to whom you should delegate.

CO5. Describe what it means to be an ethical leader.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	1	1	-	-	-	1	-	-	-	-	-	-
CO2	1	1	2	1	-	1	-	-	-	-	-	-
CO3	2	-	2	-	1	-	-	-	-	2	-	-
CO4	1	2	-	1	-	-	-	-	-	2	-	-
CO5	1	2	1	-	-	-	-	-	-	2	2	-
Course Correlation Mapping	**2**	**2**	**2**	**1**	**1**	**1**	**-**	**-**	-	**2**	**2**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION ***(06 Periods)***

What is leadership, leadership vs management, leadership and change, Maxwell's 5 levels of leadership, how to move to the next level

Module 2: LEADERSHIP VALUES & EXPECTATIONS ***(06 Periods)***

14 Leadership Values, what matters most exercise. Expectations, The Pygmalion Effect, impact of positive expectations, setting expectations

Module 3: DELEGATION ***(06 Periods)***

Definition, why delegate, delegate/empower, why people don't delegate, steps for delegation - the IDEALS model..

Module 4: ETHICS ***(06 Periods)***

Definitions, introduction to ethics, ethics vs morals, self-assessment, Good People, Bad Choices examples, how to be an ethical leader, 8 Ethical Actions for Leaders.

Module 5: COMMITMENT ***(06 Periods)***

Introduction, significance of commitment, Universal Laws of Leadership, tips towards

being accountable and committed leader.

Total Periods:30

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Collect the case studies related to successful leaders and their traits.
2. Different Case Studies Will be Given to students as per the topic that will be collected and evaluated.
3. The case studies will be collected as Assignments and the same will be evaluated.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Anderson T, *Transforming leadership*, St. Lucie Press, Boca Raton, FL, 2nd ed 1998
2. Babiak, P. & Hare, R.D., *Snakes in suits: when psychopaths go to work*, Regan Books, New York, 2006

REFERENCE BOOKS:

1. Conger J, *Inspiring others: Th e language of leadership,* Academy of Management Executive, 5(1), 31-45, 1991
2. *Leadership Skills*. MTD Training & Ventus Publishing ApS, 2010

VIDEO LECTURES:

1. Marshall Goldsmith: The Essentials Of Leadership (fs.blog)
2. https://onlinecourses.nptel.ac.in/noc23_mg28/preview

Web Resources:

1. cdn2.hubspot.net/hubfs/4654529/Expert landing pages/Peter Cox/Resources/10 Leadership Essentials .pdf
2. 3-leadership-essentials-discovery-event-w.-no.-05.11.12.pdf (imd.org)

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG101402	**ORGANIZATIONAL BEHAVIOUR**	2	-	-	-	-

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course enables the students to know the principles in an organization, the system and process of effective controlling in the organization.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Interpret the scope of organizational behaviour and its significance.

CO2. Understand the managerial strategies in achieving the organizational goals of an organization

CO3. Demonstrate the impact of motivation and leadership in group dynamics.

CO4. Solve organizational conflicts through negotiation and team building.

CO5. Improve the results – performance outcome through human behaviour and organizational behaviour can aid them in their purist of the goals.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	2	-	-	-	2	-	2	-	2	-	2
CO2	1	-	2	1	-	2	-	-	-	-	-	2
CO3	2	-	2	-	1	-	-	-	-	2	-	2
CO4	1	2	-	1	-	-	-	-	-	2	-	2
CO5	1	2	1	-	-	-	-	-	-	2	2	2
Course Correlation Mapping	**2**	**2**	**2**	**3**	**2**	**2**		**2**		**2**	**2**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION ***(06 Periods)***

Nature and scope – Linkages with other social sciences- Individualroles andorganizationalgoals–perspectivesofhumanbehavior- Perception– perceptualprocess

Module 2: LEARNING ***(06 Periods)***

Learning - Learning Process- Theories- (Pavlov, Skinner and Thorndike) - Personality andIndividualDifferences -Determinants of Personality-Values, Attitudesand Beliefs.

Module 3: MOTIVATION AND LEADERSHIP ***(06 Periods)***

Definition andnature of motivation, Theories of Motivation (Maslow,Alderfer)-Leadership–Traits-Styles–Leadershipskills–Challengestoleaders.

Module 4: ORGANIZATIONALCONFLICTS ***(06 Periods)***

CausesandconsequencesconflictandNegotiationTeamBuilding,Conflict Resolution in Groups and problem solving Techniques.

Module 5: ORGANIZATIONAL COMMUNICATION ***(06 Periods)***

Communication, types and process, importance and barriers–Organizational change-change process-resistance tochange–Organizational development and OD interventions.

Total Periods:30

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:

1. Collect the case studies related to recent topics in OB and other Contemporary OB Practices and Present them as a seminar.
2. Different Case Studies Will be Given to students as per the topic that will be collected and evaluated.
3. The case studies will be collected as Assignments and the same will be evaluated.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Robbins.P.Stephen (2006),*OrganizationalBehaviou*r,PearsonEducation,NewDelhi.
2. LuthansFred(1998),*Organizational Behaviour*, Tata McGraw Hill International Edition, New Delhi.
3. K.Aswathappa, *OrganizationalBehaviou*r-*Text,Cases and Games*, Himalaya Publishing House, New Delhi, 2008.

REFERENCE BOOKS:

1. Steven McShane, Mary Ann Von Glinow, *Organizational Behaviour*, Tata McGraw Hill Higher Education, NewDelhi, 2008.

2. PareekUdai (2007), *Understanding Organizational Behaviour*, Oxford University Press, New Delhi.
3. Jerald Greenberg and Robert.A. Baron, (2009), *Organizational Behaviour*, PHI learning Private Ltd., New Delhi.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=Sg64udtQ300&list=PL3Y_p3e-Lne2no2K5cNa8y7ti1uqCjZw8
2. https://www.youtube.com/watch?v=pHg3ZfGk5j0

WEB RESOURCES:

1. https://www.icmrindia.org
2. https://www.citeob.com/ 5 https://www.ob-guide.com

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG101403	**PROJECT MANAGEMENT**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: To understand the importance of decision-making while implementing any project and interpret and discuss the results of qualitative and quantitative analysis

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic introduction to project management

CO2. Apply the methods of project identification and selection.

CO3. Understand project allocation methods and evaluation.

CO4. Analyse the techniques for project time, review, and cost

CO5. Understand the factors of risk and quality of a project.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	1	2	2	-		2		1			-
CO3	2	2	1	2	1	-	-	1	-	-	2	
CO4	3	1	2	2	1	-	-	-	-	-	-	2
CO5	2	2	1	2	1	1	-	-	-	-	-	1
Course Correlation Mapping	**2**	**1**	**2**	**2**	**1**	**1**	**2**	**1**	**1**	-	**2**	**2**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION ***(05 Periods)***

Concept of project management, project definition and key features of projects, project life cycle phases, typical project management issues, basic project activities

Module 2: PROJECT IDENTIFICATION AND SELECTION ***(06 Periods)***

Identification and screening (brainstorming, strength and weakness in the system, environmental opportunities and threats), Project evaluation methods- Payback period, Net present value, Internal rate of return and project evaluation under uncertainty.

Module 3: PROJECT RESOURCE MANAGEMENT ***(07 Periods)***

Scheduling resources, resource allocation methods, project crashing and resource leveling, working of systems, design of systems, project work system design, project execution plan, project procedure manual project control system, planning scheduling and monitoring

Module 4: TIME AND COST MANAGEMENT ***(05 Periods)***

Time Management-Network diagram, forward and backward pass, critical path, PERT and CPM, AOA and AON methods, tools for project network, Cost management-earned value method

Module 5: RISK AND QUALITY MANAGEMENT ***(07 Periods)***

Risk identification, types of risk, risk checklist, risk management tactics, risk mitigation and contingency planning, risk register, communication management, Quality assurance and quality control, quality audit, methods of enhancing quality

Total Periods: 30

EXPERIENTIAL LEARNING

1. Refer to any video lecture on project evaluation methods and give a brief seminar using PPT
2. Select any company wherein you will get the details of activities and time and draw the project network diagram and submit a report.
3.

Activity	Predecessor Activity	Normal Time (Weeks)	Crash Time (Weeks)	Normal Cost (Rs.)	Crash Cost (Rs.)
A	-	4	3	8,000	9,000
B	A	5	3	16,000	20,000
C	A	4	3	12,000	13,000
D	B	6	5	34,000	35,000
E	C	6	4	42,000	44,000
F	D	5	4	16,000	16,500
G	E	7	4	66,000	72,000
H	G	4	3	2,000	5,000

Determine a crashing scheme for the above project so that the total

project time is reduced by 3 weeks

4. Collect any case study that discusses the process of probability calculation of success of the project and submit a report

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. R.Panneerselvam and P.Senthil Kumar (2013), Project Management, PHI Learning Private Limited.
2. Prasanna Chandra (2014), Projects: Planning, Analysis, Selection, Financing, implementation, and Review.

REFERENCE BOOKS:

1. A Guide to the Project Management Body of Knowledge: (PMBOK Guide) by Project Management Institute, 2013.
2. Gopala Krishnan & Rama Murthy, A Text book of Project Management, McMillan India.
3. S. Choudhary (2004), Project Management, Tata McGraw Hill Publication.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_mg30/preview
2. https://archive.nptel.ac.in/courses/110/104/110104073/

WEB RESOURCES:

1. https://www.pmi.org/about/learn-about-pmi/what-is-project-management
2. https://www.manage.gov.in/studymaterial/PM.pdf
3. https://imada.sdu.dk/u/jbj/DM85/lec7.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG107601	**PROFESSIONAL ETHICS AND HUMAN VALUES**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with personal conviction, and ethics and describes the accepted principles and standards of conduct regarding moral duties and virtues as applied to an organization. Codes of professional ethics guide the stakeholders of an organization about the desirable and undesirable acts related to the profession.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the principles of ethics, professional values, and social responsibility.

CO2. Analyze the problems in the implementation of moral autonomy and use ethical theories in resolving moral dilemmas.

CO3. Develop suitable strategies to resolve problems that arise in practicing professional ethics and Industrial standards.

CO4. Function as a member, consultant, manager, advisor and leader in multi-disciplinary teams.

CO5. Provide solutions to complex problems associated with professional ethics using analysis and interpretation.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	2	2	2	2	-	-	-	1	1	1	1
CO2	2	3	2	-	2	2	2	2	2	-	-	-	1	1	1	1
CO3	2	-	3	-	2	2	2	2	2	-	-	-	1	1	1	1
CO4	2	-	-	-	-	2	2	2	2	-	3	-	1	1	1	1
CO5	2	2	3	2	-	3	2	2	2	-	-	-	1	1	1	1
Course Correlation Mapping	**2**	**3**	**3**	**2**	**2**	**2**	**2**	**2**	**2**	**-**	**3**	**-**	**1**	**1**	**1**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: PROFESSIONAL ETHICS ***(06 Periods)***

Scope and aim of ethics, Senses of ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral autonomy-Kohlberg's theory, Gilligan's theory, Consensus, and controversy.

Module2: PROFESSIONAL IDEALS AND VIRTUES ***(06 Periods)***

Theories on virtues and ideals, Professions, Professionalism, Characteristics, Expectations, Professional responsibility, Integrity, Self-respect, Sense of responsibility, Self-interest, Customs and religion, Self-interest and ethical egoism, Customs and ethical relativism, Religion and divine command ethics, Use of ethical theories, Resolving moral dilemmas and moral leadership.

Module 3: SOCIAL EXPERIMENTATION ***(06 Periods)***

Experimentation, Similarities to standard experiments, Learning from the past and knowledge gained, responsible experimenters, Conscientiousness, Moral autonomy and accountability, The challenger case, Codes of ethics and limitations, Industrial standards and Problems with the law of engineering.

Module 4: RESPONSIBILITIES AND RIGHTS ***(06 Periods)***

Collegiality and loyalty, Respect for authority, Collective bargaining, Confidentiality, Conflict of interests, Occupational crime, Rights of engineers, Professional rights, Whistle-blowing, The BART case, Employee rights, and discrimination.

Module 5: HARMONY WITH PROFESSIONALETHICS ***(06 Periods)***

Acceptance of human values; Ethical Human Conduct; Basis for Humanistic Education, Constitution, and Universal Order; Competence in professional ethics; Case studies: Holistic technologies, Management Models and Production Systems; Transition from the present state to Universal Human Order: socially and ecologically responsible engineers, technologists and managers - enriching institutions and organizations.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Demonstrate orally using your experiences of what is naturally acceptable in a relationship – Feeling of respect or disrespect and what is naturally acceptable is to nurture or exploit others.
2. Identify community partners and discuss with a community partner or organization. Prepare a report by identifying and analysing the issues or opportunities.
3. Field experiences may be directed to include a range of time-intensive endeavours that require varying levels of student interaction. Prepare a report on visiting a Juvenile home.
4. Students read a speech in the classroom by former United Nations Secretary-General Kofi Annan on human values.
5. Students are encouraged to bring a daily newspaper to class or to access any news related to the need for human values and note down the points.
6. Bring out the relevance of engineering ethics theory and practice with relevance to current trends.
7. Professional ideals and virtues are important to everyone. Prepare a case study on the professional ideals and virtue of any one of the famous sports personalities from India.
8. Compare the present to the past in engineering experimentations concerning the change in professionalism.
9. Make a study on occupational crime and the role of modern technology in finding solutions.
10. Prepare a case study on how to maintain harmony with different cultural people using professional ethics.

(It's an indicative one. The course instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXTBOOKS:

1. Gaur R R, Sangal R & G P Bagaria, *Human Values and Professional Ethics*,Excel Books, New Delhi, 2010.
2. Govindarajan, M., Nata Govindarajan, M., Natarajan, S. and Senthilkumar, V. S., *Engineering Ethics*, Prentice Hall of India, 2004.
3. Mike W. Martin and Roland Schinzinger, *Ethics in Engineering*, Tata McGraw-Hill, 3rd Edition, 2007.

REFERENCE BOOKS:

1. S. Kannan and K. Srilakshmi, *Human Values and Professional Ethics*, Taxmann Allied Services Pvt Ltd., 2009.
2. Edmund G. Seebauer and Robert L. Barry, *Fundamental of Ethics for Scientists and Engineers*, Oxford University Press, 2001.
3. Charles F. Fledderman, *Engineering Ethics*, Pearson Education, 2nd Edition, 2004.
4. R. Subramanaian, *Professional Ethics*, Oxford Higher Education, 2013.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=jfGIq_EiXzI
2. https://www.youtube.com/watch?v=QFHOtH54oUc
3. https://www.youtube.com/watch?v=JJshY11nX14
4. https://www.youtube.com/watch?v=TyP09S0UEzA
5. https://www.youtube.com/watch?v=0QMwjV_ZVtc

WEB RESOURCES:

1. https://siiet.ac.in/wp-content/uploads/2020/09/7.1.10-professional-ethics-manual.pdf
2. https://soaneemrana.org/onewebmedia/Professional%20Ethics%20and%20Human%20Values%20by%20R.S%20NAAGARAZAN.pdf
3. https://india.oup.com/productPage/5591038/7421214/9780199475070

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CE107601	**ENVIRONMENTAL SCIENCE**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Thiscourse provides a detailed discussion onnatural resources, ecosystems, biodiversity, environment pollution and control, social issues and environment, human population and environment.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze natural resources to solve complex environmental problems and natural resource management considering society, environment and sustainability.

CO2. Analyze ecosystems and biodiversity to solve complex environmental problems by following environmental ethics considering society, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze various types of pollution and their control measures to solve environmental problems through appropriate tools and techniques following latest developments considering society, ethics, environment and sustainability.

CO4. Analyze social issues and its impact on environment, environmental acts to solve complex environmental problems considering society, environment and sustainability besides communicating effectively in graphical form.

CO5. Analyze human population and its impact on environment to solve complex environmental problems through team work and using appropriate tools and techniques considering ethics, society, environment and sustainability.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	-	1	1	-	-	-	1	-
CO2	3	3	-	2	-	1	1	1	-	1	-	-
CO3	3	3	-	2	1	1	1	1	-	-	-	1
CO4	3	3	-	3	-	1	1	1	-	1	-	-
CO5	3	3	-	2	1	1	1	1	1	-	-	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: NATURAL RESOURCES ***(07 Periods)***

Multidisciplinary nature of environment; Natural Resources: Renewable and non-renewable resources; Forest, Water, Mineral, Food and Energy resources -Causes, Effects, Remedies, Case studies; Role of an individual in conservation of natural resource and equitable use of resources for sustainable lifestyles.

Module 2: ECOSYSTEMS AND BIODIVERSITY ***(07 Periods)***

Ecosystems: Concept of an ecosystem, Structure and function of an ecosystem - Producers, Consumers, Decomposers; Food chains, Food webs, Ecological pyramids – Types; Characteristic features, Structure and functions of forest ecosystem, Desert ecosystem, Aquatic ecosystem.

Biodiversity: Concept and value of biodiversity, Role of biodiversity in addressing new millennium challenges, Hot spots of biodiversity, Threats to biodiversity, Man-wild life conflicts,

Endemic, Endangered and extinct species of India, Conservation of biodiversity – In-situ and ex-situ.

Module 3: ENVIRONMENTAL POLLUTION AND CONTROL ***(06 Periods)***

Causes, Adverse effects and control measures of pollution - Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution, Nuclear pollution, Solid waste management – Urban waste, industrial waste; Latest developments in pollution control, Hazards and disaster management – Floods, Earthquakes, Tsunamis, Case studies.

Module 4: SOCIAL ISSUES AND THE ENVIRONMENT ***(06 Periods)***

Sustainable development, Urban problems related to energy, Environmental ethics –Issues, Solutions; Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and case studies, Wasteland reclamation, Consumerism and waste products, Concept of green technologies, Environment justice: National Green Tribunal and its importance; Environment protection act, Air act, Water act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation, Public environmental awareness.

Module 5: HUMAN POPULATION AND THE ENVIRONMENT ***(04 Periods)***

Population growth, Population characteristics and variation among nations, Population explosion, Family welfare programme, Environment and human health, Human rights, Value education, HIV/AIDS, Women and child welfare, Role of information technology in environment and human health; Case studies - Field Work/Assignment/Seminar on Environmental assets – Water bodies/Forest/Grassland/Hill/Mountain.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Visit a nearby villages and know the status of availability of local resources that can be improved through proper education.
2. Make an awareness program in the villages for the development of natural resources, ecosystems and biodiversity.
3. Prepare a document by visiting a local urban waste dumping yard near to the Tirupati city.
4. Visit a local village and find a barren land and make the land into a useful land by planting plants or providing the soil and fertilizers required to improve the soil.
5. Visit a local zoological park and identify the species variety and variability.

(It's an indicative one. The course instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Anubha Kaushik and Kaushik, C.P., *Perspectives in Environmental Studies*, New Age International (P) Ltd. Publications, 6th Edition, 2018.
2. ErachBarucha, *Environmental Studies,* Orient Blackswan, 3rd Edition, 2021.

REFERENCE BOOKS:

1. Cunningham, W. P. and Cunningham, M. A., *Principles of Environmental Science*, Tata McGraw-Hill Publishing Company, New Delhi, 8th Edition, 2016.
2. Benny Joseph, *Environmental Studies*, Tata McGraw-Hill, 2nd Edition, 2009.
3. Anji Reddy, M., *Text Book of Environmental Science and Technology*, BS Publications, Revised Edition, 2014.
4. Rajagopalan, R., *Environmental Studies*, Oxford University Press, 3rd Edition, 2015.

VIDEO LECTURES:

1. http://nptel.ac.in/courses/109/104/109104047
2. https://www.youtube.com/watch?v=mIPBPG-5dUw

WEB RESOURCES:

1. https://nptel.ac.in/courses/122102006
2. https://www.flame.edu.in/academics/ug/program-structure/major-minor courses/environmental-studies
3. https://www.tutorialspoint.com/environmental_studies/environmental_studies_env ironment.htm

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CE107602	DISASTER MITIGATION AND MANAGEMENT	2	-	-	-	2

Pre-Requisite -

Anti-Requisite –

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion ondisasters, earthquakes, floods, cyclones, droughts, landslides and disaster management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the vulnerability of an area to natural and man-made disasters/hazards as per the guidelines to solve complex problems using appropriate techniques ensuring safety, environment and sustainability.

CO2. Propose appropriate mitigation strategies for earthquake and tsunami impacts as per code of practice using suitable techniques ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze the causes and impacts of floods, cyclones and droughts using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze the causes and impacts of landslides using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.

CO5. Design disaster management strategies to solve pre, during and post disaster problems using appropriate tools and techniques following the relevant guidelines and latest developments ensuring safety, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	2	2	2	2	2	-	-	-	-
CO2	3	3	3	3	2	2	1	2	-	2	-	-
CO3	3	3	-	2	2	2	2	-	-	2	-	-
CO4	3	3	-	3	2	2	2	-	-	-	-	-
CO5	3	2	3	2	2	2	1	2	-	1	3	2
Course Correlation Mapping	**3**	**3**	**3**	**3**	**2**	**2**	**2**	**2**	**-**	**2**	**3**	**2**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: DISASTERS ***(06 Periods)***

Types of disasters - Natural disasters; Impact of disasters on environment, infrastructure and development; Concepts of hazards and vulnerability analysis, Hazard Assessment, Guidelines for hazard assessment and vulnerability analysis, Basic principles and elements of disaster mitigation.

Module 2: EARTHQUAKES ***(06 Periods)***

Introduction to earthquake, Intensity scale (MSK–64), Seismic zones and activity in India, Action plan for earthquake disaster preparedness, Elements at risk, Recovery and rehabilitation after earthquake, Concepts of Earthquake resistant design and construction of buildings; Tsunami – Onset, Types and causes,Warning, Elements at risk, Typical effects, Specific preparedness and mitigation strategies, Case studies.

Module 3: FLOODS, CYCLONES AND DROUGHTS ***(07 Periods)***

Floods and Cyclones: Onset, Types, Causes, Warnings, Elements at risk, Typical effects, Indian floods and cyclones, Hazard zones, Potential for reducing hazards, Mitigation strategies and community based mitigation, Case studies.

Droughts: Onset, Types and warning; Causes, Impact, Early warning and response mechanisms, Mitigation strategies, Droughts in India, Case studies.

Module 4: LANDSLIDES ***(06 Periods)***

Onset, Types and warning; Causes, Elements at risk, Indian landslides, Hazards zones, Typical effects, Mitigation strategies and community based mitigation, Case studies.

Module 5: DISASTER MANAGEMENT ***(05 Periods)***

Disaster management organization and methodology, Disaster management cycle, Disaster management in India – Typical cases and Cost–benefit analysis, Disaster management programs implemented by NGOs and Government of India, Usage of GIS and Remote sensing techniques in disaster management, Leadership and Coordination in Disaster management, Emerging trends in disaster management.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Perform hazard assessment and vulnerability analysis for any nearby town/city and prepare a detailed report of possible impacts of various disasters on environment, infrastructure and development.
2. Prepare a detailed report on the causes and effects of Tsunami that was occurred in the year 2004. Also discuss various advancements in Tsunami warning systems.
3. Identify the major causes of urban floods in cities like Chennai, Hyderabad & Mumbai and submit a report along with various mitigation strategies to reduce the impact of floods.
4. Prepare a detailed report on how various man-made activities are directly/indirectly related to the occurrence of landslides that occurred in recent days in India.
5. Visit AP State Disaster Response and Fire Services Department and record about various methods used by them in mitigating disasters and their management.

RESOURCES

TEXT BOOKS:

1. Sharma V. K., *Disaster Management,* Medtech Publishing, 2nd Edition, 2013.
2. Anand S. Arya, AnupKaranth, and Ankush Agarwal, *Hazards, Disasters and Your Community: A Primer for Parliamentarians*, GOI–UNDP Disaster Risk Management Programme, Government of India, National Disaster Management Division, Ministry of Home Affairs, New Delhi, Version 1.0, 2005

REFERENCE BOOKS:

1. Donald Hyndman and David Hyndman, *Natural Hazardsand Disasters*, Cengage Learning, USA, 5th Edition, 2015.
2. *Disaster Management in India,*A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.
3. Rajendra Kumar Bhandari, *Disaster Education and Management: A Joyride for Students, Teachers, and Disaster Managers*, Springer India, 2014.
4. Singh R. B., *Natural Hazards and Disaster Management*, Rawat Publications, 2009.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105104183
2. https://www.digimat.in/nptel/courses/video/124107010/L01.html

WEB RESOURCES:

1. https://egyankosh.ac.in/handle/123456789/25093
2. https://www.egyankosh.ac.in/handle/123456789/25912
3. https://www.nios.ac.in/media/documents/333courseE/12.pdf
4. https://ndmindia.mha.gov.in/images/public-awareness/Primer%20for%20Parliamentarians.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22CE107603	**RURAL TECHNOLOGY**	2	-	-	-	2

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Thiscourse provides a detailed discussion ontechnology for rural development, nonconventional energy, technologies for rural development, community development and it in rural development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Compare various technologies for rural development by solving rural problems through different schemes by considering ethics, society, environment and sustainability.

CO2. Analyze non conventional energy sources using appropriate tools and techniquesto solve rural energy problems considering society, environment andsustainability besides communicating effectively in graphical form.

CO3. Select appropriate technologies in different areas of rural development to solve rural issues following latest developments considering society, environment and sustainability.

CO4. Relate water conservation, health, safety and rural employment issues for community development to solve rural problems through appropriate technologies considering ethics, society, environment and sustainability.

CO5. Analyze the impact of IT, public and private partnership on rural development to solve complex rural problems using appropriate tools and techniques considering ethics, society, environment and sustainability.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	-	3	2	1	1	1	-	-	-	-
CO2	2	3	-	2	2	1	1	-	-	1	-	-
CO3	2	3	-	2	2	1	1	-	-	-	-	1
CO4	2	3	-	2	2	1	2	1	-	-	-	-
CO5	2	3	-	3	2	1	1	1	-	-	-	-
Course Correlation Mapping	**2**	**3**	**-**	**3**	**2**	**1**	**2**	**1**	-	**1**	**-**	**1**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO RURAL DEVLOPMENT ***(06 Periods)***

India - Technology and rural development, Pre and post-independence period, Rural India Life, Indian farmer, Role of science and technology in rural development, Rural technology and poverty eradication, Rural business hubs, Technology in improving rural infrastructure, Various organizations related to innovation, Issues of technology transfer - CAPART, NABARD, CSIR, NIF.

Module 2: NON CONVENTIONAL ENERGY ***(06 Periods)***

Definition of energy, Types of alternative sources of energy, Sources of non-conventional energy – Solar energy: Solar pump in agriculture, Solar dryer, Solar cooker, Solar heater; Biogas, Recycling and management, Wastes conservation, Assessment and production of biomass products and their utilization.

Module 3 TECHNOLOGIES FOR RURAL DEVELOPMENT ***(06 Periods)***

Food and agro based technologies, Tissue culture, Nursery, Building and construction technologies, Cultivation and processing of economic plants, Cottage and social industries, Latest developments in rural technologies.

Module 4 COMMUNITY DEVELOPMENT ***(06 Periods)***

Water conservation, Rain water Harvesting, Drinking water Standards and simple treatments used, Environment and Sanitation, Bio fertilizers, Medical and aromatic plants, Employment generating technologies–Apiculture, Pisciculture, Aquaculture.

Module 5 IT IN RURAL DEVELOPMENT ***(06 Periods)***

Role of information technology (IT) in rural areas, Impact of IT in rural development, Need and necessity of technology, Corporate social responsibilities, Private sector participation (Activities in different spheres: Employment, Education, Health, Agriculture and service sectors) and Saansad Adarsh Gram Yojana (SAGY), Village adoptionschemes.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Visit a nearby village and know the status of small scale industries which are implanted and to be established based on the availability of the local resources.
2. Visit a local village and make an awareness program on energy utilization using biomass products.
3. Make a awareness program in the villages for the rural development in terms of home-made products.
4. Construct rain water harvesting structures in nearby villages where water scarcity is more and prepare a document.
5. Develop a small IT application the village area which will be used for the growth of the village.

(It's an indicative one. The course instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Virdi, M. S., *Sustainable Rural Technologies*, Daya Publishing House, 2nd Edition 2018.
2. Prabhath, S. V. and P. Ch. Sita Devi, *Technology and Rural India*, Serials Publications, 1st Edition, 2012

REFERENCE BOOKS:

1. Chakravarthy, R., and Murthy, P. R. S., *Information Technology and Rural Development*, Pacific Book International, 1st Edition, 2012.
2. Shivakanth Singh, *Rural Development Policies and Programmes*, Northern Book Centre, 1st Edition, 2002.
3. Katar Singh, and Anil Shishodia*, Rural Development: Principles, Policies, and Management,* SAGE Publications India Private Limited, 4th Edition, 2016.
4. Vinayak Reddy, A. and YadagiraCharyulu, M., *Rural Development in India: Policies & Initiatives,* New Century Publications, 1st Edition, 2008.

VIDEO LECTURES:

1. http://nptel.ac.in/courses/109/104/109104047
2. https://www.youtube.com/channel/UCEZxAQu3ZBulN-pYMYO2i_A/videos
3. https://www.youtube.com/watch?v=HnrIB-QmvlQ

WEB RESOURCES:

1. en.wikibooks.org/wiki/Technologies_for_Rural_Development/Complete
2. https://www.oecd-ilibrary.org/sites/ae6bf9cd-en/index.html?itemId=/content/component/ae6bf9cd-en
3. https://crdt.iitd.ac.in/

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG107603	**SPOKEN ENGLISH**	-	1	2	-	2

Pre-Requisite English for Professionals
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course deals with the development of fluency and intelligibility in spoken English. Through individual and group activities, students work on improving pronunciation, practicing conversation strategies, and delivering oral presentations.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of functional English for effective communication.
CO2. Analyze different types of vocabulary for fluency in communication
CO3. Apply correct usage of English grammar in writing and speaking.
CO4. Apply speaking strategies in terms of usage of English with accuracy, appropriacy, and fluency.
CO5. Analyze techniques to use communication skills for effective presentation.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	2	-	3	-	-	-
CO2	2	3	-	-	-	-	2	-	3	-	-	-
CO3	2	-	3	-	3	-	2	-	3	-	-	-
CO4	2	-	-	-	3	-	2	-	3	-	-	-
CO5	2	3	2	-	3	-	2	-	3	-	-	-
Course Correlation Mapping	**2**	**3**	**3**	**-**	**3**	**-**	**2**	**-**	**3**	**-**	**-**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: FUNCTIONAL ENGLISH ***(06 Periods)***

Concepts of Functional Spoken English, Self-Introduction; Listening and Speaking: Do's and Don'ts; Expressions: Ability, Admiration, Agreement, Annoyance, Appreciation, Pleasure, Sarcasm, Satisfaction, Surprise, Approval, Certainty, Doubt, Gratitude, Possibility, Fear, Worry, Condolences; Asking for: Advice, Clarification, Direction, Information, Permission; Making: Predictions, recommendations

Module 2: VOCABULARY BUILDING ***(06 Periods)***

Vocabulary for day-to-day conversations: Vegetables, Groceries, Fruits, Weather, Parts of a Human body, Dresses, Furniture; Relations: Birds, Cries of Animals, Food, Hospitality, Houses, Rooms, Tools, Airport, News Paper, Books, Gems, Corporate Vocabulary, Jobs, Occupations, Diseases; British and American spelling; Slang Words and Technical Jargons.

Module 3: FUNCTIONAL GRAMMAR - I ***(06 Periods)***

English Grammar and the Indian Student, Parts of Speech, Verb forms: Tenses, Voice and Speech.

Module 4: FUNCTIONAL GRAMMAR -II ***(06 Periods)***

Universal Auxiliaries: Sentence Structure, WH Questions, framing of Questions with answers; Question Tags, Subject and verb agreement, Spotting Errors.

Module 5: COMMUNICATION SKILLS: ***(06 Periods)***

Polite, Courteous and diplomatic expressions, Good manners and Etiquette, Conversation Techniques, Narrating Stories.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Critically analyse the value of Indian money and its impact on the common man and Prepare a PowerPoint Presentation.
2. Prepare a conversation between you and a sanitary officer regarding sanitary conditions in your locality.
3. The English Language has a rich vocabulary and it increases day by day. Present a seminar on the norms adhered to in adding new words and list out the words added in the last five years with their meaning.
4. Enact roleplays in different situations.
5. Participate in group discussions and debate on present issues
6. A conversation is an exchange of ideas, thoughts, and feelings between two or more persons. Explain it with suitable examples
7. Prepare a schedule and identify various committees to be formed for celebrating the Annual Day of a college and explain team involvement in the celebration.
8. Gather various ideas on discussing with parents the role of higher education and job opportunities.
9. Imagine you see a person wasting water. Write a dialogue objecting to such wastage of natural resources.
10. Since social media offers a wide reach easily, it becomes easier for bullies to spread gossip or issue threats. How do you think Cybercrime is a menace brought about by social media?

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22LG107602	**ESSENTIAL LIFE SKILLS FOR HOLISTIC DEVELOPMENT**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course deals with the enhancement of employability skills and maximizes the potential by introducing the principles that are for personal and professional success, and helping to apply them in their lives and careers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate life skills required in personal and professional life.

CO2. Analyse well-defined techniques to cope with emotions and stress.

CO3. Apply appropriate thinking and problem-solving methods to solve problems.

CO4. Function effectively in a team and as an individual.

CO5. Demonstrate the qualities of an effective leader.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	2	-	2	-	-	-
CO2	2	3	-	-	2	-	2	-	2	-	-	-
CO3	2	3	2	-	-	-	2	-	2	-	-	-
CO4	2	2	-	-	2	-	2	-	2	-	3	-
CO5	2	2	-	-	-	-	2	-	2	-	-	-
Course Correlation Mapping	**2**	**3**	**2**	**-**	**2**	**-**	**2**	**-**	**2**	**-**	**3**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: OVERVIEW OF LIFE SKILLS ***(06 Periods)***

Meaning and significance of life skills, Life skills identified by WHO: Self-awareness, Empathy, Critical thinking, Creative thinking, Decision making, problem-solving, Effective Communication, interpersonal relationships, coping with stress, coping with emotion.
Ethics, Moral & Professional Values: Human Values, Civic Rights, Engineering Ethics, Engineering as Social Experimentation, Environmental Ethics, Global Issues, Code of Ethics like ASME, ASCE, IEEE.

Module 2: STRESS MANAGEMENT ***(06 Periods)***

Stress Management*:* Stress, reasons, and effects, identifying stress, stress diaries, the four A's of stress management, techniques, **Approaches**: action-oriented, emotion-oriented, acceptance oriented, resilience, Gratitude Training, **Coping with emotions**: Identifying and managing emotions, harmful ways of dealing with emotions, PATH method, and relaxation techniques.

Module 3: TRANSFORMATIONAL SKILLS ***(06 Periods)***

Creativity, Critical Thinking, Collaboration, Problem Solving, Decision Making, Need for Creativity in the 21st century, Imagination, Intuition, Experience, Sources of Creativity, Lateral Thinking, Myths of creativity, Critical thinking Vs Creative thinking, Functions of Left Brain & Right brain, Convergent & Divergent Thinking, Critical reading & Multiple Intelligence.

Module 4: GROUP AND TEAM DYNAMICS ***(06 Periods)***

Introduction to Groups: formation of the group, thinking strategies, Clarifying expectations, Problem Solving, Consensus, Dynamic techniques, Group vs Team, Team Dynamics, and Virtual Teams. Managing team performance and managing conflicts, Intrapreneurship.

Module 5: LEADERSHIP ***(06 Periods)***

Leadership framework, entrepreneurial and moral leadership, vision, cultural dimensions. Growing as a leader, managing diverse stakeholders, crisis management. Types of Leadership, Traits, Styles, VUCA Leadership, Levels of Leadership, Transactional vs Transformational Leaders, Leadership Grid, Effective Leaders.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Prepare an attitude test by making small groups in the class and measure the attitudes of students in your class.
2. Students are psychologically pressurized for qualifying in campus interviews. Prepare a Case study on the Campus Interview pressure and stress of students using SWOT analysis.
3. Record and prepare a video presentation on people of different cultures and make a comment on their accents.
4. The qualities of the leaders play an important role in their success. Prepare a short film about a leader and list out the best qualities.

5. In the present context, social media plays a vital role in the success of leaders and the wide spread of their principles. Prepare a presentation on the impact of social media on a success of a leader.
6. 'Knowledge of present technologies helps us to live a harmonious life.'
   Make a video to justify the statement.
7. Prepare a PowerPoint presentation on life skills needed in our day-to-day life and their importance.
8. Every person wants to be successful in their personal and professional life and apply various strategies for that. List out the strategies to become successful in one's professional life.
9. A boy/girl who is a neighbour feels depressed for not being given with mobile for playing video games. Find methods and solutions to overcome the self-pity of the boy/girl.
10. Identify the persons who are irregular to class. Find out their problems and come up with solutions.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Dr.K Alex*, Soft Skills*, S Chand & Company Pvt.Ltd.2013.
2. Monmohan Joshi, *Soft Skills. Boolkboon.com*, 1st Edition, 2017.

REFERENCE BOOKS:

1. Agna Fernandez, *Generic Skills for Employability*, Cambridge University Press, 2020.
2. Larry James, *The First Book of Life Skills*, Embassy Books, 1st edition, 2016.
3. Shiv Khera, *You Can Win*, Macmillan Books, New York, 2003.
4. Barun K. Mitra, *Personality Development & Soft Skills*, Oxford Publishers, 3rd impression, 2017.
5. ICT Academy of Kerala, *Life Skills for Engineers*, McGraw Hill Education (India) Private Ltd., 2016.
6. David R. Caruso, *The Emotionally Intelligent Manager How to Develop and Use the Four Key Emotional Skills of Leadership*, John Wiley & Sons, 2004.
7. Kalyana, *Soft Skill for Managers*, Wiley Publishing Ltd, 1st edition, 2015.
8. Larry James, *The First Book of Life Skills*, Embassy Books, 1st edition, 2016.
9. ShaliniVerma, *Development of Life Skills and Professional Practice*, Sultan Chand (G/L) & Company, 1st edition, 2014.
10. Daniel Goleman, *Emotional Intelligence*, Bantam, 2006.
11. Remesh S., Vishnu R.G., *Life Skills for Engineers*, Ridhima Publications, 1st edition, 2016.
12. Butterfield Jeff, *Soft Skills for Everyone*, Cengage Learning India Pvt Ltd, 1st edition, 2011.
13. *Training in Interpersonal Skills: Tips for Managing People at Work*, Pearson Education, India, 6th edition, 2015.
14. *The Ace of Soft Skills: Attitude, Communication and Etiquette for Success*, Pearson Education, 1st edition, 2013.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=xM0fajUl7Bg
2. https://www.youtube.com/watch?v=HwLK9dBQn0g
3. https://www.youtube.com/watch?v=sxX5LoojdJw
4. https://www.youtube.com/watch?v=xJBgqW9-lzc
5. https://www.youtube.com/watch?v=QVwTVM1Iv1c

WEB RESOURCES:

1. https://www.clarke.edu/campus-life/health-wellness/counseling/articles-advice/developing-a-positive-attitude/
2. https://www.skillsyouneed.com/ps/personal-swot-analysis.html
3. https://ecampusontario.pressbooks.pub/profcommsontario/chapter/cross-cultural-communication/
4. https://thepeakperformancecenter.com/educational-learning/thinking/#:~:text=There%20are%20several%20core%20thinking,storing%20and%20then%20retrieving%20information.
5. https://www.webmd.com/anxiety-panic/guide/stage-fright-performance-anxiety

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22MG107401	**INNOVATION, INCUBATION, AND ENTREPRENEURSHIP**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: To course sensitize students on the prospects, opportunities, and challenges in entrepreneurship and the potential for value creation from prospective idea

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basics of generating new business ideas

CO2. Explain the concept of design thinking and product innovation.

CO3. Illustrate the roles of digital technology in entrepreneurship.

CO4. Understand the need for startup economics and market conditions

CO5. Evaluate the reasons for successful entrepreneurship.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	1	1	-	-	-	-		1			-
CO3	2	2	1	-	-	-	-	1	-	-	2	
CO4	3	1	1	-	-	-	-	-	-	-	-	1
CO5	2	2	-	-	-	1	-	-	-	-	-	1
Course Correlation Mapping	**2**	**2**	**1**	**1**	**-**	**1**	**-**	**1**	1	**-**	**2**	**1**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION ***(06 Periods)***

Concept & Definition, Taking product or service ideas to creating value: Why should one choose to become an entrepreneur, Entrepreneurial mind-set, Intrapreneurship

Module 2: PRODUCT INNOVATION ***(06 Periods)***

Product innovation process, engineering design process and the concept of frugal engineering for developing innovative affordable products, effective user-interface.

Module 3: DIGITAL TECHNOLOGY ENTREPRENEURSHIP ***(06 Periods)***

Industry 4.0 landscape and innovations using digital technologies like AI, IOT, AR/VR, Cloud, SAAS, User Applications.

Module 4: STARTUP ECONOMICS & MARKET CONSIDERATIONS ***(06 Periods)***

Economic consideration for starting a venture, Understanding Feasibility analysis, Understanding market, targeting customer and positioning product

Module 5: SUCCESSFUL BUSINESS INCUBATION ***(06 Periods)***

Business model innovation, Business process management , competitive advantages, Business model canvas, Bootstrapping.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Create and present a prototype of a new product of your choice.
2. Present at least three cases of successful business Ideas in recent times
3. Discuss in the group Entrepreneurship opportunities in terms of Orientation and Develop mentation.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Robert D. Hisrich,*Entrepreneurship,*
2. Kuratko&Hodgetts,*Entrepreneurship- Theory, Process & Practice*, Thompson South-Western Publication

REFERENCE BOOKS:

1. Peter Drucker, *Innovation and Entrepreneurship*, Harper Collins
2. Thomas N. Duening, Robert D. Hisrich and Michael A. Lechter, *Technology Entrepreneurship Taking Innovation to the Marketplace*, Elsevier
3. Prof. Nigel Cross, *Bloomsbury Design Thinking Understanding How Designers Think and Work*, 2019 Edition

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_mg63/preview
2. https://onlinecourses.nptel.ac.in/noc22_de08/preview

WEB RESOURCES:

1. https://ciie.iitism.ac.in/files/CIIE-POLICY.pdf
2. https://www.nios.ac.in/media/documents/249_Enterpreneurship/English_pdf/249_Enterpreneurship_Lesson_16.pdf

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EE107001	**INTELLECTUAL PROPERTY RIGHTS**	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course is designed to provide comprehensive knowledge to the students regarding the general principles of intellectual property rights, Concept and Theories, Criticisms of Intellectual Property Rights, International Regime Relating to IPR. The course provides an awareness on how to protect ones unique creation, claim ownership, knowledge of what falls under the purview of someone's rights and what doesn't, and safeguard their creations and gain a competitive edge over the peers.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the need and the concepts of intellectual property right and avenues for filling intellectual property rights.

CO2. Understand the legislative practices and protocols for acquisition of trademark and the judicial consequences for violating laws of trademark protection.

CO3. Understand the legislative practices and protocols for acquisition of copyrights and the judicial consequences for violating laws of copyrights protection.

CO4. Understand the fundamentals of patent laws,legislative practices and protocols for acquisition of trade secrets and the judicial consequences for violating laws of trade secrets protection.

CO5. Understand the importance of geographical indications and various laws and protocols for protecting geographical indications.

CO-POMapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	2
CO2	3	-	-	-	1	-	-	3	-	-	-	2
CO3	3	-	-	-	1	-	-	3	-	-	-	2
CO4	3	-	-	-	1	-	-	3	-	-	-	2
CO5	3	-	-	-	1	-	-	3	-	-	-	2
Course Correlation Level	**3**	**-**	**-**	**-**	**1**	**-**	**-**	**3**	**-**	**-**	**-**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO INTELLECTUAL PROPERTY RIGHTS ***(06 Periods)***

Introduction and the need for intellectual property rights (IPR); types of intellectual property- Design; International organizations, agencies and treaties.

Module 2: TRADEMARKS ***(06 Periods)***

Introduction to trademark, Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

Module 3: LAW OF COPYRIGHTS ***(06 Periods)***

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.
Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Module 4: TRADE SECRETS ***(06 Periods)***

Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.
Unfair competition: Misappropriation right of publicity, false advertising.

Module 5: GEOGRAPHICAL INDICATIONS ***(06 Periods)***

The Geographical indications law in India, The objectives and features, the registry of geographical indications powers and functions. Types of goods offered. Protection: Agriculture goods, manufactured goods and natural goods. Registration of indications and the requirements. Prohibition of misleading use of indications of geographical origins, prohibition of dilution of geographical origins.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Should conduct a survey based on the real scenario, where IPR is misused or unethically used and present an article.
2. Prepare an article on the registration processes of IPR practically (copy right/trade mark/ patents).
3. Should study a case of conflict on trademarks/patents and should produce an article mentioning the circumstances and remedial measures.
4. Prepare an article on the latest development in the international intellectual property rights.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

TEXT BOOKS:

1. Deborah, E. Bouchoux, *Intellectual property: The law of Trademarks, Copyright, Patents, and Trade Secrets,* Cengage learning, 4th Edition, 2013.
2. PrabuddhaGanguli, *Intellectual property right - Unleashing the knowledge economy*, Tata McGraw Hill Publishing Company Ltd.
3. Marsha AEchols,*Geographical Indications for Food Products*, Wolters, 2008

REFERENCE BOOKS:

1. Neeraj P., &Khusdeep D.,*Intellectual Property Rights,* PHI learning Private Limited, 1st Edition, 2019.
2. Nithyananda, K V.,*Intellectual Property Rights: Protection and Management,*Cengage Learning India Private Limited, 2019.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/110105139

Web Resources:

1. Subramanian, N., &Sundararaman, M. (2018). Intellectual Property Rights – An Overview. Retrieved from http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf
2. World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf
3. Cell for IPR Promotion and Management (http://cipam.gov.in/)
4. World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
5. Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)

SCHOOL CORE

Course Code	Course Title	L	T	P	S	C
22EE107002	FUNDAMENTALS OF RESEARCH METHODOLOGY	2	-	-	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course is developed for the students' to understand the underlying concepts of research methodology and a systematic approach for carrying out research in the domain of interest. The course is emphasised on developing skills to recognise and reflect the strength and limitation of different types of research; data collection methods, methods of Processing and analysing data. The course also emphasises on interpreting the findings and research articulating skills.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understands the underlying concepts of research methodology, types of research and the systematic research process.

CO2. Understand the philosophy of research design, types of research design and develop skills for a good research design.

CO3. Understand the philosophy of formulation of research problem, methods of data collection, review of literature and formulation of working hypothesis.

CO4. Understand various data processing and analysing techniques and their significance in research.

CO5. Develop skills to interpret the findings and researcharticulating skills along with the ethics of research.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	-	1	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	2	1	-	-	-	-	-	-
CO4	3	2	-	-	3	1	-	-	-	-	-	-
CO5	3	-	-	-	-	-	-	-	3	3	-	-
Course Correlation Level	**3**	**2**	**1**	**-**	**3**	**1**	**-**	**-**	**3**	**3**	**-**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION TO RESEARCH METHODOLOGY ***(06 Periods)***

Meaning of Research, Objectives of Research, Motivation in Research, Types of Research, Research Approaches, Significance of Research, Research and Scientific Method, Research Process, Criteria of Good Research.

Module 2: RESEARCH DESIGN ***(06 Periods)***

Research design—Basic Principles, Need of research design, Features of good design, Important concepts relating to research design, Different research designs, Basic principles of experimental designs, Developing a research plan.

Module 3: RESEARCH FORMULATION ***(06 Periods)***

Defining and formulating the research problem - Selecting the problem - Necessity of defining the problem - Importance of literature review in defining a problem – Data collection – Primary and secondary sources; Critical literature review – Identifying gap areas from literature review, Development of working hypothesis.

Module 4: PROCESSING AND ANALYSIS OF DATA ***(06 Periods)***

Processing Operations, Elements/Types of Analysis, Statistics in Research, Measures of Central Tendency, Measures of Dispersion, Measures of Relationship, Simple Regression Analysis.

Module 5: INTERPRETATION AND REPORT WRITING ***(06 Periods)***

Interpretation*:* Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation.

Report Writing: Significance, Different Steps, Layout, Types of reports, Mechanics of Writing a Research Report, Precautions in Writing Reports.

Total Periods: 30

EXPERIENTIAL LEARNING

1. Should conduct a survey based on a hypothesis, analyze the data collected and draw the inferences from the data.
2. Should review the literature on the given topic and should identify the scope/gaps in the literature and develop a research hypothesis.
3. Should study a case, formulate the hypothesis and identify an appropriate testing technique for the hypothesis.
4. Study an article and submit a report on the inferences and should interpret the findings of the article.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. C.R. Kothari, *Research Methodology: Methods and Techniques*, New Age International Publishers, 2nd revised edition, New Delhi, 2004.
2. Garg, B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., *An introduction to Research Methodology*, RBSA Publishers, 2002.

REFERENCE BOOKS:

1. R. Panneerselvam, *Research Methodology*, PHI learning Pvt. Ltd., 2009.
2. Singh, Yogesh Kumar, *Fundamental of research methodology and statistics*, New Age International, 2006.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/121106007
2. https://onlinecourses.nptel.ac.in/noc22_ge08/preview
3. https://www.youtube.com/watch?v=VK-rnA3-41c

Web Resources:

1. https://www.scribbr.com/category/methodology/
2. https://leverageedu.com/blog/research-design/
3. https://prothesiswriter.com/blog/how-to-formulate-research-problem
4. https://www.formpl.us/blog/hypothesis-testing
5. https://www.datapine.com/blog/data-interpretation-methods-benefits-problems/
6. https://leverageedu.com/blog/report-writing/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CS102003	**DATA STRUCTURES**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides an overview of data structure concepts, arrays, stack, queues, trees, and graphs. Discussion of various implementations of these data objects, programming styles, and run-time representations.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the concept of Dynamic memory management, data types, algorithms, Big O notation.

CO2. Understand basic data structures such as arrays, linked lists, stacks and queues.

CO3. Solve problem involving graphs, trees and heaps.

CO4. Apply Algorithm for solving problems like sorting, searching, insertion and deletion of data.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	-	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

MODULE 1 INTRODUCTION TO DATA STRUCTURES & STACK, QUEUE (10 *Periods*)

Introduction: Introduction to Data Structures, Basic Concepts and Notations, Abstract Data Types, Analysis and Efficiency of Algorithms, Time and Space Complexity.

Stack, Queue: Stack, Stack operations, Implementation using arrays, applications of stack, Queue, Queue operations, Implementation using arrays, various Queue Structures, applications of queue.

MODULE 2 LINKED LISTS (8 *Periods*)

Linked lists: Single linked list, double linked list, circular linked list, operations on linked lists, Applications of Linked List. Implementation of stack using Pointers, Implementation of Queue using Pointers.

MODULE 3 SEARCHING, SORTING & HASH TABLES (8 *Periods*)

Searching Techniques: Linear Search, Binary Search and Fibonacci Search.

Sorting Techniques: Selection Sort, Insertion sort, Bubble sort, Merge Sort, Quick Sort, Heap sort, Radix Sort.

Hash Tables: Hash Functions, Collision Handling Schemes, Applications.

MODULE 4 TREES (10 *Periods*)

Trees: Vocabulary and Definitions, Binary Tree, Implementation, Binary Tree Traversal, Binary Search Tree, Implementation, Balanced Search Trees: AVL Trees, Implementation, Splay Trees, Red-Black Trees.

MODULE 5 GRAPH THEORY (09 *Periods*)

GraphTheory: Graphs Terminology, Graph ADT, Data Structures for Graphs –Adjacency Matrix Structure, Graph Traversals, Shortest Paths, Minimum Spanning Trees- Prims' Algorithm, Kruskal's Algorithm, Dijkstra's Algorithm, Floyd-Warshall Algorithm

Total Periods: 45

Experiential Learning:

1. Demonstrate recursive algorithms with examples.
2. Develop a program to perform operations of a Stack and Queue using arrays.
3. Implement and perform different operations on Single, Double and Circular Linked Lists.
4. Develop a program to perform operations of Stack and Queue using Linked Lists
5. Develop programs to implement Stack applications.
6. Implement Circular Queues.
7. Implement various Searching techniques.
8. Develop programs for different Sorting techniques
9. Develop a program to represent a Tree data structure.

10. Develop a program to demonstrate operations on Binary Search Tree.
11. Demonstrate Graph Traversal Techniques.
12. Develop a program to find Minimum cost Spanning tree.

RESOURCES:

Text Books:

1. Mark Allen Weiss, Data Structures and Algorithm Analysis in C, Pearson, Second Edition, 2002.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein Introduction to Algorithms, PHI, Third Edition,2010.
3. Narasimha Karumanchi, Data Structures and Algorithms Made Easy, Career Monk Publications,2020.

Reference Books:

1. Horowitz, Sahani, Anderson Freed, Fundamental of Data Structures in C, Universities Press, Second Edition, 2008.
2. Debasis Samantha, Classic Data Structures, PHI, Second Edition, 2009.

Video Resources:

1. https://www.youtube.com/watch?v=zWg7U0OEAoE&list=PLBF3763AF2E1C572F
2. https://www.youtube.com/watch?v=S47aSEqm_0I&list=PLD9781AC5EBC9FA16
3. https://www.youtube.com/watch?v=9MmC_uGjBsM&list=PLyqSpQzTE6M_Fu6l8irVwXkUyC9Gwqr6

WEB RESOURCES:

1. https://www.tutorialspoint.com/what-is-advanced-java
2. https://www.udemy.com/course/advanced-java-programming/
3. https://www.geeksforgeeks.org/what-is-advanced-java/
4. https://cloudacademy.com/learning-paths/advanced-java-programming-518/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CS102004	**DESIGN AND ANALYSIS OF ALGORITHMS**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Algorithms and asymptotic notations; Algorithm performance analysis; Amortized analysis; Recurrences; Disjoint sets; Divide and Conquer; Dynamic programming; Greedy algorithms; Back tracking; Branch and bound; NP-hard and NP-complete problems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the complexity of algorithms by applying the knowledge of asymptotic notations and recurrence methods.

CO2. Analyze the given problem and identify appropriate algorithm design technique for problem solving.

CO3. Perceive and apply different algorithm design paradigms to find solutions for computing problems.

CO4. Apply the knowledge of NP-hard and NP-Complete complexity classes to classify decision problem.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2		-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ALGORITHMS **(10 Periods)**

Algorithm, Algorithm pseudocode conventions, Performance analysis - Space complexity, Time complexity, Asymptotic notations; Amortized analysis – Aggregate analysis, Accounting method, Potential method; Recurrences - Substitution method, Recursion-tree method, Master method.

Module 2: DISJOINT SETS, DIVIDE AND CONQUER **(08 Periods)**

Disjoint Sets: Operations, Union and Find algorithms.
Divide and Conquer: General method, Defective chess board, Binary search, Finding maximum and minimum, Merge sort, Strassen's matrix multiplication.

Module 3 DYNAMIC PROGRAMMING **(9 Periods)**

General method, Matrix-chain multiplication, All pairs shortest path, Optimal binary search trees, 0/1 Knapsack problem, Traveling salesperson problem, Flow shop scheduling.

Module 4 GREEDY METHOD, BACKTRACKING **(10 Periods)**

Greedy Method: General method, Knapsack problem, Job sequencing with deadlines, Huffman codes, Single source shortest paths, Optimal merge patterns.
Backtracking: General method, 8–Queens problem, Sum of subsets, Graph coloring, Hamiltonian cycles.

Module 5 BRANCH AND BOUND, NP-HARD AND NP-COMPLETE PROBLEMS **(08 Periods)**

Branch and Bound: LC search, LC branch and bound, FIFO branch and bound, 0/1 knapsack problem, Traveling salesperson problem.
NP Hard and NP-Complete Problems: Nondeterministic algorithms, NP-hard and NP-complete classes, Cook's theorem, NP-hard scheduling problems – Scheduling identical processors.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Sort a given set of n integer elements using Quick Sort and merge sort methods and compute its time complexities. Run the programs for varied values of n >1000 and record the time taken to sort. Plot a graph of the time taken versus n for both algorithms. The elements can be read from a file or can be generated using the random number generator. Demonstrate how the divide and conquer method works along with its time complexity analysis: worst case, average case and best case.
2. Write a program to implement knapsack problem using greedy method.
3. a) Write a program to find minimum cost spanning tree using Kruskal's Algorithm.
   b) Write a program to find minimum cost spanning tree using Prim's Algorithm.
4. Write a program to implement 0/1 Knapsack problem using Dynamic Programming method.
5. Write a program to implement All-Pairs Shortest Paths problem using Floyd's algorithm.
6. Write a program to implement Travelling Sales Person problem using Dynamic programming method.
7. Write a program to implement backtracking algorithm for the N-queens problem.
8. Write a program to find a subset of a given set S = {Sl, S2,.....,Sn} of n positive integers whose SUM is equal to a given positive integer d. For example, if S ={1, 2, 5, 6, 8} and d= 9, there are two solutions {1,2,6}and {1,8}. Display a suitable message, if the given problem instance doesn't have a solution.

9. Write a program to find all Hamiltonian Cycles in a connected undirected Graph G of n vertices using backtracking principle.

RESOURCES

TEXT BOOKS:

1. Ellis Horowitz, SartajSahni, and SanguthevarRajasekaran, Fundamentals of Computer Algorithms, 2nd Edition, Universities Press, 2008.
2. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest, Clifford Stein, Introduction to Algorithms,3rd Edition, MIT Press, 2009.

REFERENCE BOOKS:

1. Michael T. Goodrich and Roberto Tamassia, Algorithm Design and Applications, Wiley, 2014.
2. Alfred V. Aho, John E. Hopcroft and Jeffrey D. Ullman, The Design and Analysis of Computer Algorithms, Pearson, 2006.

SOFTWARE/TOOLS:

1. Software: JDK 1.8
2. OperatingSystem:Windows/Linux

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/106101060/L01.html
2. http://www.infocobuild.com/education/audio-video-courses/computer-science/DesignAnalysisOfAlgorithms-IIT-Bombay/lecture-05.html

WEB RESOURCES:

1. https://www.tutorialspoint.com/design-and-analysis-of-an-algorithm/index.asp
2. https://nptel.ac.in/courses/106/106/106106131

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22AI101001	**DISCRETE MATHEMATICAL STRUCTURES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on discrete mathematics to make students to think logically and mathematically and apply these techniques in solving problems. Topics include mathematical logic, functions, relations, deterministic algorithms and analysis techniques based on counting methods, recurrence relations, trees and graphs.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply mathematical logic and truth tables to validate precise statements.

CO2. Understand the concepts of sets, relations and functions.

CO3. Analyze and apply the concepts of mathematical induction, counting principles and properties of algebraic structures to solve computational Problems.

CO4. Formulate problems and solve recurrence relations using substitution method and generating functions.

CO5. Apply trees and graphs to solve the problems in computer applications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	2	2	-	-	-	-	-	-	-	3	-	-	-
CO2	3	-	-	2	2	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	-	3	2	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	-	3	2	-	-	-	-	-	-	-	3	-	-	-
CO5	3	-	-	3	2	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	**3**	**3**	-	**2**	**2**	-	-	-	-	-	-	-	**3**	-	-	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: MATHEMATICAL LOGIC AND NORMAL FORMS ***(08 Periods)***

Mathematical Logic: Introduction, Statements and Notation, Connectives, Well- formed formulae, Truth tables, Tautology, Equivalence, Implications.
Normal forms: Disjunctive normal form, Conjunctive normal form, Principle disjunctive normal form, Principle conjunctive normal form.

Module 2: RELATIONS AND FUNCTIONS ***(08 Periods)***

Relations: Cartesian product of sets, Relations, Properties of binary relations, Equivalence, Compatibility and Partial ordering relations, Hasse diagram and related applications, Lattices as partially ordered sets, Definition and examples, Properties of Lattices.
Functions: Types of functions, Composition of functions and inverse of functions

Module 3: INDUCTION, COUNTING AND ALGEBRAIC STRUCTURES ***(09 Periods)***

Induction, Counting: Mathematical Induction – The Basics of Counting - The Pigeonhole Principle - Principle of Inclusion-Exclusion.
Algebraic Structures: Algebraic systems, Examples and general properties, Semi groups and Monoids, Groups, Subgroups, Homomorphism, Isomorphism

Module 4: GENERATING FUNCTIONS AND RECURRENCE RELATIONS ***(11 Periods)***

Generating Functions: Generating functions of sequences, Calculating coefficients of generating functions.
Recurrence Relations: Recurrence relations, Solving recurrence relations by substitution and generating functions, The method of characteristic roots, Solutions of homogeneous recurrence relations.

Module 5: GRAPHS AND TREES ***(09 Periods)***

Graphs: Basic concepts of Graph theory, Planar and Complete graph, Matrix representation of Graphs, Graph Isomorphism, Connectivity, Euler and Hamilton Paths, Shortest path algorithms.
Trees: Introduction to Trees, Properties of Trees, Spanning Trees, Depth-First Search, Breadth-First Search, Minimum Spanning Trees.

Total Periods: 45

EXPERIENTIAL LEARNING

The following is the sample. Faculty shall frame according to the course domain.

1. Let a > 1 be a positive integer. Pretend you want to divide n people into some number of teams, each of size a or a + 1. Show that this is possible provided n is larger than values in the Fibonacci polynomial a2 −a−1 = a(a−1)−1.
2. Identify the relations on the set of bits B = {0, 1} that are partial orders and those that are equivalence relations.
3. Pretend you are writing traffic accident software and want to categorize accidents by the day of the week on which they occur. Pretend there are n accident reports to categorize.
   (a) What is the size of the sample space? That is, in how many ways can the n accident reports be distributed over 7 days?
   (b) In how many ways can all n accidents occur on one single day?
   (c) In how many ways can all n accidents occur on only two days?
   (d) Let's looks at the other end: In how many ways can all n accidents occur on seven, and no less, days.

RESOURCES

TEXT BOOKS:

1. Kenneth H. Rosen, *Discrete Mathematics and its Applications,* Tata McGraw Hill, 8th Edition, 2019.
2. Jon Pierre Fortney, *Discrete Mathematics for Computer Science*, CRC Press, Taylor & Francis Group, 1st Edition, 2021.

REFERENCE BOOKS:

1. Richard Johsonbaugh, *Discrete Mathematics*, Prentice Hall,8th Edition, 2019.
2. Narasing Deo, *Graph Theory with application to Engineering and Computer Science*, Prentice Hall India 2016.
3. J.P. Trembly and R. Manohar, *Discrete Mathematical Structures with Applications to Computer Science,*Tata McGraw Hill, 37th Edition, 2017.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106183
2. https://nptel.ac.in/courses/106106094
3. https://nptel.ac.in/courses/111107058

WEB RESOURCES:

1. https://www.coursera.org/learn/discrete-mathematics
2. https://people.cs.pitt.edu/~milos/courses/cs441/
3. https://web.stanford.edu/class/cs103x/cs103x-notes.pdf
4. https://edurev.in/studytube/Propositional-Logic-Discrete-Mathematical-Structur/8e588945-d315-41f0-a31e-0dc45829eb04_v

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CS101001	**DIGITAL LOGIC DESIGN**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite Switching Theory and Logic Design

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Foundations in the operation of digital gates, Concepts of Boolean algebra, Minimization of logic circuits, Design and implementation of combinational and sequential logic circuits, Design digital systems using Programmable logic.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply knowledge of binary systems, logic gates and Boolean functions to represent a given problem using Boolean logic.
CO2. Minimize and implement Boolean functions to build combinational logic circuits.
CO3. Design combinational and sequential logic circuits for digital systems.
CO4. Design digital systems using programmable logic to solve engineering problems.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	-	-	**3**	-

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: BINARY SYSTEMS AND BOOLEAN ALGEBRA ***(10 Periods)***

Introduction, Binary Numbers, Number Base Conversions, Error Detection and Correction, Complements of Numbers, Signed Binary Numbers, Binary Codes, Boolean Algebra, Boolean Functions, Canonical and Standard Forms, Digital Logic Gates.

Module 2: GATE LEVEL MINIMIZATION ***(09 Periods)***

The Map Method, Four Variable K-Map, Product-of-Sums and Sum-of-Products Simplification, Don't Care Conditions, NAND and NOR Implementations, Other Two Level Implementations, Exclusive–OR function.

Module 3: COMBINATIONAL LOGIC ***(09 Periods)***

Combinational Circuits, Analysis of Combinational Circuits, Design Procedure, Binary Adder-Subtractor, Decimal Adder, Binary Multiplier, Magnitude Comparator, Decoders, Encoders, Multiplexers, De-Multiplexers.

Module 4: SEQUENTIAL LOGIC ***(10 Periods)***

Latches, Flip-Flops, Analysis of Clocked Sequential Circuits, Design of Synchronous Sequential Circuits, Registers, Shift Registers, Ripple Counters, Synchronous Counters, Ring Counter and Johnson Counter.

Module 5: PROGRAMMABLE LOGIC ***(07 Periods)***

RAM, ROM, Programmable Logic Array, Programmable Array Logic, Sequential Programmable Devices.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Design the digital circuit system of the vehicle with two photocell sensors, which work as inputs. Simulate the virtual circuit using NI Multisim software considering the following specifications:
   a) Each side (right of left) of that sensor circuit which communicate with each motor to output the signals so the vehicle can correct the direction along the track and drive. The track is outlined by two LED strip lights, as an input source, on both ends adhered on the ground about one feet apart. For instance, when the vehicle is close to the LED strip lights on the right-side track, the right side of the photocell sensor detects the bright lights, and it sends a positive signal to the left motor. That is, the input of the left photocell logic is 0 (off) because the left sensor does not detect the light and the right photocell logic is 1 (on). The output of the left and right motors in this case are represented as logics 1 and 0 respectively, which makes only the left motor spins to steer to the left side moving away from the right side of LED strip.
   b) Once the vehicle moves off the light, the both sides of the motors will operate and the vehicle would move straight forward until it encounters another LED strip light. In the case of the left side, the opposite would happen. The left sensor detects the LED strip light on the left side track. Thus, only the right motor will run to make the vehicle to steer to the right side.
   c) Since two LED strips are far (about 30 cm) apart, both the left and right photocell will not detect the light at the same time. However, it can be defined as negative output for both motors to follow the logics and therefore the vehicle will stop moving.

(It's an indicative one. The course instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. M. Morris Mano, Michael D. Ciletti, Digital Design: With an Introduction to the Verilog HDL, VHDL, and System Verilog, 6th edition, Pearson, 2018.

REFERENCE BOOKS:

1. A. Anand Kumar, Switching Theory and Logic Design, 3rd edition, PHI Learning Private Limited, India, 2016.
2. Charles H. Roth, Jr. and Larry L. Kinney, Fundamentals of Logic Design, 7th edition, Cengage Learning, 2015.
3. Alan B. Marcovitz, Introduction to Logic Design, 3rd edition, McGraw Hill, 2010.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/108106177
2. https://nptel.ac.in/courses/106105185
3. https://www.youtube.com/watch?v=RZo--xYfTR4
4. https://www.youtube.com/watch?v=3vEV55D103g
5. https://www.youtube.com/watch?v=axGvxdUpEIE
6. https://www.youtube.com/watch?v=QEFW4DcyOC0
7. https://www.youtube.com/watch?v=wIeqYG4c6Ho

WEB RESOURCES:

1. https://www.rapidtables.com/convert/number/base-converter.html
2. https://learnabout-electronics.org/Digital/dig10.php
3. https://www.tutorialspoint.com/computer_logical_organization/digital_counters.htm
4. https://www.electronics-tutorial.net/programmable-logic-devices/complex-programmable-logic-device/
5. http://vlabs.iitb.ac.in/vlabs dev/labs/mit_bootcamp/comp_networks_sm/labs/exp1/procedure.php
6. https://unacademy.com/course/logic-gates-and-boolean-algebra-iit-jee/GUT1BCXY
7. https://byjus.com/jee/basic-logic-gates/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CS101002	**COMPUTER ORGANIZATION AND ARCHITECTURE**	3	-	-	-	3

Pre-Requisite Digital Logic Design
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course deals with basic function, structure and components of computer system, Central Processing Unit, Control Unit and I/O Unit. This course also imparts knowledge on different types of Memory Systems, Parallel Processing techniques and Multicore architectures with its issues.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on computer organization, architecture and interconnection structures of a digital computer.

CO2. Analyze Arithmetic Operations, Addressing Modes, Instruction Formats, Processor and Register organization.

CO3. Design digital circuits for the given functional description of microoperations and memory elements.

CO4. Investigate the performance of Input/Output Systems, Memory systems, parallel processors, Multicore architectures to evaluate the cost-performance trade-offs.

CO-PO-PSO Mapping Table

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2		-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	**3**	**2**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	-	-	-

Correlation Levels: 1: Low 2: Medium:3: High

COURSECONTENT

Module 1: INTRODUCTION TO COMPUTER SYSTEM (08 Periods)

Organization and architecture, Structure and function, IAS computer structure, Computer function, Interconnection structures, Bus interconnection.

Module 2: CENTRAL PROCESSING UNIT (09 Periods)

Arithmetic logic unit, Integer multiplication- Booth's algorithm; Floating point representation principles, Machine instruction characteristics, Addressing modes, Instruction formats – Instruction length, Allocation of bits; Processor organization, Register organization – User visible registers, Control and status registers; Instruction cycle.

Module 3: CONTROL UNIT AND INPUT/OUTPUT (10 Periods)

Control Unit: Micro operations, Control of the processor – Functional requirements, Control signals, Internal processor organization; Hardwired implementation, Microinstructions, Microprogrammed control unit, Micro instruction sequencing – Design considerations, sequencing techniques, Address generation; Micro instruction execution- A taxonomy of microinstructions, Microinstruction encoding.

Input/Output: External devices, I/O modules, Direct memory access function, I/O Channels and Processors, PCI Physical and Logical Architecture.

Module 4: MEMORY SYSTEMS (09 Periods)

Semiconductor Memories: Computer Memory System overview, Semiconductor Main Memory- Organization, DRAM and SRAM, Types of ROM, Chip logic, Chip packaging, Module organization, Interleaved memory; DDR DRAM, Flash Memory, Newer Nonvolatile Solid-State Memory Technologies.

Cache Memory: Cache Memory Principles, Elements of Cache Design-Cache Addresses, Mapping Functions.

External Memory: Solid State Drives.

Module 5: PARALLEL ORGANIZATION (09 Periods)

Parallel Processing: Multiple Processor Organizations, Instruction Pipelining, Symmetric Multiprocessors, Nonuniform Memory Access, Multicore Organization.

Multicore Computers: Hardware performance issues, Software performance issues, Multicore organization, Intel Core i7-990X.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a report on Product Specifications such as CPU, Memory, Processor Graphics and advanced technologies of Intel Core i9-12900K -New performance hybrid architecture. The World's Best Gaming Processor: Available with up to 16 cores and 24 threads, the new 12th Gen Intel Core processor family includes the world's best gaming processor, the Core i9-12900K, unleashing gaming experiences across top titles.

   (https://ark.intel.com/content/www/us/en/ark/products/134599/intel-core-i912900k-processor-30m-cache-up-to-5-20-ghz.html)
2. Write a report on OpenCL(Open Computing Language) framework used for writing programs that execute across heterogeneous platforms consisting of central processing units, graphics processing units, digital signal processors, field-programmable gate arrays and other processors or hardware accelerators.(https://www.khronos.org/api/opencl)

RESOURCES

TEXT BOOKS:

1. William Stallings, Computer Organization and Architecture: Design for performance, Pearson, 11th Edition, 2020.

REFERENCE BOOKS:

1. Carl Hamacher, ZvonkoVranesic, SafwatZaky, Computer Organization, 5th Edition, McGraw Hill Education, 2013.

2. David A. Patterson and John L. Hennessy, Computer Organization and Design - A Hardware software interface, 5th Edition, Morgan Kaufmann, 2014.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_cs37/preview
2. https://onlinecourses.nptel.ac.in/noc20_cs64/preview
3. https://onlinecourses.nptel.ac.in/noc21_cs47/preview
4. https://freevideolectures.com/course/2277/computer-organization
5. https://www.youtube.com/watch?v=4TzMyXmzL8M

WEB RESOURCES:

1. https://www.javatpoint.com/computer-organization-and-architecture-tutorial
2. https://www.geeksforgeeks.org/last-minute-notes-computer-organization/
3. https://gateoverflow.in/blog/9728/some-good-resources-for-computer-organisation-architecture
4. https://tutorialspoint.dev/computer-science/computer-organization-and-architecture/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22AI101019	**FOUNDATIONS OF OPERATING SYSTEMS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Operating Systems Operations; Process Scheduling; Process Synchronization, Deadlocks; Paging and Segmentation, Disk Scheduling; File Concepts, I/O Interface; Concepts of Protection and Security.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze performance of CPU scheduling algorithms.

CO2. Design solutions for process synchronization problems by using semaphores and monitors.

CO3. Devise solutions for deadlocks using deadlock handling mechanisms.

CO4. Solve memory management problems using page replacement and disk scheduling algorithms.

CO5. Identify efficient file allocation methods for optimal disk utilization & analyse services of I/O subsystems and mechanisms of security & protection.

CO6. Analyze the different concepts of Operating Systems using Case Studies.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	2	2	-	-	-	-	-	-	-	-	-	3	-
CO2	2	2	3	-	2	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	-	2	-	-	-	-	-	-	-	-	-	-	3
CO4	2	2	3	-	2	-	-	-	-	-	-	-	-	-	-	3
CO5	3	3	-	3	-	-	-	-	-	-	-	-	-	-	3	-
CO6	3	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3
Course Correlation Mapping	**3**	**2**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO OPERATING SYSTEM AND PROCESS MANAGEMENT ***(08 Periods)***

Introduction: Definition, Operating System Structure and Services, System Calls.
Process Management: Process Scheduling, Process Control Block, Inter Process Communication, Threads, Multithreading Models, CPU Scheduling Criteria, Scheduling Algorithms, Multiprocessor Scheduling.

Module 2 PROCESS SYNCHRONIZATION AND DEADLOCKS ***(10 Periods)***

Process Synchronization: Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Synchronization Problems, Monitors.
Deadlocks: System Model, Deadlock characterization, Methods for handling deadlocks, Prevention, Detection, Avoidance, Recovery from deadlock.

Module 3 MEMORY MANAGEMENT AND SECONDARY STORAGE ***(10 Periods)***

Memory Management: Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging.
Virtual Memory: Demand Paging, Page Replacement Algorithms, Copy-on-Write, Thrashing.
Secondary Storage Structure: Overview of Mass Storage Structure, Disk Structure, Disk Scheduling, Disk Management.

Module 4 FILE AND I/O SYSTEMS ***(08 Periods)***

File System: File concept, Access Methods, Directory Structure, File System Structure, i-node, File System Implementation, Directory Implementation, Allocation Methods.

Module 5 CASE STUDIES ***(09 Periods)***

The Linux System-History, Kernel Modules, Process Management, Input and Output, Inter-process Communication.
Windows 7- System Components, Networking, Programmer Interface, Terminal Services and Fast User

Total Periods: 45

EXPERIENTIAL LEARNING

1. Demonstrate File Permissions.
2. Design Banker's Algorithm for Deadlock Avoidance. Find the safe sequence. If Maximum request of any one process is changed, detect whether a deadlock has occurred or not. Consider the number of resources are three and Jobs are five.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, Operating System Concepts, Wiley India Edition, 9th Edition, 2016.

REFERENCE BOOKS:

1. William Stallings, Operating Systems, Internals and Design Principles, Pearson Education, 7th Edition, 2013.

2. Andrew S. Tanenbaum, Modern Operating Systems, PHI, 3rd Edition, 2009.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_cs72/preview
2. https://www.udemy.com/course/operating-systems-from-scratch-part1/

WEB RESOURCES:

1. operating-systems · GitHub Topics · GitHub
2. Operating System Introduction (w3schools.in)
3. What is Operating System (OS)? Defintion and Functions - javatpoint
4. Operating System Tutorial - GeeksforGeeks

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22AI101002	**THEORY OF COMPUTATION**	3	-	-	-	3

Pre-Requisite Data Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Finite automata; Nondeterministic Finite automata; Regular expressions; Applications of the pumping lemma; Context-Free Grammars; Normal forms for context-free grammars; pushdown automata; Chomsky hierarchy of languages; Turing machines.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Design finite state machines to recognize formal languages.

CO2. Analyze formal languages using automata.

CO3. Identify different types of grammars in formal languages.

CO4. Construct context free grammars for context free languages

CO5. Develop Turing machine for different computational problems.

CO6. Validate formal languages of automata by applying closure properties.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	-	-	-	-	-	-	-	-	3	-	-	-
CO2	2	3	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3		-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	2	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-	-
CO6	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	2	3	2	-	-	-	-	-	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1: FINITE AUTOMATA ***(10Periods)***

Introduction to Finite automata, the central concepts of automata theory, Deterministic finite automata, Nondeterministic Finite automata, the equivalence of DFA and NDFA, Finite automata with epsilon-transitions, Conversion of epsilon-NFA to NFA and DFA, Mealy and Moore models.

Module 2: REGULAR EXPRESSIONS AND LANGUAGES ***(09Periods)***

Regular expressions, Identity rules, Finite automata and Regular expressions, Applications of regular expressions, Pumping lemma for regular languages, Applications of the pumping

lemma, Closure properties of regular languages, Equivalence of two regular expressions, Equivalence of two finite automata and minimization of automata.

Module 3: CONTEXT-FREE GRAMMARS ***(09 Periods)***

Context-Free Grammars, Parse trees, Applications of context free grammars, Ambiguity in grammars and languages, Normal forms for context-free grammars, the pumping lemma for context-free languages.

Module 4: PUSH DOWN AUTOMATA ***(08 Periods)***

Definition of the pushdown automaton, the languages of a PDA, Equivalence of PDA's and CFG's, Deterministic pushdown automata, Chomsky hierarchy of languages, Undecidability.

Module 5: TURING MACHINE ***(09 Periods)***

Turing machine model, Representation of Turing machine, Language acceptability by Turing machine, Design of Turing machine, Techniques for Turing machine construction, Variants of Turing machines, Universal Turing machine, Recursive and recursively enumerable languages (REL), properties of recursive and recursively enumerable languages, the model of linear bounded automaton.

Total Periods: 45

EXPERIENTIAL LEARNING

1. State and prove pumping lemma theorem for regular language. Prove that a L = $\{a^n b^n$ for n = 0,1,2,.....$\}$ Is not regular. b L = $\{a^{2n}/n \geq 1\}$ is regular.
2. Draw DFA for all strings over {0,1} consisting of even number of 0's and 1's

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. John E. Hopcroft, Rajeev Motwani and Jeffrey D Ullman, Introduction to Automata Theory, Languages and Computation, Pearson Education, 3rd Edition, 2011.

REFERENCE BOOKS:

1. K.L.P. Mishra and N. Chandrasekaran, Theory of Computer Science: Automata Languages and Computation, PHI Learning, 3rd Edition, 2009.
2. John C Martin, Introduction to Languages and the Theory of Computation, TMH, 4 th Edition, 2010.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106104148
2. https://www.udemy.com/course/the-complete-theory-of-computation/

WEB RESOURCES:

1. Automata Tutorial | Theory of Computation - Javatpoint
2. Automata Tutorial - GeeksforGeeks
3. Automata Theory Tutorial (tutorialspoint.com)
4. theory-of-computation · GitHub Topics · GitHub

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CS102006	**COMPILER DESIGN**	3	-	2	-	4

Pre-Requisite Theory of Computation

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Lexical analysis; Parsers; Run Time Environments; Syntax Directed Translation; Type checking; Code Optimization; Code Generation and Compiler tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on the phases involved in design of compilers.

CO2. Analyze code optimization Techniques..

CO3. Design experiments for implementing parsing techniques.

CO4. Synthesize rules in compiler to demonstrate semantic attribution during Parsing.

CO5. Use compiler construction tools such as LEX and YACC for designing a Parser.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-	3
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	3
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**-**	**2**	**-**	**3**	-	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE 1: INTRODUCTION TO COMPILER AND LEXICAL ANALYSIS (09 Periods)

Structure of a compiler, Interpretation- Interpreters, Recursive interpreters, Iterative interpreters. Lexical Analysis: The Role of the Lexical Analyzer, Input Buffering, Specification of Tokens, The Lexical-Analyzer Generator LEX.

MODULE-2: SYNTAX ANALYSIS (09 Periods)

The Role of the Parser, Eliminating Ambiguity, Eliminating of Left Recursion and Left Factoring. Top-Down Parsing: Recursive descent parsing, Non Recursive Predictive parsing, LL (1) Grammars, A traditional top-down parser generator—YACC

Bottom-Up Parsing: Shift reduce parsing, LR parsers – Simple LR parser, Canonical LR parser, LALR parser, Using Ambiguous Grammars.

MODULE-3: SYNTAX DIRECTED TRANSLATION AND TYPE CHECKING (09 Periods)

Syntax directed definition, S-attributed and L-attributed definitions, Construction of syntax trees. Type Checking: Type Expressions, Type Equivalence, Rules for Type Checking, Type Conversions, Overloading of Functions and Operators.

MODULE-4: INTERMEDIATE CODE GENERATOR AND RUN TIME ENVIRONMENTS (09 Periods)

Preprocessing the intermediate code, Preprocessing of expressions, Preprocessing of if-statements and goto statements, Preprocessing of routines, Variants of Syntax Trees, Three Address Code, Boolean expressions, Flow-of-Control Statements, Control- Flow Translation of Boolean Expressions.

Run time Environments: Storage organization, Stack Allocation of Space, Access to Nonlocal Data on the Stack.

MODULE-5: CODE OPTIMIZATION AND CODE GENERATION (09 Periods)

Basic Blocks and Flow Graphs, Optimization of Basic Blocks, The principal sources of optimization, Introduction to data flow analysis.

Code Generation: Issues in the Design of a Code Generator, The Target Language, Simple Code Generator, Peephole optimization, Register allocation and assignment.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a LEX Program to scan reserved word & Identifiers of C Language language.
2. Implement Predictive Parsing algorithm.
3. Write a C program to generate three address code.
4. Implement SLR(1) Parsing algorithm.
5. Design LALR bottom up parser for the given language.
6. Write a C program for implementing the functionalities of predictive parser for the mini language specified in Note 1.
7. Write a C program for construction of LL (1) parsing.
8. Write a C program for constructing recursive descent parsing.
9. Implement a desk calculator using operator precedence parsing.
10. Consider the syntax of a programming language construct such as while-loop --

```
while ( condition )
begin
     statement ;
          :
end
```

where while, begin, end are keywords; condition can be a single comparision expression (such as x == 20, etc.); and statement is the assignment to a location the result of a single arithmatic operation (eg., a = 10 * b).

Write a program that verifies whether the input follows the above syntax.

RESOURCES:

TEXT BOOK:

1. Alfred V. Aho, Monica S.Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers–Principles, Techniques and Tools, Pearson Education, 2nd edition, 2012.

REFERENCE BOOKS:

1. Dick GruneKees van Reeuwijk Henri, Modern Compiler Design, Springer,2nd edition, 2012.

2. David Galles, Modern Compiler Design, Pearson Education Asia, 2007.

SOFTWARE/TOOLS:

Software: Turbo C++/Dev C++

VIDEO LECTURES:

https://nptel.ac.in/courses/106104123

https://www.reddit.com/r/Compilers/comments/10dpnky/compiler_design_theory_course_with_video_lectures/?rdt=44592

WEB RESOURCES:

https://nitsri.ac.in/Department/Computer%20Science%20&%20Engineering/CD-LEC-NOTES.pdf

http://www2.cs.uidaho.edu/~jeffery/courses/nmsu/370/lecture.html

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CS102005	**DATABASE MANAGEMENT SYSTEMS**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction to database systems; Database design; Relational model; Relational algebra; SQL queries; Constraints and triggers; PL/SQL; Schema refinement and normal forms; Transaction management; Concurrency control; Overview of storage and indexing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply the concepts of ER-modeling and normalization to design viable data models for a given problem.

CO2. Formulate relational database schemas, apply suitable integrity constraints, for querying databases.

CO3. Use SQL to store, query, and manipulate data in relational databases.

CO4. Develop PL/SQL blocks to centralize database applications for maintainability and reusability.

CO5. Analyze transaction processing, concurrency control and storage methods for database management.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-	3
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	3
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**-**	**2**	**-**	**3**	-	**3**

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO DATABASE SYSTEMS AND DATABASE DESIGN ***(09 Periods)***

Introduction to Database Systems: Database system applications, Purpose of database systems, View of data - Data abstraction, Instances and schemas, Data models; Database languages - Data Definition Language, Data Manipulation Language; Database architecture, Database users and administrators.

Introduction to Database design: Database design and ER diagrams, Entities, attributes and entity sets, Relationships and relationship sets, Additional features of ER model, Conceptual Design with ER model.

Module 2: RELATIONAL MODEL, RELATIONAL ALGEBRA AND TUPLE CALCULUS ***(08 Periods)***

Relational Model: Creating and modifying relations, Integrity constraints over relations, Enforcing integrity constraints, Querying relational data, Logical database design, Introduction to views, Destroying/altering tables and views.

Relational Algebra and Tuple calculus: Preliminaries, Relational Algebra operators and tuple calculus.

Module 3: SQL AND PL/SQL ***(09 Periods)***

SQL: Form of basic SQL query, Nested queries, Aggregate operators, Null values, Complex integrity constraints in SQL, Triggers and active databases.

PL/SQL: Generic PL/SQL block, PL/SQL data types, Control structure, Procedures and functions, Cursors, Database triggers.

Module 4: SCHEMA REFINEMENT AND TRANSACTIONS ***(10 Periods)***

Schema Refinement: Problems caused by redundancy, Decompositions, Problems related to decomposition, Functional dependencies, Reasoning about FDs, First normal form, Second normal form, Third normal form, Boyce-Codd normal form, Multivalued dependencies, Fourth normal form, Join dependencies, Fifth normal form.

Transactions: Transaction concept, Transaction atomicity and durability, Concurrent Executions – Serializability, Recoverability, Implementation of isolation, Testing for serializability.

Module 5: CONCURRENCY CONTROL, STORAGE AND INDEXING ***(09 Periods)***

Concurrency Control: Lock Based Protocols, Timestamp Based Protocols, Validation Based Protocols, Multiple Granularity, Deadlock Handling.

Storage and Indexing: Data on external storage, File organizations and indexing – Clustered indexes, Primary and secondary indexes; Index data structures – Hash based indexing, Tree based indexing; B and B+ Trees, Comparison of file organizations.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1.Design and analyze an ER Model for the following use case.

The Library Management System database keeps track of readers with the following considerations –

- The system keeps track of the staff with a single point authentication system comprising login Id and password.
- Staff maintains the book catalog with its ISBN, Book title, price(in INR), category(novel, general, story), edition, author Number and details.
- A publisher has publisher Id, Year when the book was published, and name of the book.
- Readers are registered with their user_id, email, name (first name, last name), Phone no (multiple entries allowed), communication address. The staff keeps track of readers.

Choose appropriate Entities and attributes and relationships and draw the complete ER diagram.

2.a). Implement Data Definition Language commands -Create, Alter, Drop, Truncate, and Rename.

b). Implement Data Manipulation Language commands - Insert, Select, Update, and Delete.

c).Implement Single Row functions - Character, Numeric and Date functions.

3.Implement various types of integrity constraints - NOT NULL constraint, DEFAULT constraint, UNIQUE constraint, PRIMARY key, FOREIGN key, CHECK constraint.

4.a).Implement group functions with different operators such as aggregate operators, group by, having and order by.

b).Implement nested and correlated nested queries using set operators and set comparison operators.

5. a).Creation of views, synonyms, sequence, indexes and save point.

b). Implement various types of joins - outer join and inner join.

Basic PL/SQL:

6. Construct PL/SQL block for the following:

a. To determine whether a number is palindrome
b. To determine whether a number is an Armstrong number
c. To find greatest of three numbers
d. To display Fibonacci series

Control Structures:

7.a) Write a program in PL/SQL to update the salary of a specific employee by 20% if the salary less than 30000/- and 10% when the salary in between 30000/- and 60000/- and 5% when the salary is above 60000/- and display the salary with a suitable message.

b).Write a PL/SQL program to display the description of the grade against a student's grade using CASE statement.

Exception Handling:

8. a). Develop a PL/SQL program that displays the name and address of a student whose ID is given. If there is no student with the given student ID in the database, the program should raise a run-time exception NO_DATA_FOUND, which should be captured in the EXCEPTION block.

b). Construct the user-defined exceptions to get the salary of an employee and check it with the job's salary range. If the salary is below the range, raise an exception BELOW_SALARY_RANGE. If the salary is above the range, raise the exception ABOVE_SALARY_RANGE.

Functions:

9.a).Write a function that accepts two numbers A and B and performs the following operations.

1. Addition
2. Subtraction
3. Multiplication
4. Division

b).Write a PL/SQL block that reverses the given number.

Procedures:

10. a).Write a procedure that accepts two numbers and displays their sum.
b).Write procedures to demonstrate IN, IN OUT and OUT parameters.

Cursors:

11.a).Write a block in PL/SQL to create a Cursor that displays the employee name and number of jobs he or she has done in the past.
b). Write a program in PL/SQL to create a cursor to display the name and salary of each employee in the EMPLOYEES table whose salary is less than that specified by a passed-in parameter value.

Triggers:

12.Develop a suitable employee database application by considering appropriate attributes.
a).Whenever the inserted or updated salary is more than 10 lacs per month a trigger should be fired.

b).Whenever, the inserted or updated salary is less than 5000 per month a trigger should be activated.

RESOURCES

TEXT BOOKS:

1. William Stallings, Computer Organization and Architecture: Design for performance, Pearson, 11th Edition, 2020.

REFERENCE BOOKS:

1. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, Computer Organization, 5th Edition, McGraw Hill Education, 2013.
2. David A. Patterson and John L. Hennessy, Computer Organization and Design - A Hardware software interface, 5th Edition, Morgan Kaufmann, 2014.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_cs37/preview
2. https://onlinecourses.nptel.ac.in/noc20_cs64/preview
3. https://onlinecourses.nptel.ac.in/noc21_cs47/preview
4. https://freevideolectures.com/course/2277/computer-organization
5. https://www.youtube.com/watch?v=4TzMyXmzL8M

WEB RESOURCES:

1. https://www.javatpoint.com/computer-organization-and-architecture-tutorial
2. https://www.geeksforgeeks.org/last-minute-notes-computer-organization/
3. https://gateoverflow.in/blog/9728/some-good-resources-for-computer-organisation-architecture
4. https://tutorialspoint.dev/computer-science/computer-organization-and-architecture/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101017	**DATA MINING**	3	-	-	-	3

Pre-Requisite Database Management Systems

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course emphasizes on the fundamental concepts of Data Mining. The course also covers concepts such as Data Pre-processing, Operational Database Systems and Data Warehouses, Mining Frequent Patterns, Classification and Prediction, Clustering, Data warehousing and Mining tools. The course also focuses on New Trends and Research Frontiers and Visualization of Multi-Dimensional Data.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply data pre-processing techniques to produce refined data.
CO2. Apply Association rules and classification techniques for data categorization.
CO3. Use clustering techniques for grouping similar data items and identify outliers.
CO4. Understand Data Mining trends and applications.
CO5. Implement Visualization of Multi-dimensional Data

CO-PO-PSO Mapping Table:

Course Outcomes	ProgramOutcomes												ProgramSpecific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	-	-	-
CO4	2	3	3	-	-	2	-	-	-	-	-	-	3	-	-	-
CO5	2	2	3	-	2	-	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	-	2	2	-	-	-	-	-	-	3	-	-	-

Correlation Levels: ***3:High;*** ***2: Medium;*** ***1:Low***

COURSE CONTENT

Module 1 DATA MINING AND DATA PRE-PROCESSING ***(08Periods)***

Introduction to Data Mining, kinds of data, kinds of patterns, major issues in Data Mining, Data Pre-processing, Data Cleaning, Data Integration, Data Reduction, Data Transformation and Discretization.

Module 2 ASSOCIATIONS AND CLASSIFICATION ***(10Periods)***

Basic Concepts, Frequent itemset Mining Methods, pattern evaluation methods- From Association Mining to Correlation Analysis, Classification, Decision Tree Introduction, BayesianClassificationMethods,RuleBasedClassification,Prediction:Linear Regression.

Module 3 CLUSTER ANALYSIS ***(09Periods)***

Cluster Analysis: Types of Data in Cluster Analysis, A Categorization of Major Clustering Methods, Partitioning Methods-k-Means and K-Medoids, Hierarchical methods-Agglomerative and divisive method, Density-Based Method-DBSCAN, Grid-Based Method-STING, Outlier Analysis.

Module 4 DATAMINING TRENDS ***(09Periods)***

Mining Complex Data Types: Mining sequence data, Mining other kinds of data: Spatial, Text, Multimedia and Web data.
Data Mining Trends: Mining Complex Data Types, Methodologies of Data Mining, Data Mining Applications, Data Mining and Society, Data Mining Trends.

Module 5 VISUALIZATIONOFMULTI-DIMESIONALDATA ***(09Periods)***

Introduction, Diagrams for Multidimensional visualization, Kiviat diagrams, 3D Scattergram,3DLineGraph,ChernoffFaces,VolumeRendering,**VisualDataMining**- Animation

Total Periods:45

EXPERIENTIAL LEARNING:

1. Create a dataset using ARFF and CSV formats and load into the Weka Explorer.
2. List all the categorical attributes and the real-valued attributes separately in 'German credit' data set.

RESOURCES

TEXT BOOKS:

1. JiaweiHan, Micheline Kamber and Jian Pei, Data Mining: Concepts and Techniques, Elsevier, Third Edition, 2013.

REFERENCE BOOKS:

1. K.P.Soman, Shyam Diwakar and V.Ajay, Insight into Data mining Theory and Practice, Easter Economy Edition, Prentice Hall of India, 2006.
2. G.K.Gupta, Introduction to Data Mining with Case Studies, Easter Economy Edition, Prentice Hall of India, 2006.
3. TanP.N, Steinbach M. and Kumar V., Introduction to Data Mining, Addison-Wesley, 2006.

VIDEOLECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_cs06/preview
2. https://www.coursera.org/specializations/data-mining-foundations-practice
3. DataMining| Coursera

WEBRESOURCES:

1. Data Mining. Concepts and Techniques, 3rd Edition (The Morgan Kaufmann Seriesin Data Management Systems) (sabanciuniv.edu)

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22IT101001	**SOFTWARE ENGINEERING**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Software Engineering, Software Process Models, Conventional and Agile Process Models, Software Requirements Engineering Process, System Analysis, Architectural Design, User Interface Design and Re-engineering, Software Testing, Risk and Quality Management.

COURSE OUTCOMES: *After successful completion of the course, students will be able to:*

CO1. Demonstrate knowledge on Fundamental concepts of software engineering and analyze process models required to develop a software system.

CO2. Analyze software requirements and model requirements for the given scenario.

CO3. Apply design concepts and metrics for software development.

CO4. Apply testing strategies and techniques for quality software.

CO5. Analyze risks in software development life cycle and apply risk strategies to mitigate risks.

CO6. Work independently or in teams to develop and present software models with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	-	3	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-	2	-	3	-
CO6	-	-	-	2	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT:

Module-1: SOFTWARE ENGINEERING AND SOFTWARE PROCESS (11 periods)

A Generic view of process: The Nature of Software, Software Engineering- Software Engineering Layers; The Software Process, Software Engineering Practice, Software myths.

Process models: A Generic Process Model, Prescriptive Process Models-The Waterfall Model, Incremental Process Models, Specialized Process Models; The Unified Process, Agile Development-Agility, Agile Process, Extreme Programming (XP), Scrum, Lean Software Development (LSD),

Dynamic System Development Method,Agile Modeling (AM), Agile Unified Process (AUP), The Cleanroom strategy.

Module-2: REQUIREMENTS ENGINEERING AND MODELING (07 periods)

Requirements Engineering: Functional and non-functional requirements, The software requirements document, Requirements specifications, Requirements engineering processes, Requirements elicitation and analysis, Requirements validation, Requirements management.

Requirements Modeling: Requirements Analysis, Data Modeling Concepts, Flow-Oriented Modeling,Scenario based Modeling, UML Models that supplement the Use Case Case study on Requirements modeling for Web and MobileApps.

Module-3: DESIGN ENGINEERING AND METRICS (08 periods)

Design Engineering: Design within the context of Software Engineering, The Design process, Design concepts, Software Architecture, Architectural Styles, Architectural design, Pattern based Design-Design Patterns, Pattern based software design.

Process and Project Metrics: Metrics in the process and project domains, Software Measurement, Metrics for software quality.

Module-4: SOFTWARE TESTING STRATEGIES AND APPLICATIONS (09 periods)

Testing strategies: A strategic approach to software testing, Strategic issues, Test strategies for conventional software, Test strategies for object oriented software, Validation testing, System testing, The art of debugging.

Testing Conventional Applications: Software testing fundamentals, White box testing-Basis path testing, Control structure testing; Black box testing, Object oriented testing methods.

Module-5: RISK, QUALITY MANAGEMENT AND REENGINEERING (10 periods)

Risk and Quality Management: Reactive and Proactive risk strategies, Software risks, Risk Mitigation Monitoring and Management (RMMM), RMMM plan, Software quality factors, Defect Amplification Model, Formal Technical Reviews (FTR), Software Quality Assurance (SQA)-Tasks, Goals and Metrics; Software reliability.

Reengineering: Introduction, Business Process Reengineering (BPR), Software Reengineering, Restructuring, Reverse engineering, Forward engineering.

Total Periods: 45

EXPERIENTIAL LEARNING:

LIST OF CASE STUDIES:

Case studies given below should be Modeled using Visual Modeling tools in different views i.e. Use case view, logical view, component view, Deployment view.

CASE STUDY 1: ONLINE TICKET RESERVATION FOR RAILWAYS

Problem Statement: Computer play an integral part of the day in today's life. It makes the entire job easier and faster, every job is computerized so as the ticket reservation we can book over the online ticket reservation system. During the booking of the ticket reservation passenger has to select origin, date of journey, destination, class of train etc. The reservation counter keeps track of passenger's information. Thus the system will have all the details about the trains and facilities provided by them. There are various trains with the different level of convenience for the passengers. The whole database will be maintained by database administrator. There are varieties of trains where the passengers can select the train according to the convenience for their destination journey. The journey could be within the state or across the India. Each train has the three types of classes i.e. Sleeper class, First class and the AC compartment. Design the application for the above problem description.

CASE STUDY 2: A POINT OF SALE (POS) SYSTEM

Problem Statement: A POS System is a computerized application used to record sales and handle payments; it is typically used in a retail store. It includes hardware components such as a computer and bar code scanner, and software to run the system. It interfaces to various service applications, such as a third-party tax calculator and inventory control. These systems must be relatively fault tolerant; that is, even if remote services and temporarily unavailable they must still be of capturing sales and handling at least cash payments. A POS system must support multiple and varied client – side terminals and interfaces such as browser, PDA's, touch – screens.

CASE STUDY 3: RECRUITMENT PROCEDURE FOR SOFTWARE INDUSTRY

Problem Statement: In the software industry the recruitment procedure is the basic thing that goes in the hand with the requirement as specified by the technical management team. HR first gives an advertisement in leading Newspapers, Journals, Weeklies and Websites. The job seekers can apply for it through by Post or by e-mail to the company. The technical skill and the experience of the candidates are reviewed and the short listed candidates are called for the interview. There may be different rounds for interview like the written test, technical interview, and HR interview. After the successful completion of all rounds of interview, the selected candidates' names are displayed. Meanwhile HR gives all the details about the salary, working hours, terms and conditions and the retirement benefit to the candidate.

CASE STUDY 4: ONLINE AUCTION SALES

Problem Statement: The online auction system is a design about a website where sellers collect and prepare a list of items they want to sell and place it on the website for visualizing. To accomplish this purpose the user has to access the site. Incase it's a new user he has to register. Purchaser's login and select items they want to buy and keep bidding for it. Interacting with the purchasers and sellers through messages does this. There is no need for customer to interact with the sellers because every time the purchasers bid, the details will be updated in the database. The purchaser making the highest bid for an item before the close of the auction is declared as the owner of the item. If the auctioneer or the purchaser doesn't want to bid for the product then there is fixed cutoff price mentioned for every product. He can pay that amount directly and own the product. The purchaser gets a confirmation of his purchase as an acknowledgement from the website. After the transition by going back to the main menu where he can view other items.

CASE STUDY 5: TWO FLOOR ELEVATOR SIMULATOR

Problem Statement: The elevator has the basic function that all elevator systems have, such as moving up and down, open and close doors, and of course, pick up passengers. The elevator is supposed to be used in a building having floors numbered from 1 to MaxFloor, where the first floor is the lobby. There are car call buttons in the car corresponding to each floor. For every floor except for the top floor and the lobby, there are two hall call buttons for the passengers to call for going up and down. There is only one down hall call button at the top floor and one up hall call button in the lobby. When the car stops at a floor, the doors are opened and the car lantern indicating the current direction the car is going is illuminated so that the passengers can get to know the current moving direction of the car. The car moves fast between floors, but it should be able to slow down early enough to stop at a desired floor. When an elevator has no requests, it remains at its current floor with its doors closed.

In order to certificate system safety, emergency brake will be triggered and the car will be forced to stop under any unsafe conditions.

CASE STUDY 6: HOME APPLIANCE CONTROL SYSTEM

Problem Statement: A home appliance control system (HACS) is a system which provides various services to remotely operate on home appliances, such as microwave oven, TV, and garage door etc

through remote devices such as mobile phone, desktop and palm-top.A home appliance control system (HACS) is a system which is controlled by a remote system such as a mobile phone or a palm-top, and at the same time controls, monitors and coordinates home appliances such as air conditioner, microwave oven, garage doors, TV set, VCR, audio controller, indoor/outdoor lights, water sprinkler, home security system, bath tub controller, etc. In order to activate home appliances and to allow for different ways of cooking, the HACS needs mechanisms for communication between the different devices in the system, and for coordination among the various processes running on such devices. The system administrator of the HACS system has the ability to add a new appliance or delete an existing one. The system administrator has the ability to add a new remote device and configure it with HACS or delete an existing one when it is not used. Also the system administrator can create an account for a new user or delete existing account if it is no longer used.

1. Identify Functional and Non Functional Requirements for
   i) Online Ticket Reservation for Railways, ii) Online Auction Sales
2. Prepare the Software Requirement Specification (SRS), High Level Design (HLD) and Detailed Design (DD) for the following experiments
   1. Employee Information System, ii) Online Airline Reservation

   Note: For the reference of SRS, HLD and DD templates refer department manual and use any open source Requirement documentation tool. Estimate project parameters such as size, effort and time for development for a Library Information system using Basic COCOMO model.

Mini project :For any given problem identify functional and non- functional requirements, prepare SRS document and design the system using UML diagrams.

RESOURCES

TEXT BOOKS:

1. Roger S. Pressman, *Software Engineering - A Practitioner's Approach,* McGraw-Hill, Eight Edition, 2015.
2. Ian Sommerville, *Software Engineering***,** Pearson Education, Ninth Edition, 2011.

REFERENCE BOOKS:

1. K. K. Aggarwal and Yogesh Singh, *Software Engineering,* New Age International Publishers, Third Edition, 2007.
2. Shely Cashman Rosenblatt, *Systems Analysis and Design*, Thomson Publications, Sixth Edition, 2006.

REFERENCE BOOKS:

1. Grady Booch, James Rum Baugh and Ivar Jacobson, *The Unified Modeling Language User Guide*, Pearson Education, Second Edition, 2009.
2. Hans-Erik Eriksson, Magnus Penker, Brian Lyons and David Fado, *UML 2 Toolkit*, WILEY-Dreamtech India Pvt. Ltd., 2003.
3. Rajesh Naik and Swapna Kishore, *Software Requirements and Estimation*, Tata McGraw Hill, New Delhi, 2001.

SOFTWARE/TOOLS USED:

- Visual Paradigm for modeling diagrams

VIDEO LECTURES:

- https://nptel.ac.in/courses/106105087/
- https://nptel.ac.in/courses/106105182/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT102002	**COMPUTER GRAPHICS AND MULTIMEDIA**	3	-	2	-	4

Pre-Requisite - **Programming for Problem Solving**
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides Introduction to Computer Graphics, Output Primitives;2D Geometric Transformations and Viewing;3D object representation and Visible Surface Detection Methods; Introduction to Multimedia, Audio and Video; Multimedia Data Compression.

COURSE OUTCOMES: *After successful completion of the course, students will be able to:*

CO1. Demonstrate knowledge on Graphical interactive devices, Viewing transformations, 3-D object representations, Surface detection methods, Image, audio, video representations and standards.

CO2. Analyze multimedia compression issues using image, audio and video compression techniques.

CO3. Design algorithms to generate points, lines, polygons for 2-D, 3-D objects.

CO4. Apply Transformations and Clipping algorithms for 2-D and 3-D objects, various lossy / lossless coding techniques on text and images for compression and decompression.

CO5. Build multimedia applications for societal requirements.

CO6. Work independently or in teams to build and present Graphics and Multimedia objects with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	2	3	-
CO5	3	2	2	2	2	3	-	-	-	-	-	-	2	2	3	-
CO6	-	-	-	2	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**2**	**3**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT:

Module-1: INTRODUCTION TO GRAPHICS AND OUTPUTPRIMITIVES (9 Periods)

Introduction: Raster-Scan systems, Random Scan systems, Graphics monitors, Work stations and Input devices.
Output Primitives: Points and Lines, Line Drawing algorithms, Mid-point Circle and Ellipse algorithms.
Filled area primitives: Scan Line Polygon Fill algorithm, Boundary-fill algorithms and Flood-Fill algorithms

Module-2: 2-D GEOMETRICAL TRANSFORMS AND 2-D VIEWING (9 Periods)

2-D Transforms: Translation, Scaling, Rotation, Reflection and Shear transformations, Homogeneous coordinates, Composite Transforms, Transformations between coordinate systems.

2-D Viewing: The Viewing Pipeline, Viewing coordinate reference frame, Window to View-Port coordinate Transformation, CohenSutherland line clipping algorithms.

Module-3: 3-D OBJECT REPRESENTATION AND VISIBLE SURFACE DETECTION METHODS (9 Periods)

3-D Object representation: Polygon Surfaces, Quadric surfaces,Spline Representation, Hermite Curve, Bezier Curve and B-Spline Curves, Bezier and B-Spline Surfaces.

Visible Surface Detection Methods: Classification, Back-Face detection, Depth-Buffer, Scan-Line, Depth Sorting, BSP-Tree methods, Area Sub-Division and Octree methods.

Module-4: INTRODUCTION TO MULTIMEDIA, AUDIO AND VIDEO (9 Periods)

Introduction: Definition of Multimedia, Multimedia and Hypermedia, Multimedia Software tools, Graphics and Image Data representations-Graphics and Image Data types, File Formats, Color models in images, Color models in video.

Audio and Video: Definition of sound, Digitization, Nyquist Theorem, Signal to Noise ratio, Signal to Quantization-Noise ratio; Types of video signals, Analog video, Digital video.

Module-5: MULTIMEDIA DATA COMPRESSION (9 Periods)

Lossless compression algorithms: Introduction, Basics of Information Theory, Run Length Coding, Variable Length coding, Dictionary Based coding, Arithmetic coding; Lossy Compression algorithms- Quantization; Image compression techniques-JPEG standard, JPEG 2000;Introduction to video compression- Video compression based on Motion Compensation, MPEG-1, MPEG-2.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Write a program for the implementation of Bresenham's line drawing algorithm.
2. Write a program to implement Bresenham's circle drawing algorithm.
3. Write a program to implement Bresenham's ellipse drawing algorithm.
4. Write a program to implement DDA line drawing algorithm.
5. Write a program to implement 2D Transformation.
6. Write a program to implement Window Viewport Mapping.

7. Write a program to implement Cohen-Sutherland 2D Clipping.

8. Write a program to convert between color models.

9. Write a program to implement text compression algorithm.

10. Write a program to implement image compression algorithm

11. Case study1: Create an animation using flash tool.

12. Case study2: Apply basic operations on image using Adobe Photoshop.

Note: 1 to 10 programs can be implemented using C

RESOURCES

TEXT BOOKS:

1. Donald Hearn and M. Pauline Baker, Computer Graphics C version, Pearson Education, Second Edition, 2006.

2. Ze-Nian Li and Mark S. Drew, Fundamentals of Multimedia, Pearson Education, Second Edition, 2008.

REFERENCE BOOKS:

1. James D. Foley, Andries van Dam, Steven K. Feiner and John F. Hughes, Computer Graphics: Principles and Practice in C, Addison Wesley Professional, Second Edition, 2013.

2. Nigel Chapman and Jenny Chapman, Digital Multimedia,Wiley Dreamtech, Second Edition, 2004.

WEB RESOURCES:

1. https://en.wikiversity.org/wiki/Internet_Fundamentals/Graphics_and_Multimedia
2. https://in.pcmag.com/software/120864/the-best-graphic-design-software-for-2020
3. https://www.lifewire.com/what-is-graphics-software-1701504

SOFTWARE/Tools:

1. An Intel-compatible platform running Windows 10 /8.1/8 /7 /Vista /XP /2000 Windows server 2019 /2016 /2012 /2008 /2003
2. At least 256 MB of RAM, a mouse, and enough disk space for recovered files, image files, etc.
3. The administrative privileges are required to install and run multimedia utilities.
4. A network connection for data recovering over network

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CB102002	**COMPUTER NETWORKS**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to computer networks; Protocols of physical layer, data link layer, medium access control sub layer, network layer, transport layer, application layer.

COURSE OUTCOMES: ***After successful completion of this course, the students will be able to:***

CO1. Analyze the types of network topologies, layers and protocols.
CO2. Evaluate sub netting and routing algorithms for finding optimal paths in networks.
CO3. Solve problems related to flow control, error control and congestion control in data transmission.
CO4. Assess the impact of wired and wireless networks in the context of network protocols Like DNS, SMTP, HTTP, and FTP.
CO5. Apply ethical principles and standards for developing network-based solutions.
CO6. Work independently and in teams to solve network related problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	3	3	2
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	2
CO4	3	2	2	2	2	-	-	-	-	-	-	-	3	3	3	2
CO5	3	2	2	-	-	-	-	-	-	-	-	-	3	3	-	-
CO6	-	-	-	-	-	-	-		3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**-**	**3**	**-**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

MODULE- I: INTRODUCTION AND PHYSICAL LAYER (9 Periods)

Network hardware, Network software, Reference models - OSI, TCP/IP; Example networks – Internet; Wireless LANs - 802.11.

Physical Layer - Guided transmission media, Wireless transmission, Switching - Circuit switching, Packet switching.

MODULE- II: DATA LINK LAYER AND MEDIUM ACCESS CONTROL SUBLAYER (9 Periods)

Data Link Layer: Data link layer design issues, Error detection and correction - CRC, Hamming codes; Elementary data link protocols, Sliding window protocols.

Medium Access Control Sub layer: ALOHA, Carrier sense multiple access protocols, Collision free protocols, Ethernet, Data link layer switching - Repeaters, Hubs, Bridges, Switches, Routers, Gateways.

MODULE- III: NETWORK LAYER (9 Periods)

Network layer design issues, Routing algorithms - Shortest path algorithm, Flooding, Distance vector routing, Link state routing, Hierarchical routing, Broadcast routing, Multicast routing, Any cast routing; Congestion control algorithms, Network layer in the internet - The IP version 4 protocol, IP addresses, IP version 6, Internet control protocols, OSPF, BGP.

MODULE- IV: TRANSPORT LAYER (9 Periods)

UDP – Segment header, Remote procedure call, Real-time transport protocols; TCP – service model, Protocol, Segment header, Connection establishment, Connection release, Sliding window, Timer management, Congestion control.

MODULE- V: APPLICATION LAYER (9 Periods)

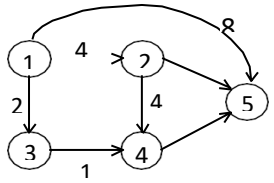
Domain Name System (DNS) - Name space, Domain resource records, Name servers; Electronic mail - Architecture and services, User agent, Message formats, Message transfer, Final delivery; The World Wide Web - Architectural overview, HTTP, FTP.

Total Periods: 45

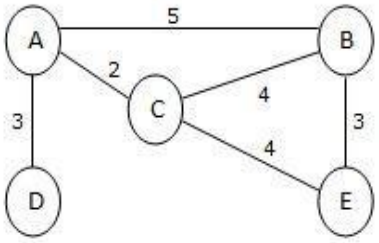
EXPERIENCED LEARNING:

LIST OF EXERCISES:

1. Implement the following data link layer framing methods.
   i) Character count
   ii) Character stuffing
   iii) Bit stuffing
2. Implement the frame sorting technique used in buffers.
3. Design and develop a program to compute checksum for the given frame 1101011011 using CRC-12, CRC-16, and CRC-CCIP. Display the actual bit string transmitted. Suppose any bit is inverted during transmission. Show that this error is detected at the receiver's end.
4. Implement Dijkstra's algorithm to compute the shortest path for the given graph.



5. Develop a program to obtain routing table for each node using Distance Vector Routing Algorithm by considering the given subnet with weights indicating delay between Nodes.



6. Write a program to simulate flow-based routing.
7. Write a program to simulate random early detection congestion control algorithm.
8. Using TCP/IP sockets, write a client-server program to open a file available in the server.
9. Write a program for congestion control using leaky bucket algorithm.
10. Write a program for the Mail Client

i) POP Client: Gives the server name, user name and password retrieve the mails and allow manipulation of mail box using POP commands.
ii) SMTP Client: Gives the server name, send email to the recipient using SMTP commands.

11. Write a program for HTTP server to implement the commands - GET, POST, HEAD and DELETE. The server must handle multiple clients.

Exercises on Packet Tracer Simulator Tool:

12. a) Study of basic network commands and network configuration commands.
i) ping ii) nslookup iii) netstat iv) ifconfig

b) Create a network topology and configure a network topology with four PCs, two switches, and two routers.

REFERENCE BOOKS:

1. Andrew S. Tanenbaum and David J. Wetherall, *Computer Networks*, Pearson, 5th Edition, 2015.
2. A. Jesin, *Packet Tracer Network Simulator*, Packt Publishing, 2014.

Software/Tools used:

1. C/Python/Java
2. Network simulator tool - Packet Tracer
3. Virtual Labs (Computer Networks Lab – http://vlabs.iitb.ac.in/vlabs-dev/labs_local/ computer-networks/ labs/explist.php)

ADDITIONAL LEARNING RESOURCES:

1. https://www.itprc.com/packet-tracers/
2. https://www.nsnam.org/docs/tutorial/html/
3. http://www.tcpipguide.com/free/t_OSIReferenceModelLayers.htm

TEXT BOOK:

1. Andrew S. Tanenbaum and David J. Wetherall, *Computer Networks*, Pearson, 5th Edition, 2015.

REFERENCE BOOKS:

1. Behrouz A. Forouzan, *Data Communications and Networking*, McGraw Hill, 5th Edition, 2013.
2. James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach*, Pearson, 7th Edition, 2017.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_cs18/preview
2. https://www.coursera.org/learn/tcpip

WEB RESOURCES:

- https://www.cisco.com/c/en/us/solutions/small-business/resourcecenter/networking/networking-basics.html
- https://memberfiles.freewebs.com/00/88/103568800/documents/Data.And.Computer.Communications.8e.WilliamStallings.pdf

Course Code	Course Title	L	T	P	S	C
22IT102003	**CLOUD COMPUTING**	3	-	2	-	4

Pre-Requisite Object Oriented Programming through Java, Operating Systems

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Fundamental Cloud Computing and Virtualization, Understanding Cloud Models and Architectures, Understanding Cloud Services, Applications and Capacity Planning, Exploring Platform as a Service (PaaS) and Exploring Infrastructure as a Service (IaaS).

COURSE OUTCOMES: *After successful completion of the course, students will be able to:*

CO1. Demonstrate knowledge on basic concepts and terminologies of Cloud Computing and Virtualization.

CO2. Demonstrate knowledge on Cloud deployment models, Service models and Architectures.

CO3. Analyze Cloud services, Applications and Capacity Planning.

CO4. Use different PaaS application frameworks to construct Cloud applications.

CO5. Develop web applications through Google, Microsoft and Amazon web services as per societal needs.

CO6. Work independently or in teams to construct Cloud applications and present with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	2	3	-
CO5	3	2	2	2	2	3	-	-	-	-	-	-	2	2	3	-
CO6	-	-	-	2	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**2**	**3**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT:

Module-1: FUNDAMENTAL CLOUD COMPUTING AND VIRTUALIZATION (10 periods)

Cloud Computing: Origin and influences, Basic concepts and terminology, Goals and benefits, Risks and challenges, Roles and boundaries and Cloud characteristics.

Introduction to Virtualization: Characteristics, Taxonomy of virtualization technologies, Pros and cons of virtualization, Virtualization Technologies: Xen**,** VMware and Hyper-V.

Module-2: UNDERSTANDING CLOUD MODELS AND ARCHITECTURES (8 periods)

Cloud Models: NIST model, Cloud Cube model, Deployment models: Public, Private, Hybrid and Community; Service models: IaaS, PaaS and SaaS.

Understanding Cloud Architecture: Exploring the Cloud Computing Stack: Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications; Connecting to the Cloud: The Jolicloud Netbook OS and Chromium OS - The Browser as an Operating System.

Module-3: UNDERSTANDING CLOUD SERVICES, APPLICATIONS AND CAPACITY PLANNING (9 periods)

Understanding Cloud Services and Applications Infrastructure as a Service (IaaS): IaaS workloads, Pods, aggregation, and silos; Platform as a Service (PaaS), Software as a Service (SaaS): SaaS characteristics, Open SaaS and SOA, Salesforce.com and CRM SaaS; Identity as a Service (IDaaS): Identity, Networked identity service classes, Identity system codes of conduct, IDaaS interoperability; Compliance as a Service (CaaS).

Capacity Planning: Defining Baseline and Metrics: Baseline measurements, System metrics, Load Testing, Resource ceilings, Server and instance types; Network Capacity and Scaling.

Module-4: EXPLORING PLATFORM AS A SERVICE (PaaS) (10 periods)

PaaS Application Frameworks: Drupal, Eccentex AppBase 3.0, LongJump, Squarespace, WaveMaker and Wolf Frameworks.

Exploring Platform as a Service using Google Web Services: Surveying the Google Application Portfolio, Google Toolkit and Working with the Google App Engine.

Exploring Platform as a Service using Microsoft Cloud Services: Exploring Microsoft Cloud Services, Defining the Windows Azure Platform, Windows Live: Windows Live Essentials, Windows Live Home and Windows Live for Mobile.

Module-5: EXPLORING INFRASTRUCTURE AS A SERVICE (IaaS) (8 periods)

Understanding Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2): Amazon Machine Images, Pricing models, System images and software, Creating an account and instance on EC2; Working with Amazon Storage Systems: Amazon Simple Storage System (S3), Amazon Elastic Block Store (EBS) and CloudFront; Understanding Amazon Database Services: Amazon SimpleDB, Amazon Relational Database Service (RDS) and Choosing a database for AWS.

Total Periods: 45

EXPERENTIAL LEARNING

List of Exercises:

1. Create a Virtual Machine on Virtual Box with Ubuntu 14LTs files, 2GB RAM and 200GB Hard Disk configuration through Infrastructure as a Service (IaaS).

2. Create a Virtual Machine on Virtual PC with Windows, 2GB RAM and 200GB Hard Disk configuration through Infrastructure as a Service (IaaS).
3. Create Virtual Private Cloud (VPC) with subnets, route table and Internet gateway using AWS Management Console.
4. Create a virtual machine instance with 2GB RAM and 200 GB hard disk configuration on Amazon Web Services (AWS) cloud through Elastic Compute Cloud (EC2) service and develop a home web page for online bookstore information.
5. Develop a catalogue web page for online bookstore and create a Simple Storage Service (S3) bucket on Amazon Web Services (AWS) cloud and upload catalogue web page into S3 bucket.
6. Compute the following tasks through AWS Lambda function in an event-driven environment using Qwiklabs Cloud:
    i. Create an AWS Lambda function
    ii. Configure an Amazon S3 bucket as a Lambda Event Source
    iii. Trigger a Lambda function by uploading an object to Amazon S3
    iv. Monitor AWS Lambda S3 functions through Amazon CloudWatch Log.
7. Compute the following tasks through Amazon DynamoDB using Qwiklabs Cloud:
    i. Create an Amazon DynamoDB table
    ii. Enter data into an Amazon DynamoDB table
    iii. Query an Amazon DynamoDB table
    iv. Delete an Amazon DynamoDB table.
8. (a) Perform the following operations through Google Cloud Pub/Sub using Qwiklabs Cloud:
    i. Setup a topic to hold data
    ii. Subscribe to a topic to access the data
    iii. Publish and then consume messages with a pull subscriber.

    (b) Create an Google Assistant environment through Actions and Dialogflow for building an Assistant application that generates quotes when prompted by a user using Qwiklabs Cloud.
9. (a) Implement a Python Program using Watson studio in IBM Cloud Environment

    (b) Deploy and Run any application in IBM Cloud Environment

    (c) Develop a chat bot using Watson Assistant in IBM Cloud Environment.
10. (a) Create two data centers in different regions with 10-20 physical host, 6-10 userbases, 100-250 executable instructions length per request using Cloud Analyst simulation tool.

    (b) Evaluate and generate reports for 10(a) with different Service Broker and Load Balancing Policies. Sketch out the comparison report on different policies.
11. Create an instance for connecting, monitoring and visualizing Internet of Things (IoT) device data through Thingspeak cloud.
12. Mini Project: Form a group of maximum 3 members as a team and assign unique projects for each team.

RESOURCES

TEXT BOOKS:

1. Barrie Sosinsky, *Cloud Computing Bible,* Wiley India Pvt Ltd, 2011 (Reprint 2017).
2. Thomas Erl and RicardoPuttini, *Cloud Computing- Concepts, Technology and Architecture,* Pearson, 2014 (Seventh Impression 2017).

REFERENCE BOOKS:

1. Rajkumar Buyya, Christian Vecchiloa and S Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill Education, 2013 (Reprint 2017).
2. George Reese, *Cloud Application and Architectures*, O'Relly, 2009 (Reprint 2017).

WEB RESOURCES:

1. "Exploring the Google Toolkit", https://code.google.com/, drafted on 23 December, 2019.
2. "Understanding Amazon Web Services", https://aws.amazon.com/, drafted on 23 December, 2019.
3. "Exploring Microsoft Cloud Services", https://www.microsoft.com/windowsazure, drafted on 23 December, 2019.
4. "Qwiklabs – Hands-on Cloud Environment", https://www.qwiklabs.com/, drafted on 23 December, 2019.
5. "IBM Cloud Envrionment", https://www.ibm.com/in-en/cloud, drafted on 23 December, 2019.
6. "Cloud Analytics Simulation Tool", http://www.cloudbus.org/cloudsim/, drafted on 23 December, 2019.
7. "Thingspeak Cloud", https://thingspeak.com/, drafted on 23 December, 2019.

SOFTWARE/TOOLS:

1. Virtual Box and Virtual PC Software
2. Cloud Analyst Simulation Tool
3. Amazon Web Services (AWS), Qwiklabs, IBM Bluemix and Thingspeak Cloud

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22CS102002	**PYTHON PROGRAMMING**	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Basics of Python programming, Control structures, Sequences, Sets, Dictionaries, Regular expressions, Functions, File handling, Object-oriented programming, Exception handling.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on Python constructs, sequences, sets and dictionaries to solve basic computational problems.

CO2. Apply the concepts of regular expressions for searching patterns in strings.

CO3. Develop and use Python modules to provide solutions to problems.

CO4. Apply the knowledge of file operations in Python for file processing.

CO5. Design applications using object-oriented programming features – encapsulation, inheritance, polymorphism and exception handling.

CO6. Work independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	3	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	2	3	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO PYTHON PROGRAMMING ***(07 Periods)***

Introduction to Python, Tokens, Variables, Literals, Identifiers, Keywords, Special symbols, Operators, Fundamental datatypes, Expressions, Type conversions, Handling Input and output in Python.

Module 2: CONTROL STRUCTURES ***(08 Periods)***

Selection Statements: if statement, if-else statement, if-elif-else statement, nested-if statement.

Iterative Statements: while loop, for loop, break statement, continue statement, pass and else statements used with loops.

Module 3: SEQUENCES, SETS, DICTIONARIES AND REGULAR EXPRESSIONS ***(11 Periods)***

Sequences: Lists and operations – Creating, Inserting elements, Updating elements, Deleting elements, Searching and sorting, List comprehensions, Nested lists; Tuples – Creating, Searching and sorting, Nested tuples; Strings – Initializing a string and string operations, String handling methods, String formatting.

Sets: Set creation, Set operations.

Dictionaries: Operations on dictionaries, Dictionary methods, Sorting elements using lambdas.

Regular Expressions: Regular expressions, Sequence characters in regular expressions, Quantifiers in regular expressions, Special characters in regular expressions.

Module 4: FUNCTIONS AND FILE HANDLING ***(09 Periods)***

Functions: Need for functions, Function definition, Function call, Variable scope and lifetime, Return statement, Positional arguments, Keyword arguments, Default arguments and variable length arguments, Recursive functions, Lambda functions, Generators.

File Handling: Types of files, Opening and closing files, Reading and writing data.

Module 5: OBJECT ORIENTED PROGRAMMING AND EXCEPTION HANDLING ***(10 Periods)***

Object Oriented Programming: Introduction to object-oriented programming, Classes and objects, Inheritance and polymorphism, Abstract Classes and interfaces.

Exception Handling: Errors in a python program, Exceptions, Exception handling, Types of exceptions, Except block, Assert statement, User defined exceptions.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1) Design a python script to the perform the various computations for the amount payable by the customer for Challenger Computers Store. A customer buying two numbers of SSD device, one SSD device cost is Rs. 3575/-. The stores offer 15% of the total cost. The customer has to pay 9% CGST, and 9% SGST. Prepare the Net Amount to be payable by the customer.
2) Design a python script to compute and generate the electricity bill as per the following slab rates. Collect the meter reading inputs, such as current unit and previous unit.

Consumption Units	Rate (in Rupees/Unit)
0-200	3.0
201-250	4.5
251-300	5.2
301-400	6.5
Above 400	7.0

3) Design a python script to display the sum of numbers divisible by 4. The code must allow the user to accept a number and add it to the sum if it is divisible by 4. It should repeatedly accepting numbers as long as the user wants to provide an input using an appropriate iterative statement and should display the final sum.
4) Food Corner home delivers vegetarian and non-vegetarian combos to its customer based on order. A vegetarian combo costs Rs.120 per plate and a non-vegetarian combo costs Rs.150 per plate. Their non-veg combo is really famous that they get more orders for their non-vegetarian combo than the vegetarian combo. Apart from the cost per plate of food, customers are also charged for home delivery based on the distance in kms from the restaurant to the delivery point. The delivery charges are as mentioned below:

Distance in kms	Delivery charge in Rs per km
For first 3kms	0
For next 3kms	3
For the remaining	6

Given the type of food, quantity (no. of plates) and the distance in kms from the restaurant to the delivery point, write a python program to calculate the final bill amount to be paid by a customer. The below information must be used to check the validity of the data provided by the customer.

- Type of food must be 'V' for vegetarian and 'N' for non-vegetarian.
- Distance in kms must be greater than 0.
- Quantity ordered should be minimum 1.
- If any of the input is invalid, bill amount should be considered as -1.

5) a) A list has the AP City Names [Tirupati, Kurnool, Kadapa]. Design a python script and perform the operations like, add 3 more AP City names Chittoor, Nellore, Guntur, insert Hyderabad in 3rd position, delete any two city names, update all city names as in Uppercase. Displays the list data, whenever an operation completes.

b) Design a python script for given an integer tuple, for each element in the tuple, check whether there exists a smaller element on the next immediate position of the tuple. If it exists print the smaller element. If there is no smaller element on the immediate next to the element then print -1.
Example: Input: 4 2 1 5 3 Output: 2 1 -1 3 -1

6) a) Sets n1 has the data {1, 3, 5, 7, 9}, n2 has the data {9, 5, 6, 8},
wd1=set(["Mon", "Tue", "Wed", "Thu", "Fri", "Sat", "Sun"]),
wd2=set(["Mon", "Tue", "Wed"]).
Design a python script to perform intersection, difference, and symmetric difference operations on the sets n1 and n2, and to perform superset, and subset operations on the sets wd1, and wd2.

b) The dictionary city_pin has the data {'Tirupati': 517101, 'Hyderabad': 500002, 'Chittoor': 517001,'Nellore': 524001}. Design a python script using lambda function to sort the dictionary on city name and produce the output and sort the dictionary on pincode and produce the output.

c) The string has the data, Wel_str = "Welcome to AI ML DS". Design a python script to search the pattern "AI" using regular expression search and display the three location numbers of the pattern. First shows the pattern starts location, second shows the pattern end location, and the last shows pattern span locations.

7) a) Design a python script for the mathematical puzzle, Towers of Hanoi. The puzzle has three rods and n disks. To move the entire stack to another rod, obeying the three rules (i) Only one disk can be moved at a time, (ii) Each move consists of taking the upper disk from one of the stacks and placing it on top of another stack i.e., a disk can only be moved if it is the uppermost disk on a stack, (iii) No disk may be placed on top of a smaller disk.

b) Design a python script to display the numbers that do not appear in the Fibonacci series of n numbers where n is given by the user. (If n is 8 then up to 8 Fibonacci numbers has to be printed Ex: 1 1 2 3 5 8 13 21 and in this series missing numbers should be traced and printed, Ex: missing numbers are: 4 6 7 9 10 11 12 14 15 16 17 18 19.

8) a) Design a function Learner_Age_Days with two formal parameters name, age and it computes Learner's age in days, then displays learners name and age in days.

(i) Design a driver code to call the function using positional arguments, keyword arguments

(ii) Apply the necessary changes in Learner_Age_Days function, and design a driver code to call the function using default arguments.

b) Design a python script using lambda and filter functions to construct an odd numbers list from numbers 1 to 10, and construct a negative numbers list from range of numbers -7 to 7 and to find the biggest number from a numbers list.

9) a) Design a python script to create a new file Collect_Literals_Phython.txt, collect the data from the keyboard about the contents of collection literals list, tuple, sets, dictionaries details, then write all the data into that file, and then close that file. Afterwards Open the Collect_Literals_Phython.txt file in read mode, read the entire contents of the file Collect_Literals_Phython.txt, then display all the contents of

that file in monitor.

b) The file feat_python1.txt has the contents of features of the Python programming language. Design a python script to open that file feat_python1.txt in read mode, open the new file in feat_python2.txt in write mode, then read entire contents of the file feat_python1.txt, then copy all the contents of that file into the new file feat_python2.txt

10) a) Construct a Python script to implement the below requirements. Create a base class Basic_Info with data members name, rollno, gender and two member functions getdata() and display(). Derive a class Physical_Fit from Basic_Info which has data members height and weight and member functions getdata() and display(). Display all the information using object of derived class.

b) Design a Python script to implement the below specifications, compute, and produce required output. Define a class REPORT with the following specification

Private members

Admno : 4-digit admission number
Name : 20 characters
Marks : A list of 5 floating point values
Average : average marks obtained
GETAVG() a function to compute the average obtained in five subjects.

Public members

READINFO() function to accept values for Adno, Name, Marks. Invoke the function GETAVG ().
DISPLAYINFO() function to display all data members of report on the screen. You should give function definitions. Write driver code to demonstrate all the functions.

11) a) The below scenarios will create Logical Error/Exception, and it will forcibly stop the execution in middle of the program. Design a Python Script the to handle these operations exceptions effectively, and avoid to stop the script execution in the middle.

i. The variable num has the data 100, the value of num dividing by the value 0.
ii. To importing a library file matheqn, this library file not available in Python.
iii. A num_List has the values[10,20,30].To print the fifth value of num_List[5]
iv. A dictionary has the data, Dict_Univ = {'1':"MBU", '2':"Tirupathi", '3':"CSE"}. to print the fifth key value Dict_Univ[5]

b) Design a python script to collect the 10 students Python course mark. Check that entered mark is negative, then throw a user defined exception called Negative, otherwise store into the mark in the List Python_mark[].

RESOURCES

TEXT BOOKS:

1. R. Nageswara Rao, *Core Python Programming*, 3rd Edition, Dreamtech Press, 2021.
2. Paul J. Deitel, Harvey Deitel, Python for Programmers with Big Data and Artificial Intelligence Case Studies, Pearson, 2019.

REFERENCE BOOKS:

1. Charles Dierbach, *Introduction to Computer Science using Python: A Computational Problem Solving Focus*, Wiley India, 2016.
2. Christian Hil, Learning Scientific Programming with Python, 2nd Edition, Cambridge University Press, 2020.

SOFTWARE/TOOLS:

1. Python 3.10

2. Jupyter Notebook/JupyterLab/IDLE/Google CoLab

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_cs41/preview
2. https://www.coursera.org/specializations/python
3. https://www.coursera.org/learn/python-for-applied-data-science-ai
4. https://www.youtube.com/watch?v=WGJJIrtnfpk
5. https://www.youtube.com/watch?v=_uQrJ0TkZlc
6. https://www.udemy.com/topic/python/
7. https://freevideolectures.com/course/2512/python-programming

WEB RESOURCES:

1. https://www.w3schools.com/python/
2. https://www.programiz.com/python-programming
3. https://www.geeksforgeeks.org/python-programming-language/
4. https://www.javatpoint.com/python-lists
5. https://www.learnpython.org/

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22IT104001	**WEB TECHNOLOGIES**	3	-	2	4	5

Pre-Requisite - Object Oriented Programming through Java

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Hyper Text Markup Language (HTML); Features of HTML5; Cascading Style Sheets (CSS); JavaScript; JQuery; Bootstrap; Hypertext Preprocessor (PHP); MySQL.

COURSE OUTCOMES: *After successful completion of this course, the students will be able to:*

CO1. Demonstrate knowledge on web page design elements, dynamic content and database connection.

CO2. Analyze user requirements to develop web applications.

CO3. Design client-server applications using web technologies.

CO4. Demonstrate problem solving skills to develop enterprise web applications.

CO5. Apply HTML, CSS, JavaScript, JQuery, Bootstrap and PHP technologies for device independent web application development.

CO6. Apply web technologies to develop interactive, dynamic and scalable web applications for societal needs.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	2	3	-
CO5	3	2	2	2	2	3	-	-	-	-	-	-	2	2	3	-
CO6				2					3	3						
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**				**3**	**3**			**3**	**2**	**3**	

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT:

Module-1: HTML (09 periods)

Introduction: Fundamentals of HTML, Working with Text, Organizing Text in HTML, Working with Links and URLs, Creating Tables, Working with Images, Canvas, Forms, Frames and Multimedia.

HTML5: Introduction, HTML5 Document Structure, Creating Editable Content, Checking Spelling Mistakes, Exploring Custom Data Attributes, Client-Side Storage, Drag and Drop Feature, Offline Web Applications, Web Communications, Cross-Document Messaging and Desktop Notifications.

Module-2: CSS AND JAVASCRIPT (10 periods)

CSS: Introduction, CSS Selectors, Inserting CSS in an HTML document, Backgrounds, Fonts, and Text Styles, Creating Boxes, Displaying, Positioning and Floating Elements, Features of CSS3, Media Queries.

Javascript: Overview of JavaScript, JavaScript Functions, Events, Image Maps and Animations, JavaScript Objects, Working with Browser and Document Objects, JQuery **-** Introduction, JQuery Selectors, Events, Methods to access HTML elements and attributes, Introduction to AJAX.

Module-3: BOOTSTRAP (09 periods)

Getting Started with Bootstrap, Creating Responsive Layouts Using Bootstrap CSS - Basic HTML structure for Bootstrap, Responsive classes, Rendering images, The grid system, Constructing data entry forms, Packaged Components in Bootstrap - The page header, Glyphicons, The navigation bar, Badges, Alerts, Toolbars and button groups, Panels.

Module-4: INTRODUCTION TO PHP (09 periods)

Introduction, Data Types, Variables, Constants, Expressions, String Interpolation, Control Structures, Functions, Arrays, Embedding PHP Code in Web Pages, Object Oriented PHP.

Module-5: PHP WEB FORMS AND MYSQL (08 periods)

PHP Web forms: PHP and Web Forms, Sending Form Data to a Server, Working with Cookies and Session Handlers

PHP with MySQL: Interacting with the Database, Prepared Statement, Database Transactions.

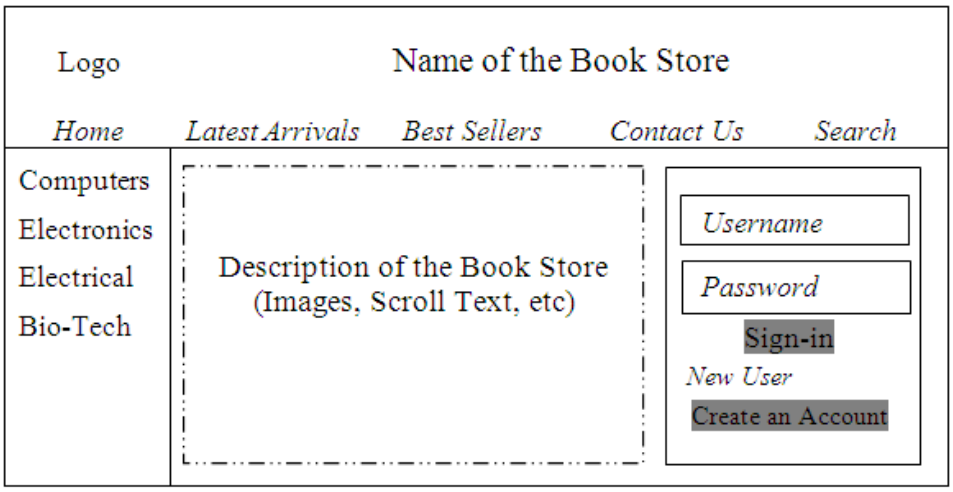
Total Periods: 45

EXPERENTIAL LEARNING

List of Exercises:

1. Design the following static web pages of an online book store web application.

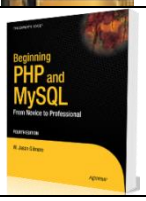
a. Home Page:



b. Catalogue Page:

The catalogue page should display the following details of available books.

i. Snap shot of cover page ii. Title of the text book iii. Author name
iv. Publisher v. Price vi. More details link.

Logo	Name of the Book Store			
Home	*Latest Arrivals*	*Best Sellers*	*Contact Us*	*Search*
Computers Electronics Electrical Bio-Tech	 	**HTML5 Black Book** Kogent Learning Solutions Dreamtech Press Rs. 570/-	More Details	
	 	**Beginning PHP and MySQL** 4th Edition W Jason Gilmore Apress Rs. 520/-	More Details	

c. Registration Page:

Design the Registration page with the following fields and navigate it with create an account link.

i. First Name ii. Last Name iii. Gender
iv. Date of Birth v. Username vi. Password
vii. Confirm Password viii. Address ix. Postal Code
x. Mobile No. xi. Email-Id

2. a. Design a web page to store username and password information using the local storage concept.
   b. Design a web page to store employee information including Name, Emp. Id, Department, Salary and Address on a client's machine using a real SQL database.

3. Apply the following styles to all web pages of online book store web application.
   a. Fonts and Styles: font-family, font-style, font-weight and font-size
   b. Backgrounds and colors: color, background-color, background-image and background-repeat
   c. Text: text-decoration, text-transformation, text-align and text-indentation, text-align
   d. Borders: border, border-width, border-color and border-style
   e. Styles for links: A: link, A: visited, A:active, A:hover
   f. Selectors, Classes, Layers and Positioning elements.

4. Write a JavaScript/JQuery code to validate the following fields of the Registration web page.
   a. First Name/Last Name - should contain only alphabets and the length should not be less than 8 characters.
   b. Username - It should contain combination of alphabets, numbers and underscore. It should not allow spaces and special symbols.
   c. Password - It should not less than 8 characters in length and it contains one uppercase letter and one special symbol.
   d. Date of Birth - It should allow only valid date; otherwise display a message stating that entered date is invalid. Ex. 29 Feb. 2009 is an invalid date.
   e. Postal Code: It must allow only 6 digit valid number.
   f. Mobile No. - It should allow only numbers and total number of digits should be equal to 10.
   g. e-mail id - It should allow the mail id with the following format:
   Ex. mailid@domainname.com

5. Design a web page with the following features using HTML5, JavaScript and JQuery
   a. Displaying of images with Custom animated effects

b. Playing of selected video from the list of videos
c. Showing the animated text in increasing and decreasing font size
d. Changing the size of the area in a web page using DIV tag
e. Hiding and Showing elements in a web page.

6. Design a web page with the following features using Bootstrap and Media Query.
   a. Components
   b. Responsive tables
   c. Responsive images and videos
   d. Toolbars, Buttons and Lists

7. a. Deploy and navigate web pages of online book store using WAMP/XAMPP web server.
   b. Write a PHP program to read user name and favorite color from the HTML form. Display the name of the user in green color and sets user favorite color as a background for the web page.

8. Write a PHP code to read the username and password entered in the Login form of the online book store and authenticate with the values available in cookies. If user enters a valid username and password, welcome the user by username otherwise display a message stating that, entered details are invalid.

9. Write a PHP code to read user details entered through the registration web page and store the same into MySQL database.

10. Write a PHP code for storing books details like Name of the book, author, publisher, edition, price, etc into MySQL database. Embed a PHP code in catalogue page of the online book store to extract books details from the database.

RESOURCES

TEXT BOOKS:

1. Kogent Learning Solutions Inc, *HTML 5 Black Book: Covers CSS3, JavaScript, XML, XHTML, AJAX, PHP and JQuery*, Dreamtech Press, First Edition, 2011.
2. W. Jason Gilmore, *Beginning PHP and MySQL*, APress, Fourth Edition, 2011.

REFERENCE BOOKS:

1. Snig Bahumik, *Bootstrap Essentials*, PACKT Publishing, First Edition, 2015

   (e-book).
2. Thomas A. Powell, *The Complete Reference: HTML and CSS,* Tata McGraw Hill, Fifth Edition, 2010.
3. Andrea Tarr, *PHP and MySQL*, Willy India, First Edition, 2012.

WEB RESOURCES:

1. https://www.w3schools.com/php/DEFAULT.asp
2. https://www.w3schools.com/js/

Program Elective

Course Code	Course Title	L	T	P	S	C
22CS104002	**MOBILE APPLICATION DEVELOPMENT**	3	-	2	4	5

Pre-Requisite - Object Oriented Programming through Java

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Mobile platforms; Mobile User Interface and tools; Introduction to Android; Activities; Views; Menus; Database Storage; SMS; e-mail; Displaying Maps; Building a Location Tracker Web Services Using HTTP; Sockets Programming; Communication between a Service and an Activity; Introduction to iOS.

COURSE OUTCOMES: *After successful completion of this course, the students will be able to:*

CO1. Demonstrate knowledge on mobile platforms, mobile user interface and user interface design requirements.

CO2. Design user interfaces by analyzing user requirements.

CO3. Develop mobile applications for Messaging, Location-Based Services, And Networking.

CO4. Develop mobile applications and publish in different mobile platforms.

CO-PO-PSO Mapping Table:

Course Outcome	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	1	2	3	2	-	-	-	-	-	-	-	-	3	-	-	-
CO3	1	2	2	2	3	2	2	1	-	-	-	-	3	-	-	2
CO4	1	2	3	2	3	2	2	1	-	-	-	-	3	-	-	-
Course Correlation Mapping	**2**	**2**	**3**	**2**	**3**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**3**	**-**	**-**	**1**

Correlation Level: 3-High; 2-Medium; 1-Low

DETAILED SYLLABUS:

Module - I: INTRODUCTION AND MOBILE USER INTERFACE DESIGN (8 periods)

Mobile web presence, Mobile applications, Marketing, App as a mobile web app; User interface design - Effective use of screen real estate, Mobile application users, Mobile information design, Mobile platforms, Tools of mobile interface design.

Android versions, Features and architecture, Required tools, Android application launching.

Module - II: ACTIVITIES, INTENTS AND ANDROID USER INTERFACE (9 periods)

Activities, Linking activities using intents, Calling Built – In Applications Using Intents, Displaying notifications, Components of a screen, Adapting to display orientation, Managing changes to screen orientation, Utilizing the action bar, Listening for UI notifications.

Module-III: ADVANCED USER INTERFACE AND DATA PERSISTENCE (10 periods)

Basic views, Picker views, List view, Image view, Menus with views, Web view, Saving and loading user preferences, Persisting data to files, Creating and using databases.

Module IV: MESSAGING, LOCATION-BASED SERVICES, AND NETWORKING (9 Periods)

SMS messaging, Sending e-mail, Displaying maps, Getting location data, Monitoring a location, Consuming web services using HTTP.

Module- V: ANDROID SERVICES, PUBLISHING ANDROID APPLICATIONS AND IOS (9 Periods)

Services, Communication between a service and an activity, Binding activities to services, Threading, Preparing for publishing, Deploying APK files.

iOS tools, iOS project, Debugging iOS apps, Objective-C basics, Hello world app, Building the derby app in iOS.

Total Periods: 45

Experiential Learning

1. Develop an application that uses GUI components, Font and Colours
2. Develop an application that uses Layout Managers and event listeners.
3. Write an application that draws basic graphical primitives on the screen.
4. Develop an application that makes use of databases.
5. Develop an application that makes use of Notification Manager.
6. Implement an application that uses Multi-threading.
7. Develop a native application that uses GPS location information
8. Implement an application that writes data to the SD card.
9. Implement an application that creates an alert upon receiving a message
10. Write a mobile application that makes use of RSS feed

MINI-PROJECT

11. Develop a mobile application to send an email.
12. Develop a Mobile application for simple needs

TEXT BOOKS:

1. J. F. DiMarzio, "Beginning Android Programming with Android Studio," Wiley India, Fourth Edition, 2017.
2. Wei – Meng Lee, "Beginning Android 4 Application Development", Wrox, 2017.
3. Jeff McWherter and Scott Gowell, "Professional Mobile Application Development," Wiley India, First Edition, 2012.

REFERENCE BOOKS:

1. Neils Smyth "Android Stduio Development Essentials," Creative Space Independent publishing platform, Seventh edition 2016.
2. Paul Deital and Harvey Deital, "Android How to Program," Detial associates publishers, First Edition, 2013.

SOFTWARE/TOOLS:

1. Software: Eclipse / Net beans / JDK 1.7
2. Java compatible web browser

VIDEO LECTURES::

1. https://www.youtube.com/playlist?list=PLknSwrodgQ72X4sKpzf5vT8kY80HKcUSe
2. https://www.udemy.com/topic/android-development/free/
3. https://www.udemy.com/course/mobile-application-development-using-android/

WEB RESOURCES:

1. https://developer.android.com/
2. https://egyankosh.ac.in/handle/123456789/70868
3. https://www.tru.ca/distance/courses/comp2161.html

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101003	**MOBILE COMPUTING**	3	-		-	3

Pre-Requisite Computer Networks
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Overview of Mobile computing and Second-Generation Architecture; Wireless Medium Access Control, CDMA, 3G, WIMAX, 4G and 5G Networks; Mobile IP Network Layer; Mobile Transport Layer; Wireless LAN and Personal Area Network Protocols.

COURSE OUTCOMES: *After successful completion of the course, students will be able to*:

CO1. Understand the basics mobile computing and second-generation architectures.
CO2. Demonstrate knowledge on Wireless Medium Access Control, CDMA, 3G, WiMax, 4G And 5G Networks.
CO3. Understand the Network protocols and their functionality.
CO4. Understand the functionality of Transport Layer.
CO5. Demonstrate knowledge on wireless LAN and Personal Area Network protocols

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1: OVERVIEW OF MOBILE COMPUTING AND SECOND-GENERATION ARCHITECTURE **10 periods)**

Module 2: WIRELESS MEDIUM ACCESS CONTROL, CDMA, 3G, WIMAX, 4G AND 5G NETWORKS **(10 periods)**

Modulation, Medium Access Control, Exposed and Hidden Terminal Problem, Near and Far Terminal Problem, and Power Control for Medium Access, MAC Algorithms, WLAN and CAMA/CA Wireless Protocols, SDMA, TDMA, FDMA and CDMA, Direct Sequence Spread Spectrum, Frequency Hopping Spread Spectrum, Code Division Multiple Access

3G: Applications of 3G Mobile Services, 3G Mobile Services: IMT2000 and UMTs, CDMA 2000: 3G, WCDMA 3G, OFDM, High-speed Packet Access, Mimo in HSPA, Long-term Evolution and WiMax 16E, Ultra-wide Band and Broadband Wireless Access
4G Networks: HS-OFDM, LTE Advanced and WiMax 16M, Upcoming 5G Network Features

Module 3: MOBILE IP NETWORK LAYER **(9 periods)**

Functioning of OSI Layers, and TCP/IP, IP, UDP and ICMP Protocols, Mobile IP, Packet Delivery and Handover Management, Location Management, Registration, IP Header: Encapsulation and Routes Optimization, Mobility Binding, Tunneling, and Reverse Tunneling, Dynamic Host Configuration Protocol, Cellular IP, Mobile IP with IPv6, Voice over IP, IP Security.

Module 4: MOBILE TRANSPORT LAYER ***(8 Periods)***

Conventional Transport Layer Protocols: UDP and TCP, Indirect TCP, Snooping Transmission Control Protocol, Mobile TCP, Other Transmission Methods at TCP Layer for Mobile Networks, TCP over 2.5G/3G Mobile Networks

Module 5: WIRELESS LAN AND PERSONAL AREA NETWORK PROTOCOLS ***(8 Periods)***

Wireless LANs, Wireless Application Protocol, Wireless Markup Language, Bluetooth, WiMax, ZigBee and Wi-Fi, Bluetooth, and ZigBee Features

Total Periods: 45

TEXT BOOKS:

1. Rajkamal, *Mobile Computing,* OXFORD University Press, 3rdEdition, 2019.

REFERENCE BOOKS:

1. Jochen Schiller*, Mobile Communications,*Pearson Education, 2ndEdition, 2009

VIDEO LECTURES:

https://onlinecourses-archive.nptel.ac.in/noc16_cs13/preview

WEB RESOURCES:

1. https://www.javatpoint.com/mobile-computing
2. https://www.geeksforgeeks.org/wireless-mobile-computing-technologies
3. https://dataconomy.com/2022/07/29/what-is-mobile-computing

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB102006	**INTERNET OF THINGS**	3	-	2	-	4

Pre-Requisite - Computer Networks

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Internet of Things Components; Domain Applications; Communication models; Sensors; Connectivity; Prototyping; Hardware; Design Methodology; Development platforms; Data Analytics for IoT; IoT Security..

COURSE OUTCOMES: *After successful completion of the course, students will be able to*:

CO1. Understand IoT Architectures , communication technologies and various applications of IoT

CO2. Demonstrate knowledge on IoT-related protocols and Smart Objects

CO3. Understand hardware platforms and cloud services related to IoT

CO4. Build IoT applications using Arduino and Raspberry Pi

CO5. Understand data analytics concepts and security issues in the context of IoT

CO6. Work independently and in teams to develop IoT applications with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	2	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-	3	2	2	-
CO4	3	2	3	2	3	-	-	-	-	-	-	-	3	2	2	3
CO5	3	2	2	3	-	-	-	-	-	-	-	-	3	2	2	3
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	3	2	2	3

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION & DOMAIN APPLICATIONS ***(09 Periods)***

Introduction to Internet of Things:
Definition, Conceptual Framework, Architectural View, Technology behind IoT, Communication Technologies, Data Enrichment, Data consolidation and Device management at Gateway.

IoT and M2M: M2M, Difference between IoT and M2M, SDN and NFV for IoT.

Domain Specific IoTs: Home automation, Cities, Environment, Health and Life Style.

Module 2: SENSORS & CONNECTIVITY ***(09 Periods)***

Sensor Technology, Actuators, RFID Technology, Internet Connectivity, Internet-Based Communications, IP Addressing in the IoT, Medium Access Control, Application Layer Protocols.

Module 3: PROTOTYPING & HARDWARE ***(8 Periods)***

Embedded Computing Basics, Embedded platforms for prototyping, Things always connected to the Internet/Cloud, Amazon Web Services for IoT.

Module 4: DESIGN METHODOLOGY & CASE STUDIES ***(10 Periods)***

Design Methodology: Purpose and Requirements specifications, Process Specifications, Domain Model Specification, Information Model Specification, Service Specification, IoT Level Specifications, Functional View Specification, Operational View Specification, Device and Component integration, Application development.
Case Studies Illustrating IoT Design: Home Automation, Cities.

Module 5: DATA ANALYTICS FOR IOT& IoT Security ***(9 Periods)***
Data Analytics for IoT: Apache Hadoop, Using Hadoop MapReduce for Batch Data Analysis.
IoT Security: Vulnerabilities, Security Requirements and Threat analysis, Security Tomography and Layered Attacker Model, Identity Management and Establishment, Access Control and Secure Message Communication, Security Models, Profiles and Protocols for IoT

Total Periods: 45

EXPERIENTIAL LEARNING

1. (a) Design and Simulate LED 7-Segment Display interfacing with Arduino.
   (b) Design and Simulate Servo motor interfacing with Arduino.
2. (a) Design and Simulate ultrasonic sensor and LCD interfacing with Arduino.
   (b) Design and Simulate Flame Sensor interfacing with Arduino.
3. Design and Implement to capture Gas Sensor and send sensor data to cloud from your NodeMCU device using Arduino IDE.
4. Design and Implementation of Humidity and Temperature Monitoring Using Arduino and upload data to cloud using MQTT.
5. Design and Implementation of an IoT ECG (Electrocardiogram) System to record hearts electrical activity.
6. Design and Simulate controlling an LED 7-Segment Display with Raspberry Pi.
7. Design and implementation of Raspberry Pi Home Security System with Camera and PIR Sensor with Email Notifications.
8. Design and Implement to upload Light sensor (TSL) data to cloud through Raspberry Pi.
9. Design and Implementation of Motion Detector with NodeMCU and BLYNK.
10. Design and Implementation of Fire notification IoT system with BLYNK.

TEXT BOOKS:

1. ArshdeepBahga, Vijay Madisetti, *Internet of Things – A hands-on approach*, University Press, 2015.
2. Raj Kamal, *Internet of Things- Architecture and Design Principles*, McGraw Hill, 2017.

REFERENCE BOOKS:

1. Adrian McEwen and Hakim Cassimally, *Designing the Internet of Things*, Wiley Publishing, 2013.
2. CharlesBell, *Beginning Sensor Networks with Arduino and Raspberry Pi*, Apress, 2013.
3. Marco Schwartz, *Internet of Things with the Arduino Yun*, Packt Publishing, 2014.
4. Matt Richardson, Shawn Wallace, *Getting Started with Raspberry Pi*, Maker Media, Inc, 2012.

SOFTWARE/TOOLS:

- Arduino IDE

VIDEO LECTURES:

1. https://www.digikey.com/en/maker/projects/how-to-interface-a-seven-segment-display-with-an-arduino/9c05f147618c4fe3b8bb79acce5c60e3
2. https://www.engineersgarage.com/interfacing-servo-motor-with-arduino-mega-2560/

WEB RESOURCES:

1. https://www.geeksforgeeks.org/top-applications-of-iot-in-the-world1.
2. https://www.javatpoint.com/internet-of-things-applications

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101018	SEMANTIC WEB AND SOCIAL NETWORKS	3	-	-	-	3

Pre-Requisite Computer Networks and Web Technologies
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Semantic web and social network analysis; web data & semantics in social network applications and knowledge representation; modeling, aggregating and social network data; developing social semantic applications; evaluation of web-based social network extraction and semantic- based network analysis in the science.

COURSE OUTCOMES: ***After successful completion of this course, the students will be able to:***

CO1. Demonstrate Knowledge on semantic web and social networks.

CO2. Analyze Ontology tools and their role in the Semantic Web.

CO3. Apply Ontological representation for Social network applications.

CO4. Develop semantic web applications with social network features.

CO5. Apply different social network applications and knowledge representations in sciences.

CO-PO-PSO MappingTable:

Course Outcomes	ProgramOutcomes												ProgramSpecific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	-	3	-
CO4	2	3	3	-	-	2	-	-	-	-	-	-	3	-	3	-
CO5	2	2	3	-	2	-	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	-	2	2	-	-	-	-	-	-	3	-	3	-

CorrelationLevels: 3:High; 2: Medium; 1:Low

DETAILED SYLLABUS:

UNIT-I: SEMANTIC WEB AND SOCIAL NETWORK ANALYSIS (8 Periods)

Introduction of Semantic Web, Limitations of the current Web, Development of semantic Web-Research, development and standardization, Technology adoption, The emergence of semantic web, network analysis, development of Social Network Analysis .Key concepts and measures in network analysis-The global structure of networks, the macro structure of social networks.

UNIT-II: SOCIAL NETWORK APPLICATIONS AND KNOWLEDGE REPRESENTATION (10 Periods)

Electronic sources for network analysis- Electronic discussion networks, Blogs and online communities , Web-based networks, Ontology and their role in the Semantic Web - Ontology-based knowledge Representation, Ontology languages for the Semantic Web- Resource Description Frame work and schema, Web Ontology Language ,comparison to the Unified modeling language, comparison to the Entity/ Relationship(E/R) model and the relational model, comparison to the Extensible Markup Language(XML) and XML schema.

UNIT-III: MODELING AND AGGREGATING SOCIAL NETWORK DATA (9 Periods)

State-of-the-art in network data representation, Ontological representation of social individuals , Ontological representation of social relationships , Aggregating and reasoning with social network data- Representing identity, On the nation of equality, Determining equality, Reasoning with instance equality ,Evaluating smushing, Advanced representations.

UNIT-IV: DEVELOPING SOCIAL SEMANTIC APPLICATIONS (9 Periods)

Building semantic Web applications with social network features- The generic architecture of semantic Web applications, Sesame, Elmo, GraphUtil. Flink- The social networks of the Semantic Web Community, The feature of Flink, system design, openacademia-distributed, semantic-based publication management- The features of openacademia, system design.

UNIT-V: EVALUATION OF WEB-BASED SOCIAL NETWORK EXTRACTION AND ANALYSIS IN THE SCIENCES (9 Periods)

Differences between survey methods and electronic data extraction, context of the empirical study, Data collection, preparing the data ,Optimizing goodness of fit ,Comparison across methods and networks, Predicting the goodness fit, Evaluation through analysis ,Methodology- Data acquisition, Representation, storage and reasoning, Visualization and analysis. Results- Descriptive analysis, Structural and cognitive effects on scientific performance.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOK:

1. Peter Mika, *Social Networks and the Semantic Web*, Springer, 1st Edition, 2007.

REFERENCE BOOK:

1. Charu C. Aggarwal, *Social Network Data Analytics*, Springer, 2011.

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101017	AD HOC AND WIRELESS SENSOR NETWORKS	3	-	-	-	3

Pre-Requisite Computer Networks
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Ad hoc Wireless Networks, Medium Access Control Protocols for Ad hoc Wireless Networks, Routing Protocols for Ad hoc Wireless Networks, Wireless Sensor Networks, Medium Access Control Protocols for WSN's.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Investigate ad hoc and wireless sensor networks to improve the network performance.

CO2. Analyze the issues in MAC, routing protocols in Ad hoc wireless networks.

CO3. Apply routing protocols of MAC Layer in sensor networks to provide networking solutions.

CO4. Follow norms and standards in engineering practice to solve ad hoc and wireless sensor network problems.

DETAILED SYLLABUS:

UNIT–I: AD HOC WIRELESS NETWORKS (8 periods)

Fundamentals of wireless communication technology, The electromagnetic spectrum, Radio propagation mechanisms, Characteristics of the wireless channel, Applications, Issues, Ad hoc wireless Internet.

UNIT–II: MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS (8 periods)

Issues in designing a MAC protocol, Classification of MAC protocols, Contention based protocols, Contention based protocols with reservation mechanisms, Contention based protocols with scheduling mechanisms.

UNIT–III:ROUTING PROTOCOLS FOR AD HOC WIRELESS NETWORKS (9 periods)

Issues in designing routing and transport layer protocol for Ad hoc networks, Classification of routing protocols, Table driven routing protocols, On demand routing protocols, Hybrid routing protocols.

UNIT–IV: WIRELESS SENSOR NETWORKS (9 periods)

Vision of ambient intelligence, Application examples, Types of applications, Challenges of WSN's, Why are sensor networks different, Enabling technologies, Hardware components, Energy consumption of sensor nodes.

UNIT–V: MEDIUM ACCESS CONTROL PROTOCOLS FOR WIRELESS SENSOR NETWORKS (11 periods)

Fundamentals of MAC protocols, Low duty cycle protocols and wake up concepts, Contention based protocols, Schedule based protocols, IEEE 802.15.4 MAC protocol, 802.11 and Bluetooth, Case study on tele healthcare – Introduction, MASN hardware design, Reliable MASN communication protocols, MASN software design, Integration of RFID and wearable sensors.

Total Periods: 45

Topics for self-study are provided in lesson plan

TEXT BOOKS:

1. C. Siva Ram Murthy, B.S. Manoj, *Ad Hoc Wireless Networks: Architectures and Protocols*, Pearson, 2012.
2. Holger Karl and Andreas Willig, *Protocols and Architectures for Wireless Sensor Networks*, Wiley, 2017.

REFERENCE BOOKS:

1. Fei Hu and Xiaojun Cao, *Wireless Sensor Networks: Principles and Practice*, CRC Press, 2010.
2. Yi Qian, Peter Muller and Hsiao–Hwa Chen, *Security in Wireless Networks and Systems*, Wiley, 2011.

Program Elective

Course Code	Course Title	L	T	P	S	C
22CS101007	**SOFTWARE PROJECT MANAGEMENT**	3	-	-	-	3

Pre-Requisite Software Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Software project management and its importance, Plans, methods and methodologies, Software processes and process models, Stepwise project planning, Software effort estimation, Cost estimation, Activity planning, Plan models, Critical path and critical activities, Risk management, Resource allocation, Monitoring and control, Managing people, Software quality.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply knowledge of software project management, project plans, process models for efficient implementation and completion of projects.

CO2. Estimate effort for the project to assign and schedule available resources in the most effective and economical way possible.

CO3. Develop network models for sequences of activities in a project for effective project management.

CO4. Identify the risk factors, monitor the progress and quality of projects to take mitigating actions.

CO5. Recognize the need for organizational behavior, teamwork and communication to improve the performance on projects.

CO-PO-PSO Mapping Table:

Course Outcome	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	1	1	1	-	-	3	-	-	-
Course Correlation Mapping	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**3**	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium;1: Low

DETAILED SYLLABUS:

Module –I: INTRODUCTION TO SOFTWARE PROJECT MANAGEMENT AND PROJECT PLANNING (11 periods)

Introduction to Software Project Management: Importance of software project management, Defining project, Software projects versus other types of project, Contract management and technical project management, Activities covered by software project management, Plans, methods and methodologies, Categorizing software projects, Project charter, Stakeholders, Setting objectives, The business case, Project success and failure, Management and management control, Project management life cycle, Traditional versus modern project management practices.

Project Planning: Step wise project planning, Select project, Identify project scope and objectives, Identify project infrastructure, Analyze project characteristics, Identify project products and activities, Estimate effort for each activity, Identify activity risks, Allocate resources, Review/publicize plan, Execute plan/lower levels of planning.

Module –II: PROJECT APPROACH AND EFFORT ESTIMATION (9 periods)

Selection of Project Approach: Build or buy, Choosing methodologies and technologies, Software processes and process models, Choice of process models, Spiral model, Software prototyping, Incremental delivery, Agile methods.

Software Effort Estimation: Effort estimation, Problems with over and under estimates, Basis for software estimating, Software effort estimation techniques, Bottom-up estimating, The top-down approach and parametric models, Albrecht function point analysis, COCOMO II.

Module –III: ACTIVITY PLANNING AND RISK MANAGEMENT (8 periods)

Activity Planning: Objectives of activity planning, Projects and activities, Sequencing and scheduling activities, Network planning models, Formulating a network model, Adding the time dimension, The forward pass, The backward pass, Identifying the critical path and critical activities, Activity float.

Risk Management: Risk, Categories of risk, Risk management approaches, A framework for dealing with risk, Risk identification, Risk assessment, Risk planning, Risk management, PERT technique, Monte Carlo simulation.

Module –IV: RESOURCE ALLOCATION, MONITORING AND CONTROL (9 periods)

Resource Allocation: Nature of resources, Identifying resource requirements, Scheduling resources, Creating critical paths, Publishing resource schedule, Cost schedules, Scheduling sequence.

Monitoring and Control: Creating framework, Review, Visualizing progress, Cost monitoring, Earned value analysis, Prioritizing monitoring, Getting the project back to target, Change control, Software configuration management.

Module –V: MANAGING PEOPLE, QUALITY IN SOFTWARE ENVIRONMENT (8 periods)

Managing People: Organizational behavior, Oldham-Hackman job characteristics model, Ethical and professional concerns, Working in teams – Decision making, Organization and team structures, Dispersed and virtual teams, Communication genres and plans, Leadership.

Software Quality: The place of software quality in project planning, Importance of software quality, Defining software quality, Software quality models, ISO 9126, Process capability models, Quality plans.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Write a program to implement function point analysis method
2. Write a program to implement Walston-Felix Model and SEL Model and compare both.
3. Write a program to implement Basic COCOMO
4. Write a program to implement Intermediate COCOMO
5. Write a program to implement Detailed COCOMO
6. Write a program to implement Application Composition Estimation Model for e effort estimation
7. Write a program to implement Early Design Model and calculate the effort for the development of project

TEXT BOOK:

1. Bob Hughes, Mike Cotterell, Rajib Mall, *Software Project Management*, 6th Edition, McGraw Hill, 2018.

REFERENCE BOOKS:

1. Michele Sliger and Stacia Broderick, *The Software Project Manager's Bridge to Agility*, Addison-Wesley, 2008.

2. S.A. Kelkar, *Software Project Management: A Concise Study*, PHI, 2012.

3. Pankaj Jalote, *Software Project Management in Practice*, Pearson, 2002.

SOFTWARE/TOOLS:

1. Rational Rose

VIDEO LECTURES:

1. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs70/
2. https://www.coursera.org/courses?query=software%20project%20management

WEB RESOURCES:

1. Richard H.Thayer, Software Engineering Project Management, IEEE Computer Society, 2004.
2. Information Technology and Project Management, Schwalbe, Thomson Learning.

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS102010	**SOFTWARE TESTING AND QUALITY ASSURANCE**	3	-	2	-	4

Pre-Requisite Software Engineering

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course presents a practical approach to software testing as a sub-discipline of software engineering. It introduces software quality concepts, standards, measurements, and practices that support the production of quality software. It offers a solid foundation in testing fundamentals including test case design, test management, and test measurement strategies, which improve the effectiveness of software test processes.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Review the similarities and differences in software quality practices between plan-driven and agile teams.

CO2. Integrate software quality assurance practices using Testing Maturity Model (TMM) levels for software development processes.

CO3. Develop a comprehensive software quality and test plan.

CO4. Analyze test cases to support multiple testing goals.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3	
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-	3	
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	3	
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-	
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**-**	**2**	**-**	**3**	-	**3**	

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1 – INTRODUCTION (9 periods)

Agile Testing – Traditional vs agile testing - Principles for agile testers – Mind set- Applying principles and values –Adding value.

Module 2 – TEAM LOGISTICS (9 periods)

Team Structure - Independent QA Teams - Integration of Testers into an Agile Project - Agile Project Teams - Physical Logistics - Resources - Tester-Developer Ratio - Hiring an Agile Tester - Building a Team - Self-Organizing Team - Involving Other Teams - Every Team Member Has Equal Value - Performance and Rewards.

Module 3 - TRANSITIONING TYPICAL PROCESSES (9 periods)

Lightweight Processes - Metrics Defect Tracking – Tracking tools - Test Planning - Test Strategy vs. Test Planning - Traceability - Existing Processes and Models - Audits - Frameworks, Models, and Standards.

Module 4 - TEST TOOL STRATEGY (9 periods)

Tools to Elicit Examples and Requirements - Checklists - Mind Maps - Spreadsheets - Mock-Ups - Flow Diagrams - Software-Based Tools - Tools for Automating Tests Based on Examples - Tools to Test below the GUI and API Level - Tools for Testing through the GUI - Strategies for Writing Tests - Testability - Code Design and Test Design.

Module 5 - TESTS THAT CRITIQUE THE PRODUCT (9 periods)

Introduction to Quadrant 3 - Demonstrations - Scenario Testing - Exploratory Testing - Usability Testing - Behind the GUI - Testing Documents and Documentation - User Documentation - Reports - Tools to Assist with Exploratory Testing.

Total Periods 45

Text Book

1. Lisa Crispin, Agile Testing, Addison Wesley, 2012.

Reference Book:

1. Burnstein, I. (2003). Practical Software Testing. Springer-Verlag. ISBN: 0-387-95131-8.

List of Experiments

1. Find out defects on the page shown below

2. Write test ideas for this Scenario: You are at the grocery store's checkout counter. You have bought five items (x, y, z, a, and b). You make payment and move to the EXIT door.

3. Write a detailed defect report for this sample defect: After logging into Gmail, it navigates to Google.com

4. How user experience can be improved for the following sign-in page?

SOFTWARE/TOOLS:

1. selenium

VIDEO LECTURES:

1. https://nptel.ac.in/noc/courses/noc19/SEM2/noc19-cs70/
2. https://archive.nptel.ac.in/courses/117/106/117106112/
3. https://www.softwaretestinghelp.org/

WEB RESOURCES:

1. https://www.geeksforgeeks.org/software-testing-manual-testing/
2. https://www.javatpoint.com/manual-testing

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT101002	**AGILE AND SCRUM METHODOLOGIES**	3	-	-	-	3

Pre-Requisite Software Engineering
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Principles of Agile Software, scrum and self-organizing teams, XP and embracing change, simplicity, and incremental design, lean, eliminating waste, and seeing the whole and kanban, flow, and constantly improving.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Understand the fundamental concepts of Agile methodology.
CO2. Apply agile principles for software project development.
CO3. Apply Scrum principles for software project development.
CO4. Apply practices of XP and Incremental design for software project development.
CO5. Apply kanban, flow, and constantly improving to eliminate waste.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	-	3	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-	2	-	3	-
CO6				2					3	3						
Course Correlation Mapping	3	3	3	2	2				3	3			3		3	

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

Module-1: LEARNING AGILE: **(9 Periods)**

Getting Agile into Your Brain, Understanding Agile Values, No Silver Bullet, Agile to the Rescue, Adding Agile Makes a Difference. A Fractured Perspective, How a Fractured Perspective Causes Project Problems. The Agile Manifesto, Purpose Behind Each Practice. Individuals and Interactions Over Processes and Tools, Working Software Over Comprehensive Documentation, Customer Collaboration Over Contract Negotiation, Responding to Change Over Following a Plan, Principles Over Practices. Understanding the Elephant, Methodologies Help You Get It All in Place at Once, Where to Start with a New Methodology.

Module-2: THE AGILE PRINCIPLES: **(9 Periods)**

The 12 Principles of Agile Software, The Customer Is Always Right...Right! , "Do As I Say, Not As I Said". Delivering the Project, Better Project Delivery for the Ebook Reader Project. Communicating and Working Together, Better Communication for the Ebook Reader Project. Project Execution—Moving the Project Along, A Better Working Environment for the Ebook Reader Project Team. Constantly Improving the Project and the Team. The Agile Project: Bringing All the Principles Together.

Module-3: SCRUM AND SELF-ORGANIZING TEAMS: **(9 Periods)**

The Rules of Scrum, Act I: I Can Haz Scrum, Everyone on a Scrum Team Owns the Project, The Scrum Master Guides the Team's Decisions, The Product Owner Helps the Team Understand the Value of the Software, Everyone Owns the Project, Scrum Has Its Own Set of Values ,Status Updates Are for Social Networks!, The Whole Team Uses the Daily Scrum, Feedback and the Visibility-Inspection-Adaptation Cycle, The Last Responsible Moment, How to Hold an Effective Daily Scrum. Sprinting into a Wall, Sprints, Planning, and Retrospectives, Iterative or Incremental, The Product Owner Makes or Breaks the Sprint, Visibility and Value, How to Plan and Run an Effective Scrum Sprint. SCRUM PLANNING AND

COLLECTIVE COMMITMENT: Not Quite Expecting the Unexpected, User Stories, Velocity, and Generally Accepted Scrum Practices, Make Your Software Useful, User Stories Help Build Features Your Users Will Use, Conditions of Satisfaction, Story Points and Velocity, Burndown Charts, Planning and Running a Sprint Using Stories, Points, Tasks, and a Task Board. Victory Lap, Scrum Values Revisited, Practices Do Work Without the Values (Just Don't Call It Scrum), Is Your Company's Culture Compatible with Scrum Values.

Module-4: XP AND EMBRACING CHANGE: **(9 Periods)**

Going into Overtime, The Primary Practices of XP, Programming Practices, Integration Practices, Planning Practices, Team Practices, Why Teams Resist Changes, and How the Practices Help. The Game Plan Changed, but We're Still Losing, The XP Values Help the Team Change Their Mindset, XP Helps Developers Learn to Work with Users, Practices Only "Stick" When the Team Truly Believes in Them, An Effective Mindset Starts with the XP Values, The XP Values, Paved with Good Intentions. The Momentum Shifts, Understanding the XP Principles Helps You Embrace Change, The Principles of XP, XP Principles Help You Understand Planning, XP Principles Help You Understand Practices—and Vice Versa, Feedback Loops. XP.

SIMPLICITY, AND INCREMENTAL DESIGN: Code and Design, Code Smells and Antipatterns (or, How to Tell If You're Being Too Clever), XP Teams Look for Code Smells and Fix Them, Hooks, Edge Cases, and Code That Does Too Much. Make Code and Design Decisions at the Last Responsible Moment, Fix Technical Debt by Refactoring Mercilessly, Use Continuous Integration to Find Design Problems, Avoid Monolithic Design, Incremental Design and the Holistic XP Practices. Teams Work Best When They Feel Like They Have Time to Think, Team Members Trust Each Other and Make Decisions Together. The XP Design, Planning, Team, and Holistic Practices Form an Ecosystem Incremental Design Versus Designing for Reuse, When Units Interact in a Simple Way, the System Can Grow Incrementally, Great Design Emerges from Simple Interactions, Final Score.

Module-5: LEAN, ELIMINATING WASTE, AND SEEING THE WHOLE: (9 Periods)

Lean Thinking, Commitment, Options Thinking, and Set-Based Development, Creating Heroes and Magical Thinking. Eliminate Waste, Use a Value Stream Map to Help See Waste Clearly, Gain a Deeper Understanding of the Product, See the Whole, Find the Root Cause of Problems That You Discover. Deliver As Fast As Possible, Use an Area Chart to Visualize Work in Progress, Control Bottlenecks by Limiting Work in Progress.

KANBAN, FLOW, AND CONSTANTLY IMPROVING: The Principles of Kanban, Find a Starting Point and Evolve Experimentally from There. Stories Go into the System; Code Comes Out, Improving Your Process with Kanban, Visualize the Workflow, Limit Work in Progress. Measure and Manage Flow, Managing Flow with WIP Limits Naturally Creates Slack. Make Process Policies Explicit So Everyone Is on the Same Page. Emergent Behavior with Kanban.

THE AGILE COACH: Coaches Understand Why People Don't Always Want to Change. The Principles of Coaching.

Total Periods: 45

RESOURCES:

TEXT BOOKS :

1. Andrew Stellman, Jill Alison Hart, Learning Agile, O'Reilly, 2015.

REFERENCE BOOKS:

1. Andrew stellman, Jennifer Green, Head first Agile, O'Reilly, 2017. Rubin K , Essential Scrum : A practical guide to the most popular Agile process, Addison-Wesley, 2013.

VIDEO LECTURES:

1. https://elearn.nptel.ac.in/shop/iit-workshops/completed/agile-testing-methodology-and-project-management-test-automation/
2. https://www.nptelvideos.com/video.php?id=904

WEB RESOURCES:

1. https://www.atlassian.com/agile/scrum
2. https://www.theserverside.com/tip/Agile-versus-Scrum-Whats-the-difference

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT101023	VFX ANIMATION	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides Knowledge on concepts of Visual Effects before Computers, Digital Effects, The VFX Team, Basic VFX Technologies and Equipment, The VFX Bible and Database, Models and Miniatures

COURSE OUTCOMES: After successful completion of the course, students will be able:

CO1.	Understand Visual Effects before Computers and digital effects.
CO2.	Analyze the VFX team and basic VFX Technologies and equipment.
CO3.	Apply breakdowns scheduling and budgeting production support.
CO4.	Analyze On-Set Operations, and On-Set References

CO-PO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	3	1	-	-	-			3			
CO2	3	1	-	-	-	-	-	-	3	-			3			
CO3	3	1	3	-	-	-	-	-	-	1			3			
CO4	2	1								1			3			
CO5	3	-	-	-	-	3	1	-	-	-			3			
Course Correlation Mapping	**3**	**1**	**3**	**-**	**-**	**3**	**1**	**-**	**3**	**1**			**3**			

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1:	**VISUAL EFFECTS BEFORE COMPUTERS**	***(09 Periods)***
Stop-Motion Animation, Puppets and Animatronics, Matte Paintings, Miniatures, In-Camera Miniatures, Hanging Miniatures with Live Action, Miniatures with Composited Elements, Front and Rear Projection, Forced Perspective with Live Action, Blue- or Green Screen Composites, Motion Control, In-Camera Practical Effects, Special (Mechanical) Effects and Visual Effects. Digital Effects: The 15-minute Version, Two-Dimensional (2D) vs. Three-Dimensional (3D) CGI, 2D CGI, 3D CGI, Creating a Digital Image, Building Digital Models, Texturing, Painting, and Lighting, CG Characters, Animation, Rendering, Compositing, Miniatures vs. Digital Models		
Module 2:	**THE VFX TEAM**	***(09 Periods)***
The Visual Effects Supervisor, The Visual Effects Producer, First In—Last Out, What Does the VFX Producer Do?, VFX Producer's Abilities and Personal Qualities, VFX Producers and Guild Membership, The VFX Producer and Marketing, Visual Effects Production Coordinator, Visual Effects Data Coordinator, Visual Effects PA, Runner, and Similar Support Positions, Freelance Visual Effects Crew, First Assistant Director (AD), Visual Effects DP, Blue or Green Screen DP, Motion Control Technician, Miniature Pyrotechnicians, Other Special VFX Crew. Basic VFX Technologies and Equipment: Blue and Green Screens, Lighting for Blue- or Greenscreen Photography, Motion Control, When to Use Motion Control, EncodaCam, VistaVision Cameras, HighSpeed Photography, Digital Video Assist with Compositing Capability, Motion Capture, SpaceCam, Wescam, Flying-Cam, Cyber scanning and Structured Light Scanning, Set Surveys, Lighting References and HDRI (High Dynamic Range Imaging), LIDAR (Light Detection and Ranging), Renting Equipment		
Module 3:	**BREAKDOWNS**	***(09 Periods)***
Production Breakdowns, The First Go-Around: Generating a VFX Breakdown, Getting Started, Marking Up the Script, Numbering Visual Effects Shots, Constructing a Digital Cost Breakdown Spreadsheet, Estimating Digital Shot Costs, A Sampling of Ancillary Digital Costs, Facility Visual Effects Supervision and Management, Preliminary Bids: Getting a Handle on the Digital Shot Costs, Budget Guidelines for Digital Work, Casting and Evaluating Potential Vendors, Practical Steps in Checking Out a Vendor, The Importance of Artists, Bidding Guidelines: Comparing Apples to Apples, Following Up, Budgeting Miniatures. Scheduling and Budgeting Production Support: The Production Support Breakdown Sheet, Using Movie Magic Scheduling, VFX Breakdown Sheets, Preparing the VFX Breakdown, Stand-Alone VFX Elements, Scheduling the Shooting of Your Effects, Collaborating with the 1st Unit, Communication- Key to Smooth Sailing, Scheduling 1st Unit Shooting, Working with a Strip Board, Separating 1st Unit and VFX Unit Shooting, Designating Different Types of VFX Plates, Modifying the Strip Board Design, Keeping Up with Changes, Scheduling the VFX Unit, Refi ning the Schedule, Reports and More Reports, Modified Day-out-of-Days Report, Modified One-Liner.		
Module 4:	THE VFX BIBLE AND DATABASE:	***(09 Periods)***
The VFX Bible and Database: Introduction to VFX Bible, Examples of Reports from a FileMaker Pro Database, Database Maintenance, Visual Aids, Storyboards, Animatics, Previs, A Case Study—Previs for The Guardian, Generating a Previs. On-Set Operations Production Meetings, The Visual Effects Review, More Meetings, Tech Scouts, Extended Location Scouts, Key to Success: Keep the ADs Informed, Influencing the 1st Unit Shooting Schedule, Motion Control: A Special Situation on Set, Production Calendars, Production Reports, When the Schedule Changes, Physical Support/1st Unit Support, Working on Sets,Laying the Groundwork, Support from Camera Assistants, Grips, Electrical, Paint and Construction, Digital Video Assist, Transportation		

Module 5:	ON-SET REFERENCES	***(09 Periods)***
Reference Photos; Art Department References, Element Data Sheets, Reference and Clean Background Plates, Performance References, Video References, Lighting Reference Tools, Tracking Markers, Tests. Models and Miniatures Introduction to Miniatures or CG Models, Early Estimates, Defining the Task, Miniatures on Contract, The Bidding Package, Monitoring Progress, Getting Things to Match, Filming Miniatures		
		Total Periods: 45

RESOURCES

TEXT BOOKS:	
	Charles Finance, Susan Zwerman, The Visual Effects Producer, Understanding the Art and Business of VFX, focal press.
REFERENCE BOOKS:	
	Wallace Jackson, VFX Fundamentals Visual Special Effects Using Fusion 8.0 2016 Edition, Apress.
2.	Pakhira, Malay K, Computer Graphics, Multimedia and Animation, 2nd edition, Prentice Hall India Learning Private Limited.
VIDEO LECTURES:	
1.	https://nptel.ac.in/courses/106101060 82 2.
2.	https://www.cse.iitm.ac.in/course_details.php?arg=OTI 3.
3.	https://swayam.gov.in/nd1_noc19_cs47/previ
WEB RESOURCES:	
1.	https://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-046j-design-and-analysis-of-algorithms-spring-2015/ 2.
2.	http://www.learnalgorithms.in/ 3. https://courses.cs.vt.edu/ csonline/Algorithms/Lessons/ 4.
3.	http://openclassroom.stanford.edu/MainFolder/Course Page.php?course=IntroToAlgorithms.

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101013	**Generative AI**	3	-	-	-	3
Pre-Requisite	Python Programming					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides aevolution of generative models, starting from restricted Boltzmann machines and deep belief networks, and progressing to more advanced techniques such as Variational Auto encoders (VAEs), Generative Adversarial Networks (GANs), Long Short-Term Memory (LSTM) networks, and Transformer models.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1.	Demonstrate fundamentals of generative AI, including the principles and concepts behind generative models.
CO2.	Use generative models, such as Variational Auto encoders (VAEs), Generative Adversarial Networks (GANs), Long Short-Term Memory (LSTM) networks, and Transformer models, using Tensor Flow 2.
CO3.	Apply knowledge of generative AI to create realistic and creative images, generate text, and compose music using the implemented models.
CO4.	Design use cases to explore the latest research and advancements in the field of generative AI, as well as discover a wide range of exciting and practical use cases for deep generative models.
CO5.	Create and implement their own generative AI models, allowing them to explore and experiment with new ideas and applications.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3										3		
CO2	3		3													
CO3	3	3														
CO4	3															
CO5	3															
Course Correlation Mapping	**3**	**3**	**3**	**3**										**3**		

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1:	**INTRODUCTION TO GENERATIVE AI**	***(09 Periods)***
Applications of AI , Discriminative and generative models, Implementing generative models; The rules of probability- Discriminative and generative modeling and Bayes 'theorem; Uses of Generative Models- The promise of deep learning, Building a better digital classifier, Generating images; Style transfer and image transformation- Fake news and chatbots, Sound composition, The rules of the game; Unique challenges of Generative models; **Tensor flow and Kubeflow** Deep neural network development and Tensor Flow; VSCode; Docker: A lightweight virtualization solution- Important Docker commands and syntax, Connecting Docker containers with docker-compose; Kubernetes :Robust management of multi-container applications- Important Kubernetes commands, Kustomize for configuration management; Kubeflow- Running Kubeflow locally with MiniKF, Installing Kubeflow in AWS, GCP, Azure, Terraform, Kubeflow's components- Kubeflow notebook servers, Kubeflow pipelines; Using Kubeflow Katib to optimize model hyperparameters		
Module 2:	**BUILDING BLOCKS OF DEEP NEURAL NETWORKS**	***(09 Periods)***
Perceptron's- a brain in a function- From tissues to TLUs, From TLUs to tuning perceptrons;Multi-layer perceptron's and back propagation- Back propagation in practice, The shortfalls of back propagation; Varieties of networks: Convolution and recursive- Networks for seeing: Convolutional architectures, Early CNNs, Alex Net and other CNN innovations, Alex Net architecture; Networks for sequence data- RNNs and LSTMs; Building a better optimizer- Gradient descent to ADAM, Xavier initialization; **Teaching Networks to Generate Digits-** The MNIST database- Retrieving and loading the MNIST dataset in Tensor Flow; Restricted Boltzmann Machines: generating pixels with statistical mechanics- Hopfield networks and energy equations for neural networks, Modeling data with uncertainty with Restricted Boltzmann Machines, Contrastive divergence: Approximating a gradient; Stacking Restricted Boltzmann Machines to generate images: the Deep Belief Network, Creating an RBM using the Tensor Flow Keras layers API, Creating a DBN with the Keras Model API		
Module 3:	**Neural Networks Using VAEs**	***(09 Periods)***
Creating separable encodings of images; The variational objective-The reparameterization trick; Inverse Autoregressive Flow; Importing CIFAR; Creating the network from TensorFlow2. **Image Generation with GANs-** The taxonomy of generative models; Generative adversarial networks-The discriminator model, The discriminator model, Training GANs, Non-saturating generator cost and Maximum likelihood game; Vanilla GAN; Improved GANs- Deep Convolutional GAN, Vector arithmetic, Conditional GAN, Wasserstein GAN; Progressive GAN- The overall method, Progressive growth –smooth fade-in, Minibatch standard deviation, Equalized learning rate, Pixel wise normalization, Tensor Flow Hub implementation; Challenges-Training instability, Mode collapse, Uninformative loss and evaluation metrics.		

Module 4:	**Rise of Methods for Text Generation**	***(09 Periods)***
Representing text- Bag of Words, Distributed representation-Word2vec, GloVe, FastText; Text generation and the magic of LSTMs-Language modeling, Hands-on: Character-level language model; Decoding strategies- Greedy decoding, Beam search, Sampling, Hands-on: Decoding strategies; LSTM variants and convolutions for text-Stacked LSTMs, Bidirectional LSTMs, Convolutions and text; **NLP 2.0: Using Transformers to Generate Text:** Attention, Contextual embeddings, Self-attention, Transformers-Overall architecture, Multi-head self-attention, Positional encodings, BERT-ology; GPT 1, 2, 3- Generative pre-training: GPT, Hands-on with GPT-2, Mammoth GPT-3. **Composing Music with Generative Models:** Getting started with music generation-Representing music, Music generation using LSTM's- Dataset preparation, LSTM model for music generation; Music generation using GANs- Generator network, Discriminator network, Training and results; MuseGAN-polyphonic music generation- Jamming model, Composer model, Hybrid model, Temporal model, MuseGAN-Generators, Critic, Training and results.		
Module 5:	**Play Video Games with Generative AI: GAIL**	***(09 Periods)***
Reinforcement learning:Actions,agents,spaces,policies, and rewards-Deep Q-learning, Inverse reinforcement learning: Learning from experts, Adversarial learning and imitation, Running GAIL on PyBullet Gym, The agent: Actor-Critic network, The discriminator, Training and results **Emerging Applications in Generative AI:** Introduction, Finding new drugs with generative models- Searching chemical space with generative molecular graph networks, Folding proteins with generative models; Solving partial differential equations with generative modeling; Few shot learning for creating videos from images; Generating recipes with deep learning		
		Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:	
11.	Demonstration of Variational Auto encoder (VAE) using Tensor Flow 2 and Python. Generate new images using the trained VAE and observe the results
12.	Demonstration of Long Short-Term Memory (LSTM) model using Tensor Flow 2 and Python.Generate new text samples using the trained LSTM model and analyze the output.
13.	Observation and understanding music samples, such as MIDI files. Generate new music compositions using the trained GAN and evaluate the results.
14.	Demonstration of GAN architectures, loss functions, and training strategies.
15.	Demonstration of working new text samples using the trained Transformer model and analyze the output. Explore techniques like fine-tuning pre-trained Transformer models or using different attention mechanisms.

RESOURCES

TEXT BOOKS:	
1.	Joseph Babcock, Raghav Bali, Generative AI with Python and TensorFlow 2: Create Images, Text, and Music with VAEs, GANs, LSTMs, Transformer Models, Packt Publishing, 2021.
2.	Numa Dhamani and Maggie EnglerIntroduction to Generative AI, Manning Publisher, 2024.
REFERENCE BOOKS:	
1	Chris Frgly, Antje Barth, Shelbee Eigenbrode, Generative AI on AWS, O'Reilly Media, Inc., 2023.
2	Bernard Marr ,Generative AI in Practice, Wiley, 2023.
VIDEO LECTURES:	
1.	https://youtu.be/6okwxO_iW7M?si=O460e6hznFobu3cV
2.	https://youtu.be/AALBGpLbj6Q?si=rKKFgi28nBSzNmes
3.	https://youtu.be/MZmNxvLDdV0?si=avwKtCQ9FmFTtVQW
WEB RESOURCES:	
6.	https://www Generative AI with Python and TensorFlow 2 (oreilly.com)
7.	Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models | Packt Publishing books | IEEE Xplore
8.	GitHub - PacktPublishing/Hands-On-Generative-AI-with-Python-and-TensorFlow-2: Hands-On Generative AI with Python and TensorFlow 2, published by Packt

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101014	**Explainable AI**	3	-	-	-	3
Pre-Requisite	-**Machine Learning**					
Anti-Requisite	-					
Co-Requisite	-					
COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to AI, Explainability for Tabular Data, Image Data,Text Data,Advanced and Emerging Topics in Explainability Techniques and Approaches,Interacting with Explainable AI its structure and case studies.						
COURSE OUTCOMES: After successful completion of the course, students will be able to:						
CO6.	Understand what Explainable AI is,its fundamental concepts and limitations of Explainable AI (XAI), its scope, and impact on various domains.					
CO7.	Use DifferentXAI methodologies for extraction of knowledge and problem solving.					
CO8.	Apply advanced tools and techniques to select and assess Explainable AI methods on Image data.					
CO9.	Design the review, present and critically assess state-of-the-art papers in relevant text data within Explainable AI					
CO1(	Discuss the ethical and societal implications of XAI development and deployment.					

CO-PO Mapping Table:

Course Outcomes	Program Outcomes									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3			3						
CO2	3	2		2						
CO3	3		3							
CO4	3	2								
CO5	3									
Course Correlation Mapping	**3**	**2**	**3**	**3**						

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1:	**INTRODUCTION**	***(09 Periods)***
Need of Explainable AI, Challenges in Explainability, Evaluating Explainability, Explainable AI in Linkedin, Auto Insurance Claims, Loan Decisions, "Third-Wave AI", Explainability Consumers- Practitioners—Data Scientists and ML Engineers, Observers—Business Stakeholders and Regulators, End Users—Domain Experts and Affected Users. Types of Explanations-PremodelingExplainability,Intrinsic Versus Post Hoc Explainability, Local, Cohort, and Global Explanations, Attributions, Counterfactual, and Example-Based Explanations; Themes Throughout Explainability, Feature Attributions, Surrogate Models, Activation		
Module 2:	**EXPLAINABILITY FOR TABULAR DATA**	***(09 Periods)***
Permutation Feature Importance- Permutation Feature Importance from Scratch, Permutation Feature Importance in scikit-learn; Shapley Values- SHAP (SHapley Additive exPlanations), Visualizing Local Feature Attributions, Visualizing Global Feature Attributions, Interpreting Feature Attributions from Shapley Values, Managed Shapley Values; Explaining Tree-Based Models- From Decision Trees to Tree Ensembles, SHAP's TreeExplainer; Partial Dependence Plots and Related Plots- Partial Dependence Plots (PDPs), Individual Conditional Expectation Plots (ICEs), Accumulated Local Effects (ALE).		
Module 3:	**EXPLAINABILITY FOR IMAGE DATA**	***(09 Periods)***
Integrated Gradients (IG)- Choosing a Baseline, Accumulating Gradients, Improvements on Integrated Gradients; XRAI- How XRAI Works, Implementing XRAI; Grad-CAM- How Grad-CAM Works, Implementing Grad-CAM, Improving Grad-CAM; LIME- How LIME Works, Implementing LIME; Guided Backpropagation and Guided Grad-CAM- Guided Backprop and DeConvNets, Guided Grad-CAM.		
Module 4:	**EXPLAINABILITY FOR TEXT DATA**	***(09 Periods)***
Overview of Building Models with Text- Tokenization, Word Embeddings and Pretrained Embeddings; LIME- How LIME Works with Text; Gradient x Input- Intuition from Linear Models, From Linear to Nonlinear and Text Models, Grad L2-norm; Layer Integrated Gradients- A Variation on Integrated Gradients; Layer-Wise Relevance Propagation (LRP)- How LRP Works, Deriving Explanations from Attention; Language Interpretability Tool. **Advanced and Emerging Topics:**Alternative Explainability Techniques- Alternate Input Attribution, Explainability by Design; Other Modalities- Time-Series Data, Multimodal Data; Evaluation of Explainability Techniques- A Theoretical Approach, Empirical Approaches.		
Module 5:	**INTERACTING WITH EXPLAINABLE AI**	***(09 Periods)***
Interacting with Explainable AI- Effectively Present Explanations, Clarify What, How, and Why the ML Performed the Way It Did, Accurately Represent the Explanations, Buildon the ML Consumer's Existing Understanding; Common Pitfalls in Using Explainability- Assuming Causality, Overfitting Intent to a Model, Overreaching for Additional Explanations. **Build with Explainability:** Look Forward to in Explainable AI, Natural and Semantic Explanations, Interrogative Explanations, Targeted Explanations **Case Studies**: Explainable AI for stock price prediction in stock market, Advancements of		

XAI in healthcare sector, Adequate lung cancer prognosis system using data mining algorithms, Comparison of artificial intelligence models for prognosis of breast cancer, AI-powered virtual therapist: for enhanced human-machine interaction.
Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:	
16.	Demonstration of Explainable AIin various domains
17.	Demonstration of Tabular data using decision treesand plots
18.	Demonstration of Image data using LIME and CAM
19.	Demonstration of Alternative Explainability Techniques on Time-Series Data, Multimodal Data
20.	Observation of the Common Pitfalls and explanation in various domains.

RESOURCES

TEXT BOOKS:	
1.	Michael Munn, David Pitman, Explainable AI for Practitioners, O'Reilly Media, Inc., 2022.
2.	Pethuru Raj, Utku Kose, and Usha Sakthivel, Explainable artificial intelligence (XAI): concepts, enabling tools, technologies and applications, Computing and networks, IET.
REFERENCE BOOKS:	
	Denis Rothman. Hands-On Explainable AI (XAI) with Python. Packt 2020.
2.	Escalante, H. J., Escalera, S., Guyon, I., Baro, X., Gucluturk, Y., Guclu, U., & van Gerven, M. A. J. (Eds.). (2018). Explainable and Interpretable Models in Computer Vision and Machine Learning. Springer
VIDEO LECTURES:	
1.	https://www.youtube.com/watch?v=YuDijSIR9iM
2.	https://www.youtube.com/playlist?list=PLqDyyww9y-1SwNZ-6CmvfXDAOdLS7yUQ4
3.	https://xai.arya.ai/resource/explainableai-workshop
WEB RESOURCES:	
1.	https://hcixaitutorial.github.io/
2.	https://christophm.github.io/interpretable-ml-book/scope-of-interpretability.html
3.	https://www.darpa.mil/program/explainable-artificial-intelligence

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101022	**QUANTUM COMPUTING**	3	-	-	-	3
Pre-Requisite	Matrix Theory and Linear Algebra					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: Introduction to Essential Linear Algebra, Some Basic Algebra, Overview of Quantum Physics Essentials,quantum architecture and design, Quantum Circuits Qubits, Quantum Gates,quantum algorithms, Current Asymmetric Algorithms and Asymmetric Cryptography, Specific Algorithms, Specific Applications

After successful completion of the course, students will be able

COURSE OUTCOME

CO11	Understand the Learn about quantum circuits and Essential Linear Algebra
CO12	Learn how to represent basic physics for quantum computing and perform gating operations on them.
CO13	Implementing and Analyzing Construct quantum circuits and quantum architecture quantum hardware
CO14	Understand particle Learn about quantum communication protocols and **quantum algorithms**, with important applications in security and cryptography
CO15	Utilize the principles of quantum Asymmetric Algorithms and Specific Applications

CO-PO Mapping Table:

Course Outcomes	Program Outcomes									
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	3	-	-	-	-	3	1	-	-	-
CO2	3	1	-	-	-	-	-	-	3	-
CO3	3	1	3	-	-	-	-	-	-	1
CO4	2	1								1
CO5	3	-	-	-	-	3	1	-	-	-
Course Correlation Mapping	**3**	**1**	**3**	**-**	**-**	**3**	**1**	**-**	**3**	**1**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1:	INTRODUCTION TO ESSENTIAL LINEAR ALGEBRA	***(09 Periods)***
Introduction to Essential Linear Algebra: Some Basic Algebra, Matrix Math, Vectors and Vector Spaces, Set Theory. Complex Numbers: Definition of Complex Numbers, Algebra of Complex Numbers, Complex Numbers Graphically, Vector Representations of Complex Numbers, Pauli Matrices, Transcendental Numbers.		
Module 2:	BASIC PHYSICS FOR QUANTUM COMPUTING	***(09 Periods)***
The Journey to Quantum, Quantum Physics Essentials, Basic Atomic Structure, Hilbert Spaces, Uncertainty, Quantum States, Entanglement. Basic Quantum Theory: Further with Quantum Mechanics, Quantum Decoherence, Quantum Electrodynamics, Quantum Chromodynamics, Feynman Diagram Quantum Entanglement and QKD, Quantum Entanglement, Interpretation, QKE.		
Module 3:	QUANTUM ARCHITECTURE	***(09 Periods)***
Further with Qubits, Quantum Gates, More with Gates, Quantum Circuits, The D-Wave Quantum Architecture. Quantum Hardware: Qubits, How Many Qubits Are Needed? Addressing Decoherence, Topological Quantum Computing, Quantum Essentials.		
Module 4:	**QUANTUM ALGORITHMS**	***(09 Periods)***
What Is an Algorithm? Deutsch's Algorithm, Deutsch-Jozsa Algorithm, Bernstein-Vazirani Algorithm, Simon's Algorithm, Shor's Algorithm. Grover's Algorithm		
Module 5:	Current Asymmetric Algorithms	***(09 Periods)***
RSA, Diffie-Hellman, Elliptic Curve. The Impact of Quantum Computing on Cryptography: Asymmetric Cryptography, Specific Algorithms, Specific Applications.		
		Total Periods: 60

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:	
21.	Develop a basic building blocks of Quantum computers and highlight the paradigm change
22.	Demonstration the Quantum state transformations and the algorithms
23.	Create a simulationentangled quantum subsystems and properties of entangled states
24.	Demonstration the applications of quantum computing
25.	Demonstration the characteristics of Quantum Current Asymmetric Algorithms

RESOURCES

TEXT BOOKS:	
	1. Nielsen M. A., Quantum Computation and Quantum Information, Cambridge University Press 2. Dr. Chuck Easttom, Quantum Computing Fundamentals, Pearson
REFERENCE BOOKS:	
3.	Quantum Computing for Computer Scientists by Noson S. Yanofsky and Mirco A. Mannucci
4.	Benenti G., Casati G. and Strini G., Principles of Quantum Computation and Information, Vol. Basic Concepts. Vol. Basic Tools and Special Topics, World Scientifi
5.	Pittenger A. O., An Introduction to Quantum Computing Algorithms
VIDEO LECTURES:	
1.	https://nptel.ac.in/courses/106101060 82 2.
2.	https://www.cse.iitm.ac.in/course_details.php?arg=OTI 3.
3.	https://swayam.gov.in/nd1_noc19_cs47/previ
WEB RESOURCES:	
1.	https://ocw.mit.edu/courses/electrical-engineering-and-computerscience/6-046j-design-and-analysis-of-algorithms-spring-2015/ 2.
2.	http://www.learnalgorithms.in/ 3. https://courses.cs.vt.edu/ csonline/Algorithms/Lessons/ 4.
3.	http://openclassroom.stanford.edu/MainFolder/Course Page.php?course=IntroToAlgorithms.

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT102004	**DEVOPs**	3	-	2	-	4

Pre-Requisite Software Engineering
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Principles of Agile Software, scrum and self-organizing teams, XP and embracing change, simplicity, and incremental design, lean, eliminating waste, and seeing the whole and kanban, flow, and constantly improving.

COURSE OUTCOMES: *After successful completion of the course, students will be able to:*
CO1. Identify components of Devops environment.
CO2. Describe Software development models and architectures of DevOps.
CO3. Apply different project management, integration, testing and code deployment tool
CO4. Investigate different DevOps Software development models
CO5. Assess various Devops practices
CO6. Collaborate and adopt Devops in real-time projects

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	-	3	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-	2	-	3	-
CO6				2					3	3						
Course Correlation Mapping	3	3	3	2	2				3	3			3		3	

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT:

Module-1: INTRODUCTION: **(9 Periods)**

Introduction, Agile development model, DevOps, and ITIL. DevOps process and Continuous Delivery, Release management, Scrum, Kanban, delivery pipeline, bottlenecks, examples.

Module-2: SOFTWARE DEVELOPMENT MODELS AND DEVOPS: **(9 Periods)**

DevOps Lifecycle for Business Agility, DevOps, and Continuous Testing. DevOps influence on Architecture: Introducing software architecture, The monolithic scenario, Architecture rules of thumb, The separation of concerns, Handling database migrations, Microservices, and the data tier, DevOps, architecture, and resilience.

Module-3: INTRODUCTION TO PROJECT MANAGEMENT: **(9 Periods)**

The need for source code control, The history of source code management, Roles and code, source code management system and migrations, Shared authentication, Hosted Git servers, Different Git server implementations, Docker intermission, Gerrit, The pull request model, GitLab.

Module-4: INTEGRATING THE SYSTEM: **(9 Periods)**

Build systems, Jenkins build server, Managing build dependencies, Jenkins plugins, and file system layout, The host server, Build slaves, Software on the host, Triggers, Job chaining and build pipelines, Build servers and infrastructure as code, Building by dependency order, Build phases, Alternative build servers, Collating quality measures.

Module-5: TESTING TOOLS AND AUTOMATION: **(9 Periods)**

Various types of testing, Automation of testing Pros and cons, Selenium - Introduction, Selenium features, JavaScript testing, Testing backend integration points, Test-driven development, REPL-driven development Deployment of the system: Deployment systems, Virtualization stacks, code execution at the client, Puppet master and agents, Ansible, Deployment tools: Chef, Salt Stack and Docker **Total Periods: 45**

EXPERIENTIAL LEARNING:

List of Experiments:

1. Write code for a simple user registration form for an event.

2. Explore Git and GitHub commands.

3. Practice Source code management on GitHub. Experiment with the source code written in exercise 1. 4. Jenkins installation and setup, explore the environment.

5. Demonstrate continuous integration and development using Jenkins.

6. Explore Docker commands for content management.

7. Develop a simple containerized application using Docker.

8. Integrate Kubernetes and Docker

9. Automate the process of running containerized application developed in exercise 7 using Kubernetes.

10. Install and Explore Selenium for automated testing.

11. Write a simple program in JavaScript and perform testing using Selenium.

12. Develop test cases for the above containerized application using selenium.

13. Implement DevOps Life Cycle using Amazon Web Services.

RESOURCES:

TEXT BOOKS:

1. Joakim Verona. Practical Devops, Second Edition. Ingram short title; 2nd edition (2018). ISBN10: 1788392574.

2. Deepak Gaikwad, Viral Thakkar. DevOps Tools from Practitioner's Viewpoint. Wiley publications. ISBN: 9788126579952.

REFERENCE BOOK:

1. Len Bass, Ingo Weber, Liming Zhu. DevOps: A Software Architect's Perspective. Addison Wesley.

VIDEO LECTURES:

1. Edureka DevOps Full Course - https://youtu.be/S_0q75eD8Yc

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT101022	**EVOLUTIONARY COMPUTING**	3	-	-	-	3
Pre-Requisite	-					
Anti-Requisite	-					
Co-Requisite	-					

COURSE DESCRIPTION: This course provides Knowledge of evolutionary computation techniques and methodologies set in the context of modern heuristic methods and also provides idea of how to apply these techniques to optimization problems and problems that require machine learning.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1.	Understand the Components of Evolutionary Computing
CO2.	Implementing and Analyzing Optimization Techniques
CO3.	Illustrate Genetic algorithms, GA operators
CO4.	Understand particle swarm optimization, artificial bee colony optimization
CO5.	Solving Real-World Problems Using Advanced Optimization Algorithms

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	3	1	-	-	-	-	-
CO2	3	1	-	-	-	-	-	-	3	-	-	-
CO3	3	1	3	-	-	-	-	-	-	1	-	-
CO4	2	1	-	-	-	-	-	-	-	1	-	-
CO5	3	-	-	-	-	3	1	-	2	-	-	1
Course Correlation Mapping	**3**	**1**	**3**	**-**	**-**	**3**	**1**	**-**	**3**	**1**	**-**	**1**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1:	**INTRODUCTION TO EVOLUTIONARY COMPUTING AND OPTIMIZATION TECHNIQUES**	***(9 Periods)***
Historical Development, Features, Classification and Components of Evolutionary Computing, Advantages, Applications. Simulated Annealing: Annealing Schedule, Parameter Selection, Applications. Hill Climbing: Mathematical Description, Local and Global Maxima, Ridges, Plateau, Applications.		
Module 2:	**GENETIC ALGORITHMS: FUNDAMENTALS AND ADVANCED VARIATIONS**	***(9 Periods)***
Genetic Algorithms: Biological Background, Schema, Theorem, GA Operators: Crossover, Mutation and Its Types-GA Algorithm, Variations Of GA: Adaptive GA and Real Coded GA.		
Module 3:	**ANT COLONY OPTIMIZATION**	***(9 Periods)***
Ant Colony Optimization: Ant Foraging Behavior, Theoretical Considerations, Convergence Proofs, ACO Algorithm, ACO And Model Based Search, Variations Of ACO: Elitist Ant System (EAS), Minmax Ant System (MMAS) And Rank Based Ant Colony System (RANKAS).		
Module 4:	**PARTICLE SWARM OPTIMIZATION**	***(9 Periods)***
Particle Swarm Optimization: Principles of Bird Flocking and Fish Schooling, Evolution of PSO, Operating Principles, PSO Algorithm, Neighbourhood Topologies, Convergence Criteria, Variations of PSO.		
Module 5:	**ARTIFICIAL BEE COLONY OPTIMIZATION**	***(9 Periods)***
Artificial Bee Colony (ABC) Optimization: Behaviour of Real Bees, ABC Algorithm, Variations of ABC: Abcgbest and Abcgbestdist Case Study: Traveling Salesman Problem, Knapsack Problem, N Queens.		
		Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXPERIMENTS:	
26.	Develop a basic genetic algorithm from scratch in a programming language of your choice.
27.	Implement a simulated annealing algorithm to solve the traveling salesman problem (TSP).
28.	Create a simulation of the ant colony optimization algorithm to solve a routing problem.
29.	Implement a particle swarm optimization (PSO) algorithm to find the global minimum of a multi-modal function.
30.	Apply the artificial bee colony (ABC) optimization algorithm to solve the knapsack problem.
31.	Conduct a detailed case study on the application of an evolutionary computing algorithm (e.g., GA, PSO, or ACO) in a real-world problem (e.g., machine learning, robotics, network optimization).

RESOURCES

TEXT BOOKS:	
1.	Goldberg D E, "Genetic Algorithms in search", Optimization and machine learning, AddisonWesley 2005.
2.	Kenneth A DeJong, "Evolutionary Computation a Unified Approach", Prentice Hall of India, New Delhi, 2006.
REFERENCE BOOKS:	
1.	Elaine Rich, Kevin Knight, "Artificial Intelligence" Tata McGraw Hil Education Private Limited, 2011.
2.	Marco Dorigo and Thomas Stutzle, "Ant Colony optimization", Prentice Hall of India, New Delhi 2005.
VIDEO LECTURES:	
1.	https://ocw.mit.edu/courses/6-034-artificial-intelligence-fall-2010/resources/lecture-13-learning-genetic-algorithms/
2.	https://archive.nptel.ac.in/courses/106/105/106105173/
3.	https://www.youtube.com/playlist?list=PLlSz1lOMWwIfyY7lnmuWMS2_5j3huAXcI
WEB RESOURCES:	
9.	https://ocw.mit.edu/courses/ids-338j-multidisciplinary-system-design-optimization-spring-2010/ec40906895b394a13ae2688e0d12960b_MITESD_77S10_lec11.pdf
10.	https://www.geeksforgeeks.org/genetic-algorithms/
11.	https://www.tutorialspoint.com/genetic_algorithms/index.htm

PROGRAM ELECTIVE

2.

Course Code	Course Title	L	T	P	S	C
22AI102002	**ARTIFICIAL INTELLIGENCE**	3	-	2	-	4

Pre-Requisite Python Programming

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Introduction to Artificial Intelligence, Designing intelligent agents, Solving general purpose problems, Search in complex environments, Probabilistic reasoning, Represent knowledge and reason under uncertainty, Robotics, Ethics and safety in AI.

COURSEOUTCOMES: Aftersuccessfulcompletionofthecourse,studentswillbeableto:

CO1. Architectintelligentagentsusingartificialintelligencetechniquesandprinciples.

CO2. Analyzeandinterprettheproblem,identifysuitablesolutionsusingheuristic functions, optimization algorithms and search algorithms.

CO3. Select and apply appropriate knowledge representation to build Bayesian networkmodels to reason under uncertainty.

CO4. Investigaterobothardwareandframeworksforintelligentroboticperception.

CO5. Demonstrate knowledge on ethical implications of intelligent machines for providing privacy, trust, security and safety.

CO6. WorkIndependentlytosolveproblemswitheffectivecommunication.

CO-PO-PSO Mapping Table:

Course Outcomes	ProgramOutcomes												ProgramSpecific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1		-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	1	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	1	-	2	-	-	-	-	-	3	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	2	2	-	-	2	-	2	3	3	**-**	**-**	**-**	**3**	**-**	**-**

Correlation Levels: 3:High; 2:Medium;1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE ***(09Periods)***

Foundations of artificial intelligence, History of artificial intelligence, State of the art, Risks and benefits of AI, Intelligent agents – Agents and environments, The concept of rationality, Structure of agents.

Module 2 PROBLEM SOLVING BY SEARCHING ***(09Periods)***

Problemsolvingagents,Searchalgorithms,Uninformedsearchstrategies,Informedsearch strategies – Greedy best-first search, A* search; Heuristic functions.

Module 3 SEARCH INCOMPLEX ENVIRONMENTS ***(09Periods)***

Local search algorithms and optimization problems – Hill-climbing search, Simulated annealing, Local beam search, Evolutionary algorithms; Optimal decisions in games – The minimax search algorithm, Optimal decisions in multiplayer games, Alpha-Beta pruning, Move ordering; Monte Carlo tree search, Kalman Filter.

Module 4 PROBABILISTIC REASONING ***(09Periods)***

Representing Knowledge in an uncertain domain, Semantics of Bayesian networks, Probabilistic reasoning over time – Time and uncertainty, Inference in temporal models, Hidden Markov models, Kalman Filter.

Module 5 ROBOTICS, ETHICS AND SAFETY IN AI ***(09Periods)***

Robots, Robot hardware, Robotic perception, Alternative robotic frameworks, Applicationdomains.

Limits of AI, Ethics of AI – Surveillance, security and privacy, Fairness and bias, Trust and transparency, AI safety.

TotalPeriods:45

EXPERIENTIAL LEARNING

LISTOFEXERCISES:

1. Design and implement agent programs for Table-driven agents using the agent function of vacuum-cleaner world.The agent cleans the current square if it is dirty, otherwise it moves to the other square.
2. ImplementagentprogramsforSimple reflexagentsandModel-basedreflexagents using the agent function of vacuum-cleaner world.
3. SolvethetravellingsalesmanproblemusingHillClimbingsearchalgorithm
4. Designandimplementsolutionfor8-puzzleproblemusingGreedyBestFirstSearch.
5. Find the shortest path between a starting location and destination location in a graph using A* search algorithm.
6. ImplementMiniMaxalgorithmforfindinganoptimaldecisioninatic-tocgame.
7. ImplementMonte-CarloTreesearchintendedtorunonsmallgametrees.
8. SolvethemontyhallproblemusingBayesianNetwork.
9. Thegameinvolvesthreedoors,giventhatbehindoneofthesedoorsisacarand

theremainingtwohave goats behindthem.So you startbypickingarandom door, say #2. On the other hand, the host knows where the car is hidden and he opens another door, say #1 (behind which there is a goat). Here's the catch, you're now given a choice, the host will ask you if you want to pick door #3 instead of yourfirst choice i.e. #2.
Implement Kalman Filter to track the aircraft by determining the position and velocity of aircraft.

10. DesignandimplementastockpricesforecastingmodelusingHiddenMarkovModel.

RESOURCES

TEXTBOOKS:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Prentice Hall, 4th Edition, 2020.

REFERENCEBOOKS:

1. Stephen Lucci, Danny Kopec, Artificial Intelligence in the 21st Century, Mercury Learning and Information, 3rd Edition,2018
2. Rich,Knight,Nair:Artificialintelligence,TataMcGrawHill,ThirdEdition,2009.
3. Deepak Khemani, A First Course in Artificial Intelligence, McGraw Hill Education, 2017.
4. SarojKaushik,ArtificialIntelligence,CengageLearning,2011.

SOFTWARE/TOOLS:

1. Python
2. pandas,matplotlib

VIDEOLECTURES:

1. https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence
2. http://aima.cs.berkeley.edu/
3. https://ai.google/education/
4. https://www.coursera.org/courses?query=artificial%20intelligence
5. https://www.edureka.co/blog/artificial-intelligence-with-python/

WEBRESOURCES:

1. http://www.airesources.org/
2. https://allthingsai.com/
3. https://designmodo.com/ai-tools-designers/
4. https://www.ulethbridge.ca/teachingcentre/chatgpt-ai-resources

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI102003	**MACHINE LEARNING**	3	-	2	-	4

Pre-Requisite Numerical Methods, Probability and Statistics, Artificial Intelligence

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Introduction to machine learning, Bayesian concept learning, Supervised learning, Unsupervised learning, Artificial neural networks, Ensemble learning.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the process of machine learning modeling and evaluation to automatically infer a general description for a given learning problem.

CO2. Analyze the underlying mathematical models within machine learning algorithms and learning tasks.

CO3. Design and implement machine learning solutions for classification, regression, and clustering problems.

CO4. Design and implement efficient neural architectures to model patterns for a given learning problem.

CO5. Develop intelligent solutions to solve societal problems related to computer vision, information security, healthcare and other areas.

CO6. Work Independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	3	3	3	3	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	3	1		-	-	-	-	-	-	-	-	-	3	-
CO5	1	3	3	3	3	3	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO MACHINE LEARNING ***(09 Periods)***

Machine Learning: Human learning, Types of human learning, Machine learning, Types of machine learning, Applications of machine learning, Issues in machine learning.

Preparing to Model: Machine learning activities, Types of data, Exploring structure of data, Data quality and remediation.

Module 2: MODELING AND EVALUATION, BAYESIAN CONCEPT LEARNING ***(09 Periods)***

Modeling and Evaluation: Selecting a model, Training a model, Model representation and interpretability, Evaluating performance of a model, Improving performance of a model.

Feature Engineering: Feature transformation, Feature subset Selection.

Bayesian Concept Learning: Introduction, Importance, Bayes' theorem, Bayes' theorem and concept learning, Bayesian belief network.

Module 3: SUPERVISED LEARNING ***(10 Periods)***

Classification: Classification model, Classification learning steps, K-Nearest Neighbor, Support vector machines, Decision Tree - Decision tree representation, Problems for decision tree learning, Decision tree learning algorithm, Hypothesis space search, Inductive bias in decision tree learning, Issues in decision tree learning.

Regression: Introduction, Simple linear regression, Improving accuracy of the linear regression model, Multiple linear regression, Assumptions and problems in regression analysis, Polynomial regression model, Logistic regression.

Module 4: UNSUPERVISED LEARNING ***(07 Periods)***

Introduction, Unsupervised vs supervised learning, Applications of unsupervised learning, Clustering as a machine learning task, Types of clustering techniques, Partitioning methods, K-Medoids, Hierarchical clustering, DBSCAN.

Module 5: ARTIFICIAL NEURAL NETWORKS, ENSEMBLE LEARNING ***(10 Periods)***

Artificial Neural Networks: Neural network representations, Appropriate problems for neural network learning, Perceptrons, Multilayer networks and Backpropagation algorithm, Convergence and local minima, Representational power of feedforward networks, Hypothesis space search and inductive bias, Hidden layer representations, Generalization, Overfitting, Stopping criterion.

Ensemble Learning: Bagging, Boosting, Gradient boosting.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Introduction to Python machine learning libraries.
2. Use Naïve Bayes classifier to solve the credit card fraud detection problem.
3. Implement K-Nearest Neighbor algorithm to solve classification problem.
4. Implement CART algorithm for decision tree learning. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample. Explore the problem of overfitting in decision tree and develop solution using pruning technique.
5. Perform Exploratory Data Analysis on the given dataset. Implement CART algorithm for decision tree learning. Use an appropriate data set for building the decision tree and apply this knowledge to classify a new sample.
6. Train an SVM Classifier with Linear Kernel. Use an appropriate data set for building the SVM Classifier and apply this knowledge to classify a new sample.
7. Build linear regression and multiple regression models to predict the price of the house (Boston House Prices Dataset).
8. Build a polynomial regression model for predicting the salary of the employees.
9. Build a neural network that will read the image of a digit and correctly identify the number.
10. Solve classification problem by constructing a feedforward neural network using Backpropagation algorithm. (Wheat Seed Data)

RESOURCES

TEXT BOOKS:

1. Tom M. Mitchell, Machine Learning, McGraw Hill, 1997.
2. Saikat Dutt, Subramanian Chandramouli, Amit kumar das, Machine Learning, Pearson, 2019.

REFERENCE BOOKS:

1. Manaranjan Pradhan, U Dinesh Kumar, Machine Learning Using Python, Packt Publishing, 2019.
2. Aurelien Geron, Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, 2nd Edition, O'Reilly, 2019.
3. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, 4th Edition, 2020.
4. Shai Shalev Shwartz, Shai Ben David, Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press, 2014.

SOFTWARE/TOOLS:

1. Python
2. Scikit-learn/Keras/TensorFlow

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106202/
2. https://www.coursera.org/learn/machine-learning
3. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
4. https://onlinecourses.nptel.ac.in/noc23_cs87/preview
5. https://onlinecourses.nptel.ac.in/noc23_ee87/preview
6. https://www.coursera.org/learn/ntumlone-algorithmicfoundations
7. https://www.coursera.org/specializations/machine-learning-introduction
8. http://ndl.iitkgp.ac.in/document/YkxlRXFvZXJrTDBkVzVVZi9ESjl6eXpRZkxRc2lhOWhlVXBhUVVWaXZlNDNyZUVldU9LdlYvd20wbkQ4MC92UQ

9. https://www.coursera.org/learn/unsupervised-learning-recommenders-reinforcement-learning

WEB RESOURCES:

1. https://www.ibm.com/topics/machine-learning
2. https://www.simplilearn.com/tutorials/machine-learning-tutorial/what-is-machine-learning
3. https://www.w3schools.com/python/python_ml_getting_started.asp
4. https://developers.google.com/machine-learning/crash-course
5. https://www.greenteapress.com/thinkstats/
6. https://info.deeplearning.ai/machine-learning-yearning-book
7. https://www.kaggle.com/code/kanncaa1/machine-learning-tutorial-for-beginners
8. https://machinelearningmastery.com/machine-learning-in-python-step-by-step/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI102006	**DEEP LEARNING**	3	-	2	-	4

Pre-Requisite Machine Learning
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: : This course provides a detailed Machine learning with shallow neural networks, Training deep neural networks, Backpropagation, Gradient based strategies, Teaching deep learners, Recurrent neural networks, Applications of Recurrent neural networks, Convolutional Architectures-AlexNet; VGG,GoogleNet; ResNet.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Acquire working knowledge of neural networks and explore the different parameters of the network.
CO2. Construct a generative model for learning probability distribution using RBM.
CO3. Analyze temporal sequential input data using gated memory based neural units.
CO4. Utilize Convolutional Neural Network for analyzing visual imagery and utilize transfer learning approaches for reducing the training efforts.
CO5. Apply encoder-decoder architecture for image denoising, and learning representation of a set of data.
CO6. Work Independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**1**	**-**	**2**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**

Correlation Level: 3-High; 2-Medium; 1-Low

COURSE CONTENT

Module 1 MACHINE LEARNING WITH SHALLOW NEURAL NETWORKS ***(09 Periods)***

Neural Architectures for Binary Classification Models, Neural Architectures for Multiclass Models, Backpropagated Saliency for Feature Selection, Autoencoders- Basic Principles, Nonlinear Activations, Deep Autoencoders, Application to Outlier Detection.

Module 2 TRAINING DEEP NEURAL NETWORKS ***(09 Periods)***

Backpropagation: Backpropagation with the Computational Graph Abstraction, Dynamic Programming,Backpropagation with Post-Activation and Pre-Activation variables, Examples of Updates for Various Activations, Loss Functions on Multiple Output Nodes and Hidden Nodes, Backpropagation Tricks for Handling Shared Weights; Setup and Initialization Issues.
Gradient based Strategies: Learning Rate Decay, Momentum-Based Learning, Parameter-Specific Learning Rates, Cliffs and Higher-Order Instability, Gradient Clipping, Second-Order Derivatives, Polyak Averaging, Local and Spurious Minima.

Module 3 GENETIC ALGORITHMS ***(09 Periods)***

The Bias-Variance Trade-Off, Generalization Issues in Model Tuning and Evaluation, Penalty-Based Regularization, Ensemble Methods, Early Stopping, Unsupervised Pretraining, Regularization in Unsupervised Applications.

Module 4 RECURRENT NEURAL NETWORKS ***(09 Periods)***

Recurrent Neural Networks: Expressiveness of Recurrent Networks, The Architecture of Recurrent Neural Networks, The Challenges of Training Recurrent Networks. Long Short-Term Memory (LSTM), Gated Recurrent Units (GRUs).
Applications of Recurrent Neural Networks: Automatic Image Captioning, Sequence-to-Sequence Learning and Machine Translation, Sentence-Level Classification, Time-Series Forecasting and Prediction, End-to-End Speech Recognition.

Module 5 CONVOLUTIONAL NEURAL NETWORKS ***(09 Periods)***

The Basic Structure of a Convolutional Network, Training a Convolutional Network, Convolutional Architectures-AlexNet,VGG,GoogleNet,ResNet, Visualizing the Features of a Trained Network, Convolutional Autoencoders, Applications of Convolutional Neural Networks- Content-Based Image Retrieval, Object Detection, Natural Language and Sequence Learning.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Perform splitting of data for training, testing, and validation using k-fold cross validation.
2. Construct and implement multi-layer feed forward neural network for hand written digit classification problem.
3. Implement the image dimensionality reduction problem using aAutoEncoder architecture.
4. Perform hyper parameter tuning using Bayesian optimization technique for a Convolution Neural Network.
5. Analyze the effectiveness of various optimization algorithm with a image classification problem.
6. Solve the overfitting problem in a neural architecture using DropOut technique.
7. Solve a seq2seq problem (machine translation) using LSTM Recurrent Neural Architecture.
8. Solve a time series forecasting (stock prediction) using LSTM RNN.
9. Implement a binary and multi class image classification using Convolution Neural Network.
10. Study the efficiency of the transfer learning approach for a classification problem on the following architectures; VGG-16, Alexnet, and ResNet

RESOURCES

TEXT BOOKS:

1. Charu C Aggarwal, Neural Networks and Deep Learning, Springer,2018. Publishing.

REFERENCE BOOKS:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, 2016
2. Deng&Yu,DeepLearning:MethodsandApplications,NowPublishers, 2013.
3. Saroj Kaushik, SunitaTewari, *Soft Computing: Fundamentals, Techniques and Applications*, McGraw Hill, 2018.

SOFTWARE/Tools used:

Environment	: Google CoLab
Programming Language	: Python 3.8
Machine Learning Library	: Tensor Flow 2.1 and Keras

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106184
2. https://www.coursera.org/specializations/deep-learning?utm_source=deeplearningai&utm_medium=institutions&utm_campaign=WebsiteC oursesDLSTopButton

ADDITIONAL LEARNING RESOURCES:

1. https://www.simplilearn.com/tutorials/deep-learning-tutorial/what-is-deep-learning
2. https://www.udemy.com/course/data-science-logistic-regression-in-python/
3. https://www.udemy.com/course/data-science-deep-learning-in-python/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT101016	**NATURAL LANGUAGE PROCESSING**	3	-	-	-	3

Pre-Requisite

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Language Modeling, Regular Expressions, Text Normalization, Word level analysis, PoS Tagging and Entropy models; Context free grammars and Parsing techniques; Semantics and pragmatics, Discourse analysis and lexical resources.

COURSE OUTCOMES: *After successful completion of the course, students will be able to:*

CO1. Demonstrate knowledge on Regular Expressions, Words, Corpora and Tokenization in Natural Language Processing.
CO2. Analyze various models and techniques for world level recognition.
CO3. Construct Grammars to implement Parsing for text Processing.
CO4. Analyze Word level similarities using Semantics and Pragmatics.
CO5. Analyze different algorithms on Discourse Analysis for Natural Language Processing applications
CO6. Investigate Probabilistic models to perform syntax analysis in Natural Language Processing

COURSE CONTENT:

Module-1: INTRODUCTION (9 periods)

Origins and challenges of NLP, Language Modeling- Grammar based LM, Statistical LM, Regular Expressions, Words, Corpora, Text Normalization – Tokenization and Normalization, Word Tokenization, Byte-Pair Encoding for Tokenization, Word Normalization, Lemmatization and Stemming, Minimum Edit Distance.

Module-2:–WORD LEVEL ANALYSIS (9 periods)

N-grams, Evaluating Language models, Generalization and Zeros, Smoothing, Kneser-Ney Smoothing, Backoff, Naive Bayes Classifiers, Training Naive Bayes Classifier, Worked example, Sentiment analysis, Test sets and cross validations, English Word classes, Part of Speech Tagging, HMM Part-of-speech Tagging, Conditional Random Field(CRFs),Evaluation of Named Entity Recognition.

MODULE-3: SYNTACTIC ANALYSIS (9 periods)

Context-Free Grammars, Grammar rules for English, Treebanks, Grammar equivalence and Normal Forms, Lexicalized grammars, Ambiguity, CYK Parsing- Dynamic Programming Approach, Span-Based Neural Constituency Parsing, Evaluating Parsers, Partial parsing, CCG Parsing, Dependency Parsing- Dependency Relations, Dependency Formalisms, Dependency Treebanks, Transition-Based Dependency Parsing, Graph-Based Dependency Parsing.

Module-4: SEMANTICS AND SEMANTICS PARSING (9 periods)
Information Extraction- Relation Extraction, Relation Extraction Algorithms, Extracting Times, Template Filling, Word Senses, Relations between Senses, WordNet, Word Sense Disambiguation, Alternate WSD algorithms and Tasks, Using Thesauruses to improve Embeddings, Semantic Roles, The Proposition Bank, FrameNet, Semantic Role Labeling, Primitive Decomposition of Predicates.

Module-5 DISCOURSE ANALYSIS AND LEXICAL RESOURCES (9 periods)
Coneference Phenomena: Linguistic Background, Coreference Tasks and Datasets, Mention Detection, Architectures for Coreference Algorithms, Classifiers using hand-built features, A neural mention-ranking algorithm, Evaluation of Coreference Resolution, Discourse Coherence, Coherence Relations, Discourse Structure Parsing Centering and Entity-Based Coherence, Representation learning models for local coherence, Global Coherence.

Case study: Question Answering and Summarization, Dialogue and Conversational Agents.

Total Periods: 45

RESOURCES
TEXT BOOK:
1. Daniel Jurafsky, James H. Martin, "*Speech and Language Processing: An Introduction to Natural Language Processing"*, Computational Linguistics and Speech, Pearson Publication, 2020.

REFERENCE BOOKS:
1. Breck Baldwin, "*Language processing with Java and LingPipe Cookbook"*, Atlantic Publisher, 2015.
2. Richard M Reese, "*Natural Language Processing with Java"*, OReilly Media, 2015
3. Steven Bird, Ewan Klein and Edward Loper, "*Natural Language Processing with Python"*, 1st Edition, OReilly Media, 2009.

WEB RESOURCES:
https://nptel.ac.in/courses/106/105/106105158/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI102008	**COMPUTER VISION**	3	-	2	-	4

Pre-Requisite Python Programming

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Concepts of low-level vision, Image filtering operations, Masking, Thresholding techniques, Edge Detection, Dilation and erosion, Background subtraction, Shot boundary detection, Interactive segmentation, Clustering based segmentation, Texture, Classification, Overfitting, Receiver Operator curves, Object detection and recognition and Information Retrieval methods.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze computer vision techniques for image enhancement, synthesis and segmentation.

CO2. Apply threshold techniques, morphological process and region growing methods for edge detection in images.

CO3. Develop clustering-based segmentation solutions for image synthesis.

CO4. Synthesize and Evaluate classification procedures for texture and feature analysis.

CO5. Select and Apply appropriate techniques for object recognition and detection in computer vision-based applications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	2	2	-	-	1	1	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**1**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	3	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 INTRODUCTION AND IMAGE ENHANCEMENT ***(08 Periods)***

The nature of the vision, Low-level vision – Gray scale versus color, Image processing operations; Basic image filtering operations – Gaussian smoothing, Median filters, Mode Filters, Rank Order Filters, Sharp and Unsharp masking.

Module 2 THRESHOLDING AND EDGE DETECTION ***(10 Periods)***

Region-growing methods, Thresholding, Adaptive thresholding, Threshold selection – Variance-based thresholding, Entropy-based thresholding, Maximum likelihood thresholding; Global valley approach to thresholding; Edge Detection – Template Matching Approach, 3×3 Template Operators, Canny Operator, Laplacian Operator; Dilation and erosion in binary images – Properties of dilation and erosion operators, Closing and opening.

Module 3 SEGMENTATION BY CLUSTERING ***(09 Periods)***

Grouping and gestalt, Important applications – Background subtraction, Shot boundary detection, Interactive segmentation, Forming imaging regions; Image segmentation by clustering pixels, Segmentation, clustering and graphs – Terminology and facts for graphs, Agglomerative clustering with a graph, Divisive clustering with a graph, Normalized cuts.

Module 4 CLASSIFICATION AND DETECTION OF OBJECTS ***(11 Periods)***

Texture – Spots and bars, Representation, Synthesizing textures and filling holes in images, Shape from texture; Learning to classify – Using loss to determine decisions, Training error, test error and overfitting, Regularization, Error rate and Cross-validation, Receiver operating curves; Classifying images – Classifying images of single objects; Detecting objects in images – The sliding window method.

Module 5 OBJECT RECOGNITION, APPLICATIONS ***(07 Periods)***

Object Recognition – Categorization, Selection, Feature questions, Geometric questions, Semantic questions; Applications – Classifying materials, Classifying scenes, Tracking people.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Implement Image sharpening using 2-D Laplacian high pass filter in spatial domain.
2. Implement Edge detection in a segmented binary image using Canny edge detector.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. David A. Forsyth, Jean Ponce, Computer Vision: A Modern Approach, Pearson, 2nd Edition, 2012.
2. E. R. Davies, Computer and Machine Vision: Theory, Algorithms, Practicalities, Elsevier, 5th Edition, 2017.

REFERENCE BOOKS:

1. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson, 4th Edition, 2018.
2. William K. Pratt, Digital Image Processing, Wiley, 4th Edition, 2006.
3. Will Ballard, Hands-on Deep Learning for Images with Tensorflow: Build Intelligent Computer Vision Applications using Tensorflow and Keras, Packt Publishing, 2018.
4. Ahmed Fawzy Mohamed Gad, Practical Computer Vision Applications using Deep Learning with CNNs: With Detailed Examples in Python using Tensorflow and Kivy, Apress, 2018.
5. Abhinav Dadhich, Practial Computer Vision: Extract Insightful Information from Images using Tensorflow, Keras, OpenCV, Packt, 2018.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/108103174
2. https://onlinecourses.nptel.ac.in/noc19_cs58/preview
3. https://onlinecourses.nptel.ac.in/noc23_ee78/preview
4. https://onlinecourses.nptel.ac.in/noc21_ee23/preview
5. https://archive.nptel.ac.in/courses/106/105/106105216/
6. https://www.coursera.org/learn/ml-computer-vision
7. https://www.coursera.org/learn/introduction-computer-vision-watson-opencv

WEB RESOURCES:

1. https://slideplayer.com/slide/5158896/
2. www.scs.carleton.ca/~c_shu/Courses/comp4900d/notes/PPT/lect1_intro.ppt
3. http://coeosmanabad.com/etc/manual/BE%20DIP%20Lab%20Manual.pdf
4. https://jnec.org/Lab-manuals/CSE/CSE1/TE-Part-1/DIP.pdf
5. http://gn.dronacharya.info/CSEDept/Downloads/Labmanuals/DIP-Lab-Manual.pdf
6. http://titagartala.ac.in/wp-content/uploads/2018/12/Digital-Lab-Processing-Lab-Manual.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT101019	ROBOTIC PROCESS AUTOMATION AND DEVELOPMENT	3	-	-	-	3

Pre-Requisite Object Oriented Programming through Java

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to automation; Need and levels of automation; Applications of automation; Programmable logical controller; Introduction to robotics; End effectors; Robotic drive mechanisms; Manipulator kinematics; Manipulator dynamics; Trajectory planning; Sensors; Robotic programming; Robotic application; Artificial intelligence; and Case studies.

COURSE OUTCOMES: *After successful completion of this course, the students will be able to:*

CO1. Demonstrate knowledge on Robotic Process Automation fundamentals.

CO2. Demonstrate basic skills on Robotic Process Automation Tool.

CO3. Apply automation techniques on Image, Text and Data Tables.

CO4. Demonstrate skills on Handling User Events, Assistant Bots, and Exception Handling.

CO5. Demonstrate skills in Deploying and Maintaining the Bot.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	3	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	-	3	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-	2	-	3	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

MODULE_1: INTRODUCTION TO ROBOTIC PROCESS AUTOMATION (9 Periods)

Scope and techniques of automation, Robotic process automation, What can RPA do, Benefits of RPA, Components of RPA, RPA platforms, The future of automation.

RPA Basics: History of Automation, What is RPA - RPA vs Automation, Processes and Flowcharts, Programming Constructs in RPA, What Processes can be Automated, Types of Bots, Workloads which can be automated, RPA Advanced Concepts: Standardization of processes, RPA Development methodologies, Difference from SDLC, Robotic control flow architecture, RPA business case: RPA Team, Process Design Document/Solution Design Document, Industries best suited for RPA, Risks & Challenges with RPA, RPA and emerging ecosystem.

Module-2: RPA TOOL INTRODUCTION AND BASICS (9 Periods)

RPA Tool: Introduction to RPA Tool, The User Interface, Variables, Managing Variables, Naming Best Practices, The Variables Panel, Generic Value Variables, Text Variables, True or False Variables, Number Variables, Array Variables, Date and Time Variables, Data Table Variables, Managing Arguments, Naming Best Practices, The Arguments Panel, Using Arguments, About Imported Namespaces, Importing New Namespaces, Control Flow, Control Flow Introduction, If-Else Statements, Loops, Advanced Control Flow, Sequences, Flowcharts, About Control Flow, Control Flow Activities, The Assign Activity, The Delay Activity, The Do While Activity, The If Activity, The Switch Activity, The While Activity, The For Each Activity, The Break Activity.

Data Manipulation: Introduction, Scalar variables, collections and Tables, Text Manipulation, Data Manipulation, Gathering and Assembling Data.

Module-3: ADVANCED AUTOMATION CONCEPTS & TECHNIQUES (9 Periods)

Recording Introduction: Basic and Desktop Recording, Web Recording, Input/Output Methods, Screen Scraping, Data Scraping, Scraping advanced techniques,

Selectors: Defining and Assessing Selectors, Customization, Debugging, Dynamic Selectors, Partial Selectors, RPA Challenge.

Image, Text and Advanced Citrix Automation: Introduction to Image and Text Automation, Image based automation, Keyboard based automation, Information Retrieval, Advanced Citrix Automation challenges, Best Practices, Using tab for Images, Starting Apps, Excel Data Tables and PDF, Data Tables in RPA, Excel and Data Table basics, Data Manipulation in excel, Extracting, Data from PDF, Extracting a single piece of data, Anchors, Using anchors in PDF.

Module-4: HANDLING USER EVENTS AND ASSISTANT BOTS, EXCEPTION HANDLING (9 Periods)

Assistant bots, Monitoring system event triggers, Hotkey trigger, Mouse trigger, System trigger, Monitoring image and element triggers, An example of monitoring email, Example of monitoring a copying event and blocking it, Launching an assistant bot on a keyboard event.

Exception Handling: Debugging and Exception Handling, Debugging Tools, Strategies for solving issues, Catching errors.

Module-5: DEPLOYING AND MAINTAINING THE BOT (9 Periods)

Publishing using publish utility, Creation of Server, Using Server to control the bots, Creating a provision Robot from the Server, Connecting a Robot to Server, Deploy the Robot to Server, Publishing and managing updates, Managing packages, Uploading packages, Deleting packages

Total Periods: 45

RESOURCES:

TEXT BOOKS:

1. Alok Mani Tripathi, Learning Robotic Process Automation, Packt Publishing, 2018.

REFERENCE BOOKS:

1. Frank Casale, Rebecca Dilla, Heidi Jaynes , Lauren Livingston, Introduction to Robotic Process Automation: a Primer, Institute of Robotic Process Automation,1st Edition, 2015.

2. Richard Murdoch, Robotic Process Automation: Guide To Building Software Robots, Automate Repetitive Tasks & Become An RPA Consultant, Independently Published,1st Edition, 2018.

3. Srikanth Merianda, Robotic Process Automation Tools, Process Automation and their benefits: Understanding RPA and Intelligent Automation, Consulting Opportunity Holdings LLC, 1st Edition, 2018.

4. Lim Mei Ying, Robotic Process Automation with Blue Prism Quick Start Guide: Create software robots and automate business processes, Packt Publishing, 1st Edition, 2018.

WEB REFERENCES:
1. https://www.uipath.com/rpa/robotic-process-automation
2. https://www.academy.uipath.com

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB102001	**CRYPTOGRAPHY AND NETWORK SECURITY**	3	-	2	-	4

Pre-Requisite COMPUTER NETWORKS
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of cryptographic algorithms, Substitution techniques, Symmetric ciphers, Block cipher operations, Cryptographic data integrity algorithms, Key management and distribution, User authentication, Transport level security, Electronic mail security, IP security.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply the knowledge of network security concepts, symmetric and public key cryptosystems for securing information.
CO2. Apply hash functions, message authentication codes and digital signatures for providing data integrity in information security applications.
CO3. Use key management and distribution techniques, user authentication techniques for assuring mutual trust among users.
CO4. Demonstrate knowledge on network and Internet security techniques for addressing the security threats.
CO5. Work independently and in teams to solve security problems with effective communication

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	3	-	-	-	3	-	-	-	-	3	3	3	2
CO2	3	3	-	3	-	-	-	-	-	-	-	-	3	3	3	2
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	3	3	2
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3	2
CO5									3	3						
Course Correlation Mapping	**3**	**3**	-	**3**	**-**	-	-	3	3	3	-	-	3	3	3	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION ***(09 Periods)***

Computer security concepts, Security attacks, Security services, Security mechanisms, Model for network security, Symmetric cipher model, Substitution techniques - Monoalphabetic ciphers and Polyalphabetic ciphers.

Module 2: SYMMETRIC CIPHERS ***(07 Periods)***

Stream ciphers and block ciphers, Data Encryption Standard (DES), Advanced Encryption Standard (AES) - Structure, Transformation Functions; Block Cipher Operation - Multiple encryption and triple DES, Cipher block chaining mode, Cipher feedback mode, Output feedback mode, Counter mode.

Module 3: PUBLIC KEY CRYPTOGRAPHY AND CRYPTOGRAPHIC DATA INTEGRITY ALGORITHMS ***(09 Periods)***

Public Key Cryptography: RSA, Diffie-Hellman key exchange, Elgamal cryptographic system.

Cryptographic Data Integrity Algorithms: Hash Functions - Simple hash functions, Secure Hash Algorithm SHA-512; Message Authentication Codes – Requirements, Functions, Security of MACs, HMAC; Digital signatures - Schnorr Digital signature scheme;

Module 4: MUTUAL TRUST ***(10 Periods)***

Key Management and Distribution: Symmetric key distribution using symmetric and asymmetric encryption, Distribution of public keys, X.509 certificates, Public key infrastructure.

User Authentication: Remote user authentication principles, Kerberos, Personal identity verification.

Module 5: NETWORK AND INTERNET SECURITY ***(10 Periods)***

Transport Level Security: Web security considerations, Transport layer security, HTTPS.

Electronic Mail Security: S/MIME, Pretty Good Privacy, DNSSEC.

IP Security: Overview, Policy, Encapsulating security payload.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Construct a Caesar cipher and convert the word "the Network security" into Cipher text with k=3.
2. Generate the Cipher text for the message "BALLOON" using play fair Cipher.
3. Generate the cipher text for the message "me" and also regenerate the message from the cipher text using hill cipher and with the key

$$\begin{pmatrix} 9 & 4 \\ 5 & 7 \end{pmatrix}$$

4. Construct a cipher for the word "the Network security" using rail fence of Depth = 2.
5. Perform the Simple DES on the following data and calculate the cipher text for the plain text "10100101" and the key is "0010010111"

P10:	3	5	2	7	4	10	1	9	8	6
P8:	6	3	7	4	8	5	10	9		
E/P:	4	1	2	3	2	3	4	1		
S0		0	1	2	3					
	0	1	0	3	2					
	1	3	2	1	0					
	2	0	2	1	3					
	3	3	1	3	2					
S1		0	1	2	3					
	0	0	1	2	3					
	1	2	0	1	3					
	2	3	0	1	0					
	3	2	1	0	3					
P4:	2	4	3	1						
IP:	2	6	3	1	4	8	5	7		
IP^{-1}:	4	1	3	5	7	2	8	6		

6. Using Fermat's theorem, find $4^{225} \bmod 13$.
7. Consider a one-way authentication technique based on asymmetric encryption:
   A -> B: ID_A
   B -> A: R_1
   A ->B: $E(PR_a, R_1)$
   a. Explain the protocol.
   b. What type of attack is this protocol susceptible to?

8. Consider a one-way authentication technique based on asymmetric encryption:
   A -> B: IDA || $E(PU_B, R_A)$
   B -> A: R_A
   a. Explain the protocol.
   b. What type of attack is this protocol susceptible to?
9. Investigate the network access control scheme used at your College. Draw a diagram and describe the principal components.
10 List some commonly used cloud-based data services. Explore and compare these services based on their use of encryption, flexibility, efficiency, speed, and ease of use. Study security breaches on these services in recent past. What changes were made by the services after these attacks?

RESOURCES

TEXT BOOKS:

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, 8th Edition, Pearson, 2020

REFERENCE BOOKS:

1. William Stallings, *Network Security Essentials: Applications and Standards*, 6th Edition, Pearson, 2018.
2. Douglas R. Stinson, Maura B. Paterson, *Cryptography: Theory and Practice*, 4th Edition, CRC Press, 2018.
3. Atul Kahate, Cryptography and Network Security, 3rd Edition, McGraw Hill, 2017.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=JoeiLuFNBc4&list=PLBlnK6fEyqRgJU3EsOYDTW7m6SUmW6kII&index=1
2. https://www.coursera.org/learn/crypto#syllabus
3. https://nptel.ac.in/courses/106105031

WEB RESOURCES:

1. https://www.javatpoint.com/computer-network-security
2. https://www.tutorialspoint.com/cryptography/index.htm
3. https://www.geeksforgeeks.org/cryptography-introduction/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101001	**CYBER SECURITY ESSENTIALS**	3	-	-	-	3

Pre-Requisite Computer Networks

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Cyber Security Fundamentals, Cyber Security Fundamentals, Attacker techniques and motivations, Fraud techniques, Threat infrastructure, Exploitation, Malicious code, Defense and analysis techniques, Intrusion detection techniques

COURSE OBJECTIVES:

- To impart knowledge on network security concepts, attacker techniques, Exploitation, defense and analysis techniques
- To develop skills on attacker techniques and malicious code to application against cyber threats
- To inculcate attitude among students to solve societal problems using cyber security concepts to defend the attacks in system.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understanding the fundamental concepts of cyber security concepts

CO2. Identify the pattern of launching attacker and fraud techniques to reduce risk and impact of cyber-attacks.

CO3. Identify the vulnerabilities using the SQL injection and web exploitation techniques in a system for securing data.

CO4. Apply code obfuscation techniques to prevent any unauthorized party from accessing logic of an application

CO5. Apply honey pots and malicious code-naming techniques to defend against attacks in memory.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-	3	3	3	3
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	3	-
CO5	3	2	3	2	-	-	-	-	-	-	-	-	3	3	3	-
Level of correlation of the course	**3**	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**2**

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT:

Module 1: CYBER SECURITY FUNDAMENTALS ***(10 Periods)***

Network Security Concepts: Information assurance fundamentals, Basic cryptography, Symmetric encryption, Public key encryption, The Domain Name System(DNS), Firewalls, Virtualization, Radio-Frequency Identification.

Module 2: ATTACER TECHNIQUES ***(09 Periods)***

Attacker techniques and motivations: Anti forensics, proxy usage, Tunneling techniques: HTTP, DNS, ICMP, Intermediaries, Steganography and other concepts, Detection and prevention.

Fraud techniques: Phishing, smishing, vishing and mobile malicious code, rogue antivirus, click

fraud.
Threat infrastructure: Botnets, Fast Flux, Advanced Fast Flux.

Module 3: EXPLOITATION ***(09 Periods)***

Shellcode, Integer overflow vulnerabilities, Stack based buffer overflows, Format string vulnerabilities, SQL injection, Malicious PDF files, Race conditions, Web exploit tools, DoS conditions, Brute force and dictionary attacks.

Module 4: MALICOUS CODE ***(10 Periods)***

Worms, viruses, Evading detection and elevating privileges: obfuscation, Virtual Machine obfuscation Persistent software techniques,Token kidnapping, Virtual machine Detection, Rootkits, Spyware, Attacks against privileged user accounts and escalation of privileges, Stealing information and Exploitation.

Module 5: DEFENSE AND ANALYSIS TECHNIQUES ***(07 Periods)***

Importance of memory forensics, Capabilities of memory forensics, Memory analysis frameworks, Dumping physical memory, Installing and using volatility, Finding hidden processes, Volatality analyst pack.
Honeypots, Malicious code naming, Automated malicious code analysis systems, Intrusion detection techniques.

Total Periods: 45

TEXT BOOKS:

1. James Graham, Richard Howard, Ryan Olson," Cyber Security Essentials", CRC Press, 2011.(Rs.6900)
2. Chwan-Hwa(john) Wu,J. David Irwin, "Introduction to Cyber Security", CRC Press T&F Group.

REFERENCE BOOKS:

1. Nina Godbole and SunitBelpure, "Cyber Security Understanding Cyber Crimes,Computer Forensics and Legal Perspectives" , Wiley publications.
2. B.B.Gupta, D.P.Agrawal, HaoxiangWang, "Computer and Cyber Security: Principle s, Algorithm, Applications, and Perspectives", CRC Press, ISBN 9780815371335, 2018.

VIDEO LECTURES:

1. https://www.coursera.org/learn/introduction-to-cybersecurity-essentials
2. https://www.udemy.com/course/cybersecurity-essentials/

WEB RESOURCES:

1. https://github.com/topics/cybersecurity
2. https://www.youtube.com/watch?v=nzZkKoREEGo

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101009	**BLOCK CHAIN TECHNOLOGIES**	3	-	-	-	3

Pre-Requisite Cryptography and Network Security
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Blockchain Technologies and its decentralization concepts, Digital Currencies, Smart Contracts, Ethereum, Hyperledger, Alternative Blockchains, Current Challenges and Scope of Research.

COURSE OUTCOMES: *After successful completion of this course, the students will be able to:*
CO1. Analyze the concepts of distributed systems, decentralization and blockchains in the Blockchain ecosystem.
CO2. Devise suitable Blockchain platforms for scalable applications.
CO3. Assess the challenges, trending technologies for understanding the research scope in Blockchain technologies.
CO4. Pertain to ethical and legal usage of Blockchain applications.
CO5. Formulate secured and sustainable Blockchains for healthy and safe society.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	2	2	-	-	-	-	-	-	-	3	2	2	2
CO2	3	2	2	2	2	-	-	-	-	-	-	-	3	2	2	2
CO3	3	2	3	2	2	-	-	-	-	-	-	-	3	2	2	2
CO4	3	2	3	2	2	-	-	-	-	-	-	-	3	2	2	2
CO5	3	2	2	3	2	-	-	-	-	-	-	-	3	2	2	2
Course Correlation Mapping	**3**	**2**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	3	2	2	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:
Module-1: INTRODUCTION TO BLOCKCHAIN AND DECENTRALIZATION

(09 Periods)

Introduction to Blockchain: Distributed systems, History of Blockchain, Introduction to Blockchain - Definitions, Generic elements, Features, Applications, Tiers; Types of Blockchain, CAP theorem and Blockchain, Benefits and limitations of Blockchain technology.

Decentralization: Decentralization using Blockchain, Decentralization methods and routes, Full ecosystem decentralization, Smart contract, Decentralized organizations, Decentralized autonomous organizations, corporations and societies, Applications and platforms for decentralization.

Module-2: DIGITAL CURRENCY – BITCOIN (09 Periods)

Definitions, Transactions – Life cycle, Structure, Types; Blockchain – Structure of block and block header, Genesis block, Bitcoin network, Wallets; Bitcoin Payments – Investment and buying and selling bitcoins, Installation; Bitcoin Limitations, Namecoin.

Module-3: SMART CONTRACTS AND ETHEREUM (11 Periods)

Smart Contracts: History & definition, Ricardian contracts - Smart contract templates, Oracles, Smart Oracles, Deployment of smart contracts on Blockchain.

Ethereum: Introduction, Ethereum Blockchain, Elements of Ethereum Blockchain, Precompiled contracts, Accounts, Block, Ether, Messages, Mining – Ethash, CPU and GPU mining; Clients and wallets, Ethereum Network, Applications developed on Ethereum, Scalability and security issues.

Module-4: HYPERLEDGERS AND ALTERNATIVE BLOCKCHAINS (08 Periods)

Hyperledgers: Projects, Hyperledger as protocol, Fabric, Hyperledger Fabric, Sawtooth Lake, Corda.

Alternative Blockchains: Blockchains - Kadena, Stellar, Rootstock, Quorum, Tezos, Storj, Maidsafe, BigChainDB, Multichain, Tendermint; Platforms - BlockApps, Eris.

Module-5: CHALLENGES AND EMERGING TRENDS (08 Periods)

Current Challenges: Scalability - Block size increase, block internal reduction, Invertible Blooms lookup tables, Sharding, State channels, Private Blockchain, Proof of stake; Privacy - Indistinguishability obfuscation, Homomorphic encryption, Zero knowledge proofs, State channels, Secure multiparty computation, Usage of hardware to provide confidentiality, Coinjoin, Confidential transactions, MimbleWimble; Security - Smart Contract Security.

Emerging Trends: Emerging trends, Improvement proposals, Blockchain Research - Smart contracts, Centralization issues, Limitations in cryptographic functions, Consensus algorithms, Scalability, Code obfuscation.

Total Periods: 45

RESOURCES:

TEXT BOOKS:

1. Imran Bashir, *Mastering Blockchain: Deeper Insights into Decentralization, Cryptography, Bitcoin, and Popular Blockchain Frameworks*, Packt Publishing, 1st Edition, 2017.

REFERENCE BOOKS:

1. Arshdeep Bahga, Vijay Madisetti, *Blockchain Applications: A Hands-On Approach*, VPT Books, 2017.
2. Josh Thompson, *Blockchain: The Blockchain for Beginnings, Guild to Blockchain Technology and Blockchain Programming*, Create Space Independent Publishing Platform, 2017.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106105184/
2. https://www.coursera.org/lecture/introduction-blockchain-technologies/

WEB RESOURCES:

1. https://medium.com/moatcoin/part-6-blockchain-simplified-notes-nptel-892f13875555
2. http://www.hands-on-books-series.com/assets/Bahga-Madisetti-Blockchain-Book-Code.zip

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT101013	**LINUX PROGRAMMING**	3	-	-	-	3

Pre-Requisite Operating Syatems

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Concepts on Linux Programming; Basic Commands in Linux; Shell Programming; Process, Signals and File System Structure; Inter process Communications and Socket Programming for Client-Server Interaction.

COURSE OUTCOMES: ***After successful completion of this course, the students will be able to:***

CO1. Demonstrate knowledge on
- Basic commands
- Program arguments
- Environment Variables

CO2. Design interactive shell scripts related to Linux Environment for solving specified computational problems.

CO3. Analyze system calls related to standard I/O library, formatted input, output, file and directory maintenance.

CO4. Apply the system calls for process management and signal handling.

CO5. Apply inter process communication and socket programming for developing client - server applications.

CO-PO-PSO Mapping:

Course Outcome	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	1	1	1	-	-	3	-	-	-
Course Correlation Mapping	**3**	**2**	**2**	**-**	**-**	**-**	**-**	**1**	**1**	**1**	**-**	**-**	**3**	**-**	**-**	**-**

Correlation Level: 3-High; 2-Medium; 1-Low

COURSE CONTENT:

Module-1 INTRODUCTION TO LINUX AND LINUX ENVIRONMENT (10 periods)

The GNU project and the Free Software Foundation, Linux distributions, Programming Linux - Linux programs, Text editors,The C Compiler; Basic commands -- cat, tail, head , sort, nl, uniq, grep, cut, paste, join, tee, pg, comm, cmp, diff, cp, mv, ln, rm, unlink, tty, clear, date, cal, mkdir, rmdir, du, df, find, umask, ps, who, sed; Program arguments - getopt,getopt_long, Environment variables - Use of environment variables, The environ variable,Time and Date, User information, Host information.

Module-2: SHELL PROGRAMMING (8 periods)

Necessity of shell programming, Pipes and redirection - Redirecting output,Redirecting input, Pipes, The Shell as a programming language - Interactive programs, Creating a script,Making a script executable, Shell syntax – Variables, Conditions,Control structures,Functions,Commands, Command execution.

Module-3: FILE SYSTEM STRUCTURE AND SYSTEM CALLS (9periods)

Linux File Structure and Commands: File structure -Directories, Files and devices, System calls and Device drivers; Library functions -Low-level file access, write, read and open commands,Initialpermissions,Other system calls for managing files; File and directory maintenance commands -chmod, chown,unlink, link, symlink, mkdir, rmdir, chdir, getcwd.
Input-Output Commands: The standard I/O library commands -fopen, fread, fwrite, fclose, fflush,fseek,fgetc, getc, and getchar,fputc, putc and putchar,fgets and gets; Formatted input and output commands - printf, fprintf, sprintf,scanf, fscanf, sscanf.

Module-4: PROCESS AND SIGNALS (9periods)

Process structure - Process table, Viewing processes,System processes, Process scheduling; Starting new processes - Waiting for a process, Zombie processes, Input and output redirection,Threads; Signals -Sending signals,Signal sets.

Module-5: INTER-PROCESS COMMUNICATION AND SOCKETS (9 periods)

Inter-Process Communication: Pipe definition, Process pipes, Sending output to popen - Passing more data, popen, implementation, The pipe call; Parent and child processes - Reading closed pipes, pipes used as standard input and output; Named pipes –FIFOs, Accessing a FIFO, Client/Server using FIFOs.
Socket Connections:Socket attributes, Creating a socket, Socket addresses, Naming a socket, Creating a socket queue, Accepting connections, Requesting connections, Closing a socket, Socket communications, Host and network byte Ordering.

Total Periods: 45

RESOURCES

TEXT BOOKS:

1. Neil Matthew and Richard Stones, *Beginning Linux Programming*, WileyDreamtech, 4th Edition, 2008.
2. Sumitabha Das, *Your UNIX: The Ultimate Guide*, Tata McGraw-Hill, 2007.

REFERENCE BOOKS:

1. Richard Petersen, *Linux: The Complete Reference*, Tata McGraw-Hill, 6th Edition, 2007.
2. YashwanthKanitkar, *Unix Shell programming*, BPB Publications, 1st Edition

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS102009	PROGRAMMING IN C# AND .NET FRAMEWORK	3	-	2	-	4

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

CO-PO-PSO Mapping Table:

Course Outcome	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5	-	-	-	-	-	-	-	1	1	1	-	-	3	-	-	-
Course Correlation Mapping	3	2	2	-	-	-	-	1	1	1	-	-	3	-	-	-

Correlation Level: 3-High; 2-Medium; 1-Low

COURSE CONTENT:

Module -1 :C# LANGUAGE BASICS (9 Periods)

.Net Architecture – Core C# – Variables – Data Types – Flow control – Objects and Types- Classes and Structs – Inheritance- Generics – Arrays and Tuples – Operators and Casts – Indexers

Module -2 C# ADVANCED FEATURES (9 Periods)

Delegates – Lambdas – Lambda Expressions – Events – Event Publisher – Event Listener – Strings and Regular Expressions – Generics – Collections – Memory Management and Pointers – Errors and Exceptions – Reflection

Module-3 BASE CLASS LIBRARIES AND DATA MANIPULATION (9 Periods)

Diagnostics -Tasks, Threads and Synchronization – .Net Security – Localization – Manipulating XML- SAX and DOM – Manipulating files and the Registry- Transactions – ADO.NET- Peer-to-Peer Networking – PNRP – Building P2P Applications – Windows Presentation Foundation (WPF).

Module -4 WINDOW BASED APPLICATIONS, WCF AND WWF (9 Periods)

Window based applications – Core ASP.NET- ASP.NET Web forms -Windows Communication Foundation (WCF)- Introduction to Web Services – .Net Remoting – Windows Service – Windows Workflow Foundation (WWF) – Activities – Workflows.

Module -5.NET FRAMEWORK AND COMPACT FRAMEWORK (9 Periods)

Assemblies – Shared assemblies – Custom Hosting with CLR Objects – Appdomains – Core XAML – Bubbling and Tunneling Events- Reading and Writing XAML – .Net Compact Framework – Compact Edition Data Stores – Errors, Testing and Debugging – Optimizing performance – Packaging and Deployment – Networking and Mobile Devices

Total Periods: 45

EXPERIENTIAL LEARNING

1

a. Write a program to C# to find the smallest single digit factor for a given value.

b. Write a program in C# to print a number if it is prime; otherwise display the largest factor of that number.

1. Write a program in C# to find the magnitude of a number.

a. Write a C# program for addition and multiplication of two matrices.

b. Write a C# program to display the digits of an integer in words.

c. Write a C# program to which reads a set of strings into the rows a two dimensional array and then prints the string having more number of vowels.

3.

a. Write a C# programs to demonstrate the concepts of Structures and Enumerations.

b. Wite a C# programs to demonstrate the concepts of Constructors and Inheritance.

c. Write a C# programs to demonstrate the concepts of Polymorphism.

4.

a. Write a C# programs to demonstrate the concepts of Partial classes and Extension methods.

b. Write a C# programs to demonstrate the concepts of Delegates.

5.

a. Write a C# programs to demonstrate the concepts of Label, Text Box and Button controls.

b. Write a C# programs to demonstrate the concepts of Combo Box and List Box controls.

6.

a. Create a Windows application in C# for registration form and fill the details and when you click the submit button it display the details inthe message box.

b. Create a Windows application in C# having two text boxes and three buttons named as factorial, prime, factorial series. When you click any button the resultant value will be displayed on the second textbox.

7.

a. Create a ADO.NET application in C# to verify if the connection is established with OLEDB and MS-ACCESS.

b. Create a ADO.NET applications in C# to demonstrate the Data Reader, Data Set, Data Adapter and Data View Objects.

RESOURCES:

TEXT BOOKS:

1. Christian Nagel, Bill Evjen, Jay Glynn, Karli Watson, Morgan Skinner . —Professional C# 2012 and .NET 4.5, Wiley, 2012
2. Harsh Bhasin, —Programming in C#, Oxford University Press, 2014.

REFERENCES

1. Ian Gariffiths, Mathew Adams, Jesse Liberty, —Programming C# 4.0‖, OReilly, Fourth Edition, 2010.
2. Andrew Troelsen, Pro C# 5.0 and the .NET 4.5 Framework, Apress publication, 2012.
3. Andy Wigley, Daniel Moth, Peter Foot, —Mobile Development Handbook, Microsoft Press, 2011.

SOFTWARE/TOOLS:

1. Visual Studio Code
2 NuGet

VIDEO LECTURES:

1 https://csharp-video-tutorials.blogspot.com/p/free-dot-net-video-tutorials-for.html

2. https://www.youtube.com/watch?v=u_0jJ-tYcsE

3. https://www.btechguru.com/training--dot-net--c-sharp-dot-net--framework--c-sharp-programming-tutorial-part-1-video-lecture--11285--27--139.html

WEB RESOURCES:

1. https://dotnettutorials.net/course/csharp-dot-net-tutorials/
2. https://www.javatpoint.com/net-framework
1. https://www.w3schools.com/cs/index.php

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS105001	**R PROGRAMMING**	-	1	2	-	2

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction to R, R Programming Structures, Doing Math and Simulation in R, Creating Graphs, Probability Distributions, correlation and Regression and Random Forests.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

CO1. Apply R programming constructs to store and manipulate datasets.

CO2. Develop modules using R programming constructs to solve statistical problems.

CO3. Perceive data models to perform descriptive and inferential statistical analysis to identify trends, patterns in data.

CO4. Create effective visualization using Histograms, Bar plots, Box plots, Scatter plots for exploratory data analysis.

CO5. Work independently to solve problems with effective communication.

CO-PO-PSO Mapping Table

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	-	-	2	3	-	-	-	-	-	-	-	3	-	-
CO2	3	1	1	1	3	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	3	3	-	-	-	-	-	-	-	3	-	-
CO4	3	3	2	3	3	-	-	-	-	-	-	-	3	-	-
CO5	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**2**	**2**	**3**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	-	**-**

Correlation Level: 3- High 2-Medium 1- Low

COURSE CONTENT

Module1: INTRODUCTION TO R (08 Periods)

Introduction, How to run R, R Sessions and Functions, Basic Math, Variables, Data Types, Vectors, Conclusion, Advanced Data Structures, Data Frames, Lists, Matrices, Arrays, Classes.

Module2: R PROGRAMMING STRUCTURES (10 Periods)

R Programming Structures, Control Statements, Loops, -Looping Over Nonvector Sets,-If-Else, Arithmetic and Boolean Operators and values, Default Values for Argument, Return Values, Deciding Whether to explicitly call return-Returning Complex Objects, Functions are Objective, No Pointers in R, Recursion, A Quicksort Implementation-Extended Extended Example: A Binary Search Tree.

Module3 DOING MATH AND SIMULATION IN R (10 Periods)

Doing Math and Simulation in R, Math Function, Extended Example Calculating Probability-Cumulative Sums and Products-Minima and Maxima-Calculus, Functions Fir Statistical Distribution, Sorting, Linear Algebra Operation on Vectors and Matrices, Extended Example:

Vector cross Product-Extended Example: Finding Stationary Distribution of Markov Chains, Set Operation, Input /out put, Accessing the Keyboard and Monitor, Reading and writer Files.

Module4 GRAPHICS (8 Periods)

Graphics, Creating Graphs, The Workhorse of R Base Graphics, the plot() Function – Customizing Graphs, Saving Graphs to Files.

Module5 PROBABILITY DISTRIBUTIONS AND REGRESSION MODELS (9 Periods)

Probability Distributions, Normal Distribution-Binomial Distribution-Poisson Distributions Other Distribution, Basic Statistics, Correlation and Covariance, T-Tests,-ANOVA. Linear Models, Simple Linear Regression, -Multiple Regression Generalized Linear Models, Logistic Regression, -Poisson Regression-other Generalized Linear Models-Survival Analysis, Nonlinear Models, Splines-Decision-Random Forests.

TotalPeriods:45

EXPERIENTIAL LEARNING:

Datatypes, Variables, Operators, Data structures – Vectors, Arrays, Matrices, Lists, Data frames; Object oriented programming – S3, S4 classes; Selection statements – if statement, if else statement, switch statement; Iterative statements – For loop, While loop, Repeat loop, Nested loops; Functions – Creating functions, Default values for arguments, Return values, Environment and scope issues, Recursion.

1. Create the vectors:
   a) (1, 2, 3, . . . , 19, 20)
   b) (20, 19, . . . , 2, 1)
   c) (1, 2, 3, . . . , 19, 20, 19, 18, . . . , 2, 1)
   d) (4, 6, 3) and assign it to the name tmp.

   For parts (e), (f) and (g) look at the help for the function rep.
   e) (4, 6, 3, 4, 6, 3, . . . , 4, 6, 3) where there are 10 occurrences of 4.
   f) (4, 6, 3, 4, 6, 3, . . . , 4, 6, 3, 4) where there are 11 occurrences of 4, 10 occurrences of 6 and 10 occurrences of 3.
   g) (4, 4, . . . , 4, 6, 6, . . . , 6, 3, 3, . . . , 3) where there are 10 occurrences of 4, 20 occurrences of 6 and 30 occurrences of 3.

2. a) Write R code that will generate a vector with the following elements. "aa" "ba" "ca" "da" "ea" "ab" "bb" "cb" "db" "eb" "ac" "bc" "cc" "dc" "ec" "ad" "bd" "cd" "dd" "ed" "ae" "be" "ce" "de" "ee"

   b) Write a R program to create a Dataframes which contain details of 5 employees and display summary of the data.

3. a) Create a vector of a data set and treat it as an object. Using the vector and object perform (.) dot product and (x) cross product. Take your own data.

   b) "Fizzbuzz" is a simple programming challenge often used at interviews to test very basic programming skill. Your goal is the following: for the numbers 1 to 100, print "fizz" if the number is a multiple of 3, "buzz" if the number is a multiple of 5, "fizzbuzz" if the number is a multiple of both 3 and 5, and simply print the number otherwise.

4. a) Imagine a high school with 1000 lockers all in a row, numbered 1 to 1000 in order. At the start, all of them are closed. 1000 students are sent, one after the other, to change the state of a set of lockers (from open to

closed or closed to open). The first student changes the state of all lockers. The second changes the state of every other one (2, 4, 6, 8, . . .). The third changes the state of every third one (3, 6, 9, 12, . . .). This process continues until all 1000 students have gone. Write a R program to determine which lockers are open at the end of this process?

b) Write a function chomp() that, given a string, removes from the string any occurrence of the character &, as well as the character to the left of each & character. So, for example, your function should return:
> chomp (" a&c ")

" c "

> chomp (" a&")

" "

> chomp (" abc ")
" abc "

5. a) Write a function which takes a single argument which is a matrix. The function should return a matrix which is the same as the function argument but every odd number is doubled.

b) Write a function that takes an array of numbers x and returns the smallest number in the array.

Importance and applications of statistical learning, Types of data, Types of variables, Frequency distributions, Measures of center – Mean, Median, Mode; Measures of spread – Range, Percentile, Quartiles & Interquartile range, Standard deviation, Variance; Correlation and Covariance.

6. a) Compute descriptive statistics for the data given below.

X: 14, 20, 22, 19, 15, 18, 30, 27
Y: 16, 25, 27, 20, 16, 18, 27, 23

b) Write a R script which will compute the mean and variance of the vector x <- 1:100. Compare with R's internal mean() and var() functions.

7. Write a function to compute running medians. Running medians are a simple smoothing method usually applied to time-series. For example, for the numbers 7,5, 2, 8, 5, 5, 9, 4, 7, 8, the running medians of length 3 are 5, 5, 5, 5, 5, 5, 7, 7. The first running median is the median of the three numbers 7, 5, and 2; the second running median is the median of 5, 2, and 8; and so on. Your function should take two arguments: the data (say, x), and the number of observations for each median (say, length).

8. Write a R program to perform data import/export (.csv, .xlxs) operations using data frames in R.

9. Write a R program to create bell curve of a random normal distribution.

10. Write a R program to design correlation matrix by choosing appropriate dataset.

RESOURCES

TEXTBOOKS:

1. The Art of R Programming, Norman Matloff, Cengage Learning
2. R for Everyone, Lander, Pearson

REFERENCEBOOKS:

1. SandipRakshit, R for Beginners, McGraw Hill, 2017.
2. SeemaAcharya, Data analytics using R, McGraw Hill, 2018.

VIDEO LECTURES:

https://www.classcentral.com/course/rprog-1713

https://www.youtube.com/playlist?list=PLVext98k2evi8mDNRo4MwIgVgSmwM3cS8

https://www.udemy.com/topic/r-programming-language/

WEB RESOURCES:

1. https://www.stats.ox.ac.uk/~evans/Rprog/LectureNotes.pdf
2. https://www.tutorialspoint.com/r/r_tutorial.pdf
3. https://www.tutorialsduniya.com/notes/r-programming-notes/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS102010	**PYSPARK**	3	-	2	-	4

Pre-Requisite - Database Management Systems
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Spark programming; Data bricks; Rdd operations; creating data frames; structured operations; spark SQL; spark streaming.

COURSE OBJECTIVES:
- To impart knowledge on Apache Spark Programming with the fundamental of Spark components
- To develop skills on spark features, Spark limitations, and the Spark Use cases.
- To inculcate attitude to solve societal problems using pyspark Tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1 Demonstrate knowledge on Apache Spark Programming
CO2 Analyze large dataset issues and solve using Resilient distributed data sets.
CO3 Design and Develop Data frames for dataset analysis.
CO4 Solve large data analysis problems using joins and aggregations.
CO5 Apply Apache spark Tools: spark streaming, spark SQL for large data management and to MQTT Server.
CO6 Build Spark programming environment suitable for societal requirements.
CO7 Work independently or in team to solve PySpark related problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	3	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	3	3	-
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	-
CO6	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	-
Average	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**
Level of correlation of the course	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**

Correlation Levels: 3: High 2: Medium 1: Low

COURSE CONTENT:

Module 1 –INTRODUCTION TO APACHE SPARK (9 periods)

Introduction: Spark Core Concepts and architecture, Unified Stack, Examples and Applications, Working with apache spark, spark scala shell,
Data Bricks: Introduction, Spark Source Code.

Module 2 –RESILIENT DISTRIBUTED DATASETS:

Introduction, RDD Operations, Working with key/value pair RDD, RDD Persistence.
Hadoop I/O: Data Integrity, Compression, Serialization, File-Based Data Structures.

Module 3 – SPARK SQL (9 periods)

Data Frames: Introduction, Creating Data frames, Data frames from RDD's, Range of Numbers,
Data Sources, Working with Structured Operations.

Module 4– ADVANCED SPARK SQL (9 periods)
Aggregations: Aggregation Functions, Aggregation with Grouping.
Joins: Join Expression and Join Types, Working with Joins.
Functions: Built in Functions, User defined Functions, Aggregation with Rollup and Cubes.
Module 5– APACHE SPARK STREAMING (9 periods)
Introduction, Errors and Recovery, Streaming Sources.
Structured Streaming: Continuous Applications, windowing, Fault Tolerance, Example of MQTT.

Total periods: 45

EXPERIENTIAL LEARNING:

1. Practice on Spark Session:
   i. Program to perform implicitly to convert RDDs to Data Frames or Data sets using toDF method ().
   ii. To perform implicitly to convert RDDs to Data Frames or Data sets using toDS method().
2. **Practice on JSON:**

i. Create file to read and parse JSON file by using Spark Data source.

3. Install and download Spark Scala shell and to define an array and to print in ascending order.
4. Write a program to create Data Clusters using Data bricks on Spark
5. Program to perform by using a Map Transformation to convert all characters in the string to Uppercase.
6. **On weather Data set perform by us**ing a map Transformation to Convert Text Data into Scala
Contact Objects.
7. **Write a program to create Spark data stream objects by using MQTT Server.**
8. Practice on Spark by using Actions on i) COLLECT ii) COUNT iii) FIRST methods.
9. Write a Scala program for Stack operations.
10. Practice on spark by using Key/Value pair RDD Actions methods.
11. **Perform** Using the SparkSession.range Function () to Create a Data Frame.
12. Practice by using a Data file for Reading **a Parquet File in Spark**

RESOURCES

TEXT BOOKS:

1. Hien Luu, *BEGINNING APACHE SPARK***,** press Publications, 2018.
2. Rome Kienzler, *Mastering Apache Spark* Packt, Second Edition, 2017.

REFERENCE BOOKS:

1. Subhashini Chellappan, Dharanitharan Ganesan, "Practical Apache Spark," Apress Publications, 2018.
2. Rashmi Shah "DataBricks® PySpark 2.x Certification,": HadoopExam Learning Resources, 2019.
3. Jules S. Damji, Brooke Wenig, Tathagata Das, Denny Lee · "Learning Spark", 2020.

SOFTWARE/Tools Used:
1. An Intel-compatible platform running Windows 10 /8.1/8 /7 /Vista /XP /2000 Windows
server 2019 /2016 /2012 /2008 /2003
2. At least 256 MB of RAM, a mouse, and enough disk space for recovered files, image files, etc.
3. The administrative privileges are required to install and run Big Data utilities and spark.
4. A network connection for data recovering over network.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=wSNPPhqrVtw&list=PLlL9SaZVnVgizWn2Gr_ssHExaQUYik2vp
2. https://www.youtube.com/watch?v=wSNPPhqrVtw&list=PLlL9SaZVnVgizWn2Gr_ssHExaQUYik2p

WEBRESOURCES:

- https://www.tutorialspoint.com/apache_spark/index.htm
- https://spark.apache.org/docs/latest/quick-start.html
- https://sparkbyexamples.com

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT101020	**GO LANG**	3	-	-	-	3

Pre-Requisite - Object Oriented Programming through Java
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Program Structure and Data Types, Functions, Methods and Interfaces, Goroutines and Channels, Packages and Reflection and Low-Level Programming.

COURSE OUTCOMES: *After successful completion of the course, students will be able to:*

CO1. Understand Program structure and Data Types of Go Lang.

CO2. Develop programs using Functions, Methods and Interfaces of Go Lang.

CO3. Build servers using Goroutines and Channels.

CO4. Demonstrate knowledge on Packages and Go Testing Tool.

CO5. Understand Go Lang Reflections and Low-Level Programming

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	-	3	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-	2	-	3	-
Course Correlation Mapping	3	3	3	2	2								3		3	

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT:

Module-1: PROGRAM STRUCTURE AND DATA TYPES (9 Periods)

Program Structure: Names, Declarations, Assignments, Type Declarations, Packages and Files, Scope.
Basic Data Types: Integers, Floating point numbers, Complex Numbers, Booleans, Strings, Constants.
Composite Types: Arrays, Slices, Maps, Structs, JSON, Text and HTML templates.

Module-2: FUNCTIONS, METHODS AND INTERFACES (9 Periods)

Functions: Function Declarations, Recursion, Multiple Return Values, Errors, Function Values, Anonymous Functions, Variadic Functions, Deferred function calls, Panic and Recover.
Methods: Method Declarations, Methods with Pointer Receiver, Composing Types by Struct Embedding, Method Values and Expressions, Example: Bit Vector Type, Encapsulation.
Interfaces: Interfaces as Contracts, Interface Types, Interface Satisfaction, Parsing Flags for flg.value, Interface Values, Sorting with sort. Interface, The http.Handler Interface, The error Interface, Example: Expression Evaluator, Type Assertions, Discriminating Errors with Type

Assertions, Querying Behavior with Type Assertions, Type Switches, Example: Token-based XML decoding.

Module-3: GOROUTINES AND CHANNELS (9 Periods)

Goroutines, Examples: Concurrent clock server, Concurrent Echo Server, Channels, Looping in parallel

Example: Concurrent Web Crawler, Multiplexing with Select, Example: Concurrent Directory Traversal, Cancellation, Example: Chat Server.

Concurrency with Shared Variables: Race Conditions, Mutual Exclusion sync. Mutex, Read/Write Mutexes: sync.RWMutex, Memory Synchronization, Lazy Initialization: sync:Once, The Race Detector, Example: Concurrent Non-Blocking cache, Goroutines and Threads.

Module-4: PACKAGES AND THE GO TOOL (9 Periods)

Introduction, Import Paths, The package Declaration, Import Declaration, Blank Imports, Packages and Naming, The Go Tool.

Testing: The go Test Tool, Test Functions, Coverage, benchmark Functions, Profiling, Example functions.

Module-5: REFLECTION AND LOW-LEVEL PROGRAMMING (9 Periods)

Reflections: reflect.Type and reflect.Value, Display, a. Recursive Value Printer, Example: Encoding S-Expressions, Accessing Struct Field Tags, Displaying the Methods of a Type, A Word of Caution.

Low-level Programming: unsafe.Sizeof, Alignof and Offsetof, unsafe. Pointer, Example: Deep Equivalence, Calling C Code with Go, Another Word of Caution.

Total Periods: 45

RESOURCES:

TEXT BOOK:

1. Alan A. A. Donovan and Brian W. Kernighan, The Go Programming Language, Addision-Wesley, 2015.

REFERENCE BOOKS:

1. Wei-Meng Lee, Go programming Language for dummies, John-Wiley&Sons. Inc, 2021
2. Caleb Doxsey, An Introduction to Programming in Go, 2012

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=YS4e4q9oBaU
2. https://www.youtube.com/watch?v=jFfo23yIWac

WEB RESOURCES:

1. https://www.geeksforgeeks.org/go-programming-language-introduction/
2. https://www.tutorialspoint.com/go/index.htm

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT101021	**GAME DEVELOPMENT**	3	-	-	-	3

Pre-Requisite - Object Oriented Programming through Java

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Third Dimension, Prototyping and Scripting Basics; Creating the Environment, Player Characters and Further Scripting; Interactions, Collection, Inventory, and HUD (heads up display); Instantiation and Rigidbodies, Particle Systems; Designing Menus, Animation Basics, and Building.

COURSE OUTCOMES: *After successful completion of the course, students will be able to*:

CO1. Demonstrate knowledge on Third Dimension, Prototyping and Scripting.
CO2. Build game environment, player characters and script for game development.
CO3. Analyze the interactions between players, understand the Collections and Inventory for game development.
CO4. Develop games using rigidbodies and particle systems.
CO5. Design menus, animations and publish the games.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2	3	2
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	2
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	2
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	2	3	2
CO5	3	2	2	2	2	3	-	-	-	-	-	-	2	2	3	2
Course Correlation Mapping	3	3	3	2	2				3	3			3	2	3	2

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT:

Module-1: Third Dimension, Prototyping and Scripting Basics (9 Periods)

Third Dimension : Getting to grips with 3D, Rigidbody physics, Essential Unity concepts, The interface
Prototyping and Scripting Basics : first Unity project, A basic prototyping environment, Introducing scripting, Understanding Translate, Testing the game so far, Storing with prefabs, Using Instantiate() to spawn objects

Module-2: Creating the Environment, Player Characters and Further Scripting (9 Periods)

Creating the Environment: Designing the game, Using the terrain editor, The terrain toolset, Creating the island—sun, sea, and sand.
Player Characters and Further Scripting: Working with the Inspector, Anatomy of a character, Deconstructing the First Person Controller object, Further scripting, Full example, Inter-script communication and Dot Syntax, Scripting for character movement.

Module-3: Interactions, Collection, Inventory, and HUD(Heads up Display) (9 Periods)

Interactions: External modeling applications, Setting up the outpost model, Adding the outpost, Collisions and triggers, Ray casting, Opening the outpost.
Collection, Inventory, and HUD: Creating the power cell prefab, Scattering power cells, Restricting outpost access, Displaying the power cell HUD.

Module-4: Instantiation and Rigidbodies, Particle Systems (9 Periods)

Instantiation and Rigidbodies: Utilizing instantiation, Rigidbodies, Making the mini-game.
Particle Systems: particle system, Creating the task, Testing and confirming**.**

Module-5: Designing Menus, Animation Basics, and Building (9 Periods)

Designing Menus: Interfaces and menus, Creating the menu with GUITextures and mouse events, Creating the menu with the Unity GUI class and GUI skins
Animation Basics: Game win sequence.
Building: Build options, Build Settings, Player Settings, Quality Settings, Building the game

Total Periods: 45

RESOURCES

TEXT BOOKS:

1. Will Goldstone**,** *Unity 3.x Game Development Essentials Game development with C# and Javascript*, PACKT Publishing, Second Edition, 2011.

REFERENCE BOOKS:

1. Sue Blackman, *Beginning 3D Game Development with Unity 4*, Apress Publisher, Second Edition, 2013.
2. Mike Geig, *Unity Game Development in 24 Hours*, Pearson Education, First Edition, 2013.

WEB RESOURCES:

1. Making your first game - https://learn.unity.com/tutorial/your-first-game#
2. Game Development Tutorial using Unity 3D - https://www.studytonight.com/game-development-in-2D/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT104002	**MERN FULL STACK DEVELOPMENT**	3	-	2	4	5

Pre-Requisite Web Technologies
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on MERN Stack, Building a Webserver with ExpressJS, Building a Restful API, Building Web Applications with React and Managing State with Redux.

COURSE OUTCOMES: *After successful completion of the course, students will be able to:*

CO1. Demonstrate skills on MongoDB and NodeJS.
CO2. Build web server with ExpressJS.
CO3. Develop web applications using RESTful API with ExpressJS and Mongoose.
CO4. Use REACTJS to design web applications.
CO5. Develop web applications through MERN stack and Redux store as per societal needs.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO4	3	3	3	2	2	-	-	-	-	-	-	-	2	-	3	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-	2	-	3	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	-	-	-	-	-	-	-	**3**	**-**	**3**	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

Module-1: MERN STACK (8 periods)

Introduction to MERN STACK, The Model View Controller (MVC) architectural pattern, Installing and configuring MongoDB, Installing Node.js and Installing npm packages.

Module-2: BUILDING A WEB SERVER WITH EXPRESSJS (9 periods)

Routing in ExpressJS, Modular route handlers, Writing middleware functions, Writing configurable middleware functions, Writing router-level middleware functions, Writing error-handler middleware functions, Using ExpressJS' built-in middleware function for serving static as sets, Parsing the HTTP request body, Compressing HTTP responses, Using an HTTP request logger.

Module-3: BUILDING A RESTFUL API (9 periods)

CRUD operations using ExpressJS' route methods, CRUD operations with Mongoose, Using Mongoose query builders, Defining document instance methods, Defining static model methods, Writing middleware functions for Mongoose, Writing custom validators for Mongoose's schemas, Building a RESTful API to manage users with ExpressJS and Mongoose.

Module-4: BUILDING WEB APPLICATIONS WITH REACT (10 periods)

Understanding React elements and React components, Composing components, Stateful components and life cycle methods, Working with React. Pure Component, React event handlers, Conditional rendering of components, Rendering lists with React, Understanding refs and how to use them, Understanding React portals, Catching errors with error boundary components, Type checking properties with PropTypes.

Module-5:MANAGING STATE WITH REDUX (9 periods)

Defining actions and action creators, Defining reducer functions, Creating a Redux store, Binding action creators to the dispatch method, Splitting and combining reducers, Writing Redux store enhancers, Time traveling with Redux, Understanding Redux middleware, Dealing with asynchronous data flow.

Total Periods: 45

EXPERIENTIAL LEARNING:

LIST OF EXERCISES:

A. **Front-endWeb Application Library:** State-of-the-art Front-End- Library: **React (Pre-requisites:** HTML and JavaScript)

1. Installing Node.js framework and configuring Visual Studio (VS) Code Integrated Development Environment (IDE), and its dependencies.

2. Create and Run "Hello World" Application in VS Code.

3. Create a React application that includes simple functional components.

4. Create a React application that includes simple class components.

5. Develop a React application to insert and access props (properties) and state of components.

6. Create a React application to demonstrate event handling.

7. Develop a React application for list rendering.

8. Implement a React application for form handling.

B: Server-side Development Framework: State-of-the-art server-side Framework: **Django(Pre-requisites:** Python)

1. Installing Python, Django framework and configuring PyCharm Integrated Development Environment (IDE), and its dependencies.

2. Creating workspace, project and setting up the necessary environment.

3. Implement a simple view to handle http response (display Hello World) in Django Application.

4. Create a simple model for storing student details.

5. Implement a Django application for form creation and storage of form data into model.

6. Write simple test cases and test any Django application.

7. Create a Django application to include static files such as images, CSS and JavaScript.

C. Hosting Web Applications Building web application and Hosting web application using WAMP/XAMPP Server

.1. Choosing a hosting server and selecting a plan for web hosting.

2. Choosing and configuring DNS address

3. Uploading, configuring and running the website over the internet.

RESOURCES:

TEXT BOOKS:

1. Eddy Wilson Iriarte Koroliova, MERN Quick Start Guide: Build Web Applications with MongoDB, Express.js, React, and Node, Packt, May 2018.
2. Greg Lim, Beginning MERN Stack Development, First Edition, June 2021.

REFERENCE BOOKS:

1. Brad Dayley, Node.js, MongoDB and Angular Web Development, Pearson, 2nd Edition,2017.
2. Kogent Learning Solutions Inc, HTML 5 Black Book: Covers CSS3, JavaScript, XML,XHTML, AJAX, PHP and JQuery, Dreamtech Press, Second Edition, 2016

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT106001	**ADVANCED WEB DEVELOPMENT**	-	1	2	4	3

Pre-Requisite Web Technologies

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides hands-on experience on Node.js framework, React JS, Django framework, PyCharm Integrated Development Environment.

COURSE OUTCOMES: *After successful completion of this course, the students will be able to:*

CO1: Develop front-end applications using Node.js framework and React JS.

CO2: Develop server-side Framework using Django.

CO3: Building web application and Host web application using front-end and back-end tools.

CO4: Work independently or in teams to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	2	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	2	3	-
CO4	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**2**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**2**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

EXPERIENTIAL LEARNING:

LIST OF EXERCISES:

A. **Front-endWeb Application Library:** State-of-the-art Front-End- Library: **React (Pre-requisites:** HTML and JavaScript)

1. Installing Node.js framework and configuring Visual Studio (VS) Code Integrated Development Environment (IDE), and its dependencies.

2. Create and Run "Hello World" Application in VS Code.

3. Create a React application that includes simple functional components.

4. Create a React application that includes simple class components.

5. Develop a React application to insert and access props (properties) and state of components.

6. Create a React application to demonstrate event handling.

7. Develop a React application for list rendering.

8. Implement a React application for form handling.

B: Server-side Development Framework: State-of-the-art server-side Framework: **Django(Pre-requisites:** Python)

1. Installing Python, Django framework and configuring PyCharm Integrated Development Environment (IDE), and its dependencies.

2. Creating workspace, project and setting up the necessary environment.

3. Implement a simple view to handle http response (display Hello World) in Django Application.

4. Create a simple model for storing student details.

5. Implement a Django application for form creation and storage of form data into model.

6. Write simple test cases and test any Django application.

7. Create a Django application to include static files such as images, CSS and JavaScript.

C. Hosting Web Applications Building web application and Hosting web application using WAMP/XAMPP Server

1. Choosing a hosting server and selecting a plan for web hosting.

2. Choosing and configuring DNS address

3. Uploading, configuring and running the website over the internet.

RESOURCES:

TEXT BOOKS:

1. Cory Gackenheimer, *Introduction to React*, Apress, 2015.
2. Ethan Brown, *Web Development with Node & Express*, O'Reilly, 2014
3. Nigel George, *Mastering Django: Core*, Packt, 2016

REFERENCE BOOKS:

1. Kolawole Mangabo, *Full Stack Django and React: Get hands-on experience in full-stack web development with Python, React, and AWS*, Packt Publishers, 2023.
2. Greg Sidelnikov, *React.js Book: Learning React JavaScript Library From Scratch*, River Tigris LLC; 1st edition, 2016.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=bMknfKXIFA8
2. https://www.youtube.com/watch?v=rHux0gMZ3Eg
3. https://www.youtube.com/results?search_query=Django

WEB RESOURCES:

1. https://www.w3schools.com/REACT/DEFAULT.ASP
2. https://nodejs.org/en
3. https://www.djangoproject.com/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT102005	**APP DEVELOPMENT WITH FLUTTER**	3	-	-	-	3

Pre-Requisite Object-Oriented Programming through Java
Anti-Requisite -
Co-Requisite -

Course Description: This course provides a detailed discussion on Basics of Flutter Programming, Dart Basics, Widget Tree, Common Widgets, Adding Animation to an App, Creating An App's Navigation, Creating Scrolling Lists and Effects, Building Layouts, Applying Interactivity, Writing Platform-Native Code, Saving Data With Local Persistence, Adding the Firebase and Firestore Backend, Adding State Management to The Firestore Client App, and Adding Blocs to Firestore Client App Pages.

COURSE OUTCOMES: *After successful completion of the course, the student will be able to:*

CO1: Understand the basics concepts of Flutter Programming and Widget Trees.

CO2: Apply Animations to App and create navigations in App.

CO3: Create Scrolling Lists, Effects, Build Layouts, Interactions and Write Platform-Native Code

CO4: Perform storage of Data with Local Persistence and add the Firebase and Firestore Backend.

CO5: Perform State Management and create Client App Pages.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	-	3	-
CO2	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO3	3	3	3	2	2	-	-	-	-	-	-	-	3	-	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3	-
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

Module-1: THE FOUNDATIONS OF FLUTTER PROGRAMMING: **(9 Periods)**

Introducing Flutter and Getting Started:

Introducing Flutter, Understanding Widget Lifecycle Events, Understanding the Widget Tree and the Element Tree, Installing the Flutter SDK, Configuring the Android Studio Editor,

Creating a Hello World App

Setting Up the Project, Using Hot Reload, Using Themes to Style Your App, Understanding Stateless and Stateful Widgets, Using External Packages.

Learning Dart Basics

Use Dart, Commenting Code, Running the main() Entry Point, Referencing Variables, Declaring Variables, Using Operators, Using Flow Statements, Using Functions, Import Packages, Using Classes, Implementing Asynchronous Programming, Creating and Organizing Folders and Files, Structuring Widgets.

Understanding the widget tree:

Introduction to Widgets, Building the Full Widget Tree, Building a Shallow Widget Tree.

Module-2: INTERMEDIATE FLUTTER: FLESHING OUT AN APP-I (10 Periods)

Using Common Widgets: Using Basic Widgets, Using Images and Icons, Using Decorators, Using the Form Widget to Validate Text Fields, Checking Orientation.

Adding Animation to an App:

Using Animated Container, Using Animated CrossFade, Using Animated Opacity, Using Animation Controller.

Creating An App's Navigation: Using the Navigator, Using Hero Animation, Using the Bottom Navigation Bar, Using the Bottom AppBar, Using the TabBar and TabBarView, Using the Drawer and ListView.

Module-3: INTERMEDIATE FLUTTER: FLESHING OUT AN APP-II (10 Periods)

Creating Scrolling Lists and Effects: Using the Card, Using the ListView and ListTile, Using the GridView, Using the Stack, Customizing the CustomScrollView with Slivers.

Building Layouts:

A High-Level View of the Layout, Creating the Layout.

Applying Interactivity: Setting Up GestureDetector: The Basics, Implementing the Draggable and Dragtarget Widgets, Using the GestureDetector for Moving and Scaling, Using the InkWell and InkResponse Gestures, Using the Dismissible Widget.

Writing Platform-Native Code:

Understanding Platform Channels, Implementing the Client Platform Channel App, Implementing the iOS Host Platform Channel, Implementing the Android Host Platform Channel.

Module-4 : **CREATING PRODUCTION-READY APPS (8 Periods)**

Saving Data With Local Persistence: Understanding the JSON Format, Using Database Classes to Write, Read, and Serialize JSON, Formatting Dates, Sorting a List of Dates, Retrieving Data with the FutureBuilder, Building the Journal App,

Adding the Firebase and Firestore Backend: Firebase and Cloud Firestore, Configuring the Firebase Project, Adding a Cloud Firestore Database and Implementing Security, Building the Client Journal App.

Module-5 : **STATE MANAGEMENT AND CLIENT APP PAGES (8 Periods)**

Adding State Management To The Firestore Client App: Implementing State Management, Building State Management.

Adding Blocs to Firestore Client App Pages: Adding the Login Page, Modifying the Main Page, Modifying the Home Page, Adding the Edit Journal Page.

Total Periods: 45

RESOURCES:

TEXT BOOKS:

1. Marco L. Napoli, *Beginning Flutter: A Hands On Guide to App Development*, John Wiley & Son, 2020.

REFERENCE BOOKS:

1.Rap Payne, Beginning App Development with Flutter, Apress Publishers, 2019.
2. Mark Clow**,** Learn Google Flutter Fast: 65 Example Apps, Amazon Publishers, 2019.

VIDEO LECTURES:

1. https://www.udemy.com/topic/google-flutter/
2. https://www.classcentral.com/report/best-flutter-and-dart-courses/

WEB RESOURCES:

1. https://developers.googleblog.com/2019/05/Flutter-io19.html
2. https://www.syncfusion.com/flutter-widgets.

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22IT105001	**DASHBOARD DESIGN TECHNOLOGIES**	-	1	2	-	2

Pre-Requisite Programming for Problem Solving, Database Management Systems
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Introducing Power BI, Hands on practice on Data sources, Modeling, ETL (Extraction, Transformation and Load) process, Creating tables, Power BI charts for visualization, Design of dashboards and reports, Bookmarks, Data Analysis Expressions (DAX).

COURSE OUTCOMES: *After successful completion of the course, the students will be able to:*

CO1. Demonstrate the practical knowledge on Power BI to design dashboards and reports.

CO2. Apply ETL process to load, extract and transform the data into the required form to fulfill the customer requirements for better analysis.

CO3. Design dashboards and reports to analyze and visualize the data using Power BI charts for providing solutions to societal problems.

CO4. Work independently or in teams to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3		3	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3		3	-
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3		3	-
CO4									3	3						
Course Correlation Mapping	3	3	3	2	3								3	3	3	

Correlation Levels: 3: High; 2: Medium; 1: Low

EXPERIENTIAL LEARNING:

LIST OF EXPERIMENTS:

1. Power BI Desktop installation and familiarizing an Interface of Power BI. (*Study on features, architecture, building blocks, and components of Power BI*).
2. Import the data from different sources such as Excel, MySQL, SQLServer, Oracle etc. to load into Power BI and creating tables manually. (*Demonstration on getting data into Power BI Desktop*, *Data sources and modeling in Power BI*).
3. Implement Extraction, Transformation and Loading (ETL) process to create a database into MySQL/SQLServer/Power BI and then perform renaming, splitting, removing and reordering of columns; managing query groups, merge queries, SQL joins and union. (*Demonstration on data transformation*)

4. Create employee, department, and location tables using Power BI and then establish relationships between tables to display employee details such as employee name, employee no., department, date-of-join, gross salary and location. (*Demonstration on relationships*).
5. Design a dashboard to show units in stock by product and a total sale by year. (*Demonstration on List of Power BI chart types for visualization*).
6. Design a dashboard to check the total amount of sales made in each month and find out which month had the highest and lowest sales. Use a simple clustered column chart. Drag the date column on the axis and the sales on to the values then change the color of the bars by going to the format option and selecting data colors. (*Demonstration on format options of charts*).
7. Design a dashboard using a pie chart to analyze the sales made by each segment and find out which segment made the highest and lowest number of sales. Click on the pie chart option, select segment on to the legend, and sales on to the values.Create a map that depicts the sales made in each country and show the Donut chart to illustrate the profit made in each Segment.Positioning, Aligning, Sorting Visuals
8. Design a dashboard to show sales, profits, regional cash inflows and the customers product-specific churn (stop using a product)of products over a period of time using necessary charts include Combo Charts, Bar Charts, Tables, Line Charts, Column Charts, and Point Maps. Interaction between Visuals.
9. Publish (Share or Embed) Power BI dashboards or reports that are designed on the Web (e-mail or social media).
10. Create a report that shows an employee detail such as employee name, employee no., designation, salary. In addition, create a custom column to show the stipend. If an employee designation is a manager, then the stipend should be 35% of his/her basic salary. If an employee is a senior consultant, then the stipend should be 25% of his/her basic, otherwise it should be 15% of the basic for remaining employees (*Study on DAX - Data Analysis Expressions functions include aggregate, counting, logical and date functions for creating calculated columns and measures*).

REFERENCE BOOKS/LINKS:

1. Teo Lachev, "*Applied Microsoft Power BI*," Prologika, Seventh Edition, 2022.
2. Alberto Ferrari and Marco Russo, "*Introducing Microsoft Power BI*," Microsoft Press, 2016.
3. Brett Powel, "*Mastering Microsoft Power BI*," Packt Publishing, First Edition, 2018.
4. https://docs.microsoft.com/en-us/power-bi/fundamentals/power-bi-overview.
5. https://www.edureka.co/blog/power-bi-tutorial/
6. https://mindmajix.com/power-bi-visualization-types
7. https://intellipaat.com/blog/tutorial/power-bi-tutorial/
8. https://docs.microsoft.com/en-us/powerapps/maker/canvas-apps/sharepoint-scenario-build-report.
9. https://www.projectpro.io/article/power-bi-microsoft-projects-examples-and-ideas-for-practice/533.

SOFTWARE/TOOLS:

- Microsoft Power BI Desktop (https://powerbi.microsoft.com/en-us/downloads/)

DATASET LINKS:

1. Customer segmentation (e-commerce) data - For dataset visit https://www.kaggle.com/fabiendaniel/customer-segmentation/data.

2. Financial Sample Excel workbook for Power BI - https://docs.microsoft.com/en-us/power-bi/create-reports/sample-financial-download.
3. Marketing Analytics dataset - https://www.kaggle.com/jackdaoud/marketing-data.

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101003	DIGITAL IMAGE PROCESSING	3	-	-	-	3

Pre-Requisite Calculus and Transformation Techniques

COURSE DESCRIPTION: This course provides discussion on the fundamentals of digital image, Image processing techniques, Mathematical tools used in image processing and applications of image processing in various fields. The concepts covering image enhancement through Fourier transforms, filtering in the frequency domain, image segmentation, feature extraction, image degradation/restoration process and color image processing are explored in detail.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on the fundamental concepts of image processing and mathematical tools used in image processing.

CO2. Apply Fourier transforms for filtering and image enhancement in the frequency domain.

CO3. Select and apply appropriate image segmentation and feature extraction techniques for image analysis and recognition.

CO4. Identify the causes of image degradation and apply appropriate methods for image restoration based on specific degradation scenarios.

CO5. Analyze and Apply Color models, Color Transformations and Segmentation to enhance visual perception and achieve desired image effects.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1		-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	1	3	1	-	-	-	-	-	-	-	-	-	3	-
CO3	3	2	2	3	1	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	1	2	-	-	-	-	-	-	-	-	-	-	3	-
CO5	2	3	2	2	1	-	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	3	3	2	3	1	-	-	-	-	-	-	-	-	-	3	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module-1: DIGITAL IMAGE FUNDAMENTALS ***(11Periods)***

Digital Image Processing Definition, Examples of Fields that Use Digital Image Processing – Gamma-Ray Imaging, X-Ray Imaging, Imaging in the Ultraviolet Band; Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Image Sensing and Acquisition, Image Sampling and Quantization, Basic Relationships between Pixels, Basic Mathematical Tools used in Image Processing – Matrix Operations, Arithmetic Operations, Image Transforms, Image Intensities as Random Variables.

Module-2: INTENSITY TRANSFORMATIONS AND FILTERING ***(09Periods)***

Basic Intensity Transformation Functions, Histogram processing, Filtering in Frequency domain-Preliminary Concepts, Fourier Transform of Sampled functions, Discrete Fourier Transforms of one variable and two variables, Basics of Filtering in Frequency domain.

Module-3: IMAGE SEGMENTATION AND FEATURE EXTRACTION ***(10Periods)***

Image Segmentation: Fundamentals, Point, Line and Edge detection-Background, Detection of Isolated Points ,Line detection, Edge Models, Basic Edge detection.

Feature Extraction: Boundary Preprocessing, Boundary Feature descriptors, Region Feature descriptors.

Module-4: IMAGE RESTORATION AND RECONSTRUCTION ***(08Periods)***

Model of Image Degradation/Restoration process, Noise Models, Periodic Noise Reduction using Frequency Domain Filtering, Linear, Position-Invariant Degradations, Estimating the Degradation Function, Inverse Filtering, Wiener Filtering, Constrained Least-Squares Filtering, Geometric Mean Filter.

Module-5: COLOR IMAGE PROCESSING ***(07Periods)***

Color Models, Pseudocolor Image Processing, Full-Color Image Processing, Color Transformations, Color Image Smoothing and Sharpening, Using Color in Image Segmentation, Noise in Color Images.

TotalPeriods:45

EXPERIENTIAL LEARNING:

1. Find the discrete Fourier transform of a gray scale image and perform inverse transform to get back the image. Analyze the rotation and convolution properties of the Fourier transform using any gray scale image. Apply histogram equalization for enhancing the given images.
2. Perform image enhancement, smoothing and sharpening, in frequency domain using different filters and compare the performances.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Rafael Gonzalez, Richard Woods,Digital Image Processing,4th edition, Pearson Education,2018.

REFERENCE BOOKS:

1. S.Sridhar,Digital Image Processing,2nd edition, Oxford University Press,2016.
2. Anil K Jain, Fundamentals of Digital Image Processing,PHI Learning Private Ltd.,2011.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_ee78/preview
2. https://nptel.ac.in/courses/117105079
3. https://youtu.be/xgXp0Thz6RI
4. https://youtu.be/XWLTXpad8Po
5. https://www.youtube.com/watch?v=xUCsfKA8bi0

WEB RESOURCES:

1. https://www.tutorialspoint.com/dip/index.htm
2. https://www.geeksforgeeks.org/image-transformations-using-opencv-in-python/
3. https://www.analyticsvidhya.com/blog/2019/04/introduction-image-segmentation-techniques-python/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101004	**AUGMENTED REALITY AND VIRTUAL REALITY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course emphasizes on the basic concepts of augmented and Virtual reality. It also covers the Characteristics of tracking technology, Stationary tracking systems and Human Computer Interaction For Augmented Reality. By the end of this course students will acquire basic knowledge on Creating WebVR application using Unity3D.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze the augmented reality display environment, applications and tracking methods for spatial measurement and alignment of objects.

CO2. Analyze optical tracking and scene reconstruction algorithms for electronically perceiving imagery from camera sensors

CO3. Investigate interaction, authoring, navigation and collaboration methods for providing human computer interaction in augmented reality systems.

CO4. Demonstrate knowledge on the fundamental concepts and hardware of virtual reality medium.

CO5. Develop virtual reality modules using Oculus SDK and WebVR API to provide simulated experience.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	-	-	-	2	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	2	2	-	2	-	-	-	-	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO AUGMENTED REALITY ***(09Periods)***

History of augmented reality, Examples, Related fields – Mixed reality, Virtual reality, Ubiquitous computing; Displays – Multimodal displays, Visual perception, Requirements and characteristics, Spatial display model, Visual displays.

Module 2 COMPUTER VISION FOR AUGMENTED REALITY ***(10 Periods)***

Tracking – Tracking, calibration and registration, Coordinate systems, Characteristics of tracking technology, Stationary tracking systems, Mobile sensors, Optical tracking, Sensor fusion; Marker Tracking, Multiple-camera Infrared tracking, Natural feature tracking by detection, Incremental tracking, Outdoor tracking.

Module 3 HUMAN COMPUTER INTERACTION FOR AUGMENTED REALITY ***(09Periods)***

Interaction – Input modalities, Output modalities, Haptic interaction, Multimodal interaction; Authoring – Requirements of AR authoring, Elements of authoring, Stand- alone authoring solutions, Plug-In approaches; Navigation – Foundations of human navigation, Route visualization, Viewpoint guidance, Multiple perspectives; Collaboration– Co-located collaboration, Remote collaboration.

Module 4 INTRODUCTION TO VIRTUAL REALITY ***(08 Periods)***

Stereoscopic displays, Motion tracking hardware, Input devices, Computing platforms, Virtual reality applications, Virtual reality hardware – Oculus Rift, Crescent Bay, Samsung Gear VR, Google Cardboard; 3D graphics basics – Coordinate systems, Meshes, Polygons, Vertices, Materials, Textures, Lights, Transforms, Matrices, Cameras, Perspective, Viewports and Projections, Stereoscopic Rendering; Unity 3D, Setting up the Oculus SDK, Example VR Application.

Module 5 Gear VR AND WebVR IN VIRTUAL REALITY ***(09Periods)***

Gear VR – Gear VR user interface and Oculus Home, Oculus Mobile SDK, Developing for Gear VR using Unity3D, Deploying applications for Gear VR; WebVR – WebVR API, Creating WebVR application, Tools and techniques for creating WebVR.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Develop a scene in Unity that includes a cube, plane and sphere. Create a new material and texture separately for three Game objects. Change the colour, material and texture of each Game object separately in the scene.
   Write a C# program in visual studio to change the colour and material/texture of the game objects dynamically on button click.
2. Create a virtual environment for any use case. The application must include at least 4 scenes which can be changed dynamically, a good UI, animation and interaction with game objects. (e.g VR application to visit a zoo)
3 Create an immersive environment (living room/ battlefield/ tennis court) with only static game objects. 3D game objects can be created using Blender or use available 3D models.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Dieter Schmalstieg, Tobias Hollerer, Augmented Reality: Principles and Practice, Addison Wesley, 2016.
2. Tony Parisi, Learning Virtual Reality: Developing Immersive Experiences and Applications for Desktop, Web and Mobile, O'Reilly, 2015.

REFERENCE BOOKS:

1. Grigore C. Burdea, Philippe Coiffet, Virtual Reality Technology, 2nd Edition, Wiley, 2006.
2. Helen Papagiannis, Augmented Human: How Technology Is Shaping the New Reality, O'Reilly, 2017.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106138
2. https://elearn.nptel.ac.in/shop/iit-workshops/completed/foundation-course-on-virtual-reality-and-augmented-reality/
3. https://www.coursera.org/learn/ar

WEB RESOURCES:

1. https://www.oreilly.com/library/view/augmented-human/9781491928363/ch01.html
2. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SCSA3019.pdf

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22DS102002	**BIG DATA TECHNOLOGIES**	3	-	2	-	4

Pre-Requisite - Database Management Systems

Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Hadoop Basics, Hadoop Distributed File system, MapReduce, Hive, Pig and HBase, Zookeeper, Sqoop and Big data Case Studies.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on Big Data characteristics, storage, processing, querying and reporting

CO2. Analyze large dataset issues and solve using data analytic techniques.

CO3. Design and Develop classification and clustering models for dataset analysis.

CO4. Solve large data analysis problems using Big data techniques.

CO5. Apply Big Data Tools: Sqoop, HBase, Hive, Pig,MapReduce and Zookeeper for large

CO6. Work independently and in teams to solve Big Data problems with effective communications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	0
CO2	2	2	3	-	-	1	-	-	-	-	-	-	3	-	-	2
CO3	2	2	2	3	-	-	2	-	-	-	-	-	3	-	-	2
CO4	2	3	-	-	2	-	-	-	-	-	-	-	3	-	-	2
CO5	-	-	-	-	-	-	-	2	3	-	-	-	3	-	-	0
CO6	-	-	-	-	-	-	-	-	-	3	-	2	3	-	-	0
Level of correlation of the course	**3**	**3**	**3**	**3**	**2**	**1**	**2**	**2**	**3**	**3**	**-**	**2**	**3**	**-**	**-**	**2**

Correlation Levels: 3: High 2: Medium 1: Low

COURSE CONTENT:

Module 1 - INTRODUCTION TO BIG DATA AND HADOOP (9 periods)

Introduction to Big Data: Evolution and Definition of Big Data, Structure of Big Data, Characteristics, Advantages, Applications and Tools.

Hadoop: Data storage and analysis, Comparison with other systems, History of Hadoop, Apache Hadoop and the Hadoop Ecosystem, Hadoop Releases.

Module 2 – HADOOP DISTRIBUTED FILE SYSTEM AND HADOOP I/O (9 periods)

Hadoop Distributed File system: HDFS concepts, Command-Line Interface, Hadoop file systems, Java Interface, Data Flow, Hadoop Archives.

Hadoop I/O: Data Integrity, Compression, Serialization, File-Based Data Structures.

Module 3 – MAPREDUCE, TYPES & FORMATS AND FEATURES (9 periods)

MapReduce: Analyzing the data with Hadoop, Scaling Out, Hadoop Streaming, Hadoop Pipes.

Types and Formats: MapReduce Types, Input Formats, Output Formats.

Features: Counters, Sorting, Joins, Side Data Distribution and MapReduce Library Classes.

Module 4– HIVE, PIG AND HBASE (9 periods)

Hive: Comparison with Traditional Databases, HiveQL, Tables, Querying Data, and User-Defined Functions.

Pig: Comparison with Databases, Pig Latin, User-Defined Functions, Data Processing Operators.

HBase: Basics, Concepts, Clients, HBase vs. RDBMS, Praxis.

Module 5– ZOOKEEPER, SQOOP AND CASE STUDIES (9 periods)

Zookeeper: Zookeeper Service, Building applications with Zookeeper, Zookeeper in production.

Sqoop: Database Imports, working with Imported Data, Importing Large Objects, Performing an Export.

Case Studies: WhatsApp, Facebook and Twitter.

Total periods: 45

EXPERIENTIAL LEARNING:

1. Practice on Hadoop:
   - i. Hadoop installation and Cluster Configuration.
   - ii. Create Name node, Secondary Name node in Safe mode.
   - **iii. Create Hadoop File system Shell and Read and write Data.**
2. **Practice on MapReduce:**
   - **i. Create file to count the number of words and display the same.**
   - ii. Create zip file of weather report and fetch the max temperature value from the report
3. Install and Run Hive and Hbase, then use Hive to create, alter, and drop databases, tables, and perform views, functions, indexes and Joins.
4. Perform Data Processing Operators using **Pig.**
5. **Import and Export data from RDBMS database using Sqoop tool**.
6. **Perform data storage and management using Zookeeper tool.**
7. **Install Spark and Pyspark in Windows and Ubuntu.**
8. Practice on Spark
   - i) Spark Transformations i.e. map(), filter(), flatmap(), groupBy(), groupByKey(), sample(), union (), join(), distinct(), keyBy(), partitionBy and zip().
   - ii) Spark Actions i.e. getNumPartitions(), collect(), reduce(), aggregate (), max(), sum(), mean(), stdev(), countByKey().
9. Writea Scala program for Linear Search,BinarySearch,Bubble Sort ,Quick Sort, and Stack operations.
10. Practice on PySpark
    - i) Actions and Transformation commands.
    - ii) Program for implementation of bubble sort and Selection Sort
    - iii) Program for implementation of stack and Queue
11. **Case study 1: Insurance Domain**
    - i) Perform Hive operations on Insurance Dataset
    - ii) Perform Pig Data Processing Operators on Insurance Dataset
12. **Case study 2: Healthcare Domain**
    - i) Perform Hive operations on Insurance Dataset
    - ii)Perform Pig Data Processing Operators on Insurance Dataset

RESOURCES

TEXT BOOKS:

1. Tom White, *Hadoop: The Definitive Guide***,**O'REILLY Publications, Third Edition, 2012.
2. Anil Maheswari, *Big Data***,**Tata McGraw Hill,First Edition, 2017.

REFERENCE BOOKS:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications," Wiley Publications, 2014.
2. Paul Zikopoulos, IBM, Chris Eaton and Paul Zikopoulos "Understanding Big Data: Analytics for Enterprise Class Hadoop and streaming Data," The McGraw-Hill Companies, 2012.
3. Chuck Lam "Hadoop in action," Manning Publications, 2011.

SOFTWARE/Tools Used:

1. An Intel-compatible platform running Windows 10 /8.1/8 /7 /Vista /XP /2000 Windows server 2019 /2016 /2012 /2008 /2003
2. At least 256 MB of RAM, a mouse, and enough disk space for recovered files, image files, etc.
3. The administrative privileges are required to install and run Big Data utilities.
4. A network connection for data recovering over network.

VIDEO LECTURES:

1. https://www.youtube.com/live/KCEPoPJ8sWw?feature=share
2. https://youtu.be/bAyrObl7TYE

WEBRESOURCES:

1. https://www.simplilearn.com/introduction-to-big-data-and-hadoop-tutorial
2. https://hadoop.apache.org/docs/r1.2.1/hdfs_design.html
3. https://www.developer.com/java/understanding-mapreduce-types-and-formats.html
4. https://prismoskills.appspot.com/lessons/System_Design_and_Big_Data/Chapter_01_-_Hadoop.jsp
5. https://www.simplilearn.com/introduction-to-zookeeper-tutorial
6. https://data-flair.training/blogs/top-hadoop-hdfs-commands-tutorial/
7. https://www.edureka.co/blog/hive-commands-with-examples
8. https://www.tutorialspoint.com/apache_pig/apache_pig_grunt_shell.htm
9. Transformations and Actions (databricks.com)

PROGRAM CORE

Course Code	Course Title	L	T	P	S	C
22DS102003	**DATA VISUALIZATION**	3	-	2	-	4

Pre-Requisite - Database Management Systems
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Data Visualization elements, tools, visualization of maps, Dashboard design using Power BI and Tableau.

Course Objectives:

- To impart knowledge on Data Visualization concepts.
- To develop skills in data visualization tools.
- To design and develop dash boards as per business requirements

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on Data Visualization concepts.

CO2. Apply data visualization tools to perform ETL process and create charts.

CO3. Develop customized Map visualizations

CO4. Demonstrate skills in developing Dashboards as per business requirements.

CO5. Perform Data Analysis using Power BI.

CO6. Work independently and in teams to solve Data Visualization problems with effective communications

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	3	3
CO2	3	3	3	-	3	2	-	-	-	-	-	-	3	-	3	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	-	3	3
CO4	2	3	2	3	2	2	-	-	-	-	-	-	3	-	3	3
CO5	3	3	3	3	3	3	-	-	-	-	-	-	3	-	3	3
CO6	-	-	-	2	-	-	-	-	3	3	-	-	-	-	-	-
Level of correlation of the course	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**-**	**3**	**3**

Correlation Levels: 3: High 2: Medium 1: Low

COURSE CONTENT:

Module 1: INTRODUCTION (9 periods)

Definition of Data Visualization, The data visualization process, Data visualization importance in reports and statements; Data types, relationships, and visualization formats, Basic principles for data visualization, Layout and design: communicative elements, Prioritize patterns in visualizations: Gestalt, Storytelling for social and market communication, Trends in market research and data visualization dashboards

Module 2: DATA VISUALIZATION TOOLS (9 periods)

Data Visualization and Benefits Data Visualization Tools, Data Visualization Tools- Google Data Studio, Tableau, Qlikview, Power BI; Features, Data Access from Data Sources, Data transformation-

Extraction, Transformation and Load (ETL), Messy data, Data formats and schemas, Data blending or fusion, Methods for data cleansing, Data profiling, Open source data-cleansing tools; Bar Chart, Pie Chart, Data Tables, Scatter Chart, Time Series Chart, Scorecards, Bullet Charts, and Area Chart.

Module 3: MAPS (9 periods)

Heat Map-Introduction, Uses of Heat map, Procedure to Create Heat Map in Tableau; Geo Map-Introduction -Need of map visualization, Uses of Geo map, Types of maps, Procedure to create Geo map / Symbol map in Tableau; Symbol Map- Introduction, Procedure to create Symbol Map; Filled Map; Editing Location in Map- Add more fields to view, Edit locations in the Special Values menu, Edit ambiguous locationsv, Edit unknown locations.

Module 4: DASH BOARDS (9 periods)

Introduction- Definition, Key Metrics for Dashboard, Benefits of Dashboard, Types of Dashboard, Customized Dashboard; Creating a Dashboard- Creating a Dashboard using Google Data Studio, Creating a dashboard in Tableau; Formatting a Dashboard- Dashboard Size, Steps to set overall dashboard size, Group items using layout containers, Tile or float dashboard items; Actions In Dashboard- Highlight Action, Dashboard Filters, URL Action; Sharing Reports- Share with specific users and groups, Sharing the link of report, Embedding report, Download the report

Module 5: POWER BI (9 periods)

Understanding Power BI, Key Features of Power BI, Advanced features of Power BI, Variants of Power BI, Data sources and modeling, Data transformation and relationships, chart types for visualization, format options of charts, Data Analysis Expressions functions include aggregate, counting, logical and date functions for creating calculated columns and measures.

Total Periods: 45

EXPERIENTIAL LEARNING:

List of Exercises:

1. Connect data sources to Tableau.
   i). Text files, Excel files, Access Databases, SQL Server

   ii). Dimensions and measures of data, Perform changing data types, Apply filters, Merge multiple data sources.

2. Create Univariate charts
   i) Create Tables
   ii) Create common visualizations (bar charts, line charts etc.) and sort the graphs
   iii) Show aggregate measures and top 10 items
3. Create Maps and Perform customization of maps
4. Calculate user-defined fields using functions
5. Assemble a dashboard layout and apply filters.
6. Perform interactions with text, visual tooltips and actions.
7. Drill down between dash boards.
8. Perform advanced visualization using Tableau.
9. Create a data story in Tableau.
10. Create a graph for telecom billing data:
    i). Bar chart for customer segment vs average bill

    ii). Sort them based on average current charges

    iii). Create a set based on last five groups

    iv). What is the count of accounts and average bill for the subset.

11. Design a dashboard to show units in stock by product and a total sale by year*.* (*Demonstration on List of Power BI chart types for visualization*).

12. Design a dashboard to check the total amount of sales made in each month and find out which month had the highest and lowest sales. Use a simple clustered column chart. Drag the date column on the axis and the sales on to the values then change the color of the bars by going to the format option and selecting data colors. (*Demonstration on format options of charts*).

RESOURCES

TEXT BOOKS:

1. Visualize It! A Comprehensive Guide to Visualization
2. Dr. S. Karpagavalli, Introduction To Data Visualization Tools, Blue Hill Publishers, 1st Edition,2020.

REFERENCE BOOKS:

10. Teo Lachev, "*Applied Microsoft Power BI*," Prologika, Seventh Edition, 2022.
11. Alberto Ferrari and Marco Russo, "*Introducing Microsoft Power BI*," Microsoft Press, 2016.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=TPMlZxRRaBQ
2. https://www.youtube.com/watch?v=yjDPgvQX-9I

Web Resources:

1. https://docs.microsoft.com/en-us/power-bi/fundamentals/power-bi-overview.
2. https://www.edureka.co/blog/power-bi-tutorial/
3. https://mindmajix.com/power-bi-visualization-types
4. https://intellipaat.com/blog/tutorial/power-bi-tutorial/
5. https://docs.microsoft.com/en-us/powerapps/maker/canvas-apps/sharepoint-scenario-build-report.
6. https://www.projectpro.io/article/power-bi-microsoft-projects-examples-and-ideas-for-practice/533.

Software/ Tools Used:

https://www.tableau.com/products/techspecs
https://www.tableau.com/tft/activation

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS102006	**DATA SCIENCE**	3	-	2	-	4

Pre-Requisite - Foundations of Data Science
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: Concepts of data science, Extracting meaning from data, The dimensionality problem, Plotting with pandas and seaborn, Probability distributions, Time series analysis, Predictive modeling.

COURSE OUTCOMES: *After successful completion of the course, students will be able to*:
CO1. Demonstrate knowledge on the concepts of data science to perform data analysis.
CO2. Develop methods to extract meaning from data using feature selection techniques.
CO3. Create data visualization using charts, plots and histograms to identify trends, patterns and outliers in data using Matplotlib and Seaborn.
CO4. Develop distribution functions to analyze and interpret data to extract meaningful statistics.
CO5. Design and develop predictive models for a given problem to support prediction and forecasting.
CO6. Work independently or in team to solve data science related problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1	1	-	-	-	-	-	-	-	-	3	3	3	-
CO2	3	3	2	2	1	-	-	-	-	-	-	-	3	3	3	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	3	3	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3	3	-
CO5	3	3	2	2	2	-	-	-	-	-	-	-	3	3	3	-
CO6	-	-	-	2	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**3**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION ***(09 Periods)***

Definition of data science, Skills for data science, Tools for data science, Data types, Data collections, Data preprocessing, Data analysis and data analytics, Descriptive analysis, Diagnostic analytics, Predictive analytics, Prescriptive analytics, Exploratory analysis, Mechanistic analysis.

Module 2: DATA EXTRACTION ***(09 Periods)***

Extracting meaning from data – Feature selection, User retention, Filters, Wrappers, Entropy, Decision tree algorithm; Random forests, The dimensionality problem, Single value decomposition, Principal component analysis.

Module 3: DATA VISUALIZATION ***(8 Periods)***

A Brief matplotlib API primer, Plotting with Pandas and Seaborn – Line plots, Bar plots, Histograms and density plots, Scatter plots, Facet grids and Categorical data; Other Python visualization tools.

Module 4: STATISTICAL THINKING ***(11 Periods)***

Distributions – Representing and plotting histograms, Outliers, Summarizing distributions, Variance, Reporting results; Probability mass function – Plotting PMFs, Other visualizations, The class size paradox, Data frame indexing; Cumulative distribution functions - Limits of PMFs, Representing CDFs, Percentile based statistics, Random numbers, Comparing percentile ranks; Modeling distributions - Exponential distribution, Normal distribution, Lognormal distribution.

Module 5: TIME SERIES ANALYSIS AND PREDICTIVE MODELING ***(8 Periods)***

Time series analysis – Importing and cleaning, Plotting, Moving averages, Missing values, Serial correlation, Autocorrelation; Predictive modeling – Overview, Evaluating predictive models, Building predictive model solutions, Sentiment analysis.

Total Periods: 45

EXPERIENTIAL LEARNING

1. **Working with different data formats using pandas**
   a. Perform reading and writing data in text format using read_csv and read_table considering any online dataset in delimited format (CSV).
   b. Perform reading, writing and parsing data in JSON (Javascript Object Notation) format using read_json.
   c. Perform reading and writing of Microsoft Excel Files (xslx) using read_excel.

2. **Interacting with Web APIs and Databases**

a. Predict the last 30 GitHub issues for pandas using request and response object's json method. Move the extracted data to DataFrame and extract fields of interest. (Use url: 'https://api.github.com/repos/pandas-dev/pandas/issues')
b. Connect to any relational database using corresponding SQL drivers and perform operations such as table creation, populating the table, selecting data from table, moving data from table to DataFrame, updating records and deleting records in a table.

3. **Data Cleaning and Preparation**

a. Perform data cleaning by creating a DataFrame and identifying missing data using NA(Not Available) handling methods, filter out missing data using dropna function, fill the missing data using fillna function and remove duplicates using duplicated and drop_duplicates functions.
b. Perform data transformation by modifying set of values using map and replace method and create transformed version of original dataset without modification using rename method.
c. Create a DataFrame with normally distributed data using random sampling and detect possible outliers.
d. Perform text manipulation with regular expression by applying relevant regular expression methods to split a string with a variable number of whitespace characters (tabs, spaces, and newlines) and get a list of all patterns matching.

4. **Data Wrangling**

a. Perform hierarchical indexing by creating a series with a list of lists (or arrays) as the index, select subsets of data at outer and inner levels using partial indexing.
b. Rearrange the tabular data with hierarchical indexing using unstack and stack method.
c. Create two different DataFrames and merge them using index as merge key and combine data with overlap using combine_first method.

5. **Perform Data Visualization with Matplotlib and SeaBorn considering online dataset for processing.**

a. Create a Line Plot by setting the title, axis labels, ticks, ticklabels , annotations on subplots and save to a file.
b. Create Bar Plots using Series and DataFrame index.
   i. Create bar plots with a DataFrame to group the values in each row together in a group in bars side by side for each value.
   ii. Create stacked bar plots from a DataFrame.
c. Create Histogram to display the value frequency and Density Plot to generate continuous probability distribution function for observed data.
d. Create Scatter Plot and examine the relationship between two one-dimensional data series.
e. Create Box plots to visualize data with many categorical variables.

6. Time Series Analysis

a. Create time series using datetime object in pandas indexed by timestamps.
b. Use pandas.date_range to generate a DatetimeIndex with an indicated length.
c. Generate data ranges by setting time zone, localize time zone and convert to particular time zone using tz_convert and combine two different time zones.
d. Perform period arithmetic such as adding and subtracting integers from periods and construct range of periods using period_range function.
e. Convert Periods and PeriodIndex objects to another frequency with asfreq method.
f. Convert Series and DataFrame objects indexed by timestamps to periods with the to_period method.
g. Perform resampling, downsampling and upsampling for the time series.

7. Data Aggregation

a. Create a tabular dataset as a DataFrame and split data into groups using groupby method including single key and multiple key values. Select group by considering single and multiple columns.
b. Compute summary statistics such as sum, mean and standard deviation for the grouped data using aggregate method.
c. Use groupby function to split data into groups based on one column, miultiple columns, compute summary statistics and perform exploratory data analysis. Consider any online dataset for processing.

8. Web Scraping using Beautiful Soup

a. Extract product reviews from Amazon website and save to a file.
b. Perform Exploratory Data Analysis on extracted product reviews.
   i. Generate WordCloud for all reviews, positive and negative reviews.
   ii. Plot the distribution of stopwords, numerics, wordcount values, charactercount values and average wordlength.
   iii. Display the sentiment value using nltk and vader.
   iv. Create Scatter Intensity Plot of Sentiments.

9. Case Study 3: Customer Personality Analysis

- *Use Case:* Customer Personality Analysis is a detailed analysis of a company's ideal customers. It helps a business to better understand its customers and makes it easier for them to modify products according to the specific needs, behaviours and concerns of different types of customers.
- You have to do an analysis which should help a business to modify its product based on its target customers from different types of customer segments. For example, instead of spending money to market a new product to every customer in the company's database, a company can analyze which customer segment is most likely to buy the product and then market the product only on that particular segment.

10. Case Study 1: Text Emotions Detection

- Use Case: A human can express his emotions in any form, such as the face, gestures, speech and text. The detection of text emotions is a content-based classification problem. Detecting a person's emotions is a difficult task, but detecting the emotions using text written by a person is even more difficult as a human can express his emotions in any form.
- Recognizing this type of emotion from a text written by a person plays an important role in applications such as chatbots, customer support forum, customer reviews etc. So you have to train a machine learning model that can identify the emotion of a text by presenting the most relevant emoji according to the input text.
  (LINK: https://thecleverprogrammer.com/2021/02/19/data-science-case-studies-solved-using-python/)

TEXT BOOKS:

1. Chirag Shah, *A Hands-on Introduction to Data Science*, Cambridge University Press, 2020.

2. Alen B. Downey, *Think Stats: Exploratory Data Analysis*, O'Reilly, 2nd Edition, 2014.

REFERENCE BOOKS:

1. Wes McKinney, *Python for Data Analysis*, O'Reilly, 2nd Edition, 2017.
2. Sinan Ozdemir, *Principles of Data Science*, Packt Publishers, 2nd Edition, 2018.
3. OferMendelevitch, Casey Stella, Douglas Eadline, *Practical Data science with Hadoop and Spark: Designing and Building Effective Analytics at Scale*, Addison Wesley, 2017.
4. Rachel Schutt, Cathy O'Neil, *Doing Data Science: Straight Talk from the Frontline*, O'Reilly, 2014.
5. Jake VanderPlas, *Python Data Science Handbook: Essential Tools for Working with Data*, O'Reilly, 2017.

SOFTWARE/TOOLS:

- Python 3.8
- Python Libraries – NumPy, Pandas, Matplotlib, Seaborn, Beautiful Soup, Vader
- Anaconda Framework

VIDEO LECTURES:

https://nptel.ac.in/courses/106106212

https://nptel.ac.in/courses/106106179

Web Resources:

- https://swayam.gov.in/nd1_noc19_cs60/preview
- https://towardsdatascience.com/
- https://www.w3schools.com/datascience/
- https://github.com/jakevdp/PythonDataScienceHandbook
- https://www.kaggle.com

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS101005	**Distributed Systems**	3	-	-	-	3

Pre-Requisite - Operating system

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course focuses on the fundamental principles and models underlying all aspects of distributed computing. It includes topics that covers the principles underlying the theory, algorithms, and systems aspects of distributed computing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Identify the design issues; select appropriate system and mode of execution to address challenges in creating a distributed systems.

CO2. Utilize the concept of causality between events for designing and analyzing distributed systems.

CO3. Record the global state of a distributed system for analyzing, testing, or verifying properties associated with distributed executions.

CO4. Implement various approaches for solving distributed mutual exclusion problem and compare their feature and performance.

CO5. Study several distributed deadlock detection techniques based on various strategies and solve deadlock problem

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-	3
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	3
CO4	2	3	3	-	-	-	-	2	-	-	-	-	3	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**-**	**2**	**-**	**3**	-	**3**

Correlation Levels: 3: High; 2: Medium;1: Low

Module 1 – INTRODUCTION (9 Periods)

Relation to parallel multiprocessor/multicomputer systems - Message-passing systems versus shared memory systems - Synchronous versus asynchronous executions - Design issues and challenges - A model of distributed executions - Models of communication networks - Past and future cones of an event - Models of process communications

Module 2 - LOGICAL TIME (9 Periods)

A framework for a system of logical clocks - Scalar time - Vector time - Efficient implementations of vector clocks - Jard–Jourdan's adaptive technique - Matrix time - Virtual time - Physical clock synchronization: NTP

Module 3 - GLOBAL STATE AND SNAPSHOT RECORDING ALGORITHMS (9 Periods)

Global state and snapshot recording algorithms - Snapshot algorithms for FIFO channels - Variations of the Chandy–Lamport algorithm - Snapshot algorithms for non-FIFO channels - Snapshots in a causal delivery system - Monitoring global state

Module 4 - DISTRIBUTED MUTUAL EXCLUSION ALGORITHMS (9 Periods)

Lamport's algorithm - Ricart–Agrawala algorithm - Singhal's dynamic information-structure algorithm - Lodha and Kshemkalyani's fair mutual exclusion algorithm - Quorum-based mutual exclusion algorithms - Maekawa's algorithm - Agarwal–El Abbadi quorum-based algorithm - Token-based algorithms - Suzuki–Kasami's broadcast algorithm - Raymond's tree-based algorithm.

Module 5 - DEADLOCK DETECTION IN DISTRIBUTED SYSTEMS (9 Periods)

System model - Models of deadlocks - Knapp's classification of distributed deadlock detection algorithms - Mitchell and Merritt's algorithm for the singleresource model - Chandy–Misra–Haas algorithm for the AND model - Chandy–Misra–Haas algorithm for the OR model - Distributed shared memory - Abstraction and advantages - Memory consistency models.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Implement concurrent echo client-server application
2. Implement concurrent day-time client-server application.
3. Create CORBA based server-client application.
4. Implementing Publish/Subscribe Paradigm using Web Services, ESB and JMS.
5. Test open source ESB using web service.
6.

SOFTWARE/TOOLS:

1. Java compatible web browser

Text Book

1. Kshemkalyani Ajay D, Mukesh Singhal, Distributed Computing: Principles, Algorithms and Systems, Cambridge Press, 2011.

Reference Books

1. George Coulouris, Jean Dollimore, Time Kindberg, Distributed Systems Concepts and Design, Fifth Edition, Pearson Education, 2012.
2. Pradeep L Sinha, Distributed Operating Systems: Concepts and Design, Prentice Hall of India, 2007.
3. Tanenbaum A S, Van Steen M, Distributed Systems: Principles and Paradigms, Pearson Education, 2007.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=UEAMfLPZZhE
2. https://www.digimat.in/nptel/courses/video/106106168/L01.html

WEB RESOURCES:

1. https://www.cl.cam.ac.uk/teaching/2122/ConcDisSys/dist-sys-notes.pdf
2. https://lass.cs.umass.edu/~shenoy/courses/677content/CourseNotes.pdf

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC104017	**EMBEDDED SYSTEMS**	3	-	2	4	5

Pre-Requisite Microcontrollers and Interfacing.

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This Course describes on MSP430 Architecture; Instruction Set; Programming; On-Chip Resources; Communication with peripherals; Embedded system design approaches

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze MSP430 Architecture, Instruction Set, addressing modes to develop programs for various control applications using Assembly and Embedded C

CO2. Solve Problems by analyzing MSP430 On Chip Resources such as Timer, Clock System, Low Power Modes/techniques and Interrupt Structure.

CO3. Realize Mixed Signal Processing and Networking Applications, by analyzing onChip Resources such as Comparator, ADC, Temperature Sensor, PWM and Communication Peripherals

CO4. Analyze Language, IDE Support, Processor IC & Design Technologies, and System Modeling Techniques to capture behavior of Embedded Prototype using suitable model

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	-	1	-	-	-	-	-	-	-	-	2	1	-
CO2	3	3	2	3	2	2	-	-	-	-	-	-	2	2	-
CO3	3	3	3	2	2	2	-	2	-	-	-	-	1	2	2
CO4	3	2	3	2	2	2	-	2	-	-	-	-	1	1	1
Course Correlation Mapping	3	3	3	2	2	2	-	2	-	-	-	-	2	2	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: ARCHITECTURE OF MSP430 ***(09 Periods)***

Embedded Systems – Introduction, MSP430 - Anatomy of microcontroller, Memory, Software, Pin out (MSP430G2553), Functional Block diagram, Memory, CPU, and Memory mapped input and output, Clock generator; Exceptions- Interrupts and Resets.

Module 2: PROGRAMMING MSP430 ***(09 Periods)***

Development Environment, Aspects of C for Embedded Systems, Assembly Language, Register Organization, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Example programs- Light LEDs, Read input from a switch; Automatic Control-Flashing light by delay, use of subroutines and Functions; Basic Clock System, Interrupts and Low Power Modes

Module 3: TIMERS AND MIXED SIGNAL SYSTEMS ***(09 Periods)***

Timers - Watchdog Timer, RTC, Timer_A, Measurement in capture mode, PWM generation; Mixed Signal Systems- Comparator_A, ADC10 SAADC –Architecture, operation- Single Conversion, Temperature Sensor on ADC10, DTC in ADC10; ADC12 – Comparison with ADC10.

Module 4: COMMUNICATION PERIPHERALS & PROTOCOLS ***(09 Periods)***

MSP430 Communication Interfaces- USART, USCI, USI; Communication Protocols- SPI, Inter-integrated Circuit Bus, USB, CAN.

Module 5: EMBEDDED SYSTEM DESIGN ***(09 Periods)***

Processor Technology, IC Technology, Design Technology, Tradeoffs. Model VS. Language, System Modelling – Data Flow Model, FSM, FSMD, HCFSM, PSM, Concurrent Process Model & implementation.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Introduction to MSP430 launch pad and Programming Environment
2. Practice on usage of Instruction Set
3. Read input from switch and Automatic control/flash LED (software delay).
4. Interrupts programming example using GPIO.
5. Configure watchdog timer in watchdog & interval mode.
6. Configure timer block for signal generation (with given frequency).
7. Read Temperature of MSP430 with the help of ADC.
8. Test various Power Down modes in MSP430.

9. Generation of Pulse Width Modulation.
10. Use Comparator to compare the signal threshold level.
11. Speed Control of DC Motor.
12. Master slave communication between MSPs using SPI.
13. Networking MSPs using Wi-Fi

PROJECT BASED LEARNING:

1. Create an Morse Code Machine
2. Create a project to control an Analog Guage machine using MSP430G2553.
3. Design an Wi-Fi Controller door lock using MSP430 and mobile phone.
4. Design an RGB mood lamp using MSP430 for low power Control.
5. Control your robot using an Android app to perform various tasks in difficult environmental conditions

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. John H. Davies, MSP430 Microcontroller Basics, Newnes Publications, 1stEdition, 2008.
2. Santanu Chattopadyay, Embedded System Design, PHI, 2010.
3. Frank Vahid, Tony D. Givargis, Embedded System Design – A Unified Hardware/Software Introduction, John Wiley, January 2006

REFERENCE BOOKS:

1. Chris Nagy, Embedded Systems Design using the TI MSP30 Series, Newness Publications, October 2003.
2. Jorgeon Staunstrup, Wayne Wolf, Hardware/Software Co-design Principles and Practice, Springer 2009.
3. Patrick R Schizont, A Practical Introduction to Hardware/Software Co-design, Springer publications, January 2010

VIDEO LECTURES:

1. https://www.udemy.com/course/bootlaoder-design-with-msp430/
2. https://in.coursera.org/learn/introduction-embedded-systems
3. https://archive.nptel.ac.in/noc/courses/noc20/SEM2/noc20-ee98/

PROGRAM ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS101007	**HIGH PERFORMANCE COMPUTING**	3	-	-	-	3

Pre-Requisite Object Oriented Programming through Java

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course focuses on the fundamental principles and models underlying all aspects of distributed computing. It includes topics that covers the principles underlying the theory, algorithms, and systems aspects of distributed computing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 To Study various computing technology architecture.

CO2 To know Emerging trends in computing technology.

CO3 To highlight the advantage of deploying computing technology.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3
CO2	3	3	-	-	-	-	2	-	-	-	-	-	3	-	3
CO3	3	3	3	-	-	-	-	-	-	-	2	-	3	-	3
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**-**	**2**	**-**	**3**	-	**3**

Correlation Levels: 3: High; 2: Medium;1: Low

Module 1 – CLUSTER COMPUTING AND ITS ARCHITECTURE: (9 Periods)

Ease of Computing, Scalable Parallel Computer Architecture, Towards Low Cost Parallel Computing & Motivation , Windows opportunity, A Cluster Computer And Its Architecture,Cluster Classification, Commodity Components for Clusters, Network Services/Communication SW, Cluster Middleware and Single Systems Image, Resource management & Scheduling (RMS)

Module 2 - CLUSTER SETUP AND ADMINISTRATION: (8 Periods)

Introduction,Setting up the cluster,Security ,System Monitoring, System Tuning

Module 3 - INTRODUCTION TO GRID AND ITS EVOLUTION: (10 Periods)

Introduction to Grid and its Evolution, Beginning of the Grid, Building blocks of Grid, Grid Application and Grid Middleware, Evolution of the Grid: First, Second & Third Generation

Module 4 - INTRODUCTION TO CLOUD COMPUTING: (9 Periods)

Defining Clouds, Cloud Providers , Consuming Cloud Services, Cloud Models – Iaas, Paas, SaaS, Inside the cloud, Administering cloud services, Technical interface,Cloud resources

Module 5 - NATURE OF CLOUD: (9 Periods)

Tradition Data Center, Cost of Cloud Data Center, Scaling computer systems, Cloud work load, Managing data on clouds, Public, private and hybrid clouds

Total Periods: 45

EXPERIENTIAL LEARNING

1 To study the basic commands of linux.

2 To establish Beowulf Cluster using MPI(Message Passing Interface) Library.

3 Installation and configuration of Alchemi Grid.

4 Running a sample application on Alchemi Grid and analysing it.

5 To study a Grid Simulation Toolkit.

6 To run two sample programs using GridSim Toolkit.

7 To study a Cloud Simulation Toolkit.

8 To setup Cloud.

SOFTWARE/TOOLS:

1. Linux Programming

Text Book

1. High Performance Cluster Computing, Volume 1, Architecture and Systems, Rajkumar Buyya, Pearson Education.

2. Berman, Fox and Hey, Grid Computing – Making the Global Infrastructure a Reality, Wiley India.

3. Hurwitz, Bllor, Kaufman, Halper, Cloud Computing for Dummies, Wiley, India.

Reference Books

1. Ronald Krutz, Cloud Security, Wiley India.
2. Cloud Computing, A Practical Approach, Anthony Velte, Toby Velte, Robert Elsenpeter, McGrawHill..

VIDEO LECTURES:

1. https://anandgharu.wordpress.com/be/
2. http://www.digimat.in/nptel/courses/video/106108055/L01.html
3. https://omscs.gatech.edu/cse-6220-intro-high-performance-computing-course-videos

WEB RESOURCES:

1. https://www.cse.iitd.ac.in/~dheerajb/hpc.htm
2. https://www.iitg.ac.in/asahu/cs528-2023/

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101005	**MULTI-AGENT SYSTEMS**	3	-	-	-	3

Pre-Requisite Artificial Intelligence

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course providesthe ability to formulate a problem in logical terms and basic knowledge of logical inference, decision making, algorithmic complexity and multi agent system.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on the origins and foundations of Agent Orientation in distributed computing

CO2. Analyze the interactions and communications in multi-agent system using agent-oriented methodologies

CO3. Evaluate the coordination and decision making process using social models in distributed robust applications.

CO4. Analyze industry based agencies by applying appropriate methodologies and tools.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	-	-	-
CO3	2	3	3	3	1	1	-	-	-	-	-	-	3	-	-	-
CO4	3	2	3	-	3	1	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	2	3	3	2	1	-	-	-	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1: INTRODUCTION ***(10Periods)***

Intelligent Agents: Introduction, Agents, Abstract Architectures for Intelligent Agents, Concrete Architectures for Intelligent Agents, Agent Programming Languages – Multi- agent Systems and Societies of Agents: Introduction, Agent Communications, Agent Interaction Protocols, Societies of Agents.

Module 2: MULTI-AGENT INTERACTION AND COMMUNICATION ***(10Periods)***

Multi-agent Interaction: Utilities and Preferences, Multi-agent Encounters, Dominant Strategies and Nash Equilibria, Competitive and Zero-Sum Interactions, The Prisoner's Dilemma, Other Symmetric 2 x 2 Interactions, Dependence Relations in Multi-agent Systems.

Communication: Speech Acts, Agent Communication Languages, Ontologies for Agent Communication, Coordination Languages

Module 3 MULTI-AGENT METHODOLOGIES ***(09 Periods)***

Agent-Based Solution Appropriate, Agent-Oriented Analysis and Design Techniques, Pitfalls of Agent Development, Mobile Agents.

Module 4 COORDINATION AND SOCIAL MODELS ***(08 Periods)***

Working Together: Cooperative Distributed Problem Solving, Task Sharing and Result Sharing, Result Sharing, Combining Task and Result Sharing, Handling Inconsistency
Coordination, Multi agent Planning and Synchronization - Distributed Rational Decision Making: Evaluation Criteria, Voting, Auctions, Bargaining, General Equilibrium Market Mechanisms, Contract Nets, Coalition Formation.

Module 5 APPLICATIONS OF AGENT-ORIENTED DESIGN ***(08 Periods)***

Application: Agents for Workflow and Business Process Management, Agents for Distributed Sensing, Agents for Information Retrieval and Management, Agents for Electronic Commerce, Agents for Human-Computer Interfaces, Agents for Virtual Environments, Agents for Social Simulation, Agents for X - Industrial and Practical Applications: Use DAI in Industry, Overview of the Industrial Life-Cycle, Life Cycle Are Agents Used, Industry Constrain the Life Cycle of an Agent-Based System, Development Tools.

Total Periods: 45

EXPERIENTIAL LEARNING:

1. Suppose the agents play for a fixed number of times (say three times). Give two equilibria if there are two or more, otherwise give the unique equilibrium and explain why there is only one. Hint: Consider the last time first.
2. Assume there is a discount factor of γ, which means there is a probability γ of stopping at each stage. Is tit-for-tat a Nash equilibrium for all values of γ? If so, prove it. If not, for which values of γ is it a Nash equilibrium?
3. Suppose there is a resource that two agents may want to fight over. Each agent chooses to act as a hawk or as a dove. Suppose the resource is worth R units, where R>0. If both agents act as doves, they share the resource. If one agent acts as a hawk and the other as a dove, the hawk agent gets the resource and the dove agent gets nothing. If they both act like hawks, there is destruction of the resource and the reward to both is −D, where D>0. This is depicted by the following payoff matrix:

		Agent 2	
		dove	*hawk*
Agent 1	*dove*	$R/2, R/2$	$0, R$
	hawk	$R, 0$	$-D, -D$

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Gerhard Weiss, "Multi-agent Systems", MIT Press, 2nd Edition, 2013.
2. Michael Wooldridge, "An Introduction to Multi-agent Systems", John Wiley & Sons, 2nd edition, 2009.

REFERENCE BOOKS:

1. Stuart Russell, Peter Norvig, Artificial Intelligence: a modern approach, Pearson Education, 4th Edition, 2020.
2. M. Wooldrige, Reasoning about Rational Agent", The MIT Press, 2000.
3. M. Huhns& M. Singh (Eds.), Readings in Agents, Morgan Kaufmann, 1998.
4. J. Ferber, Multi-Agent Systems, Addison-Wesley, 1999.

VIDEO LECTURES:

1 https://www.youtube.com/watch?v=VwQ132JpOjs
2 https://www.youtube.com/watch?v=mGmhOHUoNMY
3 https://www.youtube.com/watch?v=J9Olp6YqQhw
4 https://www.coursera.org/lecture/modeling-simulation-natural-processes/multi agent-systems-kAKyC

WEB RESOURCES:

1. http://agents.umbc.edu
2. http://jade.tilab.com , http://www.agentbuilder.com/AgentTools/
3. https://artint.info/2e/html/ArtInt2e.Ch11.S4.html#Ch11.Thmciexampler ed12
4. https://www.cs.cmu.edu/~softagents/multi.html
5. https://www.turing.ac.uk/research/interest-groups/multi-agent-systems

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101006	**MARKOV DECISION PROCESSES**	3	-	-	-	3

Pre-Requisite Artificial Intelligence

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION:

This course provides an introduction to Markov decision processes (MDPs), which is class ofproblems that involve repeated decision making in stochastic environments. MDPs allow us toalter the evolution of stochastic systems by exercising control to achieve a certain objective. Theyhave a wide range of applications within and outside transportation and operations research andplay a major role in some of the state-of-the-art artificial intelligence systems. Applications intransportation such as shortest paths, pricing, signal control, demand estimation, and parking willalso be discussed.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on the fundamental concepts of Markov decision process

CO2. Interpret the knowledge to design solutions to different problems using Infinite Horizon Discounted MDPs

CO3. Analyze the components and models of infinite horizon Markov Decision Process

CO4. Apply the Dynamic programming & Reinforcement Learning techniques for solving real-time problems

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	3	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	3	3	-	-	-	-	-	-	-	-	2	-	-	-
CO3	3	2	1	2	-	-	-	-	-	-	-	-	2	-	-	-
CO4	3	2	2	1	-	-	-	-	-	-	-	-	2	-	-	-
Course Correlation Mapping	3	2	3	3	-	-	2	-	-	-	-	-	2	-	-	-

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1 STOCHASTIC PROCESSES ***(09Periods)***

Stochastic Processes, Characterization, Transient Behavior, Marginal distributions, computation of matrix powers, Modeling, Computational and conceptual exercises

Module 2 FINITE HORIZON MDPS ***(09 Periods)***

Discrete Time Markov Chains (DTMCs) and applications, transition probabilities and occupancy times, classification of DTMCs, limiting behavior, finite horizon MDPs, backward induction, structural results, and applications

Module 3 INFINITE HORIZON DISCOUNTED MDPS ***(09Periods)***

Banach spaces and contraction mappings, Convergence of the DP algorithm and Bellman's equation,value iteration and variants, policy iteration, linear programming methods, and applications.

Module 4 INFINITE HORIZON TOTAL COST MDPS ***(09 Periods)***

Finite space models, Bellman's equations, Blackwell optimality, Existence of optimal policies, solution methods (value iteration and policy iteration), unchainand multi-chain models, and applications.

Module 5 DYNAMIC PROGRAMMING AND RL ***(09 Periods)***

The curses of dimensionality, ADP via Linear programming, Roll-out methods, look-ahead and Monte-Carlo Tree Search, model-free methods (TD (Lamda), Q-learning, SARSA), function approximation, and policy gradient.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Case study on Solving multi-agent assignment Markov decision processes
2. SolveShortest Path Problem in a Graph as an Markov decision processes

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Kulkarni, V. G., Modeling and analysis of stochastic systems, CRC Press,2016.
2. Puterman, M. L.,Markov decision processes: discrete stochastic dynamic programming, John Wiley & Sons,2014.

REFERENCE BOOKS:

3. Bertsekas, D. P. Dynamic programming and optimal control (Vol. 1 & 2). Belmont,MA: Athena Scientific,2012.
4. Sutton, R. S., &Barto, A. G. Reinforcement learning: An introduction, MIT press.2018.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=9g32v7bK3Co
2. https://www.coursera.org/lecture/fundamentals-of-reinforcement-learning/markov-decision-processes-8T0GQ
3. https://www.udemy.com/course/artificial-intelligence-iv-reinforcement-learning-in-ja

WEB RESOURCES:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4385667/
2. https://dev.to/rodolfomendes/40-resources-to-completely-master-markov-decision-processes-49o3

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101007	KNOWLEDGE REPRESENTATION AND REASONING	3	-	-	-	3

Pre-Requisite Artificial Intelligence

COURSE DESCRIPTION: This course provides a discussion on the fundamental concepts of knowledge representation and first order logic. The course further delves into concepts of knowledge engineering and resolution. The course then covers reasoning, structured descriptions, action and planning.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply knowledge representation and reasoning in knowledge-based systems with an emphasis on first-order logic for effective reasoning and decision making.

CO2. Identify and utilize various types of facts, vocabulary and entailments to represent knowledge and draw logical conclusions from knowledge bases.

CO3. Design appropriate rule formation and search strategies using horn clauses and procedural control of reasoning.

CO4. Apply taxonomies and classification techniques to categorize and organize objects based on their properties and relationships.

CO5. Analyze the principles of the Situation Calculus to represent and reason about actions, states, and change in dynamic environments.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	1	-	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	**3**	**3**	**2**	**1**	**-**	-	-	-	-	-	-	-	-	**3**	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module1: KNOWLEDGE REPRESENTATION AND FIRST ORDER LOGIC ***(07Periods)***

Knowledge, Representation, andReasoning,Knowledge-Based Systems,The Role of Logic,Introduction to First Order Logic,The Syntax, The Semantics, The Pragmatics,Explicit and Implicit Belief

Module2: EXPRESSING KNOWLEDGE, RESOLUTION ***(09Periods)***

Knowledge Engineering,Vocabulary,Basic Facts,Complex Facts,Terminological Facts,Entailments, Abstract Individuals,Other Sorts of Facts, Resolution-The Propositional Case, Handling Variables and Quantifiers,Dealing with Computational Intractability.

Module3 REASONING ***(09Periods)***

Horn Clause,SLD Resolution,Computing SLD Derivations, Procedural Control of Reasoning-Facts and Rules,Rule Formation and Search Strategy,Algorithm Design, Specifying Goal Order, Committing to Proof Methods,Controlling Backtracking,Negation as Failure,Dynamic Databases; Rules in Production Systems-Production Systems: Basic Operation,Working Memory,Production Rules.

Module4 STRUCTURED DESCRIPTIONS ***(09Periods)***

Object Oriented Representation-Objects and Frames, A Basic Frame Formalism; Descriptions, A Description Language, Meaning and Entailment,Computing Entailments,Taxonomies and Classification.

Module5 DEFAULT REASONING, ACTIONS AND PLANNING ***(11Periods)***

Introduction, The Closed-World Assumption, Circumscription, Default Logic, Autoepistemic Logic, Actions- The Situation Calculus, A Simple Solution to the Frame Problem,Complex Actions; Planning-Planning in the Situation Calculus,The STRIPS Representation,Planning as a Reasoning Task.

TotalPeriods:45

EXPERIENTIAL LEARNING

1. Choose a domain of interest, such as healthcare, finance, or robotics.Identify relevant basic facts, complex facts, and terminological facts that are essential to representing knowledge in the chosen domain.Construct a knowledge base using appropriate representation formalisms, such as first-order logic or Description Logic.Explore different types of entailments that can be derived from the knowledge base, considering both logical and semantic implications.Introduce abstract individuals to represent general concepts or categories within the domain and demonstrate their utility in reasoning.
2. Choose a domain of interest, such as healthcare, finance, or robotics.Implement a resolution-based reasoning system for the propositional case of the knowledge base, considering the handling of variables and quantifiers.
3. Investigate the computational complexity of reasoning tasks within the knowledge base and discuss strategies for dealing with computational intractability.Reflect on the challenges encountered during the knowledge engineering process and propose possible improvements or alternative approaches.Present your findings and insights through a

comprehensive report or presentation, highlighting the practical implications of knowledge engineering in the chosen domain.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXTBOOKS:

1. Ronald J. Brachman, Hector J. Levesque, Knowledge Representation and Reasoning, Morgan Kaufmann, 2004.

REFERENCEBOOKS:

1. Michael Gelfond,YuliaKahl,Knowledge Representation, Reasoning, and the Design of Intelligent Agents:The Answer-Set Programming Approach, Cambridge University Press,2014.
2. ChittaBaral,Knowledge Representation, Reasoning and Declarative Problem Solving, Cambridge University Press,2009.

VIDEOLECTURES:

1. https://onlinecourses.nptel.ac.in/noc23_cs09/preview
2. https://www.youtube.com/watch?v=hgw59_HBU2A
3. https://www.youtube.com/watch?v=GH8yBBC9n3Y
4. https://www.youtube.com/watch?v=oFTjfBUVzeA

WEBRESOURCES:

1. https://www.geeksforgeeks.org/pattern-recognition-introduction/
2. https://www.javatpoint.com/first-order-logic-in-artificial-intelligence
3. https://ocw.mit.edu/courses/6-871-knowledge-based-applications-systems-spring-2005/121ee967eebd1e43453d13e7ab4c1422_lect13_whatkr.pdf
4. https://www.geeksforgeeks.org/horn-clauses-in-deductive-databases/
5. https://pages.cpsc.ucalgary.ca/~jacob/Courses/Winter2001/CPSC533/Slides/03.4-Planning.pdf

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101008	**GRAPH ALGORITHMS**	3	-	-	-	3

Pre-Requisite Discrete Mathematical Structures

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course emphasizes on the basics of graphs, connected graphs, shortest graphs and trees. This course also focuses on Independent sets coverings and matchings and Vertex Colorings.By end of the course, students will acquire the basic knowledge,formulate and prove central theorems about trees, matching, connectivity, colouringand planar graphs.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on graph models and algorithms.

CO2. Analyse and apply the appropriate Connected graphs and shortest path algorithms for solving problems

CO3. Apply Tree constructs and other traversals to solve real-time problems

CO4. Synthesize applications using Independent sets coverings and matchings.

CO5. Apply core theorems and algorithms to solve problems using Vertex Colorings.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	1	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	2	1	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	3	3	3	2	-	1	-	-	-	-	-	-	3	-	-	-
CO5	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	3	3	3	2	-	1	-	-	-	-	-	-	3	-	-	-

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1 FUNDAMENTALS OF GRAPH ***(08Periods)***

Graph as models, Matrices and Isomorphism, Decomposition and special graphs, Paths, cycles and Trails, Vertex degree and counting, Directed graphs, vertex degrees, Eulerian digraphs.

Module 2 TREES AND DISTANCE & MATCHING AND FACTORS ***(10Periods)***

Properties of trees, Distance in Trees and graphs, Disjoint spanning trees, Spanning Trees and Enumeration, Optimization and Trees, Maximum matching, Hall's matching condition, Min-Max Theorems, Independent sets and covers, Maximimum& Weighted bipartite matching, Tutte's 1-factor theorem.

Module 3 CONNECTIVITY AND PATHS ***(09 Periods)***

Cuts and connectivity, connectivity, edge connectivity, blocks, 2- connected graphs, connectivity of digraphs, K- connected and K-edge connected graphs, Applications of Menger's theorem; Network Flow Problems: Maximum network flow, Integral flows, supplies and demands, Applications of network flow techniques.

Module 4 COLORING OF GRAPHS & PLANAR GRAPHS ***(09 Periods)***

Vertex coloring and upper bounds: Definition and examples, Upper bounds, Brook's Theorem; Structure of K-chromatic Graphs: Graphs with large chromatic number, Extremal problems and Turan's theorem, color-critical graphs; Enumerative aspects: Counting proper colorings, Chordal graphs; Planar graphs: Embedding and Euler's formula, Characterization of planar graphs, Parameters of planarity.

Module 5 EDGES AND CYCLES ***(09 Periods)***

Line graph and edge coloring: Edge coloring, Characterization of line graphs; Hamiltonian Cycles: Necessary conditions, sufficient conditions, cycles in directed graphs; Planarity, coloring and cycles: Tait's theorem, Grinberg's theorem, snarks, Flows and cycle covers.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Use Rectangular Blocks whose entries are all equal, write down an adjacency matrix for $K_{m,n.}$
2. Prove that a bipartite graph has a unique bipartition(exchange for interchanging the two partite sets) if and only if it is connected.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Dougles B. West, Introduction to Graph Theory, 2nd Edition, Pearson Education, 2011.
2. Shimon Even, Graph Algorithms, 2nd Edition, Cambridge University Press, 2011.

REFERENCE BOOKS:

1. NarsinghDeo, "Graph Theory with Application to Engineering and Computer Science", Prentice-Hall of India Pvt.Ltd, 2003.
2. John Clark, Derek Allan Holton, "A First Look at Graph Theory", World Scientific Publishing Company, 1991.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/111106102
2. https://www.udemy.com/course/graph-theory/

WEB RESOURCES:

1. https://www.geeksforgeeks.org/engineering-mathematics-tutorials/#graph
2. https://www.javatpoint.com/graph-theory

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101009	**INFORMATION THEORY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is emphasize on the Coding for Reliable Digital Transmission and storage. This course also focuses on understandingLinear Block Codes, Cyclic Codes, Convolutional Codes and BCH Codes. By end of the course, students will acquire the basic knowledge and skills necessary to implement communication systems with error control capabilities.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Apply source codes and channel codes to improve the efficiency of information.

CO2. Analyze the coded word for error detection and correction due to channel noise

CO3. Design encoders and decoders for block and cyclic codes.

CO4. Identify the errors using error control coding like block code, convolution codes

CO5. Design communication systems with error control capabilities.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO3	3	3	3	-	-	1	-	-	-	-	-	-	3	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO5	3	3	3	-	-	1	-	-	-	-	-	-	3	-	-	2
Course Correlation Mapping	3	3	3	-	-	1	-	-	-	-	-	-	3	-	-	2

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT

Module 1 CODING FOR RELIABLE DIGITAL TRANSMISSION AND STORAGE ***(09Periods)***

Mathematical model of Information, A Logarithmic Measure of Information, Average and Mutual Information and Entropy, Types of Errors, Error Control Strategies.

Module 2 LINEAR BLOCK CODES ***(09Periods)***

Introduction to Linear Block Codes, Syndrome and Error Detection, Minimum Distance of a Block code, Error-Detecting and Error-correcting Capabilities of a Block code, Standard array and Syndrome Decoding, Probability of an undetected error for Linear Codes over a BSC, Hamming Codes. Applications of Block codes for Error control in data storage system.

Module 3 CYCLIC CODES ***(09 Periods)***

Description, Generator and Parity-check Matrices, Encoding, Syndrome Computation and Error Detection, Decoding, Cyclic Hamming Codes, shortened cyclic codes, Error-trapping decoding for cyclic codes, Majority logic decoding for cyclic codes.

Module 4 CONVOLUTIONAL CODES ***(09 Periods)***

Encoding of Convolutional Codes- Structural and Distance Properties, state, tree, trellis diagrams, maximum likelihood decoding, Sequential decoding, Majority- logic decoding of Convolution codes. Application of Viterbi Decoding and Sequential Decoding, Applications of Convolutional codes in ARQ system.

Module 5 BCH CODES ***(09 Periods)***

Minimum distance and BCH bounds, Decoding procedure for BCH codes, Syndrome computation and iterative algorithms, Error locations polynomials for single and double error correction.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Let C be a linear code with both even & odd weight vectors. Show that the number of even-weight code vectors is equal to the number of odd-weight code vectors.
2. Show that Hamming codes achieve the hamming bound

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Shu Lin, Daniel J.Costello,Jr.,Error Control Coding: Fundamentals and Applications, Prentice Hall, Inc 2004.
2. S Gravano, Introduction to Error Control Codes, Oxford University Press, 2007

REFERENCE BOOKS:

1. Todd K.Moon., Error Correction Coding: Mathematical Methods and Algorithms, Wiley India 2006.
2. Ranjan Bose, Information Theory, Coding and Cryptography, 2nd Edition, Tata

MC Graw- Hill, 2009, TMH.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/117101053
2. https://nptel.ac.in/courses/117104129

WEB RESOURCES:

1. https://www.tutorialspoint.com/principles_of_communication/principles_of_communication_information_theory.htm
2. https://www.udemy.com/course/information-theory/

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI102014	**NATURE-INSPIRED ALGORITHMS**	3	-	-	-	3

Pre-Requisite Differential Equations and Multivariable Calculus, Optimization Techniques

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Optimization, Classical optimization techniques, Nature inspired algorithms, Genetic algorithm, Particle swarm optimization, Ant colony optimization, Bee colony optimization, Cuckoo search algorithm, Firefly algorithm, Batalgorithm, Gray wolf optimization, Elephant herding optimization, Applications of nature inspired algorithms.

COURSE OUTCOMES: *After successful completion of this course, the students will be able to:*

CO1. Demonstrate knowledge on optimization and classical optimization techniques to find optimal solutions for a given problem.

CO2. Analyze the key components and mathematical aspects of nature inspired algorithms.

CO3. Design efficient solutions for optimization problems using nature inspired algorithms.

CO4. Investigate the applications of nature inspired algorithms to solve wide range of optimization problems.

CO-PO-PSO Mapping Table*:*

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	2	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium;1: Low

COURSE CONTENT:

Module 1 INTRODUCTION TO OPTIMIZATION (09periods)

Introduction to Optimization: Fundamentals of optimization, Types of optimization problems, Examples of optimization, Formulation of optimization problems, Classification of optimization algorithms, Traveling salesman problem, Knapsack problem.

Classical Optimization Techniques: Mathematical model of optimization, Linear programming – Simplex method, Revised simplex method, Kamarkar's method, Dualitytheorem, Decomposition principle, Transportation problem; Nonlinear Programming –Quadratic programming, Geometric programming; Dynamic programming, Integer programming, Stochastic programming, Lagrange multiplier method.

Module 2: NATURE INSPIRED ALGORITHMS AND GENETIC ALGORITHM (08 periods)

Nature Inspired Algorithms: Traditional vs nature inspired algorithms, Bio-inspired algorithms, Swarm intelligence, Metaheuristics, Diversification and intensification, No free lunch theorem, Parameter tuning and control, Algorithm.

GeneticAlgorithm: Basics, Genetic operators, Example of GA, Algorithm, Schematheory, Prisoner's dilemma problem, Variants and hybrids of GA.

Module 3: PARTICLE SWARM, ANT COLONY, BEE COLONY AND CUCKOO SEARCH OPTIMIZATION ALGORITHMS (10periods)

Particle Swarm Optimization: Swarm behavior, Algorithm, Variants of algorithm.

Ant Colony Optimization: Ant colony characteristics, Ant colony optimization–Travelling salesman problem, algorithm; Variants of algorithm.

BeeColony Optimization: Honeybee characteristics, Algorithm, Variants of algorithm.

Cuckoo Search Algorithm: Cuckoo bird behavior, Levy flights, Algorithm, Variants of algorithm.

Module 4: FIREFLY, BAT, GRAY WOLF AND ELEPHANT HERDING OPTIMIZATION ALGORITHMS (09periods)

Firefly Algorithm: Firefly behavior and characteristics, Algorithm, Variants and applications.

Bat Algorithm: Behavior of bats in nature, Algorithm, Variants and applications.

Gray Wolf Optimization: Gray wolf characteristics, Gray wolf optimization, Variants and applications.

Elephant Herding Optimization: Elephant herding behavior, Algorithm, Pseudocode, Variants of the algorithm.

Module 5APPLICATIONSOFNATUREINSPIREDALGORITHMS (09periods)

Image processing, Classification, clustering and feature selection, Traveling salesmanproblem, Vehicle routing, Scheduling, Software testing, Deep belief networks, Swarmrobots, Data mining and deep learning – Clustering, Support vector machines, Artificialneuralnetworks,Optimizers for machinelearning,Deeplearning.

Total Periods:45

EXPERIENTIAL LEARNING

1. Usage of Cuckoo Search Algorithm for Data Clustering
2. How to Solve vehicle routing problem with nature-inspired algorithms

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

TEXTBOOKS:

1. A.Vasuki,Nature-InspiredOptimizationAlgorithms,CRCPress,2020.
2. Xin-SheYang,Nature-InspiredOptimizationAlgorithms, Elsevier,2nd Edition,2020.

REFERENCEBOOKS:

1. Xin-SheYang,Xing-ShiHe,MathematicalFoundationsofNature-InspiredAlgorithms,Springer,2019.
2. GeorgeLindfield,JohnPenny,IntroductiontoNature-InspiredOptimization,Elsevier,2017.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/112103301
2. https://www.coursera.org/learn/operations-research-algorithms
3. https://www.udemy.com/course/bio-inspired-artificial-intelligence-algorithms-for-optimization/

WEB RESOURCES:

1. https://www.hindawi.com/journals/jam/2015/359203/
2. https://www.baeldung.com/cs/nature-inspired-algorithms
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7300069/

SPECIALIZATION ELECTIVE

CourseCode	CourseTitle	L	T	P	S	C
22AI101011	FEATURE ENGINEERING FOR MACHINE LEARNING	3	-	-	-	3

Pre-Requisite Machine Learning

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides discussion and hands-on experience on machine learning pipeline, Feature Scaling, Selection, Textparsing, Vectorization, Classification, Hashing, Dimensionality Reduction, non-linear Featurization, Feature Extraction, End-to-End learning with Deep Neural architectures.

COURSEOUTCOMES: Aftersuccessfulcompletionofthecourse,studentswillbeableto:

CO1. Performpre-processing of datasetstobuildefficientmachinelearningmodels.

CO2. Transformtextandimagedataintoamoresuitableformforfurtherprocessingandbuildingmachinelearning model.

CO3. Analyzethegivenproblemanddesignsuitable featureengineeringstrategy.

CO4. Reducethedimensionalityofthedataandselectoptimalsubsetofthefeatureset.

CO5. Implementautomatedfeatureextractionusingdeeplearningarchitectures.

CO6. Workindependentlytosolveproblemswith effectivecommunication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	-	3	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	3	-	2	-	-	-	-	-	-	-	-	-	3	-
CO3	2	2	3	-	2	-	-	-	-	-	-	-	-	-	3	-
CO4	3	2	3	-	2	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	2	-	2	-	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**3**	**-**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSECONTENT

Module1 INTRODUCTION ***(09Periods)***

Machine Learning Pipeline, Scalars, Vectors, and Spaces, Log transformation, FeatureScalingorNormalization,FeatureSelection,TextData-Bag-of-X:TurningNaturalTextintoFlatVectors,FilteringforCleanerFeatures,ParsingandTokenization, CollocationExtractionfor Phrase Detection.

Module2 FEATURESCALING ***(09Periods)***

TermFrequency&InverseDocumentfrequency,ScalingBag-of-WordswithTf-IdfTransformation, Classification with Logistic Regression, Tuning Logistic Regression withRegularization,EncodingCategoricalVariables,FeatureHashing,Bin-Counting.

Module3 DIMENSIONALITYREDUCTION ***(09Periods)***

Intuition,Derivation,LinearProjection,VarianceandEmpiricalVariance,PrincipalComponents: First Formulation, Principal Components: Matrix-Vector Formulation, GeneralSolutionofthePrincipalComponents,TransformingFeatures,WhiteningandZCA,Considerations and LimitationsofPCA.

Module4 NONLINEARFEATURIZATION ***(09Periods)***

K-MeansClustering,ClusteringasSurfaceTiling,k-Means,FeaturizationforClassification, AlternativeDense Featurization.

Module5 IMAGEFEATUREEXTRACTIONANDDEEPLEARNING ***(09Periods)***

FeatureExtraction-SIFT and HOG, Image Gradients, Gradient Orientation Histograms, SIFT Architecture; Learning Image Features with Deep Neural Networks-FullyConnectedLayers,ConvolutionalLayers.

TotalPeriods:45

EXPERIENTIAL LEARNING

1. Visualizethedistributionofreviewcountsofyelpbusinessreviewsbeforeandafterlogtransform,and Box-Coxtransformed counts.

   Dataset:https://www.kaggle.com/datasets/omkarsabnis/yelp-reviews-dataset

2. Visualize the distribution of data with different feature scaling methods on online newspopularitydataset forarticlewordcount.

   Dataset:https://www.kaggle.com/datasets/deepakshende/onlinenewspopularity

RESOURCES

TEXTBOOKS:

1. AliceZheng,AmandaCasari,*FeatureEngineeringforMachineLearning*,O'ReillyMedia,Inc.(ISBN : 9781491953242),2018.

REFERENCEBOOKS:

1. KjellJohnsonandMaxKuhn,*FeatureEngineeringandSelection:APracticalApproachfor Predictive Models,*CRCPress,2020.

SOFTWARE/TOOLS:

1. Environment:GoogleCoLab
2. ProgrammingLanguage:Python3.8,OpenCV
3. MachineLearningLibrary: Pandas,numpy,scikit-learn

VIDEOLECTURES:

1. https://www.datacamp.com/courses/feature-engineering-for-machine-learning-in-python
2. https://www.coursera.org/learn/feature-engineering
3. https://www.udemy.com/course/feature-engineering-for-machine-learning/
4. https://www.datacamp.com/courses/feature-engineering-with-pyspark?irclickid=xHmUT903Ez6CRdrTwkRSeVn8UkDzXNV5dSZS0w0&irgwc=1&utm_medium=affiliate&utm_source=impact&utm_campaign=2355712
5. https://www.coursera.org/learn/feature-engineering-matlab?irclickid=WCW2O%3AQXWxyIUq2WaWTSN2NBUkDzXNVRdSZS0w0&irgwc=1&utm_medium=partners&utm_source=impact&utm_campaign=3310965&utm_content=b2c

WEBRESOURCES:

1. https://neptune.ai/blog/feature-engineering-tools
2. https://www.analyticsvidhya.com/blog/2021/03/step-by-step-process-of-feature-engineering-for-machine-learning-algorithms-in-data-science/
3. https://www.udemy.com/course/feature-engineering-for-machine-learning/
4. https://developers.google.com/machine-learning/data-prep
5. https://www.analyticsvidhya.com/blog/2021/05/feature-scaling-techniques-in-python-a-complete-guide/
6. https://medium.com/@dennisndungu68/text-classification-using-k-means-33bea24e4a94

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI102016	**REINFORCEMENT LEARNING**	3	-	-	-	3

Pre-Requisite Machine Learning

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides an introduction to Reinforcement Learning, Multi-Arm Bandits, Markov decision process, Dynamic programming, Monte Carlo methods, Temporal difference learning, Models and Planning, Monte Carlo tree search.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the basic concepts of Reinforcement learning and Multi-arm Bandits.

CO2. Formalize problems as Markov Decision Process and solve using dynamic programming.

CO3. Analyze Monte-Carlo method, Temporal difference learning for prediction and control.

CO4. Utilize planning and control to perform Trajectory sampling and Heuristic search.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	1	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	2	-	-	1	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	**3**	**3**	**2**	-	-	**1**	**-**	**-**	-	-	**-**	**-**	**-**	**-**	**3**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO REINFORCEMENT LEARNING AND MULTI-ARM BANDITS *(09 Periods)*

Reinforcement Learning: Introduction, Elements of Reinforcement Learning, Limitations and Scope, Tic-Tac-Toe, History of Reinforcement Learning

Multi-Arm Bandits : An n-Armed Bandit Problem, Action-Value Methods, Incremental Implementation, Tracking a Nonstationary Problem, Optimistic Initial Values, Upper Confidence Bound Action Selection, Gradient Bandits, Associative Search (Contextual Bandits).

Module 2 FINITE MARKOV DECISION PROCESS *(09 Periods)*

The Agent– Environment Interface, Goals and Rewards, Returns and Episodes, Unified Notation for Episodic and Continuing Tasks, The Markov Property, Markov Decision Processes, Value Functions, Optimal Value Functions, Optimality, and Approximation.

Module 3 DYNAMIC PROGRAMMING *(09 Periods)*

Policy Evaluation, Policy Improvement, Policy Iteration, Value Iteration, Asynchronous Dynamic Programming Generalized Policy Iteration, Efficiency of Dynamic Programming.

Module 4 MONTE CARLO METHODS AND TEMPORAL-DIFFERENCE LEARNING *(09 Periods)*

Monte Carlo Methods: Monte Carlo Prediction - Monte Carlo Estimation of Action Values, Monte Carlo Control, Monte Carlo Control without Exploring Starts, Off-policy Prediction via Importance Sampling, Incremental Implementation, Off-Policy Monte Carlo Control, Importance Sampling on Truncated Returns

Temporal-Difference Learning: TD Prediction - Advantages of TD Prediction Methods, Optimality on TD(0), Sarsa: On-Policy TD Control, Q-Learning: Off-PolicyTD Control.

Module 5 PLANNING AND LEARNING *(09 Periods)*

Models and Planning, Integrating Planning, Acting, and Learning, Model Incorrectness, Prioritized Sweeping, Full vs. Sample Backups, Trajectory Sampling, Heuristic Search, Monte Carlo Tree Search.

Total Periods: 45

EXPERIENTIAL LEARNING

1. In class we saw that it is possible to learn via a sequence of stationary policies, i.e., during an episode, the policy does not change, but we move to a different stationary policy before the next episode begins. Does the temporal difference method encountered when discussing the tic-tac-toe example follow this pattern of learning?
2. Suppose, instead of playing against a random opponent, the reinforcement learning algorithm described above played against itself, with both sides learning. What do you think would happen in this case? Would it learn a different policy for selecting moves?

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Richard S. Sutton and Andrew G. Barto, Reinforcement Learning an Introduction, The MITPress Cambridge, Massachusetts London, England, 2nd edition 2018.

REFERENCE BOOKS:

1. Phil Winder,Reinforcement Learning Industrial Applications of Intelligent Agents, O'Reilly Media, Inc., First Edition , 2020.
2. Aske Plat , Learning to Play: Reinforcement Learning and Games, Springer,2020.
3. A, Taweh Beysolow , Applied Reinforcement Learning with Python: With OpenAI Gym, Tensorflow, and Keras , 2019.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106/106/106106143/
2. https://onlinecourses.nptel.ac.in/noc19_cs55/preview
3. https://www.coursera.org/specializations/reinforcementlearning?utm_source=bg&utm_med ium=sem&utm
4. https://www.youtube.com/watch?v=LzaWrmKL1Z4

WEB RESOURCES:

1. https://web.stanford.edu/class/cs234/
2. https://tianlinliu.com/files/notes_exercise_RL.pdf
3. https://web.stanford.edu/class/cs234/CS234Win2022/index.html

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101013	**APPROXIMATION ALGORITHMS**	3	-	-	-	3

Pre-Requisite Design and Analysis of Algorithms

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is an introduction to the techniques and results of the field of approximation algorithms. This course is about approximation algorithms for NP-hard optimization problems and their limitations. the course should understand many o new optimization problems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on Combinatorial Algorithms.

CO2. Apply MultiwayCut, *k*-Cut and *k*-Center techniques to solve problems

CO3. Identify suitable algorithms for solving Shortest Superstring, Knapsack, Scheduling and Euclidean problems

CO4. Apply LP-Based and Shortest VectorAlgorithms for optimization of Problems

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	2	3	-	-	1	-	-	-	-	-	-	3	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO4	2	3	2	-	-	-	2	-	-	-	-	-	3	-	-	-
Course Correlation Mapping	1	3	3	-	-	1	2	-	-	-	-	-	3	-	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION AND COMBINATORIAL ALGORITHMS ***(09 Periods)***

Introduction: Lower bounding OPT,An approximation algorithm for cardinality vertex cover, Well-characterized problems and min–max relations.
Set Cover: The greedy algorithm, Layering, Application to shortest superstring, **Steiner Tree and TSP -** Metric Steiner tree, Metric TSP.

Module 2: MULTIWAYCUT, *K*-CUT AND *K*-CENTER ***(07 Periods)***

Multiway Cut- The multiway cut problem, The minimum *k*-cut problem, ***k*-Center -** Parametric pruning applied to metric *k*- center, The weighted version, **Feedback Vertex Set -** Cyclomatic weighted graphs, Layering applied to feedback vertex set.

Module 3 SHORTEST SUPERSTRING, KNAPSACK, SCHEDULING AND EUCLIDEAN ***(10 Periods)***

Shortest Superstring - A factor 4 algorithm, Improving to factor, Achieving half the optimal compression, Knapsack - A pseudo-polynomial time algorithm for knapsack, An FPTAS for knapsack, Strong NP-hardness and the existence of FPTAS's, Is an FPTAS the most desirable approximation algorithm?, Bin Packing - An asymptotic PTAS
Minimum Makespan Scheduling - Factor 2 algorithm, PTAS for minimum makespan, Bin packing with fixed number of object sizes, Reducing makespan to restricted bin packing, Euclidean TSP - The algorithm, Proof of correctness

Module 4 LP-BASED ALGORITHMS ***(10 Periods)***

The LP-duality theorem Min–max relations and LP-duality, Fundamental algorithm design techniques, A comparison of the techniques and the notion of integrality gap, Set Cover via Dual Fitting - Dual-fitting-based analysis for the greedy set cover algorithm, Generalizations of set cover.

Module 5 SHORTEST VECTOR ***(09 Periods)***

Bases, determinants, and orthogonality defect, The algorithms of Euclid and Gauss, Lower bounding OPT using Gram–Schmidt orthogonalization, Extension to n dimensions, The dual lattice and its algorithmic use

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prove that if the Gomory–Hu tree for an edge-weighted undirected graph G contains all $n - 1$ distinct weights, then G can have only one minimum weight cut.
2. Show that if the edge costs do not satisfy the triangle inequality, then the k-center problem cannot be approximated within factor $a(n)$ for any computable function $a(n)$.

(It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Vijay Vazirani, Approximation Algorithms, Springer-Verlag, 2001.

REFERENCE BOOKS:

1. Sanjeev Arora and Boaz Barak, Computational Complexity – A Modern Approach, Cambridge University Press, 2009.
2. Ryan O'Donnell, Analysis of Boolean Functions, Cambridge University Press, 2014.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=MEz1J9wY2iM
2. https://www.udemy.com/course/java-tutorial/

WEB RESOURCES:

1. http://cse.iitkgp.ac.in/~swagato/ApproxOnline.html
2. https://www.youtube.com/watch?v=YS0VKIM8zyY

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI102006	**DEEP LEARNING**	3	-	2	-	4

Pre-Requisite Machine Learning

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: : This course provides a detailed Machine learning with shallow neural networks, Training deep neural networks, Backpropagation, Gradient based strategies, Teaching deep learners, Recurrent neural networks, Applications of Recurrent neural networks, Convolutional Architectures-AlexNet; VGG,GoogleNet; ResNet.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Acquire working knowledge of neural networks and explore the different parameters of the network.

CO2. Construct a generative model for learning probability distribution using RBM.

CO3. Analyze temporal sequential input data using gated memory based neural units.

CO4. Utilize Convolutional Neural Network for analyzing visual imagery and utilize transfer learning approaches for reducing the training efforts.

CO5. Apply encoder-decoder architecture for image denoising, and learning representation of a set of data.

CO6. Work Independently to solve problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	1	-	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO4	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	1	-	2	-	-	3	3	-	-	-	-	3	-

Correlation Level: 3-High; 2-Medium; 1-Low

COURSE CONTENT

Module 1 MACHINE LEARNING WITH SHALLOW NEURAL NETWORKS ***(09 Periods)***

Neural Architectures for Binary Classification Models, Neural Architectures for Multiclass Models, Backpropagated Saliency for Feature Selection, Autoencoders- Basic Principles, Nonlinear Activations, Deep Autoencoders, Application to Outlier Detection.

Module 2 TRAINING DEEP NEURAL NETWORKS ***(09 Periods)***

Backpropagation: Backpropagation with the Computational Graph Abstraction, Dynamic Programming,Backpropagation with Post-Activation and Pre-Activation variables, Examples of Updates for Various Activations, Loss Functions on Multiple Output Nodes and Hidden Nodes, Backpropagation Tricks for Handling Shared Weights; Setup and Initialization Issues.
Gradient based Strategies: Learning Rate Decay, Momentum-Based Learning, Parameter-Specific Learning Rates, Cliffs and Higher-Order Instability, Gradient Clipping, Second-Order Derivatives, Polyak Averaging, Local and Spurious Minima.

Module 3 GENETIC ALGORITHMS ***(09 Periods)***

The Bias-Variance Trade-Off, Generalization Issues in Model Tuning and Evaluation, Penalty-Based Regularization, Ensemble Methods, Early Stopping, Unsupervised Pretraining, Regularization in Unsupervised Applications.

Module 4 RECURRENT NEURAL NETWORKS ***(09 Periods)***

Recurrent Neural Networks: Expressiveness of Recurrent Networks, The Architecture of Recurrent Neural Networks, The Challenges of Training Recurrent Networks. Long Short-Term Memory (LSTM), Gated Recurrent Units (GRUs).
Applications of Recurrent Neural Networks: Automatic Image Captioning, Sequence-to-Sequence Learning and Machine Translation, Sentence-Level Classification, Time-Series Forecasting and Prediction, End-to-End Speech Recognition.

Module 5 CONVOLUTIONAL NEURAL NETWORKS ***(09 Periods)***

The Basic Structure of a Convolutional Network, Training a Convolutional Network, Convolutional Architectures-AlexNet,VGG,GoogleNet,ResNet, Visualizing the Features of a Trained Network, Convolutional Autoencoders, Applications of Convolutional Neural Networks- Content-Based Image Retrieval, Object Detection, Natural Language and Sequence Learning.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Perform splitting of data for training, testing, and validation using k-fold cross validation.
2. Construct and implement multi-layer feed forward neural network for hand written digit classification problem.
3. Implement the image dimensionality reduction problem using aAutoEncoder architecture.
4. Perform hyper parameter tuning using Bayesian optimization technique for a Convolution Neural Network.

5. Analyze the effectiveness of various optimization algorithm with a image classification problem.
6. Solve the overfitting problem in a neural architecture using DropOut technique.
7. Solve a seq2seq problem (machine translation) using LSTM Recurrent Neural Architecture.
8. Solve a time series forecasting (stock prediction) using LSTM RNN.
9. Implement a binary and multi class image classification using Convolution Neural Network.
10. Study the efficiency of the transfer learning approach for a classification problem on the following architectures; VGG-16, Alexnet, and ResNet

RESOURCES

TEXT BOOKS:

1. Charu C Aggarwal, Neural Networks and Deep Learning, Springer,2018. Publishing.

REFERENCE BOOKS:

1. Ian Goodfellow, YoshuaBengio, Aaron Courville, Deep Learning, 2016
2. Deng&Yu,DeepLearning:MethodsandApplications,NowPublishers, 2013.
3. Saroj Kaushik, SunitaTewari, *Soft Computing: Fundamentals, Techniques and Applications*, McGraw Hill, 2018.

SOFTWARE/Tools used:

Environment	: Google CoLab
Programming Language	: Python 3.8
Machine Learning Library	: Tensor Flow 2.1 and Keras

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106184
2. https://www.coursera.org/specializations/deep-learning?utm_source=deeplearningai&utm_medium=institutions&utm_campaign=WebsiteC oursesDLSTopButton

ADDITIONAL LEARNING RESOURCES:

1. https://www.simplilearn.com/tutorials/deep-learning-tutorial/what-is-deep-learning
2. https://www.udemy.com/course/data-science-logistic-regression-in-python/
3. https://www.udemy.com/course/data-science-deep-learning-in-python/

SPECIALIZATION ELECTIVE

CourseCode	Course Title	L	T	P	S	C
22AI101010	GENERATIVE DEEP LEARNING	3	-	-	-	3

Pre-Requisite Deep Learning

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course emphasizes on the fundamental concepts of Generative AI technology. This course also focuses on how to use TensorFlow and Keras to create impressive generative deep learning models from scratch, including variational auto encoders (VAEs), generative adversarial networks (GANs), Transformers, normalizing flows, energy-based models, and denoising diffusion models.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the knowledge on generative models to solve computational problems.

CO2. Apply Variational auto-encoder and adversarial network models to solve problems effectively.

CO3. Analyze Auto regressive and Energy-based Models used for image processing.

CO4. Identify and Apply appropriate Diffusion based model store cover the data

CO-PO-PSO MappingTable:

Course Outcomes	ProgramOutcomes												ProgramSpecific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	3	3	3	-	-	1	-	-	-	-	-	-	-	-	3	-
CO3	3	3	-	-	-	1	1	-	-	-	2	-	-	-	3	-
CO4	2	3	3	-	-	1	-	-	-	-	-	-	-	-	3	-
Course Correlation Mapping	3	3	3	-	-	1	1	-	-	-	-	-	-	-	3	-

CorrelationLevels: 3:High; 2:Medium; 1:Low

COURSE CONTENT

Module1: INTRODUCTION TO GENERATIVE DEEP LEARNING ***(09 Periods)***

Introduction: Generative Modeling, First Generative Model, Core Probability Theory, Generative Model Taxonomy, The Generative Deep Learning Codebase.
DeepLearning: Data for Deep Learning, Deep Neural Networks, Multilayer Perceptron (MLP), Convolutional Neural Network (CNN).

Module2: VARIATIONAL AUTO ENCODERS ***(09 Periods)***

Introduction, Autoencoders, Variational Autoencoders, Exploring the Latent Space, **Generative Adversarial Networks:** Deep Convolutional GAN (DCGAN), Wasserstein GAN with Gradient Penalty (WGAN-GP), Conditional GAN (CGAN).

Module 3 AUTO REGRESSIVE MODELS ***(09 Periods)***

Introduction, Long Short-Term Memory Network (LSTM), Recurrent Neural Network (RNN) Extensions, Pixel CNN.
Normalizing Flow Models: C Normalizing Flows, Real NVP.

Module 4 ENERGY-BASED MODELS ***(09 Periods)***

Introduction, Energy-Based Models - The MNIST Dataset, The Energy Function, Sampling Using Langevin Dynamics, Training with Contrastive Divergence, Analysis of the Energy-Based Model, Other Energy-Based Models.

Module 5 DIFFUSION MODELS ***(09 Periods)***

Introduction, Denoising Diffusion Models (DDM), The Flowers Dataset, The Forward Diffusion Process, The Reparameterization Trick, Diffusion Schedules, The Reverse Diffusion Process, The U-Net Denoising Model, Training the Diffusion Model, Sampling from the Denoising Diffusion Model, Analysis of the Diffusion Model.

Total Periods:45

EXPERIENTIAL LEARNING

1. Illustrate on the Generative models used in Image reconstruction
2. Appropriately demonstrate how image denoising is undertaken using Auto encoder

(It's an indicative one.The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. David Foster, Generative Deep Learning, 2nd edition, O'Reilly Media, ISBN: 9781098134181, 2023.

REFERENCE BOOKS:

1. Jakub M. Tomczak, Deep Generative Modelling, 3rd edition, John Wiley & sons, 2008.
2. ViladimirBok, GANs in Action: Deep learning with generative Adversarial Networks, 1st edition, Kindle Edition.

VIDEO LECTURES:

1. https://www.coursera.org/learn/generative-deep-learning-with-tensorflow
2. https://www.youtube.com/watch?v=Q3HU2vEhD5Y

WEB RESOURCES:

1. http://stat.columbia.edu/~cunningham/teaching/GR8201/
2. https://www.mccormick.northwestern.edu/computer-science/academics/courses/descriptions/496-25.html

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101010	**MACHINE LEARNING FOR CYBER SECURITY**	3	-	-	-	3

Pre-Requisite Cyber Security Essentials and Machine Learning
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Machine Learning concepts, quick way to detect anomalies, malware analysis and network traffic analysis by extracting used information, Examining how attackers exploit consumer-facing websites and app functionality and building machine learning based models to create a production system.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Demonstrate knowledge on cyber security and machine learning Concepts.
CO2. Analyze Anomaly Detection methods for building secure system.
CO3. Select and apply to Perform malware and Network Traffic Analysis to build robust cyber system..
CO4. Apply Security mechanisms for protecting consumer web.
CO5. Apply Machine techniques for building secured validate production system

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	-	-	-	-	-	-	-	-	-	3	3	3	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	3	3	-
CO3	3	2	2	3	2	-	-	-	-	-	-	-	3	3	3	-
CO4	3	2	2	2	2	-	-	-	-	-	-	-	3	3	3	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-	3	3	3	-
Level of correlation of the course	**3**	**2**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**-**

Correlation Levels: ***3: High*** ***2: Medium*** ***1: Low***

COURSE CONTENT

Module 1: CONVERGENCE OF MACHINE LEARNING AND CYBER SECURITY ***(09 Periods)***

Cyber Threat Landscape, The Cyber Attacker's Economy, Overview of Machine Learning, Real-World Uses of Machine Learning in Security, Spam Fighting: An Iterative Approach.
Classifying and Clustering: Training Algorithms to Learn, Supervised Classification Algorithms: Logistic Regression, Decision Trees, Decision Forests, Support Vector Machines, Naive Bayes ,k-Nearest Neighbors ,Neural Networks

Module 2: ANOMALY DETECTION ***(07 Periods)***

Detection: Anomaly Detection Versus Supervised Learning, Intrusion Detection with Heuristics, Data-Driven Methods, Feature Engineering for Anomaly Detection, Anomaly Detection with Data and Algorithms, Challenges of Using Machine Learning in Anomaly Detection.

Module 3 MALWARE ANALYSIS AND NETWORK TRAFFIC ANALYSIS ***(11 Periods)***

Malware Analysis: Understanding Malware, Feature Generation, From Features to Classification, Live malware analysis, dead malware analysis, Android Malware Analysis.
Network Traffic Analysis: Theory of Network Defense, Machine Learning and Network Security, Building a Predictive Model to Classify Network Attacks

Module 4 PROTECTING THE CONSUMER WEB ***(09 Periods)***

Monetizing the Consumer Web, Types of Abuse and the Data That Can Stop Them, Supervised Learning for Abuse Problems, Clustering Abuse.

Module 5 PRODUCTION SYSTEMS ***(09 Periods)***

Defining Machine Learning System Maturity and Scalability, Data Quality, Model Quality, Performance, Maintainability, Monitoring and Alerting, Security and Reliability.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Anomaly detection using supervised learning algorithm like LOF(Local Outlier factor)
2. Study and implement intrusion detection system using SVM(Support Vector Machines)
3. Live malware analysis using unsupervised learning algorithm
4. Study and implement clustering abuse using K-Means Algorithm

RESOURCES

TEXT BOOKS:

1. Clarence Chio, David Freeman "Machine Learning and Security", O'Reilly Media, Inc.ISBN: 9781491979907
2. SumeetDua, Xian Du. "Data Mining and Machine Learning in Cyber security", CRC Press, ISBN:978-1439839423

REFERENCE BOOKS:

1. Emmanuel Tsukerman, Machine Learning for Cybersecurity Cookbook, Packt Publishers, 2019

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=cpCKhhV1wQU
2. https://www.youtube.com/watch?v=oBdB61A8Yt8

WEB RESOURCES:

1. Machine Learning for Cyber Security: Machine Learning and Security Protecting Systems with Data and Algorithms (Clarence Chio David Freeman) (z-lib.org)
2. https://cset.georgetown.edu/wp-content/uploads/Machine-Learning-and-Cybersecurity.pdf
3. https://www.geeksforgeeks.org/machine-learning-for-anomaly-detection/
4. https://www.malware-traffic-analysis.net/

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
		3	-	-	-	3
22AI101012	SOCIAL NETWORK ANALYSIS					

Pre-Requisite Data Mining
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course emphasizes on the basic concepts and Sources of Social Network Data. It covers the query representation models and Microblog search models for short text classification. By the end of this course students will acquire basic knowledge to implement topic discovery and recommendation techniques to promote the customers for maximizing the influence of a topic discovery.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Demonstrate knowledge on Social Network Data and Electronic sources for network analysis.
CO2. Apply information retrieval models to search and classify the text in Social Networks.
CO3. Build Social Recommendation Systems.
CO4. Perform Topic discovery from social network data through Machine Learning algorithms.
CO5. Apply Greedy and Heuristic algorithms to maximize the influence of content discovery in a Social Network.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-	-	-
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-	-
CO3	3	2	2	3	2	-	-	-	-	-	-	-	3	-	3	-
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	-	-
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	-	-	3
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SOCIAL NETWORK ANALYSIS ***(9 Periods)***

Introduction to Network Analysis, Development of Social Network Analysis, Key concepts in network analysis: global structure, macro-structure, Electronic sources for network analysis: Electronic discussion networks, Blogs and online communities, Web-based networks, Modelling and aggregating social network data: State-of-the-art in network data representation, Ontological representation of social individuals and relationships, Aggregating and reasoning with social network data.

Module 2: INFORMATION RETRIEVAL IN SOCIAL NETWORKS ***(9 Periods)***

Introduction, Content search in social network, **Classical information retrieval and relevant feedback models:** Vector space model, Probabilistic retrieval model, Statistical language modeling-based retrieval models and query likelihood models, **Query representation in microblog search**: Query expansion based on internal and external resources and time factor ,Document representation in microblog search, Microblog retrieval models. Content classification: Feature processing in short text classification, Short text classification algorithm.

Module 3: SOCIAL NETWORK RECOMMENDATION TECHNIQUES *(9Periods)*

Memory-based social recommendation, Model-based social recommendation, The rules of information diffusion in social networks, Influencing factors related to information diffusion in social networks, Diffusion model based on network structure: Linear threshold model, Independent cascades model, Diffusion model based on the states of groups Diffusion model based on information characteristics, Prediction models based on historical popularity, network structure and user behaviors and Time series.

Module 4 TOPIC DISCOVERY AND EVOLUTION *(9 Periods)*

Models and algorithms of topic discovery, Topic based Model: LDA model, latent dirichlet allocation model, Gibbs sampling, Vector space model-based topic discovery, Term relationship graph-based topic discovery.

Module 5 ALGORITHMS OF INFLUENCE MAXIMIZATION *(9Periods)*

Basic concepts and theory basis, Metrics of influence maximization, Classification of influence maximization algorithms, Greedy algorithm of influence maximization: Basic concepts, CELF algorithm, Mix Greedy algorithm, Heuristic algorithms of influence maximization.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Design a self-configured frame work for scalable prediction in twitter data
2. Granular Multi-label encrypted traffic classification using classifier chain.
3. Analyze website performance using Google Analytics.

RESOURCES

TEXT BOOKS:

1. MoutusyMaity and Pavankumar Gurazada,*Marketing Analytics For Strategic Decision Making,*Oxford University Press,1st Edition,2021
2. Rob Strokes, ”eMarketing The essential guide to marketing in a digital world”,Quirk eMarketing (Pty) Ltd,2013

REFERENCE BOOKS:

1. Puneet Singh Bhatia,Fundamentals of Digital Marketing,Pearson Education,2017.
2. Mike Grigsby, *Marketing Analytics,*Kogan Page, 2nd Edition, 2018

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc22_cs117
2. https/nptel/courses/video/106106169/

Web Resources:

1. https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SITA3005.pdf
2. https://study.com/learn/lesson/social-network-analysis-purpose-examples.html

Course Code	Course Title	L	T	P	S	C
22DS101016	**IMAGE AND VIDEO ANALYTICS**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION:
This course provides a detailed discussion on the basic principles and concepts in digital image and video processing. To explore and demonstrate real time image and video analytics in solving practical problems of commercial and scientific interests.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the Image Segmentation, Compression and Colour Image Processing concepts
CO2 Demonstrate knowledge on digital image processing techniques in developing societal applications
CO3 Apply feature extraction and texture analysis techniques in object recognition and image retrieval.
CO4 Understand the fundamentals of digital video processing.
CO5 Apply video segmentation and tracking techniques for motion detection and tracing applications.
CO6 Apply video analytics techniques for action detection in real-time applications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	-	-	-	-	-	-	-	-	-	3	3	3	
CO2	2	3	2	2		-	-	-	-	-	-	-	3	3	3	
CO3	2	3	2	2	2	-	-	-	-	-	-	-	3	3	3	
CO4	2	3	2	2		-	-	-	-	-	-	-	3	3	3	
CO5	2	3	2	2		-	-	-	-	-	-	-	3	3	3	3
CO6	2	3	2	2	2	-	-	-	-	-	-	-	3	3	3	3
Level of correlation of the course	**2**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**

Level of Correlation: 3 - High 2 - Medium 1 - Low

COURSE CONTENT

Module 1: INTRODUCTION (09 Periods)
Basic steps of Image processing system – Pixel relationship- Image Transforms-. Image Enhancement- Histogram Processing, Spatial filtering, Frequency Domain filtering
Image Segmentation, Compression and Colour Image Processing
Image Segmentation –Detection of Discontinuities. - Edge Linking and Boundary Detection. - Thresholding. - Region-Based Segmentation. Image Compression – Encoder-Decoder model, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, JPEG, JPEG 2000. Colour Image Processing – Colour Models, Color Transformations Color Image Smoothing and Sharpening, Color Noise Reduction, Color-Based Image Segmentation.

(09 Periods)
Module 2: FEATURE EXTRACTION AND TEXTURE ANALYSIS
Feature Extraction - Binary object feature, Histogram-based (Statistical) Features, Intensity features, Shape feature extraction, PCA - SIFT – SURF. Texture Analysis - Concepts and classification, statistical, structural and spectral analysis.
Object recognition and Image Retrieval
Object Recognition -Patterns and pattern class, Bayes' Parametric classification, Feature Selection and Boosting, Template- Matching. Content Based Image Retrieval - Feature

based image retrieval, Object Based Retrieval

(08 Periods)

Module 3 DIGITAL VIDEO PROCESSING

Digital Video, Sampling of video signal, Video Enhancement and Noise Reduction- Rate control and buffering, MPEG, H.264, Inter frame Filtering Techniques, Fundamentals of Motion Estimation and Motion Compensation

(11 Periods)

Module 4 VIDEO SEGMENTATION AND TRACKING

Change Detection, Background modelling, Motion Segmentation, Simultaneous Motion Estimation and Segmentation, Motion Tracking, Multi-target/Multi-camera tracking

(08 Periods)

Module 5 VIDEO ANALYSIS ACTION RECOGNITION

Video Analysis Action Recognition, Video based rendering, Context and scene understanding. Case Study: Surveillance - Advanced Driver Assistance System

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Understand and know how to apply state-of-the-art machine learning techniques (convolution neural networks) to solving problems in image and video analysis
2. Understand and describe the fundamental principles of image and video analysis and have an idea of their application.
3. Image and video segmentation and texture models
4. Fundamentals of digital image processing, image and video analysis, computer vision including camera calibration, feature matching and object detection and recognition
5. Image and video analysis, processing, machine learning for image analysis.

RESOURCES

TEXT BOOK:

1. Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Ed., Prentice-Hall, 2008

2. A Murat Tekalp, "Digital Video Processing", Second Edition, Prentice Hall, 2015.

REFERENCE BOOKS:

1. Oge Marques, "Practical Image and Video Processing Using MATLAB", Wiley-IEEE Press,2011
2. Yu Jin Zhang, "Image Engineering: Processing, Analysis and Understanding", Tsinghua University Press, 2009.
3. Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012
4. Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010
5. Boguslaw Cyganek,"Object Detection and Recognition in Digital Images: Theory and Practice", Wiley, 2013

WEB REFERENCES:

1. http://homepages.inf.ed.ac.uk/rbf/CVonline/Imagedbase.htm
2. https://www.cs.cmu.edu/~cil/v-images.html
3. http://www.imageprocessingplace.com/root_files_V3/image_databases.htm

VIDEO LECTURES:

1. https://gengo.ai/datasets/20-best-image-datasets-for-computer-vision
2. https://nptel.ac.in/courses

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS104001	**DATA ANALYTICS**	3	-	2	4	5

Pre-Requisite Data Mining

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The course provides Introduction to Data Analytics and its Life Cycle, Review of Basic Data Analytic Methods Using R, Advanced Analytical Theory and Methods, Advanced Analytics-Technology and Tools: In-Database Analytics and Communicating and Operationalizing an Analytics Project.

COURSE OUTCOMES: *After successful completion of the course, students will be able to*:

CO1. Use Analytical Architecture and its life cycle in Data Analytics

CO2. Analyze and Visualize the Data Analytics Methods using R.

CO3. Apply Advanced Analytical Methods for Text Analysis and Time –Series Analysis.

CO4. Develop Analytical Report for given Analytical problems.

CO5. Analyze and Design Data Analytics Application on Societal Issues.

CO6. Work independently or in team to solve data analytics related problems with effective communication

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	3	-	2	-	-	-	-	-	-	-	3	3	3	-
CO2	2	3	-	-	2	2	-	-	-	-	-	-	3	3	3	-
CO3	1	2	3	-	2	-	-	-	-	-	-	-	3	3	3	-
CO4	2	3	3	2	2	-	-	-	-	-	-	-	3	3	3	-
CO5	2	2	3	2	2	3	-	-	-	-	-	-	3	3	3	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**2**	**3**	**3**	**2**	**3**	**2**	-	-	**3**	**3**	-	-	**3**	**3**	**3**	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION TO DATA ANALYTICS and R ***(09 Periods)***

Practice in Analytics: BI versus Data Science, Current Analytical Architecture, Emerging Big Data Ecosystem and a New Approach to Analytics. **Data Analytics Life Cycle**: Key Roles for a Successful Analytics Project Background and Overview of Data Analytics Lifecycle Phases - Discovery Phase, Data Preparation Phase, Model Planning, Model Building, Communicate Results, Operationalize. **Introduction to R:**R Graphical User Interfaces, Data Import and Export, Attribute and Data Types, Descriptive Statistics.

Module 2: BASIC DATA ANALYTICAL METHODS ***(09 Periods)***

Exploratory Data Analysis: Visualization Before Analysis, Dirty Data, Visualizing a Single Variable, Examining Multiple Variables, Data Exploration Versus Presentation. **Statistical Methods for Evaluation**: Hypothesis Testing, Difference of Means, Wilcoxon Rank-Sum Test, Type I and Type II Errors, Power and Sample Size, ANOVA, Decision Trees in R, Naïve Bayes in R.

Module 3: ADVANCED ANALYTICAL TECHNOLOGY AND METHODS ***(09 Periods)***

Time Series Analysis: Overview of Time Series Analysis, Box-Jenkins Methodology, ARIMA Model, Autocorrelation Function (ACF),Autoregressive Models, Moving Average Models , ARMA and ARIMA Models ,Building and Evaluating an ARIMA Model, Reasons to Choose and Cautions.

Text Analysis: Text Analysis Steps, A Text Analysis Example, Collecting Raw Text, Representing Text, Term Frequency—Inverse Document Frequency (TFIDF), Categorizing Documents by Topics, Determining Sentiments, Gaining Insights.

Module 4: ANALYTICAL DATA REPORT AND VISULAIZATION ***(09 Periods)***

Communicating and Operationalizing an Analytics Project, Creating the Final Deliverables: Developing Core Material for Multiple Audiences, Project Goals, Main Findings, Approach, Model Description, Key Points Supported with Data, Model Details Recommendations, Additional Tips on Final Presentation, Providing Technical Specifications and Code, Data Visualization.

Module 5: DATA ANALYTICS APPLICATIONS ***(09 Periods)***

Text and Web: Data Acquisition, Feature Extraction, Tokenization, Stemming, Conversion to Structured Data, Sentiment Analysis, Web Mining.

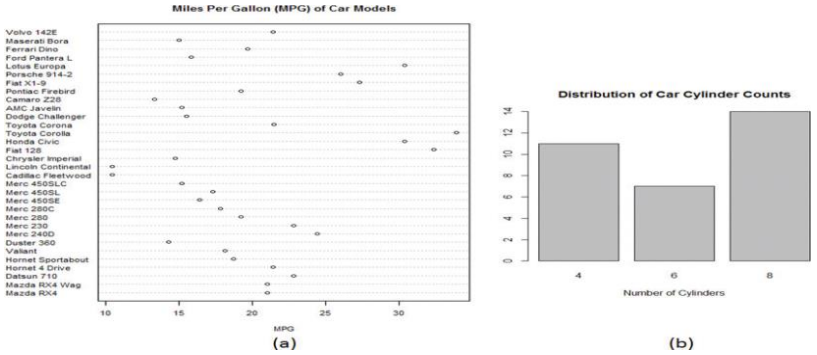
Recommender Systems: Feedback, Recommendation Tasks, Recommendation Techniques, Final Remarks.

Social Network Analysis: Representing Social Networks, Basic Properties of Nodes, Basic and Structural Properties of Networks.

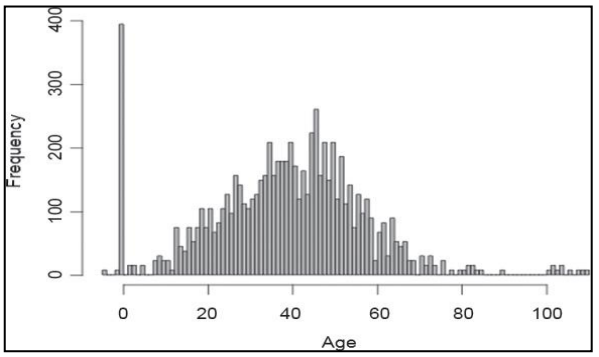
Total Periods: 45

EXPERIENTIAL LEARNING

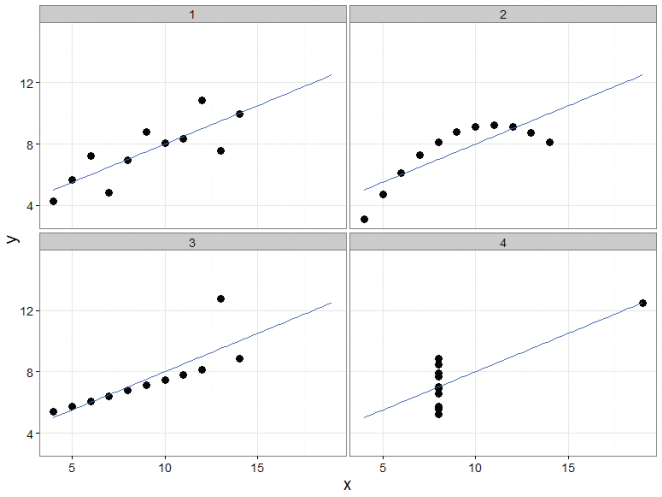
1. Introduction to R Studio, Basic operations and import and export of data using R Tool.
2. Implement Data Exploration and Visualization on different Datasets to explore multiple and Individual Variables.
3. Draw the scatter plots using ggplot2 package for Anscombe's quartet four datasets.



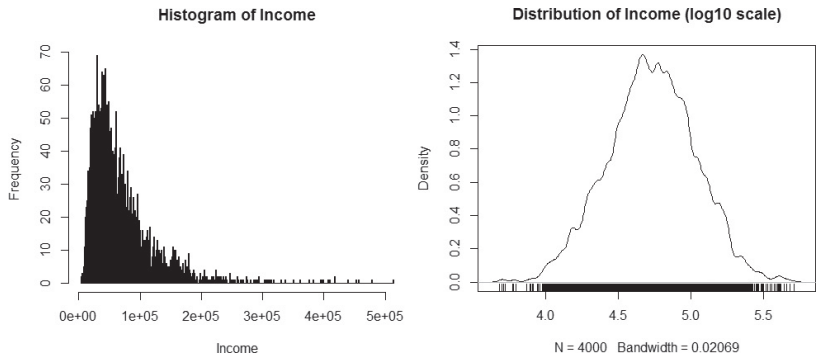
4. Build a Decision Tree using party and rpart packages.
5. Consider a scenario in which a bank is conducting data analyses of its account holders to gauge customer retention. Draw the histogram for age distribution of the account holders.



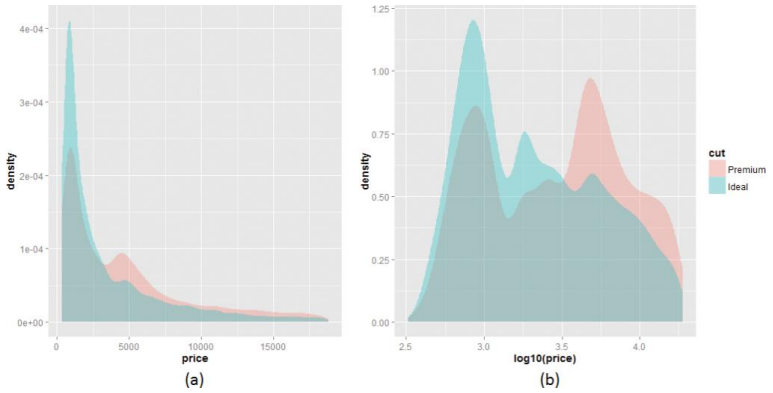
6. Build a predictive model using Random Forest Package.
7. Implement Linear and logistic Regression on Datasets to predict the probability.
8. Draw a dotchart and a barplot based on the mtcars dataset, which includes the fuel consumption and 10 aspects of automobile design and performance of 32 automobiles.



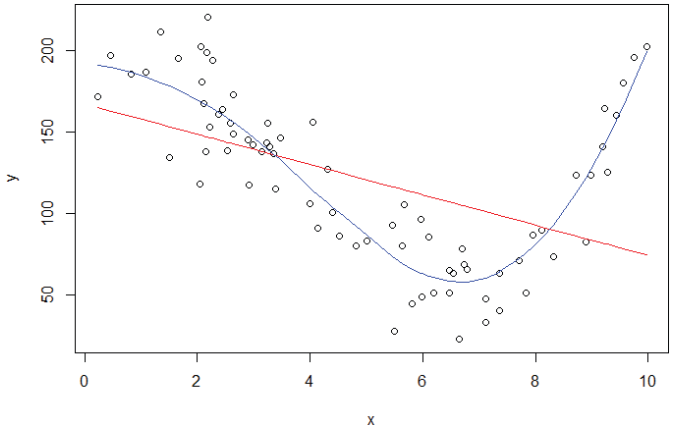
9. Draw a histogram of household income. The histogram shows a clear concentration of low household incomes on the left and the long tail of the higher incomes on the right and also draws a density plot of the logarithm of household income values, which emphasizes the distribution. The income distribution is concentrated in the center portion of the graph.



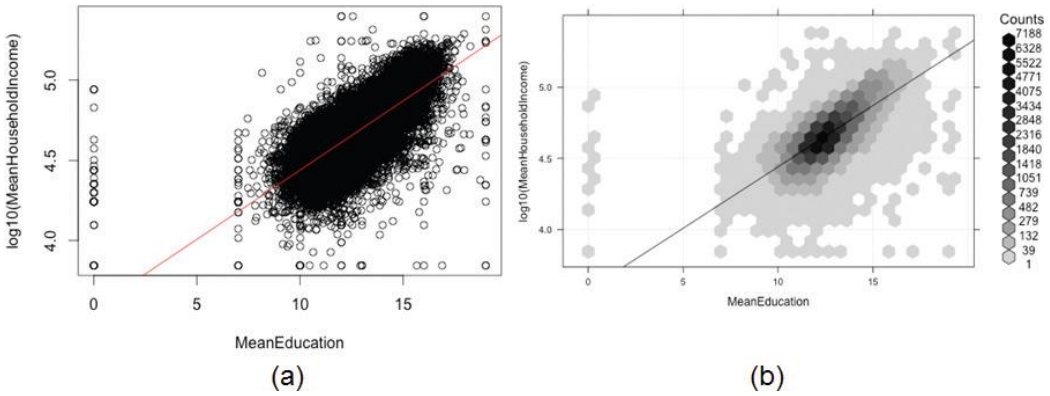
10. Consider a density plot of diamond prices (in USD). It contains two density plots for premium and ideal cuts of diamonds. Draw density plot of diamond prices and also density plot of the log10 of diamond prices.



11. Draw the following scatterplot by considering a vector of vector of uniform distribution, use the runif() function.



12. Consider a case to compare the logarithm of household income against the years of education, as shown in Figure (a). The cluster in the scatterplot on the left (a) suggests a somewhat linear relationship of the two variables. In Figure (b), the same data is plotted using a hexbinplot. Draw the same.



13. Implement Apriori Algorithm in Association Rule Mining.
14. Implement Text Mining on Twitter data using twitteR package.
15. Implement K-Means, K-Medoids, Hierarchical and Density-based Clustering techniques.
16. Implement Time Series Analysis using Classification and clustering Techniques.

TEXT BOOKS:

1. EMC Education Services, *Data Science and Big Data Analytics – Discovering, Analyzing, Visualizing and Presenting Data*, John Wiley and Sons, 2015.
2. Joao Moreira, Andre Carvalho, Andre Carlos Ponce de Leon Ferreira Carvalho, Tomas Horvath, *A General Introduction to Data Analytics*, John Wiley and Sons, 1st Edition, 2019.

REFERENCE BOOKS:

1. Anil Maheshwari, *Data Analytics Made Accessible*, Lake Union Publishing, 1st Edition, 2017.
2. Richard Dorsey, Data Analytics: Become a Master in Data Analytics, Create Space Independent Publishing Platform, 2017.
3. Yanchang Zhao*, R and Data Mining: Examples and Case Studies*, Eleiver, 1st Edition, 2015, (PDF URL: http://www.RDataMining.com).

SOFTWARE/TOOLS:

- R and Python 3.8

VIDEO LECTURES:

https://nptel.ac.in/courses/106107220

Web Resources:

1. https://www.simplilearn.com/tutorials/data-analytics-tutorial
2. https://www.tutorialspoint.com/excel_data_analysis/data_analysis_overview.htm
3. https://intellipaat.com/blog/tutorial/data-analytics-tutorial/
4. https://www.educba.com/data-science/data-science-tutorials/data-analytics-basics/

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101001	**TEXT ANALYTICS**	3	-	-	-	3

Pre-Requisite Machine Learning

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This Course provides a detailed discussion on Text tokenization, Text normalization, Text syntax and structure, Text classification, Feature extraction, Classification algorithms, Text summarization, Keyphrase extraction, Topic modeling, Text similarity and clustering, Document clustering, Automated document summarization, Semantic analysis, Sentiment analysis.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on preprocessing techniques for text data.

CO2. Apply various computational, language processing, machine learning techniques to classify and cluster text.

CO3. Build manual and automated text summarizers for getting more insights from the given text data.

CO4. Apply various distance or similarity measures to estimate the degree of similarity between two text documents.

CO5. Design machine learning models using supervised learning approaches and perform sentiment analysis.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3			-	-	-	-	-	-	-	-	-	3	3	3	
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3	
CO3	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3	
CO4	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3	
CO5	3	3	3	2	3	3	-	-		-	-	-	3	3	3	
Course Correlation Mapping	**3**	**3**	**3**	**2**	**3**	**3**	-	-	-	**-**	**-**	-	**3**	**3**	**3**	

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: TEXT PROCESSING *(09 Periods)*

Text tokenization– Sentence tokenization, Word tokenization; Text normalization, Cleaning, Tokenizing, Removing special characters, Expanding contractions, Case conversions, Removing stop words, Correcting words, Stemming, Lemmatization; Text syntax and structure–Parts of Speech tagging, Text parsing.

Module 2: TEXT CLASSIFICATION *(09 Periods)*

Text classification, Automated text classification, Blueprint of text classification, Feature extraction – Bag of Words model, TF-IDF model, Averaged word vectors, TF-IDF weighted averaged word vectors; Classification algorithms – Naïve Bayes, Support vector machines Evaluating classification models, Building a multi-class classification system.

Module 3: TEXT SUMMARIZATION *(08 Periods)*

Text summarization and information extraction, Singular value decomposition, Key phrase extraction – Weighted tag–based phrase extraction; Topic modeling – Latent semantic indexing, Latent Dirichlet allocation, Non-negative matrix factorization, Extracting Topics from Product Reviews, Automated Document Summarization.

Module 4: TEXT SIMILARITY AND CLUSTERING ***(09 Periods)***

Information Retrieval (IR), Feature Engineering, Similarity Measures, Unsupervised Machine Learning Algorithms, Text Normalization, Feature Extraction, Text Similarity, Analyzing Term Similarity, Analyzing Document Similarity, Document Clustering, Clustering Greatest Movies of All Time.

Module 5: SEMANTIC AND SENTIMENT ANALYSIS ***(10 Periods)***

Semantic Analysis, Exploring WordNet, Word Sense Disambiguation, Named Entity Recognition, Analyzing Semantic Representations, Sentiment Analysis, Sentiment Analysis of IMDb Movie Reviews.

Total Periods: 45

EXPERIENTIAL LEARNING

List of Exercises

1. Perform clustering of popular movies based on their IMDb synopses as raw data using K-Means clustering. Find out similarities within groups of people in order to build a movie recommending system for users and they are going to analyze a dataset from Netflix database to explore the characteristics that people share in movies' taste, based on how they rate them.
2. Classify the given texts using Naïve Bayes algorithm and evaluate the classifier performance. Implement the Naïve Bayes Classifier in R/Python.
3. Keep Track of Marketing Trends: Trend analysis is an important aspect of marketing the product or service. Use Google Trends and other tools to look for trending terms. Discover hidden patterns, such as specialized niche keywords, by doing a keyword analysis on feedback from the target audience across various social media platforms and review sites. Use text summarize key phrases extraction approach to analyse trending marketing.

RESOURCES

TEXT BOOKS:

1. Dipanjan Sarkar, Text Analytics with Python, APRESS,2016.

REFERENCE BOOKS:

1 Steven Bird, Ewan Klein and Edward Loper, Natural Language Processing with Python, O'Reilly, 2018.
2 Charu C. Aggarwal, Machine Learning for Text, Springer, 2018.
3 Benjamin Bengfort, Rebecca Bilbro,Tony Ojeda, Applied Text Analysis with Python, O'Reilly, 2018.

VIDEO LECTURES:

1 http://nptel.ac.in/courses/110107129
2 https://freevideolectures.com/course/4135/nptel-business-analytics-text-mining-modeling-using-python/38
3 https://freevideolectures.com/course/4135/nptel-business-analytics-text-mining-modeling-using-python/39
4 https://freevideolectures.com/course/4135/nptel-business-analytics-text-mining-modeling-using-python/40
5 https://www.youtube.com/watch?v=FtGBzBi51mQ

WEB RESOURCES:

1 https://www.lexalytics.com/technology/text-analytics
2 https://download.e-bookshelf.de/download/0008/3870/64/L-G-0008387064-0017200370.
3 https://www.linguamatics.com/what-text-mining-text-analytics-and-natural-language-processing.

4 https://www.coursera.org/learn/text-mining

5 https://onlinecourses.nptel.ac.in/noc19_mg47/preview

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS102025	**WEB ANALYTICS**	3	-	-	-	3

Pre-Requisite -Web Technologies and Data Mining
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Web Data Collection procedures, qualitative analysis and web analytic fundamentals, Web Metrics, Web Analytics 2.0, Google Analytics and Relevant Technologies.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Understanding the basic concepts of Web Analytics and Search Engine.
CO2. Demonstrate knowledge on Qualitative Analysis and Web Analytic fundamentals.
CO3. Understand the concepts Web Analytical Metrics.
CO4. Perform Website traffic analysis using Web Analytics 2.0
CO5. Apply Google Analytics for web traffic analysis.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	2	1	2	-	-	-	-	-	-	-	3	2	3	3
CO2	2	3		2	-	-	-	-	-	-	-	-	3	2	3	3
CO3	2	2	3	1	-	-	-	-	-	-	-	-	3	2	3	3
CO4	3	2	3	1	3	-	-	-	-	-	-	-	3	2	3	3
CO5	2	2	3	1	3	-	-	-	-	-	-	-	3	2	3	3
Level of correlation of the course	**3**	**2**	**3**	**1**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**3**

Correlation Levels: 3: High 2: Medium 1: Low

COURSE CONTENT:

Module 1 - INTRODUCTION AND DATA COLLECTION (9 periods)

Introduction: Definition, Process, Key terms: Site references, Keywords and Key phrases; building block terms: Visit characterization terms, Content characterization terms, Conversion metrics; Categories: Offsite web, On site web; Web analytics platform, Web analytics evolution, Need for web analytics, Advantages, Limitations.

Data Collection: Click stream Data: Web logs, Web Beacons, JavaScript tags, Packet Sniffing; Outcomes Data: E-commerce, Lead generation, Brand/Advocacy and Support; Research data: Mindset, Organizational structure, Timing; Competitive Data: Panel-Based measurement, ISP-based measurement, Search Engine data.

Module 2 – QUALITATIVE ANALYSIS AND WEB ANALYTIC FUNDAMENTALS

(9 periods)

Qualitative Analysis: Heuristic evaluations: Conducting a heuristic evaluation, Benefits of heuristic evaluations; Site Visits: Conducting a site visit, Benefits of site visits; Surveys: Website surveys, post-visit surveys, creating and running a survey, Benefits of surveys.

Web Analytic fundamentals: Capturing data: Web logs or JavaScript's tags, Separate data serving and data capture, Type and size of data, Innovation, Integration, selecting optimal web analytic tool, Understanding click stream data quality, Identifying unique page definition, Using cookies, Link coding issues.

Module 3 – WEB METRICS **(9 periods)**

Web Metrics: Common metrics: Hits, Page views, Visits, Unique visitors, Unique page views, Bounce, Bounce rate, Page/visit, Average time on site, New visits; Optimization e-Commerce, non e-commerce sites: Improving bounce rates, Optimizing AdWords campaigns; Real time report, Audience report, Traffic source report, Custom campaigns, Content report, Google analytics, Introduction to KPI, characteristics, Need for KPI, Perspective of KPI, Uses of KPI.

Module 4–WEB ANALYTICS 2.0 **(9 periods)**

Web Analytics 2.0: Web analytics 1.0, Limitations of web analytics 1.0, Introduction to analytic 2.0, Competitive intelligence analysis: CI data sources, Toolbar data, Panel data, ISP data, Search engine data, Hybrid data, Website traffic analysis: Comparing long term traffic trends, Analyzing competitive site overlap and opportunities.

Module 5– GOOGLE ANALYTICS AND RELEVANT TECHNOLOGIES (9 periods)

Google Analytics: Brief introduction and working, Adwords, Benchmarking, Categories of traffic: Organic traffic, Paid traffic; Google website optimizer, Implementation technology, Limitations, Performance concerns, Privacy issues.

Relevant Technologies: Internet & TCP/IP, Client / Server Computing, HTTP (Hypertext TransferProtocol), Server Log Files & Cookies, Web Bugs.

Total periods: 45

RESOURCES

TEXT BOOKS:

1. Clifton B., Advanced Web Metrics with Google Analytics, Wiley Publishing, Inc.2nd ed.

REFERENCE BOOKS:

1. Kaushik A., Web Analytics 2.0, The Art of Online Accountability and Science of CustomerCentricity, Wiley Publishing, Inc. 1st ed.
2. Sterne J., Web Metrics: Proven methods for measuring web site success, John Wiley and Sons

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101001	**DECISION SUPPORT AND INTELLIGENT SYSTEMS**	3	-	-	-	3

Pre-Requisite Database Management Systems
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Decision Support Systems Development, Collaborative Computing Technologies, Enterprise Information Systems, Knowledge Acquisition, Representation & Reasoning, Advanced intelligence system, Implementing MSS in the E-Business ERA and Integration, Impacts and the future of management support systems.

COURSE OBJECTIVES:
- To impart Knowledge on Decision Support Systems and Artificial Intelligence.
- To provide skills on the applications of Decision Support Systems, Group Support System, knowledge management, Expert System, Neural computing, Intelligent Agents.
- To analyze major ethical and legal issues of Management Support System implementation in E-commerce and Future support Systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Understand phases of management support and decision-making systems.
CO2. Develop efficient decision support systems by choosing appropriate decision support system models.
CO3. Understand collaborative computing technologies, enterprise information systems and knowledge management for making Decision Support Systems.
CO4. Apply Artificial Intelligence, Machine Learning and Genetics Algorithms for decision making.
CO5. Understand Management Support Systems in E-Business, E-Commerce, L-Commerce, Intra-business, Legal and Ethical Issues in E-commerce

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-	3
CO2	2	2	3	-	2	-	-	-	-	-	-	-	3	2	-	3
CO3	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-	3
CO4	1	2	3	-	-	1	-	-	-	-	-	-	3	2	-	3
CO5	3	-	-	-	-	-	-	-	-	-	-	-	3	2	-	-
Level of correlation of the course	3	3	3		2	1							3	2		3

Correlation Levels: 3: High 2: Medium 1: Low

COURSE CONTENT:

DETAILED SYLLABUS:

MODULE - I – DECISION MAKING AND COMPUTERIZED SUPPORT (9 periods)

Management support systems: Managers and Decision-Making, Managerial Decision-Making and Information Systems, Managers and Computer Support, Computerized Decision Support and the Supporting Technologies, A Framework for Decision Support, The Concept of Decision Support Systems, Group Support Systems ,Enterprise Information System, Knowledge Management Systems, Expert Systems, Artificial Neural Networks, Advanced Intelligent Decision Support Systems, Hybrid Support Systems . **Decision making systems modeling- support**: Phases of decision-Making Process.

MODULE - II– DECISION SUPPORT SYSTEMS (9 periods)

Decision Support Systems: DSS Configurations, What Is a DSS, Characteristics and Capabilities of DSS, Components of DSS, The User, DSS Hardware, DSS Classifications. **Modeling and Analysis**: MSS Modeling, Static and Dynamic Models, Certainty, Uncertainty, and Risk. Decision Analysis of a Few Alternatives (Decision Tables and Decision Trees), The Structure of MSS Mathematical Models. **Decision Support System Development**: The Traditional System Development Life Cycle, Alternative Development Methodologies.

MODULE - III– COLLABORATIVE COMPUTING TECHNOLO (9 periods)

Collaborative Computing Technologies: Group Support Systems, Group Decision-Making, Communication and Collaboration, Communication Support, Group Support Systems, Group Support Systems Technologies, Group systems Meeting room and Online, The GSS Meeting Process. **Enterprise Information Systems:** Concepts and Definitions, The Evolution of Executive and Enterprise Information Systems, Executive Roles and Information Needs**. Knowledge Management**: Introduction to Knowledge Management, Organizational Learning and Transformation, Knowledge Management Initiatives, Approaches to Knowledge.

MODULE - IV– INTELLIGENT DECISION SUPPORT SYSTEM (9 periods)

Artificial Intelligence and Expert Systems: Concepts and Definitions of Artificial Intelligence, Evolution of Artificial Intelligence, The Artificial Intelligence Field, Basic Concepts of Expert Systems, Applications of Expert Systems, Structure of Expert Systems. **Knowledge Acquisition, Representation & Reasoning:** Methods of Knowledge Acquisition from Experts, Knowledge Verification and Validation, Representation of Knowledge, Reasoning in Rule-Based Systems. **Advanced intelligence system:** Machine-Learning Techniques, Case-Based Reasoning, and Genetic Algorithms Fundamentals.

MODULE - V– IMPLEMENTING MSS IN THE E-BUSINESS ERA (9 periods)

Implementing MSS in the E-Business ERA: E-Commerce Mechanisms: Auctions and Portals, Business-to-Consumer Applications, Market Research, e-CRM, and Online Advertising, Intrabusiness, Business-to-Employees, and People-to-People, E-Government, E-Learning, and Customer-to-Customer EC, M-Commerce, L-Commerce, and Pervasive Computing, Legal and Ethical Issues in E-Commerce. **Integration, Impacts and the future of management support systems**: Models of MSS Integration Intelligent Modeling and Model Management, MSS Impacts on Organizations, Intelligent Systems and Employment Levels, Internet Communities, The Future of Management-Support Systems

Total Periods: 45

EXPERIENTIAL LEARNING:

1. Farmers use crop-planning tools to determine the best time to plant, fertilize and reap. Medical diagnosis software that allows medical personnel to diagnose illnesses is another example.
2. GPS route planning. A DSS can be used to plan the fastest and best routes between two points by analyzing the available options. These systems often include the capability to monitor traffic in real-time to route around congestion.
3. Decision Support System Software That Helps to
   Predict Future Trends

RESOURCES

TEXT BOOKS:

1. Efraim Turban & Jay E,Aronson Ting-Peng Liang-"Decision Support Systems & Intelligent Systems" - Seventh edition - Pearson/prentice Hall.

REFERENCE BOOKS:

1. V.S. Janakiraman& K. Sarukesi, "Decision Support Systems" – Published by PHI Learning
2. Efrem G Mallach – "Decision Support systems and Data warehouse Systems" – Published by Mc Graw Hill.

VIDEO LECTURES:

1. https://youtu.be/B4pZsl4A2h0
2. https://youtu.be/MaGqDqBH4yc

WEBRESOURCES:

1. https://repository.up.ac.za/bitstream/handle/2263/22959/02Chapter2.pdf
2. https://www.csie.ntu.edu.tw/~sylee/courses/ai/kbdss/L17%20-20Knowledge%20Engineering.ppshttps://www.developer.com/java/understanding-mapreduce-types-and-formats.html

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
	PREDICTIVE ANALYTICS	3	-	-	-	3

Pre-Requisite Data Mining
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This Course provides a detailed discussion on Overview of Predictive analytics, Predictive Modeling, Data understanding, Data preparation, Item sets and Association Rules, Descriptive modeling, Assessing Predictive Models.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge on the basics of Predictive Analytics and Modelling.
CO2. Analyze the insights of data using data visualization and preparation methods for improved decision making.
CO3. Apply data pre-processing techniques to prepare data for predictive analytics.
CO4. Identify patterns in categorical data and build descriptive models using Association rules, Principal Component Analysis and Clustering algorithms.
CO5. Identify and deploy appropriate predictive models using batch approach, Regression and Ensemble Models to improve corporate operations.

CO-PO-PSO Mapping Table

Course Outcome	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	-	-	-	-	-	-	-	-	-	-	3	3	3	-
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	3	3	-
CO3	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3	-
CO4	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3	-
CO5	3	3	2	2	3											
Course Correlation Level	3	2	2	**2**	**3**		-	-	-	-	-	-	3	3	3	-

Correlation Level: 3-High 2-Medium 1-Low

COURSE CONTENT:

Module–1: INTRODUCTION (9 periods)

Overview of Predictive Analytics: Analytics, Predictive Analytics, Business Intelligence, Predictive Analytics vs. Statistics, Predictive Analytics vs. Data Mining, Challenges in Using Predictive Analytics, Educational Background. Setting up the Problem: Predictive Analytics Processing Steps, Defining Data for Predictive Modelling, Defining the Target Variable, Defining Measures of Success for Predictive Models, Doing Predictive Modelling Out of Order, and Case Study: Recovering Lapsed Donors and Fraud Detection.

Module-2: DATA UNDERSTANDING (8 periods)

What the Data Looks Like, Single Variable Summaries, Data Visualization in One Dimension, Histograms, Multiple Variable Summaries, Data Visualization, Two or Higher Dimensions, The Value of Statistical Significance, Pulling It All Together into a Data Audit.

Module-3: DATA PREPARATION (8 periods)

Variable Cleaning: Incorrect Values, Consistency in Data Formats, Outliers, Multi-dimensional Outliers, Missing Values, Fixing Missing Data. Feature Creation: Simple Variable Transformations, Fixing Skew, Binning Continuous Variables, Numeric Variable Scaling, Nominal Variable Transformation, Ordinal Variable Transformations, Date and Time Variable Features, ZIP Code Features, Multidimensional Features, Variable Selection Prior to Modelling, Sampling.

Module-4: ASSOCIATION RULES AND DESCRIPTIVE MODELING (10 periods)

Item sets and Association Rules: Terminology, Condition, Left-Hand-Side, Antecedent, Right-Hand-Side, Consequent, Output, Conclusion, Rule (Item Set), Support, Antecedent Support, Confidence, Accuracy, Lift. Parameter Settings, How the Data Is Organized, Measures of Interesting Rules, Deploying Association Rules, Problems with Association Rules, Building Classification Rules from Association Rules.

Descriptive Modeling: Data Preparation Issues with Descriptive Modeling, Principal Component Analysis, Clustering Algorithms.

UNIT–V: PREDICTIVEMODELING (10 periods)

Predictive Modeling and Assessing Predictive Models: Batch Approach to Model Assessment, Assessing Regression Models. Model Ensembles: Motivation for Ensembles, Bagging, Boosting, Improvements to Bagging and Boosting, Model Ensembles and Occam's razor, Interpreting Model Ensembles. Model Deployment, Help Desk Case Study.

Total Periods: 45

RESOURCES:

TEXT BOOK:

1. DeanAbbott-AppliedPredictiveAnalytics_PrinciplesandTechniquesfortheProfessional DataAnalyst-Wiley,2014.

REFERENCE BOOKS:

1. Siegel, Eric, Predictive Analytics: The Power to Predict Who Will Click, Buy, Lie, or Die, Wiley, 2016.
2. Theobald, Oliver, Data Analytics for Absolute Beginners Cengage Learning, 2nd Edition,2019.
3. Bari, A., Chaouchi, M., Jung, T. Analytics for Dummies, 2nd Edition, 2016.

VIDEO LECTURES

- https://onlinecourses.nptel.ac.in/noc21_mg86
- http://www.nitttrc.edu.in/nptel/courses/video/110104086/L08.html
- https://www.coursera.org/articles/predictive-analytics
- https://onlinecourses.swayam2.ac.in/imb20_mg19
- https://nptel.ac.in/courses/110105089

WEB RESOURCES:

- https://www.investopedia.com/terms/p/predictive-analytics.asp
- www.ibm.com/topics/predictive-analytics
- https://cloud.google.com/learn/what-is-predictive-analytics
- https://www.mathworks.com/discovery/predictive-analytics

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
20DS102008	BUSINESS INTELLIGENCE TOOLS	3	-	2	-	4

Pre-Requisite Data Mining
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course is emphasize on the fundamentals of business intelligence and tools including introduction of business intelligence and analytics, market research and operational intelligence, Agile Methodologies for BI Projects Data Modeling for BI Solutions business intelligence reporting interface and practical mastery of experiments using business intelligence open source tools.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Use different business intelligences and analyze them.
CO2. Apply market research and operational intelligence on different data sets.
CO3. Design and develop Agile Methodologies for BI Projects
CO4. Create Data Modeling for BI Solutions
CO5. Develop The BI Reporting Interface by choosing suitable BI Tool.
CO6. Work independently or in team to solve BI related problems with effective communication

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	3	-	-	-	-	-	-	-	-	-	3	-	3	2
CO2	3	3	3	2	2	-	2	-	-	-	-	-	3	-	3	2
CO3	3	3	3	3	3	-	-	-	-	-	2	-	3	-	3	2
CO4	2	3	3	3	3	-	-	2	-	-	-	-	3	-	3	2
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	-	3	2
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	3	**3**	**2**	**-**	**3**	-	**3**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction to Business Intelligence and Analytics ***(10 Periods)***
Introduction: Business Intelligence, Mobile Business Intelligence, Real-time Business Intelligence;
Analytics: Business Analytics, Software Analytics, Embedded Analytics, Learning Analytics, Predictive Analytics, Prescriptive Analytics, Social Media Analytics and Behavior Analytics.
Essential Aspects of Business Intelligence: Context Analysis, Business Performance Management, Business Process Discovery, Information System, Organizational Intelligence, Data Visualization, Data Profiling, Data Cleansing, Process Mining and Competitive Intelligence.
Module 2: Market Research and Operational Intelligence ***(08 Periods)***
Market Research: Introduction, Market Segmentation, Market Trend, SWOT Analysis, Marketing Research;
Operational Intelligence: Introduction, Business Activity Monitoring, Complex Event Processing, Business Process Management, Root Cause Analysis;
Module 3 Agile Methodologies for BI Projects ***(9 Periods)***
Introduction to Agile Methodologies, Agile Approaches : Our Recommended Mix between

Scrum and Kanban, Developing Projects with Scrum, Maintenance with Kanban , Mix of Both Methodologies, Scrumban; Peculiarities of Scrum for BI, Agile Management Tools.

Data Modeling for BI Solutions:

Modeling Steps, Defining our Model, Exploring Data Modeling Possibilities: View Layer, Data Split, Fact Normalization and Denormalization , Time Transformations , Fact Phases , Real vs. Potential , Historical Hierarchies ; Multiple Views Using a Table, Entity Isolation , Modifying Existing Structures, Adding More Sales Document Status , Data Modeling Tools : Erwin DataModeler, MySQL Workbench , Preparing the ETL.

Module 4 ETL Basics ***(9 Periods)***

Need of ETL Process, Details of the solution, Open Source ETL suites, Understanding ETL concepts.

Performance Improvements: Database Optimizations, ETL Optimizations.

Module 5 The BI Reporting Interface ***(09 Periods)***

How to Choose the BI Tool, Best Practices in Dashboarding: Starting from Top Left , Joining Related Information , Focus on Relevant Data , Formatting Recommendations, Graphic Usages; BI Tools: Microstrategy Desktop , Microsoft Power BI, Qlik Sense.

BI Process Scheduling: Finishing the ETL, PDI Command-Line Tools, Scheduling Jobs in the Task Scheduler, Running Database Maintenance Tasks.

Moving to a Production Environment: Multienvironment Scenario, Maintaining the Environment, Security, Auditing.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Power BI Desktop installation and familiarizing an Interface of Power BI. (*Study on features, architecture, building blocks, and components of Power BI*).
2. Import the data from different sources such as Excel, MySQL, SQLServer, Oracle etc. to load into Power BI and creating tables manually. (*Demonstration on getting data into Power BI Desktop*, *Data sources and modeling in Power BI*).
3. Implement Extraction, Transformation and Loading (ETL) process to create a database into MySQL/SQLServer/Power BI and then perform renaming, splitting, removing and reordering of columns; managing query groups, merge queries, SQL joins and union. (*Demonstration on data transformation*)
4. Create employee, department, and location tables using Power BI and then establish relationships between tables to display employee details such as employee name, employee no., department, date-of-join, gross salary and location. (*Demonstration on relationships*).
5. Design a dashboard to show units in stock by product and a total sale by year. (*Demonstration on List of Power BI chart types for visualization*).
6. Design a dashboard to check the total amount of sales made in each month and find out which month had the highest and lowest sales. Use a simple clustered column chart. Drag the date column on the axis and the sales on to the values then change the color of the bars by going to the format option and selecting data colors. (*Demonstration on format options of charts*).
7. Design a dashboard using a pie chart to analyze the sales made by each segment and find out which segment made the highest and lowest number of sales. Click on the pie chart option, select segment on to the legend, and sales on to the values. Create a map that depicts the sales made in each country and show the Donut chart to illustrate the profit made in each Segment. Positioning, Aligning, Sorting Visuals.
8. Design a dashboard to show sales, profits, regional cash inflows and the customers product-specific churn (stop using a product)of products over a period of time using necessary charts include Combo Charts, Bar Charts, Tables, Line Charts, Column Charts, and Point Maps. Interaction between Visuals.
9. Publish (Share or Embed) Power BI dashboards or reports that are designed on the Web (e-mail or social media).
10. Create a report that shows an employee detail such as employee name, employee no., designation, salary. In addition, create a custom column to show the stipend. If an employee designation is a manager, then the stipend should be 35% of his/her basic salary. If an employee is a senior consultant, then the stipend should be 25% of his/her basic, otherwise it should be 15% of the basic for remaining employees (*Study on DAX - Data Analysis Expressions functions include aggregate, counting, logical and date functions for creating calculated columns and measures*).

RESOURCES

TEXT BOOKS:

1. Drew Bentley, ”Business Intelligence and Analytics”, 1st edition, Library Press,2017.
2. Albert Nogues, Juan Valladares, “Business Intelligence Tools for small companies, 1st edition, APress, 2017.

REFERENCE BOOKS:

1. Swain Scheps,“Business Intelligence for Dummies”,1st edition, Wiley publishing, 2008
2. Wilfried Grossmann, Stefanie Rinderle-Ma,“Fundamentals of Business Intelligence”, 1st edition, Springer Press, 2015.
3. Teo Lachev, "Applied Microsoft Power BI," Prologika, Seventh Edition, 2022.
4. Alberto Ferrari and Marco Russo, "Introducing Microsoft Power BI," Microsoft Press, 2016.
5. Brett Powel, "Mastering Microsoft Power BI," Packt Publishing, First Edition, 2018

SOFTWARE/TOOLS:

Microsoft Power BI Desktop (https://powerbi.microsoft.com/en-us/downloads/)

WEB RESOURCES:

1. https://docs.microsoft.com/en-us/power-bi/fundamentals/power-bi-overview.
2. https://www.edureka.co/blog/power-bi-tutorial/
3. https://mindmajix.com/power-bi-visualization-types
4. https://intellipaat.com/blog/tutorial/power-bi-tutorial/
5. https://docs.microsoft.com/en-us/powerapps/maker/canvas-apps/sharepoint-scenario-build-report.
6. https://www.projectpro.io/article/power-bi-microsoft-projects-examples-and-ideas-for-practice/533

DATASET LINKS:

4. Customer segmentation (e-commerce) data - For dataset visit https://www.kaggle.com/fabiendaniel/customer-segmentation/data.
5. Financial Sample Excel workbook for Power BI - https://docs.microsoft.com/en-us/power-bi/create-reports/sample-financial-download.
6. Marketing Analytics dataset - https://www.kaggle.com/jackdaoud/marketing-data.

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
20DS102027	TIME SERIES ANALYSIS AND FORECASTING	3	-	-	-	3

Pre-Requisite Statistics for Engineers
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Time Series Concepts and Python, Time series analysis Exploratory Time Series Data Analysis, Stationary Time Series Models, ARMA and ARIMA Models, non-stationary time series models Modern Machine Learning Methods for Time Series Analysis, time series forecasting and tensor flow.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understanding the fundamental concepts of time series analysis and forecasting.
CO2 Perform Data Analysis using Time Series analysis methods.
CO3 Perform Data Analysis using stationary time series models.
CO4 Forecast data trends using Non-stationary Time Series Models.
CO5 Apply Deep Learning Techniques for Time Series Analysis.
CO6 Work independently or in team to solve Time Series related problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	-	-	-	-	-	-	-	-	-	3	3	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	3	3	-	-
CO3	3	3	2	2	2	-	-	-	-	-	-	-	3	3	-	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-	3	3	-	-
CO5	3	3	2	2	2	-	-	-	-	-	-	-	3	3	-	-
CO6	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**	**-**	**-**	**-**	**3**	**3**	**-**	**-**	**3**	**3**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: TIME SERIES CONCEPTS AND PYTHON (09 Periods)

The Concept of Time Series, History of Time Series Analysis, Objectives of Time Series Analysis, The Programming Language python, Introduction and Installing, Demonstrations, Python Extension Packages and Some Usages, Time Series Moment Functions and Stationarity, Moment Functions, Stationarity and Ergodicity, Sample Autocorrelation Function, White Noise and Random Walk, Time Series Data Visualization.

Module 2: EXPLORATORY TIME SERIES DATA ANALYSIS (09 Periods)

Partial Autocorrelation Functions, Definition of PACF, Sample PACF and PACF Plot, White Noise Test, Simple Time Series Compositions, Time Series Decomposition and Smoothing, Deterministic Components and Decomposition Models, Decomposition and Smoothing Methods.

Module 3 STATIONARY TIME SERIES MODELS (08 Periods)

Introduction, Backshift Operator, Differencing, and Stationarity Test, Moving Average Models, Definition of Moving Average Models, Properties of MA Models, Invertibility, Autoregressive Models, Definition of Autoregressive Models, Durbin-Levinson Recursion Algorithm, Properties of Autoregressive Models, Stationarity and Causality of AR Models, Autoregressive Moving Average Models, Properties of ARMA Models.

Module 4 ARMA AND ARIMA MODELING AND FORECASTING (11 Periods)

Model Building Problems, Estimation Methods, The Innovations Algorithm, Method of Moments, Method of Conditional Least Squares, Method of Maximum Likelihood, Order Determination,

Diagnosis of Models, Forecasting.

Nonstationary Time Series Models: The Box-Jenkins Method, Seasonal Differencing, SARIMA Models, SARIMA Model Building, REGARMA Models.

Module 5 MODERN MACHINE LEARNING METHODS FOR TIME SERIES ANALYSIS (08 Periods)

Introduction, Brief History of Artificial Intelligence, AI in Time Series Analysis, Artificial Neural Networks, Artificial Neural Network Developments, Neural Network Models, Deep Learning and Back propagation Algorithms, Gradient Descent and Backpropagation Algorithms.

Time Series Forecasting and TensorFlow: Introduction, Time Series Forecasting, TensorFlow and Keras Implementation Steps, case study on forecasting.

Total Periods: *45*

EXPERIENTIAL LEARNING

1. Fit a trend line by the method of freehand method for the given data.

Year	2000	2001	2002	2003	2004	2005	2006	2007
Sales	30	46	25	59	40	60	38	65

2. Given below are the data relating to the production of sugarcane in a district.
   Fit a straight line trend by the method of least squares and tabulate the trend values.

Year	2000	2001	2002	2003	2004	2005	2006
Prod. of Sugarcane	40	45	46	42	47	50	46

3. Compute the average seasonal movement for the following series

year	Quarterly Production			
	I	II	III	IV
2002	3.5	3.8	3.7	3.5
2003	3.6	4.2	3.4	4.1
2004	3.4	3.9	3.7	4.2
2005	4.2	4.5	3.8	4.4
2006	3.9	4.4	4.2	4.6

4. The following figures relates to the profits of a commercial concern for 8 years

Year	1986	1987	1988	1989	1990	1991	1992	1993
Profit (₹)	15,420	15,470	15,520	21,020	26,500	31,950	35,600	34,900

.
   Find the trend of profits by the method of three yearly moving averages.

5. Find the trend of production by the method of a five-yearly period of moving average for the following data:

Year	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
Production('000)	126	123	117	128	125	124	130	114	122	129	118	123

6. The following table gives the number of small-scale units registered with the Directorate of Industries between 1985 and 1991. Show the growth on a trend line by the free hand method.

Year	1985	1986	1987	1988	1989	1990	1991	1992
No. of units (in'000)	10	22	36	62	55	40	34	50

7. The annual production of a commodity is given as follows :

Year	1995	1996	1997	1998	1999	2000	2001
Production (in tones)	155	162	171	182	158	180	178

Fit a straight line trend by the method of least squares.

8. Determine the equation of a straight line which best fits the following data

Year	2000	2001	2002	2003	2004
Sales (₹ '000)	35	36	79	80	40

Compute the trend values for all years from 2000 to 2004

9. The sales of a commodity in tones varied from January 2010 to December 2010 as follows:

in year 2010	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sales (in tones)	280	240	270	300	280	290	210	200	230	200	230	210

Fit a trend line by the method of semi-average.

10. Use the method of monthly averages to find the monthly indices for the following data of production of a commodity for the years 2002, 2003 and 2004.

2002	15	18	17	19	16	20	21	18	17	15	14	18
2003	20	18	16	13	12	15	22	16	18	20	17	15
2004	18	25	21	11	14	16	19	20	17	16	18	20

11. Calculate the seasonal indices from the following data using the average from the following data using the average method:

	I Quarterly	II Quarterly	III Quarterly	IV Quarterly
2008	72	68	62	76
2009	78	74	78	72
2010	74	70	72	76
2011	76	74	74	72
2012	72	72	76	68

12. The following table shows the number of salesmen working for a certain concern:

Year	1992	1993	1994	1995	1996
No. of salesmen	46	48	42	56	52

Use the method of least squares to fit a straight line and estimate the number of salesmen in 1997.

13. Read temperature dataset with MinTemp, MaxTemp, AvgTemp, Sunrise, Sunset and apply preprocessing techniques to handle Detrending/stationary, Anomaly detection, and Missing data. Apply ARIMA model to predict future temperatures, Focus on the AvgTemp column and, and set Date as our index. Calculate the mean squared error to check how the model performance.

RESOURCES:

TEXT BOOKS:

1. Changquan Huang Alla Petukhina, Applied Time Series Analysis and Forecasting with Python, Springer, 2022.
2. Peter J. Brockwell Richard A. Davis Springe, Introduction to Time Series and Forecasting, springer, 2nd Edition, 2001.

REFERENCE BOOKS:

1. Douglas C. Montgomery Cheryl L. Jennings Murat Kulahci, Introduction to Time Series Analysis and Forecasting, Wiley Series, 2nd Edition, 2015.

WEB REFERENCES:

1. https://www.analyticsvidhya.com/blog/2021/10/a-comprehensive-guide-to-time-series-analysis/
2. https://link.springer.com/chapter/10.1007/978-3-030-57805-3_26
3. https://www.brainkart.com/article/Exercise-9-1--Time-Series-Analysis-and-Measurements-of-Trends_39020/

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc21_ch28/preview
2. https://www.udemy.com/course/machine-learning-time-series-forecasting-in-python/
3. https://www.coursera.org/learn/machine-learning-accounting-python

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101016	**IMAGE AND VIDEO ANALYTICS**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION:
This course provides a detailed discussion on the basic principles and concepts in digital image and video processing. To explore and demonstrate real time image and video analytics in solving practical problems of commercial and scientific interests.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the Image Segmentation, Compression and Colour Image Processing concepts
CO2 Demonstrate knowledge on digital image processing techniques in developing societal applications
CO3 Apply feature extraction and texture analysis techniques in object recognition and image retrieval.
CO4 Understand the fundamentals of digital video processing.
CO5 Apply video segmentation and tracking techniques for motion detection and tracing applications.
CO6 Apply video analytics techniques for action detection in real-time applications.

CO-PO and PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	2	3	2	-	-	-	-	-	-	-	-	-	3	3	3	
CO2	2	3	2	2		-	-	-	-	-	-	-	3	3	3	
CO3	2	3	2	2	2	-	-	-	-	-	-	-	3	3	3	
CO4	2	3	2	2		-	-	-	-	-	-	-	3	3	3	
CO5	2	3	2	2		-	-	-	-	-	-	-	3	3	3	3
CO6	2	3	2	2	2	-	-	-	-	-	-	-	3	3	3	3
Level of correlation of the course	**2**	**3**	**2**	**3**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**3**	**3**

Level of Correlation: 3 - High 2 - Medium 1 - Low

COURSE CONTENT

Module 1: INTRODUCTION (09 Periods)

Basic steps of Image processing system – Pixel relationship- Image Transforms-. Image Enhancement- Histogram Processing, Spatial filtering, Frequency Domain filtering

Image Segmentation, Compression and Colour Image Processing

Image Segmentation –Detection of Discontinuities. - Edge Linking and Boundary Detection. - Thresholding. - Region-Based Segmentation. Image Compression – Encoder-Decoder model, Lossy and Lossless compression, Huffman Coding, Arithmetic Coding, JPEG, JPEG 2000. Colour Image Processing – Colour Models, Color Transformations Color Image Smoothing and Sharpening, Color Noise Reduction, Color-Based Image Segmentation.

(09 Periods)

Module 2: FEATURE EXTRACTION AND TEXTURE ANALYSIS

Feature Extraction - Binary object feature, Histogram-based (Statistical) Features, Intensity features, Shape feature extraction, PCA - SIFT – SURF. Texture Analysis - Concepts and classification, statistical, structural and spectral analysis.

Object recognition and Image Retrieval

Object Recognition -Patterns and pattern class, Bayes' Parametric classification, Feature Selection and Boosting, Template- Matching. Content Based Image Retrieval - Feature

based image retrieval, Object Based Retrieval

(08 Periods)

Module 3 DIGITAL VIDEO PROCESSING

Digital Video, Sampling of video signal, Video Enhancement and Noise Reduction- Rate control and buffering, MPEG, H.264, Inter frame Filtering Techniques, Fundamentals of Motion Estimation and Motion Compensation

(11 Periods)

Module 4 VIDEO SEGMENTATION AND TRACKING

Change Detection, Background modelling, Motion Segmentation, Simultaneous Motion Estimation and Segmentation, Motion Tracking, Multi-target/Multi-camera tracking

(08 Periods)

Module 5 VIDEO ANALYSIS ACTION RECOGNITION

Video Analysis Action Recognition, Video based rendering, Context and scene understanding. Case Study: Surveillance - Advanced Driver Assistance System

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

EXPERIENTIAL LEARNING

1. Understand and know how to apply state-of-the-art machine learning techniques (convolution neural networks) to solving problems in image and video analysis
2. Understand and describe the fundamental principles of image and video analysis and have an idea of their application.
3. Image and video segmentation and texture models
4. Fundamentals of digital image processing, image and video analysis, computer vision including camera calibration, feature matching and object detection and recognition
5. Image and video analysis, processing, machine learning for image analysis.

RESOURCES

TEXT BOOK:

1. *Rafael C. Gonzalez and Richard E. Woods, "Digital Image Processing", Third Ed., Prentice-Hall, 2008*

2. *A Murat Tekalp, "Digital Video Processing", Second Edition, Prentice Hall, 2015.*

REFERENCE BOOKS:

1. *Oge Marques, "Practical Image and Video Processing Using MATLAB", Wiley-IEEE Press,2011*
2. *Yu Jin Zhang, "Image Engineering: Processing, Analysis and Understanding", Tsinghua University Press, 2009.*
3. *Mark Nixon and Alberto S. Aquado, "Feature Extraction & Image Processing for Computer Vision", Third Edition, Academic Press, 2012*
4. *Richard Szeliski, "Computer Vision: Algorithms and Applications", Springer, 2010*
5. *Boguslaw Cyganek,"Object Detection and Recognition in Digital Images: Theory and Practice", Wiley, 2013*

WEB REFERENCES:

1. *http://homepages.inf.ed.ac.uk/rbf/CVonline/Imagedbase.htm*
2. *https://www.cs.cmu.edu/~cil/v-images.html*
3. *http://www.imageprocessingplace.com/root_files_V3/image_databases.htm*

VIDEO LECTURES:

1. *https://gengo.ai/datasets/20-best-image-datasets-for-computer-vision*
2. https://nptel.ac.in/courses

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS104005	RECOMMENDER SYSTEMS WITH TENSOR FLOW	3	-	2	-	3

Pre-Requisite Data Mining
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION:

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1 Understand the basic concepts of Recommender System and its types.
CO2 Apply content-based and collaborative filters for designing Recommender systems.
CO3 Understand Context awareness and Learning principles in Recommender systems and evaluate their performance.
CO4 Develop Recommender Systems for content media, social media and communities by understanding user preferences and/or behaviour.
CO5 Develop Recommender Systems using Tensorflow.
CO6 Work independently or in team to solve Recommender System related problems with effective communication.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	-	-	-	-	-	-	-	-	-	-	3	3	2	2
CO2	3	3	3	2	3	-	-	-	-	-	-	-	3	3	2	2
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	3	2	2
CO4	3	3	3	2	3	-	-	-	-	-	-	-	3	3	2	2
CO5	3	3	3	2	3	-	-	-	-	-	-	-	3	3	2	2
Course Correlation Mapping	**3**	**3**	**3**	**2**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION ***(9 Periods)***

Introduction and basic taxonomy of recommender systems (RSs). Traditional and non-personalized RSs. Overview of data mining methods for recommender systems (similarity measures, classification, Bayes classifiers, ensembles of classifiers, Clustering, SVMs, dimensionality reduction). Overview of convex and linear optimization principles.

Content-based recommender systems:

The long-tail principle. Domain-specific challenges in recommender systems. Content-based recommender systems. Advantages and drawbacks. Basic components of content-based RSs. Feature selection. Item representation Methods for learning user profiles.

Module 2: COLLABORATIVE FILTERING BASED RECOMMENDATION SYSTEMS: ***(9 Periods)***

Mathematical foundations: Mathematical optimization in CF RSs. Optimization objective. Baseline predictor through least squares. Regularization and overfitting. Temporal models. Step-by-step solution of the RS problem.

Collaborative Filtering (CF)-based RSs: systematic approach: Nearest-neighbor collaborative filtering (CF). User-based and item-based CF, comparison. Components of neighborhood methods (rating normalization, similarity weight computation, neighborhood selection). Hybrid recommender systems

Advanced CF methods: Matrix factorization models and dimensionality reduction. Matrix Decomposition. Latent factor models. Solution via alternative projections method. Examples.

The Netflix data challenge. Constraint-based RSs. Introduction to tensors and their applications.

Module 3: PERFORMANCE EVALUATION OF RECOMMENDER SYSTEMS ***(11 Periods)***

Experimental settings. Working with RSs data sets. Examples. The cold-start problem. Evaluation metrics. Rating prediction and accuracy. Other metrics (fairness, coverage, diversity, novelty, serendipity).

Context awareness and Learning principles in RSs:

Context-aware recommender systems. Contextual information models for RSs. Incorporating context in Rs. Learning to rank. Active learning in RSs. Multi-armed bandits and Reinforcement learning in RSs. Dynamic RSs.

Module 4: USER BEHAVIOR UNDERSTANDING IN RSs: ***(8 Periods)***

Foundations of behavioral science. User choice and decisions models. Choice models in RSs. Digital nudging and user choice engineering principles. Applications and examples for recommender systems.

Applications of RSs for content media, social media and communities:

Music and video RSs. Datasets. Group recommender systems. Social recommendations. Recommending friends: link prediction models. Similarities and differences of RSs with task assignment in mobile crowdsensing. Social network diffusion awareness in RSs.

Module 5: UNDERSTANDING NEURAL NETWORKS WITH TENSOR FLOW ***(08 Periods)***

Deep Learning model and Working, Activation Functions Illustrate Perceptron, Training a Perceptron Important Parameters of Perceptron, Introduction to TensorFlow, TensorFlow code-basics,Graph Visualization, Constants, Placeholders, Variables, Creating a Model, Step by Step - Use-Case Implementation

Total Periods: 45

EXPERIENTIAL LEARNING

List of Exercises

1. Build A Collaborative Filtering Book Recommender System with TensorFlow
2. Consider Amazon Product Review Dataset and build electronic products recommender system using Tensorflow.
3. Build Content-Based Recommender Systems in TensorFlow and BERT Embeddings using Web Ad campaign dataset.
4. Build a movie recommender system based on Netflix dataset using Tensorflow.
5. Word2Vec: Build Semantic Recommeder System with TensorFlow.
6. Build a RNN based personalized Recommendation Engine with TensorFlow for Flipkart products.

RESOURCES

TEXT BOOKS:

1. Kim Falk Jørgen-sen, *Practical Recommender Systems,* O'Reilly Learning, 2018.

REFERENCE BOOKS:

1. *Statistical Methods for Recommender Systems* by Agarwal and Chen (Cambridge, ISBN 978-1-13-956586-8; available electronically at the library)
2. **James Densemore, Data Pipelines Pocket Reference, O'Reilly Media, Inc., 1st Edition, 2022**

SOFTWARE/TOOLS:

1. Python

VIDEO LECTURES:

1. h ttps://www.coursera.org/learn/Statistical Methods for Recommender System
2. https://www.udemy.com/course/Recommender Systems

Web Resources:

1. https://lkpy.lenskit.org/
2. https://md.ekstrandom.net/

SPECIALIZATION ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS102011	**HADOOP APPLICATION ARCHITECTURES**	**3**	**-**	**-**	**-**	**3**

Pre-Requisite - Foundations of Data Science
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION:

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Develop data models using Hadoop.
CO2. Perform Data Movement Operations using Hadoop.
CO3. Apply Hadoop modules for Data Processing.
CO4. Apply Graph processing and Orchestration for Distributed Systems.
CO5. Perform real-time data processing using Hadoop eco system.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes												Program Specific Outcomes			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	2	3	2	3	-	-	-	-	-	-	-	3	3	2	3
CO2	3	3	3	3	3	-	-	-	-	-	-	-	3	3	2	3
CO3	3	3	3	3	3	-	-	-	-	-	-	-	3	3	2	3
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	2	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	2	3
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**	**2**	**3**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT:

Module 1: DATA MODELING IN HADOOP (9 periods)

Introduction: Data storage formats, Multitenancy, Schema design, Metadata management; Data Storage Options, Standard File Formats, Hadoop File Types, Serialization Formats, Columnar Formats, Compression

HDFS Schema Design: Location of HDFS Files, Advanced HDFS Schema Design, HBase Schema Design, Managing Meta Data.

Module2: DATA MOVEMENT (9 periods)

Data Ingestion Considerations, Timeliness of Data Ingestion, Incremental Updates, Access Patterns, Original Source System and Data Structure, Transformations, Network Bottlenecks, Push or Pull, Failure Handling, Level of Complexity, Data Ingestion Options, Considerations for File Transfers versus Other Ingest Methods, Flume: Event-Based Data Collection and Processing, Kafka, Data Extraction.

Module 3: PROCESSING DATA IN HADOOP (9 periods)

MapReduce, Spark, Abstractions, Pig, Crunch, Cascading, Hive, Impala.

Common Hadoop Processing Patterns: Pattern: Removing Duplicate Records by Primary Key, Pattern: Windowing Analysis, Pattern: Time Series Modifications.

Module 4: Graph Processing on Hadoop (9 periods)

Graph Processing on Hadoop: Definition, Graph Processing, Processing a Graph in a Distributed System, Giraph, Batch Process the Graph with BSP, GraphX.
Orchestration: Need of Workflow Orchestration, The Limits of Scripting, The Enterprise Job Scheduler and Hadoop, Orchestration Frameworks in the Hadoop Ecosystem, Oozie,

Workflow Patterns, Capture-and-Decide Workflow, Parameterizing Workflows, Classpath Definition, Scheduling Patterns, Executing Workflows.

Module 5 : NEAR-REAL-TIME PROCESSING WITH HADOOP (9 periods)

Stream Processing, Apache Storm- Storm High-Level Architecture, Storm Topologies, Tuples and Streams, Spouts and Bolts, Stream Groupings, Reliability of Storm Applications, Exactly-Once Processing, Fault Tolerance, Integrating Storm with HDFS, Integrating Storm with HBase, Storm Example: Simple Moving Average, Evaluating Storm, Trident, Spark Streaming, Flume Interceptors

Case Studies: Clickstream Analysis, Fraud Detection

Total Periods: 45

Text book:

1. Mark Grover, Ted Malaska, Jonathan Seidman & Gwen Shapira, Hadoop Application Architectures- DESIGNING REAL-WORLD BIG DATA APPLICATIONS, O'Reilly, 2015.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101701	**AI IN HEALTHCARE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Artificial Intelligence (AI) in Healthcare; The Present State and Future of AI in Healthcare Specialties; The Role of Major Corporations in AI in Healthcare; Applications of AI in Healthcare.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the fundamental concepts of AI in Healthcare sector.

CO2 Analyse the present state and future of AI in Healthcare specialties for different scenarios.

CO3 Apply design concepts and metrics for AI in Healthcare.

CO4 Demonstrate basic concepts and terminologies of future applications of Healthcare in AI.

CO5 Develop AI applications through AI techniques for healthcare

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	2	2	-	-	-	-	-	-	-	-
CO2	2	3	-	2	-	2	2	-	-	-	-	-
CO3	2	-	2	2	-	-	-	-	-	-	-	-
CO4	2	-	-	-	2	2	-	-	-	-	-	-
CO5			3									
Course Correlation Mapping	2	-	3	2	2	2	2	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE ***(08 Periods)***

Introduction to AI in Healthcare, Benefits & Risks, AI in the health sector, AI versus human intelligence, The future of AI in health sector, AI & Neural networks.

Module 2: THE PRESENT STATE & FUTURE OF AI IN HEALTHCARE SPECIALTIES ***(10 Periods)***

Artificial Intelligence in: preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

Module 3: THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE *(08 Periods)*

IBM Watson, The role of Google & Deep mind in AI in Healthcare, Baidu, Facebook & AI in Healthcare, Microsoft & AI in Healthcare.

Module 4: FUTURE OF HEALTHCARE IN AI *(10 Periods)*

Evidence-based medicine, personalized medicine, Connected medicine, Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantables, Digital Health and Therapeutics, Incentivized Wellness, Block chain, Robots, Robot-Assisted Surgery, Exoskeletons, Inpatient Care, Companions, Drones, Smart Places, Smart Homes, Smart Hospitals.

Module 5: APPLICATIONS OF AI IN HEALTHCARE *(09 Periods)*

Case Study 1: AI for Imaging of Diabetic Foot Concerns and Prioritization of Referral for Improvements in Morbidity and Mortality.

Case Study 2: Outcomes of a Digitally Delivered, Low-Carbohydrate, Type 2 Diabetes Self-Management.

Case Study 3: Delivering A Scalable and Engaging Digital Therapy.

Case Study 4: Improving Learning Outcomes for Junior Doctors through the Novel Use of Augmented and Virtual Reality for Epilepsy.

Case Study 5: Big Data, Big Impact, Big Ethics: Diagnosing Disease Risk from Patient Data.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Analyze how the artificial intelligence is used to predict the disease result and Prognosis Assessment of a patient.
2. How does drug discovery happen and how does AI is helping in drug discovery and Labs.
3. Justify that artificial intelligence provide engineering solutions for early detection and Diagnosis of diseases.
4. Demonstrate the prediction of bladder volume of a patient.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Dr. Parag Mahajan, *Artificial Intelligence in Healthcare*, MedManthra Publications, First Edition 2019.
2. Arjun Panesar, *Machine Learning and AI for Healthcare Big Data for Improved Health*, Apress Publications, 2019.

REFERENCE BOOKS:

1. Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher, *Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril*, National Academy of Medicine Publication, First Edition 2019.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=-aHBwTQQyNU
2. https://intellipaat.com/blog/artificial-intelligence-in-healthcare/

Web Resources:

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6616181/
2. https://www.ibm.com/topics/artificial-intelligence-healthcare
3. https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CM101701	**BANKING AND INSURANCE**	3	-	-	-	3

Pre-Requisite

Anti-Requisite

Co-Requisite

COURSE DESCRIPTION: Introduction to Banking; Bank-Customer Relationship; Electronic Payment System and Business Models; Introduction to Risk and Insurance; Insurance Overview.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Demonstrate the importance of Banking and functions of the Reserve Bank of India and its role in the country's sustainable development.

CO2 Demonstrate the role, relationships, and operations between Banker and Customer.

CO3 Demonstrate the Online Banking system, various types of Electronic Payments, and Business models.

CO4 Demonstrate the concept of risk and principles, functions, and, types of Insurance companies.

CO5 Understand the principles of insurance and its functions.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	2	-	-	-	1
CO2	3	-	-	-	-	-	-	2	-	-	-	1
CO3	3	-	-	-	-	-	-	2	-	-	-	1
CO4	3	-	-	-	-	-	-	2	-	-	1	1
CO5	3	-	-	-	-	-	-	2	-	-	1	1
Course Correlation Mapping	**3**	-	-	-	-	-	-	**2**	-	-	**1**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO BANKING ***(09 Periods)***

Meaning - Importance of banking- Functions of banking - Reserve Bank of India: Functions – Role of RBI in sustainable development.

Module 2: BANK-CUSTOMER RELATIONSHIP **(09 Periods)**

Debtor-creditor relationship, deposit products or services, payment, and collection of cheques. Accounts – Types of accounts, the procedure for opening and closing an account - Loans and Advances- principles of lending.

Module 3 ELECTRONIC PAYMENT SYSTEM&BUSINESS MODELS (09 Periods)

Introduction to Online Banking - types of e-payment system, e-cash, NEFT, RTGS, Credit cards, Electronic Wallet and Debit cards. **Business models**- B2B, B2C, C2C, and B2G.

Module 4 INTRODUCTION TO RISK AND INSURANCE (09 Periods)

Insurance: Definition, Insurance as risk mitigation mechanism, elements of insurance. Concept of risk, risk *Vs*uncertainty.

Module 5 INSURANCE OVERVIEW *(09 Periods)*

Principles of insurance - insurance types - LIC & GIC – insurance functions, IRDA - Insurance Players in India.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Make a PowerPoint presentation on the banking system in India.
2. Submit a report on the working of insurance companies.
3. Prepare a report on the functions of RBI & IRDA in India.
4. Submit a report on electronic banking facilities provided by Indian banks.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. RanganadhaChary, A.V. and Paul, R.R., *Banking and Financial system*, Kalyani Publisher, New Delhi, 3rdedition, 2016.
2. Sharma, R.K., Shashi K. Gupta and Jagwant Singh, *Banking and Insurance*, Kalyani Publishers, New Delhi, 17th edition, 2014

REFERENCES BOOKS:

1. *Indian Institute of Banking & Finance, Digital Banking*, Taxman Publications Pvt. Ltd., 2016 edition, 2016.
2. Jyotsna Sethi and Nishwan Bhatia, *Elements of Banking and Insurance*, PHI Learning Pvt. Ltd., 2nd edition, 2012.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=a1_p8zhbAfE
2. https://www.youtube.com/watch?v=bxNw9VB5Y_0

WEB RESOURCES:

1. https://unacademy.com/content/railway-exam/study material/economics/importance-of-banking-sector-in-the-country/
2. https://www.geeksforgeeks.org/ life-insurance-meaning-elements-and-types-of-life-insurance-policies/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22DS101701	**BIOINFORMATICS**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course focus on Biological Data Acquisition, Databases, Data Processing, Methods of Analysis, Applications of Bio-informatics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand basic biological data acquisition in bioinformatics.

CO2 Identify the proper databases for the information search by choosing the biological databases and also submission and retrieval of data from databases.

CO3 Analyze the results of bioinformatics data using text and sequence-based searching techniques.

CO4 Analyze the secondary and tertiary structures of proteins by applying different alignment programs

CO5 Design biological databases by using contextual knowledge on bioinformatics.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	3	-	-	-	-	-	-	-	-	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-
CO5	3	2	3	3	3	-	-	-	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	-	-	-	-	-	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: BIOLOGICAL DATA ACQUISITION ***(09 Periods)***

Biological information, Retrieval methods for DNA sequence, protein sequence and protein structure information

Module 2: DATABASES ***(09 Periods)***

Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary and secondary sequence databases, protein sequence and structure databases.

Module 3: DATA PROCESSING ***(09 Periods)***

Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity Searches: Local and global. Distance metrics. Similarity and homology. Scoring matrices, PAM and BLOSUM

Module 4: METHODS OF ANALYSIS ***(09 Periods)***

Dynamic programming algorithms, Needleman-Wunsch and Smith-waterman.Heuristic Methods of sequence alignment, FASTA and BLAST; Multiple Sequence Alignment and software tools for pair wise and multiple sequence alignment, CLUSTAL program, Prediction of Tertiary structure of proteins.

Module 5: APPLICATIONS ***(09 Periods)***

Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis, Genomics, Proteomics, Genome analysis – Genome annotation, DNA Microarray, computer aided drug design (CADD).

Total Periods: 45

EXPERIENTIAL LEARNING

1. Calculate the dynamic programming matrix and one or more optimal alignment(s) for the sequences GAATTC and GATTA, scoring +2 for a match, – 1 for a mismatch and with a linear gap penalty of d = 2.
2. Determine whether the RNA string GGACCACCAGG should be folded into two substructures.
3. Discuss how to carry out the multiple sequence alignment of the following three sequences: TTTTAAAA, AAAACCCC, CCCCTTTT.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Lesk, A. K., *Introduction to Bioinformatics*, Oxford University Press, 4th Edition, 2013
2. Dan Gusfield, *Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology*, Cambridge University Press, 1997.

REFERENCE BOOKS:

1. Baldi, P. and Brunak, S., *Bioinformatics: The Machine Learning Approach*, MIT Press, 2nd Edition, 2001.
2. Mount, D.W., *Bioinformatics Sequence and Genome Analysis*, Cold Spring Harbor Laboratory Press, 2nd Edition, 2004.
3. Tindall, J., *Beginning Perl for Bioinformatics: An introduction to Perl for Biologists*, O'Reilly Media, 1st Edition, 2001.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=liNblw4x50E
2. https://www.youtube.com/watch?v=eZfyWdHnzR0

WEB RESOURCES:

1. https://www.britannica.com/science/bioinformatics
2. https://www.ebi.ac.uk/training/online/courses/bioinformatics-terrified/what-bioinformatics/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22BS101036	**BIOLOGY FOR ENGINEERS**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to living organisms, Proteins, Nucleic acids and enzymes, Genetics and Molecular biology, Recombinant DNA technology, Human physiology and applied biology.

COURSE OUTCOMES: After successful completion of the course, students will be able to

CO1 Identify difference between cells, Cellular components and their functions.
CO2 Understand Proteins, Nucleic acids structure and function and also Mechanism of enzyme action.
CO3 Identify Central dogma of Molecular biology and processes of Molecular Biology.
CO4 Understand Recombinant DNA technology and its importance in creating new Animals and Plants.
CO5 Understand basics and Mechanism of different Physiological process including nerve function and applications of biological sciences.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	-	-	-	-	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: LIVING ORGANISMS ***(09 Periods)***

Comparison of biological organisms with manmade systems, Classification of living organisms, Cellular basis of life, differences between prokaryotes and eukaryotes, classification on the basis of carbon and energy sources, molecular taxonomy

Module 2: PROTEINS, NUCLEIC ACIDS AND ENZYMES ***(10 periods)***

Biomolecules, structure, function and Classification of proteins, structure, function and Classification of and Nucleic acids, Enzymes, Enzyme nomenclature, Classification of Enzymes and Mechanism of Enzyme action, Industrial applications of enzymes, Fermentation and its industrial applications

Module 3 GENETICS AND MOLECULAR BIOLOGY ***(11 Periods)***

Mendel's laws, single gene disorders in humans, Genetic code, DNA replication, Transcription, Translation.

Module 4 RECOMBINANT DNA TECHNOLOGY ***(08 Periods)***

Recombinant DNA Technology: recombinant vaccines, transgenic microbes, plants and animals, animal cloning, biosensors, biochips.

Module 5 HUMAN PHYSIOLOGY AND APPLIED BIOLOGY ***(07 Periods)***

Fundamentals of Human physiology, neurons, synaptic and neuromuscular junctions, Introduction to EEG, DNA fingerprinting, DNA Micro array and Genomics.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Identify the Cell and Cellular organelle spotters and write the functions of spotters identified
2. Prepare a table of Enzymes and their importance.
3. Assignments on Central dogma of Molecular biology
4. Identify different organs in the organ system diagrams.
5. Assignments on photosynthesis.
6. Quiz related to organ system and functions.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rajiv Singal, Gaurav Agarwal, *Biology for Engineers*, CBS, 2019.
2. S. Sing and T. Allen, *Biology for Engineers*, Vayu Education of India, 2014.

REFERENCE BOOKS:

1. B. Alberts, A. Johnson et al., *The molecular biology of the cell*, Garland Science, 6th edition, 2014.
2. A. T. Johnson, *Biology for Engineers*, CRC press, 2011.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=N0Y386SVGN8
2. https://www.youtube.com/watch?v=1Pzk-UqilW4
3. https://www.youtube.com/watch?v=208pMhKoQeo

Web Resources:

1. Structure and function of Proteins: https://nptel.ac.in/courses/104102016/16
2. Enzyme catalysis: https://nptel.ac.in/courses/103103026/module3/lec35/4.html
3. Biochips: https://nptel.ac.in/courses/112104029/3

Course Code	Course Title	L	T	P	S	C
22LG101701	BUSINESS COMMUNICATION AND CAREER SKILLS	3	-	-	-	3

Pre-Requisite

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Nature and Scope of Communication, Corporate Communication, Writing Business Messages & Documents, Careers & Résumés, and Interviews.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge of professional communication by analyzing and applying the styles and strategies of business communication in Communication Networks, Interpersonal, and Informal communication.

CO2. Analyze the limitations of communication by applying and demonstrating corporate and cross-cultural communication strategies effectively in a business context and Crisis Management situations.

CO3. Apply appropriate strategies and techniques in writing business messages, business letters, and résumé for effective professional communication and career building.

CO4. Demonstrate appropriate communication techniques and answering strategies by analyzing the expectations during presentations and interviews.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	2	-	-	-	-	3	-	-
CO2	1	2	-	-	2	-	-	-	-	3	1	-
CO3	1	-	-	-	2	-	-	-	-	3	-	-
CO4	1	2	-	-	2	-	-	-	-	3	-	-
Course Correlation Mapping	**2**	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**3**	**1**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: NATURE AND SCOPE OF COMMUNICATION ***(9 Periods)***

Introduction – Communication Basics – Functions of Communication – Communication Networks – Interpersonal Communication – Informal Communication – Communication Barriers – Roles of a Manager.

Module 2: CORPORATE COMMUNICATION ***(9 Periods)***

Introduction – Corporate Communication – Cross-Cultural Communication; Concept & Styles – Corporate Communication Strategy – Corporate Citizenship – Crisis Communication: Case Study.

Module 3: WRITING BUSINESS MESSAGES & DOCUMENTS ***(9 Periods)***

Introduction – Importance of Written Business Communication – Types of Business Messages – Five Main Stages of Writing Business Messages – Business Letter Writing – Kinds of Business Letters – Common Components of Business Letters – Strategies for Writing the Body of a Letter.

Module 4: CAREERS AND RÉSUMÉS ***(9 Periods)***

Introduction – Career Building – Résumé Formats: Traditional, Electronic and Video Résumé – Sending Résumés – Follow-up Letters – Business Presentations and Speeches: Planning –Structuring – Organizing – Delivery.

Module 5: INTERVIEWS ***(9 Periods)***

Introduction – General Preparation for an Interview – Success in an Interview – Important Non-verbal Aspects – Types of Interviews – Styles of Interviewing – Types of Interviewing –Online Recruitment Process.

Total Periods: 45

EXPERIENTIAL LEARNING

1. People often get confused in identifying or using English vocabulary on most occasions. Prepare a list of confusing words and find methods to overcome the difficulties in using those words to uplift the career of professionals.
2. Organizations and institutions use modern technology in communicating with their colleagues, clients, and stakeholders. Make a PowerPoint presentation on the modern communication system of any organization and its role in the success of the organization and its career.
3. As a student in the modern technological world, organizing or attending webinars is inevitable. Analyze the pros and cons of video conferencing by organizing webinars and preparing a report.
4. Form a team and act as a team leader. Prepare a performance appraisal report of the team using visual aids to support the presentation.
5. Make a detailed study on social networking and its impact on modern business and Career.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Meenakshi Raman, Prakash Singh, *Business Communication*, Oxford University Press, New Delhi, 2nd edition, 2012.
2. Neera Jain, Sharma Mukherji, *Effective Business Communication*, Tata Mc Graw–Hill

REFERENCE BOOKS:

1. Courtland L. Bovee et al., *Business Communication Today*, Pearson, New Delhi, 2011.
2. Krizan, *Effective Business Communication*, Cengage Learning, New Delhi, 2010.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/110105052
2. https://edurev.in/courses/14522_Business-Communication-The-Ultimate-Guide

Web Resources:

1. http://www.career.vt.edu/interviewing/TelephoneInterviews.html
2. http://job-search-search.com/interviewing/behavioral_interviews
3. https://goo.gl/laEHOY (dealing with complaints)
4. http://www.adm.uwaterloo.ca/infocecs/CRC/manual/resumes.html
5. https://goo.gl/FEMGXS
6. http://www.resumania.com/arcindex.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101701	**CIVIL ENGINEERING AND THE SOCIETY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on introduction to civil engineering, aesthetics of historic and modern civil engineering structures, unpredictable nature and the civil engineering; civil engineering solutions for the problems of traffic, pollution, water and waste management; building sustainable smart cities.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze principles of civil engineering to basic civil engineering problems following ethics and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze aesthetics of historic and modern civil engineering structures to solve complex civil engineering problems using tools and techniques by following ethics and latest trends considering society, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze unpredictable nature and the role of civil engineering to solve complex civil engineering problems using tools and techniques by following ethics and considering society, environment and sustainability besides communicating effectively in graphical form.

CO4. Analyze civil engineering solutions for the problems of traffic, pollution, water and waste management to solve complex problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO5. Analyze the building principles of sustainable smart cities to solve complex problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	-	-	-	2	3	2	-	1	-	1
CO2	3	3	-	1	2	2	2	2	-	1	-	1
CO3	3	3	-	1	2	2	2	2	-	1	-	-
CO4	3	3	-	1	2	2	2	2	-	1	2	-
CO5	3	3	-	1	2	2	2	2	-	1	2	-
Course Correlation Mapping	**3**	**3**	**-**	**1**	**2**	**2**	**2**	**2**	-	**1**	**2**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO CIVIL ENGINEERING ***(07 Periods)***

Philosophy of civil engineering, Disciplines of civil engineering, Evolution of construction and civil engineering in the world; Civil engineer - Duties and responsibilities, Role of Civil engineer in the society; Civil engineering materials and their applications, Latest advancements in civil engineering.

Module 2: AESTHETICS OF HISTORIC AND MODERN CIVIL ENGINEERING STRUCTURES ***(09 Periods)***

Aesthetics in civil engineering structures; Aesthetic principles and techniques - Analysis of materials, textures and colors in aesthetic design, Integration of aesthetics with structural engineering principles; Historic civil engineering structures - Case studies of iconic historic structures (e.g. Colosseum, Taj Mahal, Eiffel Tower); Modern civil engineering structures - Exploration of contemporary iconic structures (e.g. Burj Khalifa, Sydney Opera House, Golden Gate Bridge); Integration of aesthetics and functionality - Ethical considerations in balancing aesthetics, functionality and sustainability; Future trends in aesthetic engineering.

Module 3 UNPREDICTABLE NATURE AND THE CIVIL ENGINEERING ***(09 Periods)***

Unpredictable nature, Examples of unpredictable natural disasters - Earthquakes, Floods, Landslides, Hurricanes, Tsunamis, Impacts of unpredictable natural events on infrastructure; Role of civil engineering; Resilience in civil engineering - Strategies for building resilient structures, Risk assessment and analysis, Incorporating safety factors, Using robust construction materials, Implementing redundancy and backup systems, Sustainable design practices; Case studies of successful resilient designs.

Module 4 CIVIL ENGINEERING SOLUTIONS FOR THE PROBLEMS OF TRAFFIC, POLLUTION, WATER AND WASTE MANAGEMENT ***(11 Periods)***

Introduction to urban challenges and sustainable development; Traffic management solutions - Causes and impacts of traffic congestion, Intelligent transportation systems; Pollution control and environmental engineering, Sources and types of urban pollution, Air quality monitoring and control strategies, Water pollution control, Noise pollution management, Sustainable construction practices to reduce pollution; Water resource management, Water demand and supply management in urban areas, Rainwater harvesting techniques, Water conservation and wastewater treatment technologies; Waste management strategies, Solid waste generation and disposal challenges, Waste-to-energy conversion technologies, Case studies of successful waste management initiatives; Integration and synergies among Solutions, Multi-disciplinary approach for holistic solutions.

Module 5 BUILDING SUSTAINABLE SMART CITIES ***(09 Periods)***

Smart city; Elements of smart city infrastructure – Buildings, Mobility, Energy, Water, Waste management, Health and digital layers; Need for an integrated approach; Role of science, technology and innovation in the implementation of smart infrastructure; Smart infrastructure design principles and policies; Case studies: Gujarat International Finance Tech-City in India.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Group discussion on compatibility of modern construction materials compared to that of traditional civil engineering materials
2. Poster presentation on historic and modern civil engineering structures.

3. Submit a case study report on Life Cycle Analysis (LCA) of any one of the historic civil engineering structure.
4. Submit a case study report on the theme of severity of the natural disasters on the Civil engineering structures.
5. Debate on challenges, limitations and solutions for design and implementation of smart city.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. David Muir Wood., *Civil Engineering: A Very Short Introduction*, Oxford University Press, 1st Edition, 2012.
2. Roger Scruton, *The Aesthetics of Architecture*, Princeton University Press, 2nd Edition, 2013.

REFERENCE BOOKS:

1. Anubha Kaushik and C. P. Kaushik, *Perspectives in Environmental Studies*, New Age International (P) Ltd Publications, 6th Edition, 2018.
2. Sang Lee (Editor), *Aesthetics of Sustainable Architecture*, 010 publishers, 1st Edition, 2013.
3. Marc Kushner, *The Future of Architecture in 100 Buildings*, Simon and Schuster, 1st Edition, 2015.
4. Nicholas J. Garber and Lester A. Hoel, *Traffic and Highway Engineering*, Nelson Engineering, 1st Edition, 2008.
5. Stephen M. Wheeler and Timothy Beatley, *Sustainable Urban Development*, Reader Routledge Urban Reader Series, 3rd Edition, 2014.
6. Larry W. Mays, *Water Resources Engineering*, Wiley India Private Limited, 3rd Edition, 2011.
7. Hans Straub, *A History of Civil Engineering: An Outline from Ancient to Modern Times*, The MIT Press, 4th Edition, 1964.
8. Brian Vanden Brink, *Iconic: Perspectives on the Man-Made World*, Down East Books, Illustrated Edition, 2012.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/123/105/123105001/
2. https://onlinecourses.nptel.ac.in/noc22_ce42/preview
3. https://onlinecourses.nptel.ac.in/noc19_ce31/preview
4. https://onlinecourses.nptel.ac.in/noc20_ce07/preview

WEB RESOURCES:

1. https://bregroup.com/insights/aesthetics-in-architecture-how-beauty-and-design-are-inspiring-each-other/
2. https://keckwood.com/news-updates/how-civil-engineers-help-during-disaster-recovery/#:~:text=Civil%20engineers%20provide%20humanitarian%20and,shortages%20to%20hard%2Dhit%20communities
3. https://smartcities.gov.in/
4. https://www.twi-global.com/technical-knowledge/faqs/what-is-civil-engineering
5. https://www.ice.org.uk/engineering-resources/knowledge-resources/water-and-waste-water-management

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101701	**CONSTITUTION OF INDIA**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides and in-depth knowledge about Constitution of India's Preamble and its Philosophy; Union Legislature; Federalism in India; Judiciary and Public Services; Nation Building. The students can gain first-hand information and knowledge about these dynamics and accordingly act based on these sources in their professional and routine activities.

COURSE OUTCOMES: After successful completion of this course, the students will be able to:

CO1: Demonstrate knowledge in the Parliamentary proceedings, Election Commission, Public Services and Foreign Policy of India.

CO2: Apply the reasoning informed by the various aspects of the Constitution and its provisions to assess societal issues and the consequent responsibilities relevant to the professional engineering practice.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	1	-	-	-	-	3	2	-	-	-	-	-
CO2	2	-	-	-	-	3	-	3	-	-	-	-
Course Correlation Mapping	**2**	**-**	**-**	**-**	**-**	**3**	**2**	**3**	**-**	**-**	**-**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: PREAMBLE AND ITS PHILOSOPHY ***(9 Periods)***

Introduction to Indian Constitution; Evolution of Indian Constitution; preamble and its philosophy

Module 2: UNION LEGISLATURE ***(9 Periods)***

The Parliament, Parliamentary Structure, Process of Legislation; President of India – Powers and Functions; Prime Minister and Council of Ministers; Constitution Amendment Procedure.

Module 3: FEDERALISM IN INDIA ***(9 Periods)***

Centre-State Administrative Relationship; Governors – Powers and Functions; State Legislature - Composition and powers; Chief Ministers - Powers and Functions; The Election Commission – Powers and Functions.

Module 4: JUDICIARY AND PUBLIC SERVICES ***(9 Periods)***

The Union Judiciary - Supreme Court and High Court; Fundamental Rights and Duties All India Services - Central Civil Services -State Services - Local Services.

Module 5: INTERNATIONAL PARTICIPATION ***(9 Periods)***

Foreign Policy of India; International Institutions Influence: UNO, WTO, WHO, SAARC, International Summits: BRICS, NSS, UNEP – India's Role in International Negotiations; Environmentalism in India.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Review newspapers and submit a report on critical analysis of Indian Civil Servants exercise of powers, in the awake of constitutionally assigned authority.
2. Visit your village Panchayat office or Municipality office and generate a report on your observations about maintained Constitutional symbolism.
3. Watch few videos on recent Indian Independence Day and Republic Day celebrations as marked in New Delhi and present a detailed report, by considering the following aspects:
   a) Comparatively analyze the speeches of the President of India and Prime Minister of India as delivered on these two occasions.
   b) Compare these two events relevance in terms of Indian Armed Forces presence.
   c) Observe, compare and analyse 'flag code' relevance as marked in these two events.
4. Watch a few videos on recent 'proceedings' of any state Legislative Assembly session and submit a detailed report.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Briji Kishore Sharma, *Introduction to the Constitution of India*, Prentice Hall of India, 2005

REFERENCE BOOKS:

1. Mahendra Pal Singh,V. N. Shukla's, *Constitution of India*, Eastern Book Company, 2011.
2. Pandey J. N., *Constitutional Law of India*, Central Law Agency, 1998

VIDEO LECTURES:

1. Doctrine of Basic Structure: https://www.youtube.com/watch?v=cvUf9ZeEe8Y
2. Significance of the Constitution: https://www.youtube.com/watch?v=vr1Dc_-ZKbQ

Web Resources:

1. The Constitution of India: https://www.youtube.com/watch?v=of2SoO8i8mM
2. Protection of Constitutional Democracy: https://www.youtube.com/watch?v=smJ99cdPrns

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CM101702	COST ACCOUNTING AND FINANCIAL MANAGEMENT	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Cost accounting; cost sheet & preparation of cost sheet; standard costing & variance analysis; financial management & ratio analysis; introduction to investment**.**

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Demonstrate the concepts of Cost Accounting and Management Accounting and the elements of costing.

CO2 Determine the Cost of Production for pricing decisions.

CO3 Apply the Standard Costing and Variance techniques for the control of the cost of production

CO4 Analyze the Profitability and financial condition of an organization using Ratios.

CO5 Apply Capital Budgeting techniques for making investment decisions in an organization.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	2	-	-	1	-	-	-	-
CO2	3	-	-	-	2	-	-	1	-	-	1	-
CO3	3	-	-	-	2	-	-	1	-	-	1	-
CO4	3	-	-	-	2	-	-	1	-	-	1	-
CO5	3	-	-	-	2	-	-	1	-	-		-
Course Correlation Mapping	**3**	-	-	-	**2**	-	-	**1**	-	-	**1**	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: COST ACCOUNTING ***(09 Periods)***

Meaning of Cost and Cost Accounting, Objectives, Scope, Advantages, and Disadvantages – Cost Accounting *Vs* Management Accounting – Elements of Costing – Installation of costing system – Material Control, Labor Control, Overhead Control.

Module 2: COST SHEET & PREPARATION OF COST SHEET (09 Periods)

Analysis of Cost – Preparation of cost sheet, estimate, tender, and quotation (Simple problems) – Importance of Costing while pricing the products

Module 3 STANDARD COSTING & VARIANCE ANALYSIS (09 Periods)

Introduction to Standard Costing & Variances – Variance Analysis: Material variances, Labor variances (Simple Problems).

Module 4 FINANCIAL MANAGEMENT & RATIO ANALYSIS (09 Periods)

Meaning, Objectives - Nature and Scope, Importance of FM – Ratio Analysis**:** Types of Ratios: Solvency Ratios, Liquidity Ratios, Turnover Ratios, and Profitability Ratios - Financial Statement Analysis through Ratios (Simple Problems).

Module 5 INTRODUCTION TO INVESTMENT ***(09 Periods)***

Investment - Meaning and Definition- concept of risk and returns - Capital budgeting techniques – Security Analysis and Portfolio Management (Basic concepts).

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a report on the role of cost accountants in the growth of a company.
2. To visit the manufacturing unit to observe how they used various techniques for analyzing the financial health of a company.
3. Prepare a report on factors influencing the form of business organization.
4. Prepare the cost sheet with practical examples of any two manufacturing companies.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. S.P. Jain and K.L. Narang: *Cost Accounting*, Kalyani Publishers, Ludhiana, 10th edition, 2016.
2. I.M. Pandey, *Financial Management*, Vikas Publishing House Pvt. Ltd., 14th edition, 2016.

REFERENCE BOOKS:

1. The Institute of Company Secretaries of India, *Cost and Management Study Material*, New Delhi.
2. CA Saravana Prasath, *Cost Accounting and Financial management*, Wolters Kluwer India Pvt. Ltd., New Delhi, 2018.

VIDEO LECTURES:

1 https://www.youtube.com/watch?v=ESqO8sFgQa0&list=PLLhSIFfDZcUVE2kzOhEubO9rkvUOAgZbz

2 https://www.youtube.com/watch?v=tzasFmP1CpAhttps://www.youtube.com/watch?v=tzasFmP1CpA

WEB RESOURCES:

1 https://www.tutorialspoint.com/accounting_basics/management_versus_cost_accounting.htm

2 https://www.netsuite.com/portal/resource/articles/financial-management/financial-management.shtml

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101701	CYBER LAWS AND SECURITY	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Cyber Crimes and Indian IT Act; Cyber Offenses; Tools and Methods used in Cyber Crime; Phishing ad Identity Theft; Indian and Global Perspective on Cyber Crimes and Cyber Security; Organizational Implications on Cyber Security; IPR Issues; Cyber
Crime and Terrorism; Cyber Crime Illustrations

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge in Cyber security, Cybercrimes and its related laws in Indian and Global Act.
CO2. Analyze the legal perspectives and laws related to cybercrimes in Indian context.
CO3. Apply security and privacy methods in development of modern applications and in organizations to protect people and to prevent cybercrimes.
CO4. Solve Cyber security issues using privacy policies and Use antivirus tools to minimize the impact of cyber threats.
CO5. Apply security standards for the implementation of Cyber Security and laws.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	2	3	-	-	-	-	-	-	-	-	-
CO4	3	2	3	-	-	-	-	-	-	-	-	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**3**	-	-	-	-	-	-	-	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION TO CYBER CRIMES AND OFFENSES ***(09 Periods)***

Cyber Crimes: Introduction, Definition, Origin, Cybercrime and information security, Cyber criminals, Classifications of cybercrimes, The legal perspectives and Indian perspective, Cybercrime and Indian ITA 2000, Global perspective on cybercrimes.
Cyber Offenses: Introduction, Criminals planning on attacks, Social engineering, Cyber stalking, Cyber cafe and crimes, Botnets.

Module 2: TOOLS AND METHODS USED IN CYBER CRIME AND PHISHING AND IDENTITY THEFT ***(09 Periods)***

Introduction, Proxy servers and Anonymizers, Phishing, Password cracking, Key loggers and Spywares, Virus, Worms and Ransomware, Trojan horses and Backdoors, Steganography, DoS and DDoS attacks.
Phishing and Identity Theft: Introduction, Phishing, Identity Theft (ID Theft).

Module 3 CYBER CRIMES AND CYBER SECURITY-LEGAL PERSPECTIVES ***(08 Periods)***

Introduction, Cyber laws in Indian context, The Indian IT act, Challenges to Indian law and Cybercrime scenario in India, Consequences of not addressing the weakness in IT act, Digital signatures and the Indian IT Act, Cyber Crime and Punishment, Cyber law, Technology and Students in India scenario.

Module 4 CYBER SECURITY-ORGANIZATIONAL IMPLICATIONS ***(10 Periods)***

Introduction, Web threats for organizations – evils and perils, Security and privacy implications from cloud computing, Social Media Marketing-Security risks and Perils for organizations, Social computing and associated challenges for organizations, Protecting people's privacy in organization, Organizational guidelines for internet usage, Safe computing and Usage policy, Incident handling and Best practices.

Module 5 CYBER CRIME AND TERRORISMAND ILLUSTRATIONS ***(09 Periods)***

Cyber Crime & Terrorism: Introduction, Intellectual property in the cyber space, The ethical dimension of cybercrimes, The psychology, Mindset and skills of hackers and cyber criminals, Sociology of cyber criminals, Information warfare.

Cyber Crime Illustrations: Indian banks lose millions of rupees, Justice vs. Justice, Parliament attack, The Indian case of online gambling, Bank and credit card related frauds, Purchasing goods and services scam, Nigerian 419 scam.

Total Periods: 45

EXPERIENTIAL LEARNING

1. The Cyber Security Risks on Social Media – Learn from Case Studies: https://www.rswebsols.com/tutorials/internet/cyber-security-risks-social-media
2. SIX automates key cybersecurity tasks to actively protect itself against social media threats: https://www.hootsuite.com/resources/six-group-case-study
3. Important Cyber Law Case Studies : https://www.cyberralegalservices.com/detail-casestudies.php

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Nina Gobole, SunitBelapure, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley India, 2011.

REFERENCE BOOKS:

1. Prashant Mali, *Cyber Law and Cyber Crimes*, Snow White Publications Pvt. Ltd., 2013.
2. Alfred Basta and et al, *Cyber Security and Cyber Laws*, Cengage Learning India 2018

VIDEO LECTURES:

1. Learn Cyber Security | Cyber Security Training: https://www.youtube.com/watch?v=PlHnamdwGmw
2. Cyber Security For Beginners: https://www.youtube.com/watch?v=4RE4d23tDFw

WEB RESOURCES:

1. https://study.com/academy/course/computer-science-110-introduction-to-cybersecurity.html
2. https://www.pandasecurity.com/en/mediacenter/panda-security/types-of-cybercrime/
3. https://mediasmarts.ca/digital-media-literacy/digital-issues/cyber-security/cyber-security-spam-scams-frauds-identity-theft

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101701	ELECTRICAL SAFETY AND SAFETY MANAGEMENT	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION:
The course deals with the various aspects of potential risk due to electrical shock; safety precautions to be followed while working in hazardous zones; safe practices while handling various electrical equipment and during maintenance; and relevant electrical safety standards and Indian rules and acts.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the Indian electricity rules, regulations and various standards to be maintained for the safety of life and equipment.
CO2. Understand the potential effects of electrical shock and safety measures to protect against such risk.
CO3. Understand the safety aspects and safe practices to be followed while installing residential, commercial, and agricultural appliances.
CO4. Identify various hazardous working zones and take necessary precautionary measures while working in such areas.
CO5. Follow safety measures during installation, testing and commissioning, and maintenance of electrical equipment/plant.

CO-PO Mapping Table

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	1	3	1	3	-	-	-	1
CO2	3	-	-	-	1	2	2	-	-	-	-	1
CO3	3	-	-	-	1	2	2	-	-	-	-	1
CO4	3	-	-	-	2	3	2	2	-	-	-	1
CO5	3	-	-	-	-	3	2	2	-	-	-	1
Course Correlation Mapping	**3**	**-**	**-**	**-**	**1**	**3**	**2**	**3**	**-**	**-**	**-**	**1**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INDIAN ELECTRICITY RULES AND ACTS, AND THEIR SIGNIFICANCE ***(10 Periods)***

OSHA standards of electrical safety, Basic electrical safety rules as per OSHA; Objectives and scope of IE acts and IE rules, Ground clearance and Section Clearances, Clearance in transmission and distribution lines, Significance of Equipment Earthing, Earthing of equipment bodies, structures and non-current carrying metallic parts, Earthing of system neutral; Rules regarding first aid and firefighting facility, Electrical safety general requirements as per IE rules.

Module 2: INTRODUCTION TO ELECTRICAL SAFETY AND SAFETY MANAGEMENT ***(10 Periods)***

Electric Safety: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, Protection against electrical hazards and types, Effect of current on the human body, Principles of electrical safety and approach to prevent accidents.

Electric shocks and its prevention: Primary and secondary electrical shocks, possibilities of getting an electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns, Safety precautions in LV installations and electric plant.

Module 3: ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL, AND AGRICULTURAL INSTALLATIONS ***(08 Periods)***

Introduction—Wiring and fitting; Domestic appliances—water tap giving a shock, shock from wet wall, fan firing shock; Multi-storied building, Temporary installations, Agricultural pump installation; Do's and Don'ts for safety in the use of domestic electrical appliances; Principles of safety management in electrical plants, safety auditing, and economic aspects.

Module 4: ELECTRICAL SAFETY IN HAZARDOUS AREAS ***(07 Periods)***

Hazardous zones—class 0, 1 and 2; Sparks, flashovers and corona discharge in electrical plants; equipment for hazardous locations; scope for live line work, principles of live line maintenance, special tools for live line maintenance, safety instructions for working on HV lines/apparatus.

Module 5: SAFETY DURING INSTALLATION TESTING AND MAINTENANCE ***(10 Periods)***

Safety during installations: Preliminary preparations, preconditions for the start of installation work and safe sequence, safety aspects during installations of Transformers and Rotating machines.

Safety during testing: Purpose of commissioning checks and tests, equipment tests, high voltage energization tests, performance and acceptance tests, and safety aspects during commissioning.

Safety during maintenance: Operators' safety, Types of safety maintenance, Safety procedures, safety precautions during maintenance, and planning of maintenance.

Total Periods: *45*

EXPERIENTIAL LEARNING

1. Study and submit a report on various electrical safety standards followed in abroad countries.
2. Visit a nearby industry and submit a report on various safety measures followed in the industry.
3. Study and submit a report on standard practices followed during the maintenance/commissioning of the electrical apparatus in any industry.
4. Collect information about various safety/alert sign boards and the relative measures for a particular situation.
5. Should practice preliminary first aid assistance such as Cardiopulmonary resuscitation (CPR) and shall demonstrate.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rao, Prof. H.L. Saluja, *Electrical Safety, Fire Safety Engineering and Safety Management*, Khanna Publishers. New Delhi, 2nd Edition, 2018 Reprint.

REFERENCE BOOKS:

1. Cadick, John, Mary Capelli-Schellpfeffer, and Dennis K. Neitzel, *Electrical safety Handbook,* McGraw-Hill Education, 2012.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=g-ofq7i_u48

WEB RESOURCES:

1. https://cercind.gov.in/Act-with-amendment.pdf
2. https://www.edapp.com/blog/electrical-safety-training-topics/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22MG101701	ENTREPRENEURSHIP FOR MICRO, SMALL AND MEDIUM ENTERPRISES	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: To understand the setting up and management of MSMEs and initiatives of Government and other institutions support for growth and development of MSMEs

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic of SME and challenges of MSMEs

CO2. Explain the opportunities to Set-Up SSI/SME Units and role of rural & women entrepreneurship.

CO3. Illustrate roles of various institutions supporting MSMEs.

CO4. Understand Management of MSME, NPA & sickness units

CO5. Evaluate role of Government in Promoting Entrepreneurship

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	2	1	-	-	-	-	-	-	-	-
CO2	1	1	2	-	-	-	2	-	1	-	-	-
CO3	2	2	1	-	-	-	-	1	-	-	2	-
CO4	3	1	2	-	-	-	-	-	-	-	-	2
CO5	2	2	1	-	-	1	-	-	-	-	-	1
Course Correlation Mapping	**2**	**2**	**2**	**2**	**1**	**1**	**2**	**1**	1	**-**	**2**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: Introduction2 ***(07 Periods)***

Concept & Definition, Role of Business in the modern Indian Economy SMEs in India, Employment and export opportunities in MSMEs. Issues and challenges of MSMEs

Module 2: MSME Setting ***(09 Periods)***

Identifying the Business opportunity, Business opportunities in various sectors, formalities for setting up an enterprise - Location of Enterprise – steps in setting up an enterprise – Environmental aspects in setting up, Incentives and subsidies.

Module 3: MSMEs Supporting Institutions ***(09 Periods)***

Forms of Financial support, Long term and Short term financial support, Sources of Financial support, Development Financial Institutions, Investment Institutions, Central level institutions, State level institutions, Other agencies, Commercial Bank – Appraisal of Bank for loans

Module 4: Management of MSME ***(10 Periods)***

Management of Product Line; Communication with clients – Credit Monitoring System - Management of NPAs - Restructuring, Revival and Rehabilitation of MSME, Problems of entrepreneurs – sickness in SMI – Reasons and remedies –– Evaluating entrepreneurial performance

Module 5: Entrepreneurship Promotion ***(10 Periods)***

MSME policy in India, Agencies for Policy Formulation and Implementation: District Industries Centers (DIC), Small Industries Service Institute (SISI), Entrepreneurship Development Institute of India (EDII), National Institute of Entrepreneurship & Small Business Development (NIESBUD), National Entrepreneurship Development Board (NEDB)

Total Periods: 45

EXPERIENTIAL LEARNING

1. Present a case study on MSMEs Business Strategies.
2. Collect the data about nearby MSMEs and Present their structures in a PPT
3. Discuss in the group MSMEs opportunities in terms of Orientation and Develop mentation.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Vasant Desai, *Small Scale Industries and Entrepreneurship*, Himalaya Publishing House, 2003..
2. Poornima M Charanthimath, *Entrepreneurship Development Small Business Enterprises*, Pearson, 2006.

REFERENCE BOOKS:

1. Suman Kalyan Chaudhury, *Micro Small and Medium Enterprises in India Hardcover*, Raj Publications, 2013.
2. Aneet Monika Agarwal, *Small and medium enterprises in transitional economies, challenges and opportunities*, DEEP and DEEP Publications
3. Paul Burns & Jim Dew Hunt, *Small Business Entrepreneurship*, Palgrave Macmillan publishers, 2010.

VIDEO LECTURES:

1. https://sdgs.un.org/topics/capacity-development/msmes
2. https://blog.tatanexarc.com/msme/msme-schemes-in-india-for-new-entrepreneurs-and-start-ups/

Web Resources:

1. ncert.nic.in/textbook/pdf/kebs109.pdf
2. https://www.jetir.org/papers/JETIR1805251.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101702	ENVIRONMENTAL POLLUTION AND CONTROL	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on fundamentals of air pollution, dispersion of pollutants, effects and control of air pollution, water pollution, soil pollution and control, and municipal solid waste management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Analyze air and noise pollution using appropriate tools and techniques to solve complex environmental issues following relevant standards considering society, environment and sustainability besides communicating effectively in graphical form.

CO2 Analyze air and noise pollution control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO3 Analyze water pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO4 Analyze soil pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO5 Analyze solid waste and its management measures using appropriate tools and techniques to solve solid waste disposal issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	3	-	2	2	3	3	2	-	1	-	-
CO2	2	3	-	2	2	3	3	2	-	1	-	1
CO3	2	3	-	2	2	3	3	2	-	1	-	1
CO4	2	3	-	2	2	3	3	2	-	1	-	1
CO5	2	3	-	2	2	3	3	2	-	1	1	1
Course Correlation Mapping	**2**	**3**	**2**	**2**	**2**	**3**	**3**	**2**	**-**	**1**	**1**	**1**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: AIR AND NOISE POLLUTION ***(08 Periods)***

Air Pollution: Scope, Significance, Classification, Sources – Line, Area, Stationary, Mobile; Effects of air pollutants on man, material and vegetation; Global effects of air pollution; Air pollution meteorology - Lapse rate, Inversion, Plume pattern; Dispersion of air pollutants - Dispersion models and applications; Ambient air quality standards.
Noise Pollution: Sound pressure, Power and intensity, Impacts of noise, permissible limits of noise pollution, measurement of noise, Noise standards.

Module 2: AIR AND NOISE POLLUTION CONTROL ***(10 Periods)***

Self-cleansing properties of the environment, Dilution method, Control at source, Process changes and equipment modifications, Control of particulates – Types of equipment, Design and operation - Settling chambers, Centrifugal separators, Bag house filters, Wet scrubbers, Electrostatic precipitators; Control of gaseous pollutants – Adsorption, Absorption, Condensation, Combustion; Control of air pollution from automobiles, Control of noise pollution, Case studies, Latest developments in the air and noise pollution control.

Module 3: WATER POLLUTION AND CONTROL ***(10 Periods)***

Water pollution – Sources, Causes, Effects; Surface and groundwater quality – Physical, Chemical, Biological; Drinking water quality standards, Water purification – Processes, Engineered systems – Aeration, Solids separation, Settling operations, Coagulation, Softening, Filtration, Disinfection; Wastewater – Sources, Causes, Effects, Treatment process and disposal – Primary, Secondary, Tertiary; Case studies, Latest developments in the water pollution control.

Module 4: SOIL POLLUTION AND CONTROL ***(08 Periods)***

Soil pollutants, Sources of soil pollution, Causes, Effects and control of soil pollution, Diseases caused by soil pollution, Methods to minimize soil pollution, Effective measures to control soil pollution, Soil quality standards, Case studies, Latest developments in the soil pollution control.

Module 5: MUNICIPAL SOLID WASTE MANAGEMENT ***(09 Periods)***

Municipal solid waste – Types, Composition and characteristics; Methods of collection and transportation; Methods of disposal – Open dumping, Sanitary landfill, Composting and Incineration; Utilization - 6R Concept, Recovery and recycling and Energy Recovery; Latest developments in solid waste management.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Explain plume patterns due to air pollution and meteorology effects and draw a neat sketch of plume pattern from any chimney that you have observed in recent times.

2. Compare the different air pollution control equipment used in India and draw a neat sketch line diagram of equipment you have seen in any of your industrial visit.

3. Submit a study report on Coagulation, Flocculation, Sedimentation, Filtration and Disinfection in your own words after watching a YouTube video on water treatment.

4. Enumerate the effective measures to control soil pollution with any two case studies.

5. Submit a report on case studies on the use of 6Rs concept of Municipal Solid Waste Management.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Peavy, H. S, Rowe, D. R., and Tchobanoglous, G., *Environmental Engineering*, McGraw Hill Inc., 1985.
2. C. S. Rao, *Environmental Pollution Control Engineering*, New Age International Pvt. Ltd., 2nd Edition, 2007.
3. Ibrahim A. Mirsa, *Soil Pollution: Origin, Monitoring & Remediation*, Springer, UK, 2nd Edition, 2008.

REFERENCE BOOKS:

1. M. N. Rao and H. V. N. Rao, *Air Pollution,* Tata McGraw–Hill Education Pvt. Ltd., 19th Edition, 2010.
2. Daniel Vallero, *Fundamentals of Air Pollution,* Academic Press (Elsevier), 5th Edition, 2014.
3. S. M. Khopkar, *Environmental Pollution Monitoring and Control,* New Age International Pvt. Ltd., 2nd Edition, 2007.
4. V. M. Domkundwar, *Environmental Engineering*, DhanpatRai & Co. Pvt. Ltd., New Delhi, 2014.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/123/105/123105001/
2. https://archive.nptel.ac.in/courses/105/107/105107213/
3. https://archive.nptel.ac.in/courses/103/107/103107084/

WEB RESOURCES:

1. https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200501211601643 5Ranvijay-Pratap-Singh-Environmental-Pollution.pdf
2. https://www.deshbandhucollege.ac.in/pdf/resources/1585622878_HIST_(HONS.)_II_Env-Pollution.pdf
3. https://www.jica.go.jp/jica-ri/IFIC_and_JBICI-Studies/english/publications/reports/study/topical/health/pdf/health_08.pdf
4. https://www.iitr.ac.in/wfw/web_ua_water_for_welfare/education/proceeding_of_short-term_training/diploma/Environmental_Sciences_May_24-28_2007/Lecture_notes/Env_Pollution-rb.pdf
5. https://anits.edu.in/online_tutorials/es/Unit%203.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101702	**ESSENTIALS OF VLSI**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course contains the topics that make student realize the need for Testing. The various types of testing along with Fault Modeling. Test methods for evaluation and test generation algorithms, Delay Tests, IDDQ Tests for testing the circuits , Ad-Hoc DFT Methods, Scan Based Designs, Built-In Self Test.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the importance of Testing, fault models and related theorems.

CO2. Analyze various test methods as applicable to digital circuits.

CO3. Appraise the various combinational and sequential circuit test generation algorithms for functional verification of digital circuits

CO4. Assess delay test algorithms and IDDQ test algorithms for at-speed testing of CMOS Integrated Circuits.

CO5. Recognize the concepts and architectures for Built-In Self Test to satisfy industry specifications.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	
CO3	3	3	2	2	2	-	-	-	-	-	-	-
CO4	3	3	2	2	2	-	2	3	-	-	-	-
CO5	3	-	-	-	-	-	-	3	-	-	-	-
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**	**-**	**2**	**3**	**-**	**-**	**-**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION TO VLSI ***(09 Periods)***

Levels of Abstraction, VLSI Design Flow, MOS Transistor - Characteristics, I_{DS} – V_{DS} Relation, NMOS and CMOS Logic – Logic Gates Design, NMOS and CMOS Fabrication Process.

Module 2: CMOS CIRCUIT DESIGN PROCESS ***(10 Periods)***

MOS Layers, Stick Diagrams, NMOS and CMOS Design Styles, Lambda based Design Rules, NMOS and CMOS Layouts for Inverter and Universal Gates, Sheet Resistance, Capacitance and Delay Calculations, Effects of Scaling.

Module 3: SUBSYSTEM DESIGN ***(11 Periods)***

Adders – Manchester Carry Chain Adder, Carry Look Ahead Adder, Carry Select Adder, Carry Skip adder, Barrel Shifter, Multiplier – Array Multiplier, Booth Multiplier.

Module 4: PROGRAMMABLE HARDWARE ***(06 Periods)***

Design Styles, Programmable Interconnects, Field Programmable Gate Arrays, Complex Programmable Logic Devices, Cell based Design Methodology.

Module 5: DESIGN FOR TESTABILITY ***(09 Periods)***

Ad-Hoc DFT Methods, Full Scan Design, Partial Scan Design, Random Logic BIST – Test-per-Clock and Test-per-Scan BIST Systems; Boundary Scan Standard – TAP Controller and Port.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Develop and Illustrate D – algorithm for Sequential Circuits.
2. Illustrate the applicability of existing testing algorithms for circuits with multiple stuck-at-faults.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Michael L. Bushnell, Vishwani D. Agrawal*, Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits,* Kluwer Academic Pulishers, Springer US, New York, 2006.

REFERENCE BOOKS:

1. Miron Abramovici, Melvin A. Breur, Arthur D.Friedman, *Digital Systems Testing and Testable Design*, Wiley, Jaico Publishing House, 1st Edition, 2001.

2. Alfred L. Crouch, *Design for Test for Digital ICs & Embedded Core Systems*, Pearson Education, 1st Reprint Edition, 2007.
3. Robert J.Feugate, Jr., Steven M.Mclntyre, *Introduction to VLSI Testing*, Prentice Hall, 1st Illustrated Edition, 1998.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/117105137
2. https://nptel.ac.in/courses/117103125
3. https://nptel.ac.in/courses/106103016
4. https://archive.nptel.ac.in/courses/106/103/106103116/

Web Resources:

1. https://www.electronics-tutorial.net/vlsi-design-for-testability/IC-Testing.html
2. https://alexromanov.github.io/2022/08/14/what-is-testability/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101702	**INTRODUCTION TO ETHICAL HACKING**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on ethical hacking overview, role of security and penetration testers, foot printing, reconnaissance and scanning networks, enumeration and vulnerability analysis, system hacking, network protection systems.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand and recognize role of security and penetration testers to protect the system from malware attacks.
CO2. Apply the foot printing tools to find the vulnerabilities in the system.
CO3. Analyze vulnerabilities to find the system security loopholes or flaws in networked systems within a given range of IP
CO4. Apply the web attackers tools to assess the website's security
CO5. Identify the possible incidents and threats, alert administrators, and prevent potential attacks using IDS

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	-	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-
CO5	3	2	3	2	-	-	-	-	-	-	-	-
Course Correlation mapping	**3**	**3**	**3**	**2**	-	-	-	-	-	-	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION ***(10 Periods)***

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.

Module 2: FOOT PRINTING, RECONNAISSANCE AND SCANNING NETWORKS ***(09 Periods)***

Foot printing Concepts, Foot printing through Search Engines, Web Services, Social Networking Sites, Website, Email, Competitive Intelligence, Foot printing through Social Engineering, Foot printing Tools, Network Scanning Concepts, Port-Scanning Tools, Scanning Techniques, Scanning Beyond IDS and Firewall

Module 3: ENUMERATION AND VULNERABILITY ANALYSIS ***(09 Periods)***

Enumeration Concepts, NetBIOS Enumeration, SNMP, LDAP, NTP, SMTP and DNS Enumeration, Vulnerability Assessment Concepts, Desktop and Server OS Vulnerabilities, Windows OS Vulnerabilities, Tools for Identifying Vulnerabilities in Windows, Linux OS Vulnerabilities, Vulnerabilities of Embedded Oss.

Module 4: SYSTEM HACKING ***(10 Periods)***

Hacking Web Servers, Web Application Components, Vulnerabilities, Tools for Web Attackers and Security Testers Hacking Wireless Networks, Components of a Wireless Network, Wardriving, Wireless Hacking, Tools of the Trade.

Module 5: NETWORK PROTECTION SYSTEMS ***(07 Periods)***

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 Periods: 45

EXPERIENTIAL LEARNING

1. List out various ways used to Protect Yourself from Hackers.
2. Demonstrate how do White Hackers work?
3. Demonstrate The bug bounty program.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Michael T. Simpson, Kent Backman, and James E. Corley, *Hands-On Ethical Hacking and Network Defense, Course Technology*, Delmar Cengage Learning, 2010.
2. Patrick Engebretson, *The Basics of Hacking and Penetration Testing*, SYNGRESS, Elsevier, 2013.

REFERENCE BOOKS:

1. Dafydd Stuttard and Marcus Pinto, *The Web Application Hacker's Handbook: Finding and Exploiting Security Flaws*, Wiley, 2nd Edition, 2011.
2. Justin Seitz, *Black Hat Python: Python Programming for Hackers and Pentesters*, 2nd Edition, 2014.

VIDEO LECTURES:

1. https://www.coursera.org/learn/ethical-hacking-essentials-ehe
2. https://www.udacity.com/course/ethical-hacker-nanodegree--nd350

WEB RESOURCES:

1. https://github.com/PacktPublishing/Python-Ethical-Hacking
2. https://www.youtube.com/watch?v=x3IwvPvDpKE

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101703	**FORENSIC SCIENCE**	3	-		-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Concepts of Forensic Science, Tools and Techniques in Forensic Science, Forensic Photography, Crime Scene Management, Crime Scene Management Laws and Forensic Science.

COURSE OUTCOMES: *After successful completion of the course, students will be able to*:

CO1 Understand the basic concepts of Forensic science.
CO2 Apply various tools and techniques in forensic science for crime investigation.
CO3 Understand Forensic Photography fundamentals.
CO4 Perform Crime scene investigation, scene reconstruction and prepare reports.
CO5 Understand Legal aspects of Forensic Science.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	2	2	-	-	-	-	-	-	-
CO5	3	3	2	2	2	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**2**	**2**	**2**	-	-	-	-	-	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION ***(09 Periods)***

Introduction, Need, Scope, Concepts and Significance of Forensic Science, History and Development of Forensic Science, Laws and Basic principles of Forensic Science, Branches of forensic science, Organizational set-up of a Forensic Science Laboratory. Investigative strategies. Expert testimony and eye-witness report.

Module 2: TOOLS AND TECHNIQUES IN FORENSIC SCIENCE ***(09 Periods)***

Basic principles of microscopy, spectroscopy, chromatography, Electrophoresis, Enzyme_Linked Immunosorbent Assay (ELISA), Radio Immuno Assay (RIA). Measuring and optical instruments. Research methodologies; Formation of research design on a specific problem. Central tendency and Dispersion. Test of significance. Analysis of variance, Correlation and Regression.

Module 3: FORENSIC PHOTOGRAPHY ***(8 Periods)***

Basic principles of Photography, Techniques of black & white and color photography, cameras, lenses, shutters, depth of field, film; exposing, development and printing techniques; Different kinds of developers and fixers; UV, IR, fluorescence illumination guided photography; Modern development in photography- digital photography, working and basic principles of digital photography; Surveillance photography. Videography and Crime Scene & laboratory photography.

Module 4: CRIME SCENE MANAGEMENT ***(11 Periods)***

Crime scene investigations, protecting and isolating the crime scene; Documentation, sketching, field notes and photography. Searching, handling and collection, preservation and transportation of physical evidences, Chain of custody and Reconstruction of scene of crime. Report writing.

Module 5: LAW AND FORENSIC SCIENCE ***(8 Periods)***

Legal aspects of Forensic Science: Forensic Science in the Criminal Justice System, The Criminal Investigation Process, Production of Evidence: The Subpoena, The Rules of Evidence, Authentication of Evidence: The Chain of Custody, The Admissibility of Evidence, Laboratory Reports, Examples of Analysis and Reports, Expert Testimony, Getting into Court, Testifying, Being a Witness and an Expert, Considerations for Testimony.

Total Periods: 45

EXPERIENCIAL LEARNING

1. Study of Computer Forensics and different tools used for forensic investigation
2. Identify and list the steps for hiding and extract any text file behind an image file/ Audio file using Command Prompt

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Houck M.M and Siegel J.A, *Fundamentals of Forensic Science*, Elsevier, 2nd edition, 2010.
2. Sharma B.R, *Forensic Science in Criminal Investigation and Trials*, Universal Publishing Co., New Delhi, 2003.

REFERENCE BOOKS:

1. Nanda B.B and Tewari, R.K, *Forensic Science in India- A vision for the Twenty First Century*, Select Publisher, New Delhi, 2001.
2. James, S.H and Nordby, J.J, *Forensic Science- An Introduction to Scientific and Investigative Techniques*, CRC Press, USA, 2003.
3. Saferstein, Criminalistics, *An Introduction of Forensic Science*, Prentice Hall Inc, USA,2007.

4. Barry, A.J. Fisher, *Techniques of Crime Scene Investigation*, CRC Press, NewYork, 7th edition, 2003.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106178
2. https://www.youtube.com/watch?v=X5fo1H7bc0g

WEB RESOURCES:

1. https://www.nist.gov/forensic-science
2. https://www.coursera.org/learn/forensic-science

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101702	**GENDER AND ENVIRONMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Gender and the environment relationship, Gendered Roles in the Family & Community, Gender and sustainable development, Gender in environmental justice, Gender & Environmental Security.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Apply the knowledge of gender & environmental connections by analyzing key issues and topics within global environmental politics in environmental decision-making.

CO2 Demonstrate knowledge of the concepts of gender and sustainable development through debates and policy documents.

CO3 Analyze the concept of environmental security and justice by identifying the sources of insecurity.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	-	-	-	3	3	-	-	-	-	-
CO2	3	-	-	-	-	2	3	1	-	2	-	-
CO3	3	1	-	-	-	3	3	-	-	-	-	2
Course Correlation Mapping	**3**	**1**	**-**	**-**	**-**	**3**	**3**	**1**	**-**	**2**	**-**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: GENDER AND ENVIRONMENT RELATIONSHIP ***(09 Periods)***

Introduction – Gender and Environment – Development of gender roles – Society, gender & environment – Understanding environmental politics – Gender-environment connections– Eco-feminism – Cultural eco-feminism – Social eco-feminism – Feminist political ecology

Module 2: GENDERED ROLES IN THE FAMILY & COMMUNITY ***(09 Periods)***

Organization of the household – Domestic division of labour – Food: growing, harvesting, shopping, preparing, and cooking

Gender & Power – Planning – Politics – NGO – Gendering of environmental protest – Environmental decision-making

Module 3: GENDER AND SUSTAINABLE DEVELOPMENT ***(09 Periods)***

Concept of sustainability & its achievement – Concept of sustainable development – Ecological Modernization – Gender & sustainability debates – Gender & sustainable development debates - Gender in policy documents – Gender, poverty & equity in sustainable development

Module 4: GENDER IN ENVIRONMENTAL JUSTICE ***(09 Periods)***

Normative Concerns (Fairness, Inequality & Justice) –Making sense of Environmental justice – Ecological debt, Transnational harm, & human rights – Ecological justice – Gender &Environmental Justice – Gender, Vulnerability & risk – Women in environmental justice movements – Knowledge & participation – Gender, sustainability & justice as guiding concepts.

Module 5: GENDER AND ENVIRONMENTAL SECURITY ***(09 Periods)***

Connections between security & the environment – **Gender, environment & security:** Sustainability as security – poverty & insecurity – Insecurity as injustice – Competing ways of thinking security – Reflecting on sources of insecurity – **Case Study** – Food Security - **Case Study** – The impacts of natural disasters

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a poster presentation on the impact of globalization on family structure and society.
2. Prepare a presentation on the family setup of different countries and their peculiar customs.
3. Prepare poster presentation on "Ancient hominin walked like a human but climbed like an ape."
4. Find out the problems of present society and being part of future generations how you may help to strengthen environmental security.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Nicole Detraz, *Gender and the Environment,* Polity Press, Cambridge, UK. 2017
2. Susan Buckingham- Hatfield, *Gender and Environment*, Routledge, London. 2000

REFERENCE BOOKS:

1. Promillakapur ed., *Empowering Indian Women*, Publication Division, Government of India, New Delhi. 2000.
2. Ronnie Vernooy, Ed., *Social and Gender Analysis Natural Resource Management: Learning Studies and Lessons from Asia,* Sage, New Delhi. 2006
3. Swarup Hemlata and Rajput, Pam, *Gender Dimensions of Environmental and Development Debate: The Indian Experience,* In Sturat S. Nagel, (ed). *India's Development and Public Policy*. Ashgate, Burlington. 2000

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101701	GLOBAL STRATEGY AND TECHNOLOGY	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION:
Introduction to strategic management; Strategic management process; Principles of good strategy; Globalization strategies; Research and Development strategies; Technology Management and Transfer; Elements of Transfer Process; Corporate Governance in the Indian scenario.

COURSE OUTCOMES:
After successful completion of the course, students will be able to:

CO1 Demonstrate the knowledge on strategic management, its approaches, and tools through ethical decision making.

CO2 Analyse the globalization challenges for scrupulous selection of globalization strategies.

CO3 Apply the R&D strategies and trends to enhance the technological breakthroughs for new products and applications.

CO4 Demonstrate the knowledge on technology management and transfer that strengthen the economy and accelerate the application of technology and resources.

CO5 Analyze the challenges of corporate governance in Indian scenario for the effective development of value-oriented organizations.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	1	-	1	1	-	1	-	-	1	-
CO2	3	2	1	-	1	1	-	-	-	-	1	-
CO3	3	2	1	-	1	1	-	-	-	-	1	-
CO4	3	2	1	-	1	1	-	-	-	-	1	-
CO5	3	2	1	-	1	1	-	1	-	-	1	-
Course Correlation Mapping	**3**	**2**	**1**	**-**	**1**	**1**	**-**	**1**	**-**	**-**	**1**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: STRATEGIC MANAGEMENT (09 Periods)
Introduction, Classes of decisions, Levels of strategy, Core competence, Strategic intent and stretch, Approaches to strategy making, Roles of different strategists, Strategic Management-Process, Benefits, Limitations; Ethics in strategic decision making, Principles of good strategy, Strategic Management in India; Common managerial strategy formulation tools.

Module 2: GLOBALIZATION (09 Periods)

Definition, Stages, Essential conditions for globalization, Globalization strategies, Competitive advantage of Nations and regions, Factors affecting Globalization, Globalization of Indian business.

Module 3: RESEARCH & DEVELOPMENT STRATEGIES (09 Periods)

Concept, Evolution of R and D Management, R and D as a business, R and D as competitive advantage, Elements of R and D strategies, Integration of R and D, Selection and implementation of R and D strategies, R and D trends and challenges.

Module 4: TECHNOLOGY MANAGEMENT AND TRANSFER (09 Periods)

Technology Management: Introduction, Technology-Definition, Components, Classification Features; Technology Management-Concept, Nature; Drivers of Management of Technology-Significance, Scope, Responding to technology challenges.

Technology Transfer: Introduction, Definition, Classification, Significance, Elements of process, Types of Technology Transfer, Package, Modes of Transfer, Routes, Channels and Effectiveness of Technology Transfer.

Module 5: CORPORATE GOVERNANCE: THE INDIAN SCENARIO (09 Periods)

Emergence of corporate governance in India-Landmarks, Models, Codes and status in India, Role and Responsibilities of Regulators, The Board of Directors; Corporate Governance- Specific issues in India, Family-owned Business, Corporate Governance and the Indian ethos.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Case studies: Using real-world examples of global businesses and their technological strategies, students can examine the challenges and opportunities presented by different markets and technologies. This can involve analyzing data, conducting market research, and making decisions based on their findings.

2. Simulation games: Students can participate in simulation games that allow them to make decisions about global strategy and technology in a virtual environment. This can help them understand the complexities of international business, such as navigating different cultures, regulations, and economic systems.

3. Industry partnerships: Partnerships with technology companies and global businesses can provide students with hands-on experience in global strategy and technology. This can include internships, shadowing, or working on real projects with industry professionals.

4. Project-based learning: Students can work on real-world projects that require them to apply their knowledge of global strategy and technology. This can include developing a business plan for a new product or service, designing a marketing campaign for a global audience, or analyzing the impact of a new technology on a specific industry.

5. Field trips: Visiting international businesses or attending technology conferences can provide students with a first-hand look at global strategy and technology in action. This can help them understand the challenges and opportunities of different markets and technologies, as well as connect with industry professionals.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

CASE STUDIES:

1. Tesla: Can Elon Musk's electric car company succeed globally?
2. Uber: How the ride-sharing giant is expanding its global footprint.
3. Alibaba: How China's e-commerce giant is competing on the global stage.
4. Airbnb: How the home-sharing platform is disrupting the global hotel industry.
5. Netflix: How the streaming service is expanding globally and adapting to local markets.

ARTICLES:

1. "Digital Transformation: Why it Matters for Global Business" by Forbes
2. "How AI is Changing Global Business Strategy" by Harvard Business Review
3. "The Future of Globalization: Exploring the Role of Technology" by World Economic Forum
4. "Globalization 4.0: What it Means for Technology and Strategy" by McKinsey & Company
5. "How Technology is Transforming Global Supply Chains" by MIT Sloan Management Review

RESOURCES

TEXT BOOKS:

1. Francis Cherunilam, *Strategic Management*, Himalaya Publishing House, 3rdEdition, 2002.

2. C. S. G. Krishnamacharyulu and Lalitha Ramakrishnan, *Management of Technology*, Himalaya Publishing House, Second Edition, 2012.

REFERENCE BOOKS:

1. White and Bruton, *The Management of Technology and Innovation: A Strategic Approach*, Cengage Learning, 1stEdition, 2007.
2. S.K.Mandak, *Ethics in Business and Corporate Governance*, TMH, 2ndEdition, 2012.

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/110106157/L01.html
2. https://www.digimat.in/nptel/courses/video/110106157/L43.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101704	**GREEN TECHNOLOGIES**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on green technology concepts, the role of industry and government in establishing green energy footprints and cleaner development mechanisms. It also presents energy-efficient and sustainable green production systems, concepts of energy ecosystems, and concepts of green buildings.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the green technology concepts and the consequences of greenhouse gas emissions.
CO2. Acquire basic knowledge on cleaner development mechanism, the importance of re-use of materials, and the oxidation technology for wastewater.
CO3. Go beyond energy-efficient machinery, biofuels, and environmentally friendly materials.
CO4. Acquire basic knowledge on man-made ecosystems, sources, and control of pollution.
CO5. Understand the concepts and requirements for green buildings.

CO-PO Mapping Table

Course Outcome	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	3	-	-	-	-	1
CO2	3	-	-	-	-	-	3	-	-	-	-	1
CO3	3	-	-	-	-	-	3	-	-	-	-	1
CO4	3	-	-	-	-	-	3	-	-	-	-	1
CO5	3	-	-	-	-	-	3	-	-	-	-	1
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**-**	**3**	-	-	-	-	**1**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION TO GREEN TECHNOLOGY ***(09 Periods)***

Green technology-definition, importance, factors affecting green technology. Global atmosphere- green house gases, global warming, acid rain, ozone depletion and photochemical smog. Role of industry, government and institutions; industrial ecology, role of industrial ecology in green technology.

Module 2: CLEANER DEVELOPMENT TECHNOLOGIES ***(08 Periods)***

Cleaner development mechanisms, role of industry; reuse, reduce and recycle, raw material substitution; wealth from waste; carbon credits, carbon trading, carbon sequestration, eco labeling. Oxidation technology for wastewater treatment - cavitation, fenton chemistry, photocatalysis and hybrid processes.

Module 3: ENERGY EFFICIENT SYSTEMS AND PROCESSES ***(09 Periods)***

Energy efficient motors, energy efficient lighting, control and selection of luminaries; bio-fuels, fuel cells- working, selection of fuels, Green manufacturing systems, selection of recyclable and environment friendly materials in manufacturing, design and implementation of sustainable green production systems.

Module 4: ENERGY ECOLOGY AND ENVIRONMENT ***(08 Periods)***

Concept and theories of ecosystems - energy flow in major manmade ecosystems- agricultural, industrial and urban ecosystems - sources of pollution from energy technologies and its impact on atmosphere - air, water, soil, and environment - environmental laws on pollution control – innovation and sustainability: - eco-restoration / phyto-remediation, renewable energy technologies, industrial ecology and agro ecology.

Module 5: GREEN BUILDINGS ***(10 Periods)***

Definition- Features and benefits, Fundamental planning decisions for energy efficient building- site selection, buildings forms and orientations, building fabrics and insulation, ventilation, passive solar features. Eco-friendly and cost effective materials, energy management. Rooftop solar photovoltaic system and solar tracking system, alternating roofing systems.

Total Periods: 45

EXPERIENTIAL LEARNING

1. The student shall prepare a report on the causes of global warming and should suggest possible remedies for reducing the global warming
2. The student shall prepare a report on the wastewater management system.
3. The student shall prepare a report on controlling pollution in the environment.
4. The student shall observe the various considerations in a greenhouse building and should prepare the report on the observations made and should suggest possible avenues for improvement.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. Khan B.H, *Non conventional energy resources*, Tata McGraw-Hill, New Delhi 2006.
2. Paul L. Bishop, *Pollution prevention –Fundamentals and Practices*, McGraw-Hill-international 2000.

REFERENCE BOOKS:

1. P. Aarne Veslind, *Introduction to environmental engineering*, Cenage Learning 2010.
2. Joseph A. Salvato, *Environmental engineering,* Wiley
3. Tom D Reynolds, *Unit operations and processes in environmental engineering*, PWS Publishing.
4. D. Y. Goswami, F. Kreith and J. F. Kreider, *Principles of Solar Engineering*, Taylor and Francis.
5. C. S. Solanki, *Solar Photovoltaics: Fundamental Applications and Technologies*, Prentice Hall.

WEB RESOURCES:

1. N. Vinutha bai, R. Ravindra, Energy efficient and green technology concepts, International Journal of Research in Engineering and Technology p 253-258, Volume: 03 Special Issue: 06, 2014, eISSN: 2319-1163 pISSN: 2321-7308.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101702	**HUMAN RESOURCE MANAGEMENT**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION:
Concepts of HRM; Environmental Scanning; Human Resource Planning; Job analysis; Job design; Job evaluation; Recruitment; Selection; Placement; Orientation; Training and Development; Performance appraisal; Merit rating; Compensation; Industrial relations; Trade unions; Industrial disputes; Ethical issues; Employee safety.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1. Demonstrate the knowledge on the principles, processes and practices of human resource management.
CO2. Analyze the key issues related to administering the human elements such as motivation, recruitment, training and development, compensation, appraisal, and career development.
CO3. Provide solutions to plan and manage human resource functions effectively within organization.
CO4. Apply HRM concepts and techniques in strategic planning to improve organizational effectiveness.
CO5. Evaluate HRM related social, cultural and safe responsibilities and issues in a global context.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	2	1	1	-	1	-	-	-	-	-	-
CO2	3	3	1	1	-	1	-	-	-	-	-	-
CO3	3	2	3	1	-	-	-	-	-	-	-	-
CO4	2	1	1	1	3	1	-	-	-	-	-	-
CO5	3	1	1	1	1	1	2	3	-	-	-	-
Course Correlation Mapping	**3**	**2**	**1**	**1**	**2**	**2**	**2**	**3**				

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION TO HRM & HRP ***(09 Periods)***
Introduction to Human Resource Management (HRM): Objectives, Scope and significance of HRM, Functions of HRM, Prospects in HRM, Environmental scanning.

Human Resource Planning (HRP): Introduction, Nature and importance of HRP, Factors affecting HRP, The planning process, Human resource planning and the Government, Requisites for successful HRP, Barriers to HRP.

Module 2: RECRUITMENT AND PLACEMENT ***(09 Periods)***

Job Analysis – Nature and process of job analysis, Methods of collecting job data, Potential problems with job analysis, Requisites for job analysis; Job Design - Factors, Job design approaches, Contemporary issues; Job evaluation - Process, Methods; Recruitment - Nature, Purposes and importance, Factors governing recruitment, Recruitment process, Evaluation and control; Selection – Nature, Process, Barriers to effective selection, Evaluation of selection process, Placement; Separation.

Module 3: HUMAN RESOURCE DEVELOPMENT AND COMPENSATION ***(09 Periods)***

Orientation - Orientation programme, Requisites of an effective programme, Evaluation of orientation programme, Problems of orientation; Training and development – Nature, Inputs, Training process, Methods, Impediments to effective training, Management development, Career development, Talent management; Performance Appraisal - Nature, Appraisal process, Challenges of performance appraisal; Merit rating; Compensation - Philosophy, Components, Theories, Factors influencing employee compensation, Challenges, Wage and salary administration.

Module 4: INDUSTRIAL RELATIONS AND TRADE UNIONS ***(09 Periods)***

Industrial Relations (IR): Nature of IR, Importance of Peaceful IR; Approaches to IR - Unitary Approach, Pluralistic approach, Marxist approach; Parties to IR; IR strategy; Industrial Disputes - Nature, Causes, and Settlement.

Trade unions: Nature of trade unions, Strategic choices before unions, Union tactics, Trade union movement in India, Trends in trade union movement, Managing unions; Indian Factories Act; Employee's compensation Act; Industrial disputes Act.

Module 5: ETHICAL ISSUES AND SAFETY ADMINISTRATION ***(09 Periods)***

Managing Ethical Issues in HRM: Nature of ethics, Sources of business ethics, Myths about ethics, Ethical dilemmas, HR ethical issues, Managing ethics, Improving ethical decision making.

Employee Safety: Safety, Need for safety, Types of accidents, Safety programme, ISO safety standards.

Total Periods: 45

EXPERIENTIAL LEARNING

1. What are the challenges that are faced by HR in effective performance management including performance appraisal in MNCs? Discuss in detail in the contemporary of HRM.
2. Evaluate employee relations in a comparative perspective across few countries of your choice. Describe in brief by taking a case study.
3. Visit an organization or industry and Evaluate HRM related social, cultural, ethical and environmental responsibilities and issues in a global context.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. Aswathappa K, *Human Resource Management,* Tata McGraw Hill Private Limited, 8th edition, 2017.
2. Garry Dessler and Biju Varkkey, *Human Resource Management,* Pearson India, 16th Edition, 2020.

REFERENCE BOOKS:

1. Raymond A. Noe, John R. Hollenbeck, *HRM: Gaining a Competitive Advantage*, TMH, 7th edition, 2010.
2. Bohlander George W, Snell Scott, *Principles of Human Resource Management,* Cengage Learning, 16th edition, 2016.
3. Edwin B. Flippo, *Personnel Management,* McGraw-Hill International editions, 6th edition, 1984.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/122105020
2. https://onlinecourses.nptel.ac.in/noc20_mg15/preview
3. https://www.digimat.in/nptel/courses/video/122105020/L01.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101703	**INDIAN ECONOMY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction; Elementary Economic Analysis; Economic Planning; Time Value of Money; Value Analysis/Value Engineering.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the basic concepts of economics, economic analysis, economic planning and strata.

CO2 Demonstrate knowledge in capital budgeting, evaluation of engineering projects, depreciation policy and familiarize with the concepts of value analysis vs value engineering.

CO3 Analyze and apply financial information for the evaluation of finance.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	2	-	-	-	-	-	-
CO2	3	-	-	-	-	2	-	-	-	-	-	2
CO3	3	-	-	-	-	2	-	-	-	-	-	2
Course Correlation Mapping	3	-	-	-	-	2	-	-	-	-	-	2

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION ***(09 Periods)***

Economics-Flow in an Economy, Law of Supply and Demand; Micro and Macro Economics; Relationship between Science, Engineering, Technology and Economic Development; Concept of Engineering Economics-Types of Efficiency, Definition and Scope of Engineering Economics.

Module 2: ELEMENTARY ECONOMIC ANALYSIS ***(09 Periods)***

Economic Analysis – Meaning, Significance, Simple Economic Analysis; Material Selection for a Product, Substitution of Raw Material; Design Selection for a Product; Material Selection-Process Planning, Process Modification.

Module 3: ECONOMIC PLANNING ***(09 Periods)***

Introduction - Need For Planning in India, Five-year plans(1951-2012), NITI Aayog (from 2014 onwards); Inclusive Growth-Meaning, Significance, Need for inclusive growth in India, Strategy for more inclusive growth, Challenges and Prospects; Employment and Inclusive Growth in India, Role of engineers in sustaining inclusive growth.

Module 4: TIME VALUE OF MONEY ***(12 Periods)***

Concepts and Application; Capital Budgeting-Traditional and Modern Methods; Simple and Compound Interest, Cash Flow Diagram, Principle of Economic Equivalence; Evaluation of Engineering Projects - Present Worth Method, Future Worth Method, Annual Worth Method, Internal Rate of Return Method, Cost-benefit Analysis in Public Projects; Depreciation Policy-Depreciation of Capital Assets, Causes of Depreciation, Straight Line Method and Declining Balance Method.

Module 5: VALUE ANALYSIS/VALUE ENGINEERING ***(06 Periods)***

Introduction-Value Analysis, Value Engineering, Functions, Aims; Value Analysis vs Value Engineering; Value Engineering Procedure- Advantages, Application Areas.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a poster presentation on the impact of globalization on family structure and society.
2. Prepare a presentation on family setups of different countries and their peculiar customs if any.
3. Prepare a poster presentation on "Ancient hominin walked like a human but climbed like an ape."
4. Find out the problems of present society and being part of future generations and how you may help to strengthen environmental security.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Panneerselvam. R., *Engineering Economics*, PHI Learning Private Limited, New Delhi, 2nd edition, 2013.
2. Jain. T. R., V. K. Ohri, O. P. Khanna., *Economics for Engineers*, VK Publication, 1st edition, 2015.

REFERENCE BOOKS:

1. DuttRudar & Sundhram K. P. M., *Indian Economy*, S. Chand, New Delhi, 62nd revised edition, 2010.
2. Misra, S. K. & V. K. Puri., *Indian Economy*: *Its Development Experience*, Himalaya Publishing House, Mumbai, 32nd edition, 2010.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101704	**INDIAN HISTORY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Introduction; Ancient India; Classical and Medieval era; Modern India; India after independence.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Demonstrate contextual knowledge in the evolution of ancient and medieval Indian History and acquire an awareness of societal and cultural transformation.

CO2 Analyze the situations before and after Independence and assess the societal reforms implemented in India after Independence.

CO3 Practice culture transformations and appreciate its influence to adapt themselves in global scenarios.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	-	-	-	-	1	-	-	-	-	-	-
CO2	1	2	-	-	-	1	-	-	-	-	-	-
CO3	1	1	-	-	-	2	-	-	-	-	-	-
Course Correlation Mapping	2	1	-	-	-	2	-	-	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: INTRODUCTION TO INDIAN HISTORY ***(08 Periods)***

Elements of Indian History; History Sources: Archaeology, Numismatics, Epigraphy & Archival research; Methods used in History; History & historiography; Sociological concepts-structure, system, organization, social institutions, Culture and social stratification (caste, class, gender, power), State& Civil Society.

Module 2: ANCIENT INDIA ***(09 Periods)***

Mohenjo-Daro civilization; Harappa civilization; Mauryan Empire.

Module 3: CLASSICAL & MEDIEVAL ERA ***(12 Periods)***

Classic Era (200 BC - 1200 AD); Hindu - Islamic Era (1200 - 1800 AD).

Module 4: MODERN INDIA ***(06 Periods)***

Age of Colonialism (17th - 19th centuries); First war of Indian Independence; Freedom Struggle (1857-1947)

Module 5: INDIA AFTER INDEPENDENCE (1947 -) ***(10 Periods)***

The Evolution of the Constitution and Main Provisions; Consolidation of India as a Nation; Politics in the States; Indian economy; Modernization and globalization, Secularism and communalism, Nature of development, Processes of social exclusion and Inclusion, Changing Nature of Work and Organization.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare a write-up on how to safeguard ancient monuments.
2. Analyze the most famous historically important place you visited.
3. Prepare a presentation on the ancient Seven Wonders of the World with their significance and how they are destroyed.
4. Prepare a presentation on "Wars of the past not only destroyed people and their livelihood but also the people's tradition and culture."
5. Prepare a poster on " Continents that No Longer Exist" with causes

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. K. Krishna Reddy, *Indian History,* Tata McGraw-Hill, 21st reprint, 2017.

REFERENCE BOOKS:

1. Guha, Ramachandra, *India after Gandhi*, Pan Macmillan, 2007.
2. Romila Thapar, *Early India***,** Penguin India, New Delhi 2002.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101705	**INDIAN TRADITION AND CULTURE**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Basic traits of Indian Culture; Humanistic Reforms under Jainism and Buddhism; Culture in the medieval period; Socio Religious reforms in Indian Culture; Reform movements for harmonious relations.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Demonstrate knowledge of Vedic and Upanishadic culture and society to consider human aspirations, values and theories.

CO2 Understand the contributions of Buddhism and Jainism to Indian culture.

CO3 Examine the cultural conditions and achievements of India under Mouryas and Guptas.

CO4 Analyze social religious reforms and reform movements.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	1	-	-	-	-	-	-
CO2	3	-	-	-	-	1	-	-	-	-	-	2
CO3	2	-	-	-	-	3	-	-	-	-	-	-
CO4	2	-	-	-	-	3	-	-	-	-	-	2
Course Correlation Mapping	**3**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**2**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: BASIC TRAITS OF INDIAN CULTURE ***(08 Periods)***

Meaning and definition and various interpretations of culture - Culture and its features - The Vedic and Upanishad culture and society - Human aspirations and values in these societies - Chaturvidha purushardhas, Chaturashrma and Chaturvarna theory.

Module 2: HUMANISTIC REFORMS UNDER JAINISM AND BUDDHISM ***(09 Periods)***

Salient features of Jainism - contributions of Jainism to Indian culture - Contributions of Aachaarya and Mahaapragya - Buddhism as a humanistic culture - The four noble truths of Buddhism - Contributions of Buddhism to Indian culture.

Module 3: CULTURE IN THE MEDIEVAL PERIOD ***(09 Periods)***

Unifications of India under Mouryas and Guptas and their cultural achievements - Cultural conditions under satavahanas - Contributions to Pallavas and cholas to art and cultural achievements of Vijayanagara rulers

Module 4: SOCIO RELIGIOUS REFORMS IN INDIAN CULTURE ***(09 Periods)***

Western impact on India - Introduction of Western education - social and cultural awakening and social reform movements of Rajaramohan Roy - Dayanandha Saraswathi - Anne Besant (theosophical society).

Module 5: REFORM MOVEMENTS FOR HARMONIOUS RELATIONS ***(09 Periods)***

Vivekananda, Eswarchandravidyasagar and Veeresalingam - emancipation of women and struggle against caste - Rise of Indian nationalism - Mahatma Gandhi – Non-violence and satyagraha and eradication of untouchability.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Identify different cultural festivals of Indian States and prepare a write-up on their uniqueness.
2. India has a rich history with numerous architectural wonders. Prepare a report on any three famous architectural wonders in India.
3. Explore the diverse flavors of Indian cuisine and prepare a poster on the different dishes and their distinctiveness.
4. India is a country of Unity in Diversity. Make a PowerPoint presentation on different traditional dresses of various cultural people.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. Valluru Prabhakaraiah, *Indian Heritage and Culture*, Neelkamal Publications Pvt. Ltd. Delhi, 1/e, reprint 2015.

REFERENCE BOOKS:

1. L. P. Sharma, *History of Ancient India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
2. L. P. Sharma, *History of Medieval India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
3. The Cultural Heritage of India Vol-I, II, III, IV, V, The Ramakrishna Mission Institute of Culture, Calcutta

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101703	**INSTRUMENTATION IN INDUSTRIES**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on measurement of various parameters like displacement, force, torque, acceleration, velocity, density, viscometer, hygrometers, temperature, pressure, level and flow.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Select appropriate displacement, force and torque measuring devices for specific measurement application.
CO2 Identify suitable acceleration, velocity and density measuring devices for specific measurement application.
CO3 Apply suitable viscometer and hygrometer for measurement of viscosity, humidity and moisture for a specific application.
CO4 Select appropriate temperature and pressure transducer for an industrial requirement.
CO5 Identify appropriate level and flow transducer for measurement of level and flow for a specific application.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	3	-	-	-	-	-	-	-	-
CO2	3	2	-	3	-	-	-	-	-	-	-	-
CO3	3	2	-	3	-	-	-	-	-	-	-	-
CO4	3	2	-	3	-	-	-	-	-	-	-	-
CO5	3	2	-	3	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: DISPLACEMENT, FORCE & TORQUE MEASUREMENT ***(08 Periods)***

Displacement Measurement: Introduction, Strain gauge, LVDT, Capacitive Gauges and applications.
Force Measurement: Introduction, Analytical Balance, Spring Balance, Load cells.
Torque Measurement: Introduction, Strain gauge, Relative angular twist and applications.

Module 2: ACCELERATION, VELOCITY & DENSITY MEASUREMENT ***(08 Periods)***

Acceleration Measurement: Introduction, LVDT, Piezoelectric, Strain gauge and Variable reluctance type accelerometers and applications.
Velocity Measurement: Introduction, Revolution Counter, Capacitive Tacho, Drag-cup Type, Tacho and Stroboscope and applications.
Density Measurement: Introduction, Pressure type densitometers, Float type densitometers, Ultrasonic densitometer and gas densitometer.

Module 3: VISOCITY, HUMIDITY & MOISTURE MEASUREMENT ***(09 Periods)***

Viscosity Measurement: Introduction, friction tube viscometer, say bolt's viscometer, rotameter viscometer, Searle's rotating cylinder, cone and plate viscometer.
Humidity Measurement: Introduction, Dry and wet bulb psychrometers, Resistive and capacitive type hygrometers
Moisture Measurement: Introduction, Thermal Conductivity and Capacitive sensors, Applications of moisture measurement, Moisture measurement in solids.

Module 4: TEMPERATURE & PRESSURE MEASUREMENT ***(10 Periods)***

Temperature Measurement: Definitions and standards, RTD, Thermistor, Thermocouples: Laws of thermocouple, Reference junctions compensation, Radiation fundamentals, Radiation methods of temperature measurement, Total radiation pyrometers, Optical pyrometers, Applications.
Pressure Measurement: Introduction, manometer and its types, elastic transducers Bourdon tube, diaphragm, bellows, electrical types, resistive, inductive and capacitive, Thermal conductivity gage, Ionization gage, Sound level meter, Microphone, Applications.

Module 5: LEVEL & FLOW MEASUREMENT ***(10 Periods)***

Level Measurement: Introduction, Gauge Glass technique, Float Types – Float–and–tape method, Float–and–shaft method, Magnetic float types. Electrical types – Resistance switch type, Inductive and Capacitance type. Ultrasonic methods. Applications
Flow Measurement: Introduction, Head types – Orifice, Venturi, Flow Nozzle. Rotameter & types. Coriolis flow meter, Gyroscopic flow meter, Liquid bridge mass flow meter, Calorimetric flow meter. Electromagnetic flow meter, Ultrasonic flow meter, Hotwire anemometer type. Applications.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Record temperature from RTD and convert temperature in to voltage.
2. Measure the speed of rotating shaft using stroboscope.
3. Record level of the tank using suitable device.
4. Measure the flow rate of water in boiler plant.
5. Measure the displacement using LVDT.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, New Delhi, 19th Revised Edition, 2013
2. D. Patranabis, *Principles of Industrial Instrumentation*, TMH, 3rd Edition, 2010.

REFERENCE BOOKS:

1. Ernest Doebelin & Dhanesh Manik, *Measurement Systems*, McGraw Hill International, 6th Edition, 2011.

VIDEO LECTURES:

1. https://www.vlab.co.in/
2. https://archive.nptel.ac.in/courses/103/103/103103135/
3. https://nptel.ac.in/courses/103103135

Web Resources:

1. https://www.tutorialspoint.com/electronic_measuring_instruments/index.htm
2. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108105064/lec1.pdf
3. https://www.ibiblio.org/kuphaldt/socratic/sinst/book/liii.pdf.

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101704	**INTRODUCTION TO NANOTECHNOLOGY**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: The fundamental principles of nanoelectronics and the utilization of nanostructures as nano electronic devices.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the basic knowledge in nanoelectronics, crystal structure of semiconducting material various techniques for fabrication and measurement of nanostructure, semiconducting nano electronic devices.

CO2. Analyze Crystal structure of nanomaterials Nanostructure based device

CO3. Design and develop new nano devices for advanced technological applications.

CO4. Capable of solving problems in the field of nanoelectronics.

CO5. Involve and resolve the future research challenges in the fields related to nanoelectronics.

CO6. Apply the environmental context with ethical principle in developing new nano devices.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-
CO4	2	2	2	3	-	-	-	-	-	-	-	-
CO5	3	3	-	-	3	-	-	-	-	-	-	-
CO6	3	-	-	-	-	3	3	2	-	-	-	-
Course Correlation Mapping	3	3	3	3	3	3	3	2	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

MODULE-I: INTRODUCTION TO NANOELECTRONICS ***(08 Periods)***

The "Top-Down" Approach, Lithography, The "Bottom-Up" Approach; Why Nanoelectronics? Nanotechnology Potential. The Schr¨odinger wave equation, Wave mechanics of particles, Atoms and atomic orbitals

MODULE II: MATERIALS FOR NANOELECTRONICS ***(09 Periods)***

Semiconductors, Crystal lattices: bonding in crystals, Electron energy bands, Semiconductor heterostructures, Lattice-matched and pseudomorphic heterostructures; Organic semiconductors, Carbon nanomaterials: nanotubes and fullerenes.

MODULE III: FABRICATION AND MEASUREMENT TECHNIQUES FOR NANOSTRUCTURES ***(10 Periods)***

Bulk crystal and heterostructure growth: Nanolithography, etching, and other means for fabrication of nanostructures and nanodevices; Techniques for characterization of nanostructures, Spontaneous formation and ordering of nanostructures; Clusters and nanocrystals, Methods of nanotube growth, Chemical and biological methods for nanoscale fabrication, Fabrication of nanoelectromechanical systems.

MODULE IV : SEMICONDUCTING NANO STRUCTURES ***(09 Periods)***

Time and length scales of the electrons in solids, Statistics of the electrons in solids and nanostructures; The density of states of electrons in nanostructures, Electron transport in nanostructures, Electrons in Quantum well, Quantum wire and Quantum dots.

MODULE V : NANOELECTRONIC DEVICES ***(09 Periods)***

Resonant tunneling diodes, Field effect transistors, Single electron transfer devices, Potential effect transistors, Light emitting diodes and lasers; Nanoelectromechanical system devices, Quantum dot cellular automata.

Total No. of Periods: 45

EXPERIENTIAL LEARNING

1. Submission of report on specifications of Clean room.
2. Submission of report on specifications of Clean bench.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Vladimir V. Mitin, Viatcheslav A. Kochelap, Michael A. Stroscio, *Introduction to Nanoelectronics: Science, Nanotechnology, Engineering, and Applications,* Cambridge University Press, 2012.
2. George W. Hanson, *Fundamentals of Nanoelectronics*, Prentice Hall, 2007

REFERENCE BOOKS:

1. Mitin.V, Kochelap.V and Stroscio.M, *Introduction to Nanoelectronics*, Cambridge University Press, 2008
2. Karl Goser et.al, *Nanoelectronics and Nanosystems: From Transistors to Molecular and Quantum devices*, Springer, 2005.

VIDEO LECTURES:

1. Introduction to Nanotechnology, nanohub.org
2. https://nptel.ac.in/courses/103103033

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101701	INTRODUCTION TO ARTIFICIAL INTELLIGENCE	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion and hands-on experience on Introduction to Artificial Intelligence, Designing intelligent agents, Solving general purpose problems, Search in complex environments, Represent knowledge, Robotics, Ethics.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Analyze and Architect intelligent agents using Artificial Intelligence Techniques and principles

CO2 Analyze the usage of Knowledge representation techniques in Artificial Intelligence

CO3 Analyze and interpret the problem, identify suitable solutions using heuristic functions and search algorithms

CO4 Investigate robot hardware and frameworks for intelligent robotic perception.

CO5 Demonstrate knowledge on ethical implications of intelligent machines for providing privacy, trust, security and safety.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	1	-	-	-	-	-	-
CO5	-	-	-	-	-	1	-	2	-	-	-	-
Course Correlation Mapping	3	3	2	-	-	1	-	2	-	-	-	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1 INTRODUCTION TO ARTIFICIAL INTELLIGENCE ***(09 Periods)***

Foundations of artificial intelligence, History of artificial intelligence, State of the art, Risks and benefits of AI, Intelligent agents – Agents and environments, The concept of rationality, Structure of agents.

Module 2 KNOWLEDGE & REASONING ***(09 Periods)***

Logic, Propositional Logic, Propositional Theorem Proving: Inference and proofs, Proof by resolution, Horn clauses and definite clauses.

First-Order Logic - Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic. Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification, Forward Chaining, Backward Chaining, Resolution.

Module 3 PROBLEM SOLVING BY SEARCHING ***(09 Periods)***

Problem solving agents, Search algorithms, Uninformed search strategies, Informed search strategies – Greedy best-first search, A* search; Heuristic functions.

Module 4 SEARCH IN COMPLEX ENVIRONMENTS ***(09 Periods)***

Local search algorithms and optimization problems – Hill-climbing search, Simulated annealing, Local beam search, Evolutionary algorithms; Optimal decisions in games – The minimax search algorithm, Optimal decisions in multiplayer games, Alpha-Beta pruning, Move ordering; Monte Carlo tree search.

Module 5: ROBOTICS ***(09 Periods)***

Robots, Robot hardware, Robotic perception, Alternative robotic frameworks, Application domains.

Limits of AI, Ethics of AI – Surveillance, security and privacy, Fairness and bias, Trust and transparency, AI safety

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Design and implement agent programs for Table-driven agents using the agent function of vacuum-cleaner world. The agent cleans the current square if it is dirty, otherwise it moves to the other square.
2. Implement agent programs for Simple reflex agents and Model-based reflex agents using the agent function of vacuum-cleaner world.
3. Solve the travelling sales man problem using Hill Climbing search algorithm

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Stuart Russell, Peter Norvig, *Artificial Intelligence: A Modern Approach*, Prentice Hall, 4th Edition, 2020.

REFERENCE BOOKS:

1. Stephen Lucci, Danny Kopec, *Artificial Intelligence in the 21st Century*, MercuryLearning and Information, 3rd Edition,2018

2. Rich, Knight, Nair*, Artificial intelligence*, Tata McGraw Hill, Third Edition, 2009.
3. Deepak Khemani, *A First Course in Artificial Intelligence*, McGraw Hill Education, 2017.
4. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning, 2011.

SOFTWARE/TOOLS:

1. Python
2. pandas, matplotlib

VIDEO LECTURES:

1. https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence
2. http://aima.cs.berkeley.edu/
3. https://ai.google/education/
4. https://www.coursera.org/courses?query=artificial%20intelligence
5. https://www.edureka.co/blog/artificial-intelligence-with-python/

WEB RESOURCES:

1. http://www.airesources.org/
2. https://allthingsai.com/
3. https://designmodo.com/ai-tools-designers/
4. https://www.ulethbridge.ca/teachingcentre/chatgpt-ai-resources

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101703	INTRODUCTION TO DATA SCIENCE	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to Data Science; Data Collection and Data Pre-Processing, Exploratory Data Analytics, Model Development, and Model Evaluation**.**

COURSE OUTCOMES: *After successful completion of the course, students will be able to*:

CO1. Demonstrate knowledge on Data science concepts.
CO2. Perform data collection and pre-processing.
CO3. Perform exploratory data analytics.
CO4. Design and develop data visualization models.
CO5. Evaluate performance of data models.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	2	2	3	2	2	-	-	-	-	-	-	-
CO3	2	2	2	3	2	-	-	-	-	-	-	-
CO4	2	3	2	2	2	-	-	-	-	-	-	-
CO5	3	2	2	2	2	-	-	-	-	-	-	-
Level of correlation of the course	**3**	**2**	**2**	**2**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**-**

Correlation Levels: ***3: High*** ***2: Medium*** ***1: Low***

COURSE CONTENT

Module-1: INTRODUCTION ***(09 periods)***
Introduction to Data Science, Evolution of Data Science, Data Science Roles, Stages in a Data Science Project, Applications of Data Science in various fields, Data Security Issues.

Module-2: DATA COLLECTION AND DATA PRE-PROCESSING ***(09 periods)***
Data Collection Strategies, Data Pre-Processing- Overview, Data Cleaning, Data Integration and Transformation, Data Reduction, Data Discretization.

Module-3: EXPLORATORY DATA ANALYTICS ***(09 periods)***
Descriptive Statistics, Mean, Standard Deviation, Skewness and Kurtosis, Box Plots, Pivot Table, Heat Map, Correlation Statistics, ANOVA.

Module-4: MODEL DEVELOPMENT ***(09 periods)***

Simple and Multiple Regression, Model Evaluation using Visualization, Residual Plot, Distribution Plot, Polynomial Regression and Pipelines, Measures for In-sample Evaluation, Prediction and Decision Making.

Module-5: MODEL EVALUATION ***(09 periods)***

Generalization Error, Out-of-Sample Evaluation Metrics, Cross Validation, Overfitting, Under Fitting and Model Selection, Prediction by using Ridge Regression, Testing Multiple Parameters by using Grid Search.

Total periods: 45

EXPERIENTIAL LEARNING

1. ***Use Case:*** A human can express his emotions in any form, such as the face, gestures, speech and text. The detection of text emotions is a content-based classification problem. Detecting a person's emotions is a difficult task, but detecting the emotions using text written by a person is even more difficult as a human can express his emotions in any form.

   Recognizing this type of emotion from a text written by a person plays an important role in applications such as chatbots, customer support forum, customer reviews etc. So you have to train a machine learning model that can identify the emotion of a text by presenting the most relevant emoji according to the input text.

2. ***Use Case:*** Customer Personality Analysis is a detailed analysis of a company's ideal customers. It helps a business to better understand its customers and makes it easier for them to modify products according to the specific needs, behaviours and concerns of different types of customers.

   You have to do an analysis that should help a business to modify its product based on its target customers from different types of customer segments. For example, instead of spending money to market a new product to every customer in the company's database, a company can analyze which customer segment is most likely to buy the product and then market the product only on that particular segment.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOK:

1. Cathy O'Neil and Rachel Schutt, *Doing Data Science*, O'Reilly, 2015

REFERENCE BOOKS:

1. David Dietrich, Barry Heller, Beibei Yang, *Data Science and Big Data Analytics*, EMC 2013.
2. Davy cielen, *Introducing Data Science*, Manning Publications, 2022.
3. Chirag Shah, *A Hands-on Introduction to Data Science*, Cambridge University Press, 2020

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=JL_grPUnXzY&list=PLeo1K3hjS3us_ELKYSj_Fth2tIEkdKXvV
2. https://www.youtube.com/watch?v=-ETQ97mXXF0

WEB RESOURCES:

1. https://swayam.gov.in/nd1_noc19_cs60/preview
2. https://towardsdatascience.com/
3. https://www.w3schools.com/datascience/
4. https://github.com/jakevdp/PythonDataScienceHandbook
5. https://www.kaggle.com

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22AI101702	INTRODUCTION TO MACHINE LEARNING	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Introduction to machine learning, Bayesian concept learning, Supervised learning, Unsupervised learning, Artificial neural networks.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Analyze the process of machine learning modeling and evaluation to automatically infer a general description for a given learning problem.

CO2 Analyze the underlying mathematical models within machine learning algorithms and learning tasks.

CO3 Design and implement machine learning solutions for classification, regression, and clustering problems.

CO4 Design and implement efficient neural architectures to model patterns for a given learning problem.

CO5 Develop intelligent solutions to solve societal problems related to computer vision, information security, healthcare and other areas.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	3	3	3	3	-	-	-	-	-	-	-
CO4	3	3	3	1	-	-	-	-	-	-	-	-
CO5	1	3	3	3	3	3	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**3**	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION TO MACHINE LEARNING ***(10 Periods)***

Machine Learning: Human learning, Types of human learning, Machine learning, Types of machine learning, Applications of machine learning, Issues in machine learning, Machine learning activities, Types of data, Selecting a model, Training a model, Model representation and interpretability, Evaluating performance of a model, Improving performance of a model.

Module 2: BAYESIAN CONCEPT LEARNING ***(07 Periods)***

Introduction, Importance, Bayes' theorem, Bayes optimal classifier, Naïve Bayes classifier, Applications of Bayes classifier.

Module 3: SUPERVISED LEARNING ***(10 Periods)***

Classification: Classification model, Classification learning steps, K-Nearest Neighbor, Decision Tree, Support vector machines.

Regression: Introduction, Simple linear regression, Improving accuracy of the linear regression model, Multiple linear regression, Assumptions and problems in regression analysis.

Module 4: UNSUPERVISED LEARNING ***(09 Periods)***

Introduction, Unsupervised vs supervised learning, Applications of unsupervised learning, Clustering as a machine learning task, Types of clustering techniques, Partitioning methods, K-Medoids, Hierarchical clustering, DBSCAN.

Module 5: ARTIFICIAL NEURAL NETWORKS ***(09 Periods)***

Artificial neuron, Types of activation functions, Early implementations of ANN, Architectures of neural network, Learning process in ANN, Backpropagation.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Use Naïve Bayes classifier to solve the credit card fraud detection problem.
2. Build a neural network that will read the image of a digit and correctly identify the number.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Tom M. Mitchell, *Machine Learning*, McGraw Hill, 1997.
2. Saikat Dutt, Subramanian Chandramouli, Amit kumar das, *Machine Learning*, Pearson, 2019.

REFERENCE BOOKS:

1. Manaranjan Pradhan, U Dinesh Kumar, *Machine Learning Using Python*, Packt Publishing, 2019.
2. Aurelien Geron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*, O'Reilly, 2nd Edition, 2019.
3. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press, 4th Edition, 2020.

4. Shai Shalev Shwartz, Shai Ben David, *Understanding Machine Learning: From Theory to Algorithms*, Cambridge University Press, 2014.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/106106202/
2. https://www.coursera.org/learn/machine-learning
3. https://onlinecourses.nptel.ac.in/noc23_cs18/preview
4. https://onlinecourses.nptel.ac.in/noc23_cs87/preview
5. https://onlinecourses.nptel.ac.in/noc23_ee87/preview
6. https://www.coursera.org/learn/ntumlone-algorithmicfoundations
7. https://www.coursera.org/specializations/machine-learning-introduction
8. http://ndl.iitkgp.ac.in/document/YkxlRXFvZXJrTDBkVzVVZi9ESjl6eXpRZkxRc2lhOWhlVXBhUVVWaXZlNDNyZUVldU9LdlYvd20wbkQ4MC92UQ
9. https://www.coursera.org/learn/unsupervised-learning-recommenders-reinforcement-learning

WEB RESOURCES:

1. https://www.ibm.com/topics/machine-learning
2. https://www.simplilearn.com/tutorials/machine-learning-tutorial/what-is-machine-learning
3. https://www.w3schools.com/python/python_ml_getting_started.asp
4. https://developers.google.com/machine-learning/crash-course
5. https://www.greenteapress.com/thinkstats/
6. https://info.deeplearning.ai/machine-learning-yearning-book
7. https://www.kaggle.com/code/kanncaa1/machine-learning-tutorial-for-beginners
8. https://machinelearningmastery.com/machine-learning-in-python-step-by-step/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS101701	INTRODUCTION TO PYTHON PROGRAMMING	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is aimed at offering the fundamental concepts of Python scripting language to the students. It starts with the basics of Python programming and deals with lists, dictionaries, functions, exceptions and files. The objective of this course is to enable the students to develop the applications using the concepts of Python.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the basic terminology used in computer programming to write, compile and debug programs in Python programming language.

CO2. Use appropriate data type for handling user data and write optimized programs using the functions, and statements.

CO3. Manage the exceptions raised during the program execution and avoid abrupt termination of the program execution.

CO4. Process files and solve real world problems using classes and objects in the Python programming environment.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	2	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	2	-
CO4	2	3	3	-	-	-	-	2	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**-**	**2**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: DATA TYPES AND INPUT/OUTPUT ***(09 Periods)***

Internal working of Python, Python character set, Tokens, Python Core Data Types (list, set, tuple, and dctionary), The print () function, Assignment of values to variables, The input() function, The eval() function.

Module 2: OPERATORS AND CONTROL STATEMENTS ***(09 Periods)***

Operators- Arithmetic Operators, Operator precedence and Associativity, Bitwise operator, The compound assignment operator; Decision statements- Boolean operators, Boolean

Expressions and Relational operators, Decision making statements; Loop Control Statements-while loop, range() function, for loop; break statement, continue statement.

Module 3: FUNCTIONS AND LISTS ***(09 Periods)***

Functions- Syntax and basics of a function, Use of a function, Parameters and arguments in a function, The local and global scope of a variable, The return statement, Recursive functions, The lambda function; Lists-Creating Lists, Accessing the elements of a List, List slicing, Python in-built functions for lists, List Comprehension, List Methods, Passing list to a function, Returning a list to function.

Module 4: TUPLES, SETS AND DICTIONARIES ***(09 Periods)***

Tuples - Creating tuples, tuple() function, Inbuilt functions for tuples, Indexing and Slicing, Operations on tuples, Passing variable length arguments to tuples, Sort tuples, Traverse tuplesfrom a list, The zip()function, The Inverse zip(*) function; Sets - Creating sets, The set in and not in operator, The Python Set Class, Set operations; Dictionaries -Basics of Dictionaries, Creating a Dictionary, Adding and replacing values, Retrieving values, Formatting dictionaries, Deleting items, Comparing two dictionaries, Methods of dictionary class, Traversing dictionaries, Nested dictionaries, Traversing nested dictionaries.

Module 5: V FILES ***(09 Periods)***

File Handling-Opening a file, Writing Text, Closing files, Writing numbers to a file, Reading Text, Reading numbers from a file, Appending data, seek() function.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Calculator: Create a basic calculator program that can perform addition, subtraction, multiplication, and division operations. You can enhance it by adding more functionality, such as handling decimal numbers or including additional mathematical operations.
2. Develop recursive functions to solve problems that involve self-referential definitions.
3. Develop program to create dictionaries, add, retrieve and delete items from dictionaries.
4. Word Counter: Design a program that counts the number of words, characters, or lines in a given text file. You can also include additional features like finding the most common words or displaying statistics about the text.
5. Tic-Tac-Toe: Implement a two-player tic-tac-toe game where users take turns marking Xs and Os on a 3x3 grid. Determine the winner or detect a tie by checking the board after each move.
6. Dice Rolling Simulator: Create a program that simulates rolling dice. Allow the user to specify the number of dice to roll and display the results. You can also add features like keeping track of the roll history or calculating the probability of certain outcomes.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXTBOOKS:

1. Ashok Namdev kamthane and Amit Ashok Kamthane, *Programming and Problem solving with PYTHON*, McGraw Hill Education, 1st Edition, 2016.

REFERENCE BOOKS:

1. Allen Downey, *Think Python*, Green Tea Press, 1st Edition, 2016.
2. W.J. Chun, *Core Python Programming*, Prentice Hall, 3rd Edition, 2013.
3. Kenneth A. Lambert, *Fundamentals of Python*, Cengage, 2nd Edition, 2015.

VIDEO LECTURES:

1. https://onlinecourses.nptel.ac.in/noc19_cs41/preview
2. https://www.coursera.org/specializations/python
3. https://www.coursera.org/learn/python-for-applied-data-science-ai
4. https://www.youtube.com/watch?v=WGJJIrtnfpk
5. https://www.youtube.com/watch?v=_uQrJ0TkZlc
6. https://www.udemy.com/topic/python/
7. https://freevideolectures.com/course/2512/python-programming

WEB RESOURCES:

1. https://www.w3schools.com/python/
2. https://www.programiz.com/python-programming
3. https://www.geeksforgeeks.org/python-programming-language/
4. https://www.javatpoint.com/python-lists
5. https://www.learnpython.org/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CB101704	INTRODUCTION TO INTERNET OF THINGS	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course is emphasize on the Architecture of IoT and Summarize the roles of various organizations for IoT, To Develop simple applications using Arduino and Rasberry, Test for errors in the application, Predict the market value, Experiment with embedded boards for creating IoT prototypes, To understand the domain specific IoTs and IoT system management.

COURSE OUTCOMES: After successful completion of the course, students will be able to:
CO1 Understand the fundamental concepts of IoT and physical computing.
CO2 Demonstrate knowledge on variety of embedded boards and IoT Platforms
CO3 Understand the communication protocols in IoT communications.
CO4 Demonstrate knowledge on Domain specific IoT applications.
CO5 Understand the IoT System management and network management protocols.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	-	-	-	-	-	-	-	-	-	-	-
CO2	3	3	3	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	3	-	-	-	-	-	-	-	-	-
CO5	3	2	2				-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	-	-	-	-	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: OVERVIEW OF IOT ***(09 Periods)***

The Internet of Things: An Overview, The Flavour of the Internet of Things, The "Internet" of "Things", The Technology of the Internet of Things, Enchanted Objects, Who is Making the Internet of Things?
Design Principles for Connected Devices: Calm and Ambient Technology, Privacy, Web Thinking for Connected Devices, Affordances.
Prototyping: Sketching, Familiarity, Costs Vs Ease of Prototyping, Prototypes and Production, Open source Vs Close source, Tapping into the community.

Module 2: EMBEDDED DEVICES: ***(09 Periods)***

Electronics, Embedded Computing Basics, Arduino, Raspberry Pi, Mobile phones and tablets, Plug Computing: Always-on Internet of Things

Module 3 COMMUNICATION IN THE IOT: ***(09 Periods)***

Internet Communications: An Overview, IP Addresses, MAC Addresses, TCP and UDP Ports, Application Layer Protocols

Prototyping Online Components: Getting Started with an API, Writing a New API, Real-Time Reactions, Other Protocols Protocol

Module 4 DOMAIN SPECIFIC IOTS ***(09 Periods)***

Introduction: Home automation, Cities, Environment, Energy, Retail, Logistics, Agriculture, Industry, Health and Lifestyle

Module 5 IOT AND M2M ***(09 Periods)***

Introduction- M2M, Difference between IoT and M2M, SDN and NFV for IoT

IoT System Management with NETCONF-YANG: Need for IoT Systems Management, Simple network management protocol(SNMP), Network operator requirements, NETCONF,YANG

Total Periods: 45

EXPERIENTIAL LEARNING

1. (a) Design and Simulate LED 7-Segment Display interfacing with Arduino.
   (b) Design and Simulate Servo motor interfacing with Arduino.
2. (a) Design and Simulate ultrasonic sensor and LCD interfacing with Arduino.
   (b) Design and Simulate Flame Sensor interfacing with Arduino.

(Note: It's an indicative one. The Course Instructor may change the activities and the same shall be reflected in Course Handout)

RESOURCES

TEXT BOOKS:

1. Adrian McEwen, Hakim Cassimally, *Designing the Internet of Things*, Wiley Publications, 2012
2. Arshdeep Bahga, Vijay Madisetti, *Internet of Things: A Hands-On Approach*, Universities Press, 2014.

REFERENCE BOOKS:

1. Pethuru Raj, Anupama C. Raman, *The Internet of Things, Enabling technologies and use cases*, CRC Press.

VIDEO LECTURES:

1. https://www.digimat.in/nptel/courses/video/106105166/L01.html
2. https://www.youtube.com/watch?v=oBZnySDgst8

WEB RESOURCES:

1. https://www.arduino
2. https://www.raspberrypi.org/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101703	**MANAGEMENT SCIENCE**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION:
Concepts of Management; Concepts Related to ethics and social responsibility; Human Resource Management; Operations Management; Statistical Process Control; Inventory Management; Marketing; Project Management; Project Crashing.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Demonstrate the concepts of management, its functions and processes used in optimum resource utilization within the context of ethics and social responsibility.
CO2 Apply the concepts of HRM for selection and management of human resources.
CO3 Analyze different operations management problems using quality management tools to produce effective, efficient and adoptable products/services
CO4 Identify different marketing strategies to maximize enterprise profitability and customer satisfaction within the realistic constraints
CO5 Develop network models in time-cost trade-off for effective project management.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	1	1	1	1	-	-	1	-
CO2	3	2	1	-	1	-	-	-	-	-	1	-
CO3	3	3	1	1	1	-	-	-	-	-	1	-
CO4	3	2	1	-	1	1	-	-	-	-	1	-
CO5	3	3	3	1	1	1	-	-	-	-	2	-
Course Correlation Mapping	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	-	-	**1**	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: MANAGERIAL FUNCTION AND PROCESS ***(10 Periods)***
Concept and foundations of management, Evolution of management thought; Managerial functions – Planning, Organizing, Directing and Controlling; Decision-making; Role of manager, managerial skills; Managing in a global environment, Flexible systems management; Social responsibility and managerial ethics; Process and customer orientation; Managerial processes on direct and indirect value chain.

Module 2: HUMAN RESOURCE MANAGEMENT ***(08 Periods)***
Human Resource challenges; Human Resource Management functions; Human Resource Planning; Job analysis; Job evaluation, Recruitment and selection; Training and Development; Promotion and transfer; Performance management; Compensation management and benefits; Employee morale and productivity; Human Resource Information System.

Module 3: OPERATIONS MANAGEMENT ***(10 Periods)***

Fundamentals of Operations Management, Services as a part of operations management; Facilities location and layout; Line balancing; Quality management – Statistical Process Control, Total Quality Management, Six sigma; Role and importance of materials management, Value analysis, Make or Buy decision, Inventory control, Materials Requirement Planning, Enterprise Resource Planning, Supply Chain Management.

Module 4: MARKETING MANAGEMENT ***(08 Periods)***

Concept, evolution and scope; Marketing strategy formulation and components of marketing plan; Segmenting and targeting the market; Positioning and differentiating the market offering, Analyzing competition; Product strategy; Pricing strategies; Designing and managing marketing channels; Integrated marketing communications.

Module 5: PROJECT MANAGEMENT ***(09 Periods)***

Project management concepts; Project planning – Work Breakdown Structure, Gantt chart; Project scheduling – Critical Path Method, Program Evaluation and Review Technique, Crashing the project for time-cost trade off; Resource Levelling.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Find the social responsibilities in the context of management theoretically and practically in an organization? Explain them by taking a real case study in any organization (preferably in your organization).
2. Gaining market share should be one of management's primary goals because of its effect on operations and profitability. Comment. What Strategies Do Companies Employ to Increase Market Share?
3. A Gantt chart is a visualization that helps in scheduling, managing, and monitoring specific tasks and resources in a project. Prepare a gantt chart for Online food ordering system.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. MartandT. Telsang, *Industrial Engineering and Production Management,* S. Chand, 3rd Edition, 2018.
2. Koontz and Weihrich, *Essentials of Management*, TMH, New Delhi, 11th Edition, 2020.

REFERENCE BOOKS:

1. O.P. Khanna, *Industrial Engineering and Management,* Dhanpat Rai and Sons, 2018.
2. N.D. Vohra, *Quantitative Techniques in Management,* TMH, New Delhi, 5th Edition, 2014.
3. L.M. Prasad, *Principles and practice of Management,* S. Chand and Sons, 2019.

VIDEO LECTURES:

1. https://archive.nptel.ac.in/courses/122/106/122106032/
2. https://www.digimat.in/nptel/courses/video/122102007/L01.html

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101704	MANAGING INNOVATION AND ENTERPRENEURSHIP	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION:
Evolution of entrepreneurship from economic theory Managerial and entrepreneurial competencies; Concepts of Shifting Composition of the Economy Purposeful Innovation & Sources of Innovative Opportunity; The Innovation Process; Innovative Strategies; Entrepreneurial Motivation; Entrepreneurs versus inventors; Ethics and International Entrepreneurship; Strategic Issues in International Entrepreneurship; Problem solving Innovation and Diversification

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate the principles of innovation process for establishing Industrial ventures.
CO2. Identify and analyze the gaps in an organization for innovation in the context of developed economies
CO3. Develop a comprehensive and well-planned business structure for a new venture.
CO4. Demonstrate knowledge on intellectual property rights, patents, trademarks, copyrights, trade secrets and commercialization of intellectual property.
CO5. Apply ethics in constructive innovation framework and problem solving.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	1	-	1	1	1	1	-	-	1	-
CO2	3	2	1	-	1	-	-	-	-	-	1	-
CO3	3	3	1	1	1	-	-	-	-	-	1	-
CO4	3	2	1	1	1	1	-	-	-	-	1	-
CO5	3	3	3	1	1	1	-	-	-	-	2	-
Course Correlation Mapping	**3**	**2**	**1**	**1**	**1**	**1**	**1**	**1**	-	-	**1**	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: CREATIVITY AND INNOVATION ***(09 Periods)***

Introduction, Levels of innovation, Purposeful innovation and the sources of innovative opportunity, The innovation process, Innovative strategies, Strategies that aim at introducing and innovation, Dynamics of ideation and creativity – Inbound, Outbound; Context and process of new product development, Theories of outsourcing.

Module 2: PARADIGMS OF INNOVATION ***(09 Periods)***

Systems approach to innovation, Innovation in the context of developed economies and Emerging economies, Examining reverse innovation and itsapplication,Performancegap,Infrastructuregap,Sustainabilitygap,Regulatory gap, Preference gap, organizational factors effecting innovation at firm level.

Module 3: SOUCES OF FINANCE AND VENTURE CAPITAL ***(09 Periods)***

Importance of finance, Comparison of venture capital with conventional development capital, Strategies of venture funding, Investment phases, Investment process, Advantages and disadvantages of venture capital, Venture capital developments in India.

Module 4: INTELLECTUAL PROPERTY INNOVATION AND ENTREPRENEURSHIP ***(09 Periods)***

Introduction to Entrepreneurship, Evolution of entrepreneurship from economic theory, Managerial and entrepreneurial competencies, Entrepreneurial growth and development, Concepts, Ethics and Nature of International Entrepreneurship, Intellectual property – forms of IP, Patents, Trademarks, Design registration, Copy rights, Geographical indications, Patent process in India.

Module 5: OPEN INNOVATION FRAME WORK & PROBLEM SOLVING ***(09 Periods)***

Concept of open innovation approach, Difference between open innovations and Cloud innovation approaches, Limitations and Opportunities of open innovation frame work, Global context of strategic alliance, Role of strategic alliance, Problem Identification and Problem Solving, Innovation and Diversification

Total Periods:45

EXPERIENTIAL LEARNING

1. Identify the Innovative Marketing Strategies for Startups
2. Identify the Coca-cola Company Intellectual Property Rights

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

CASE STUDIES/ARTICELS:

Contemporary relevant case studies/ Articles will be provided by the course instructor at the beginning.

1. Tesla Inc.: Disrupting the Automobile Industry
   This case study examines how Tesla Inc. disrupted the traditional automobile industry through its innovative electric vehicles and sustainable energy solutions. It discusses the sources of innovative opportunity that Tesla leverages, the ideation and creativity dynamics involved in new product development, and the strategies that the company uses to introduce and market its innovations.
2. Google Inc.: Innovation in Developed Economies
   This case study explores how Google Inc. became a global leader in the technology industry through its innovative search engine, advertising, and cloud computing solutions. It highlights the performance gap that Google addressed, the regulatory and sustainability gaps that it leveraged, and the impact of its innovation strategies on the company's growth and profitability.

3. Flipkart: From Startup to Unicorn
   This case study examines how Flipkart, an Indian e-commerce company, secured venture capital funding to become one of the largest online marketplaces in India. It discusses the importance of finance in entrepreneurship, the advantages and disadvantages of venture capital, and the strategies that Flipkart used to attract venture funding.

4. Patanjali Ayurved: Building a Brand through Intellectual Property
   This case study explores how Patanjali Ayurved, an Indian consumer goods company, built a strong brand through its intellectual property strategies. It discusses the forms of IP that Patanjali leverages, the patent process in India, and the impact of IP on the company's growth and profitability.

5. Procter & Gamble: Innovation through Open Innovation
   This case study analyzes how Procter & Gamble, a global consumer goods company, leveraged open innovation to achieve unprecedented success in product development and marketing. It discusses the difference between open and cloud innovation approaches, the limitations and opportunities of open innovation, and the role of strategic alliances in global innovation.

RESOURCES

TEXT BOOKS:

1. Vinnie Jauhari, Sudhanshu Bhushan, *Innovation Management*, Oxford University Press, 1st Edition, 2014.
2. Drucker, P.F., *Innovation and Entrepreneurship*, Taylor & Francis, 2nd Edition, 2007.

REFERENCE BOOKS:

1. Robert D Hisrich, Claudine Kearney, *Managing Innovation and Entrepreneurship,* Sage Publications, 1st Edition, 2014.
2. V.K. Narayanan, *Managing Technology and Innovation for Competitive Advantage,* Pearson India, 1st Edition, 2002.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=wWsl48VLfVY
2. https://www.youtube.com/watch?v=dDpQ9ALKX0U
3. https://www.youtube.com/watch?v=Eu_hkxkJGTg

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22ME101705	MATERIAL SCIENCE	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Materials Structure and Constitution of Alloys; Heat treatment of steels; Properties of ferrous materials and its alloys; Properties of non-ferrous materials and its alloys; Properties and applications of Ceramics, Polymers and Composite materials.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Ability to understand and apply the principles of materials science to analyze and design materials for specific applications.

CO2. Analyze the properties of materials and enhance the same through heat-treatment processes.

CO3. Demonstrate the knowledge of ferrous and Non-ferrous materials and its alloys for engineering applications.

CO4. Understand the relationship between materials properties and structure at the atomic and molecular level.

CO5. Demonstrate the knowledge of Ceramics, Polymers, and Composite materials for suitable engineering applications.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	-	-	-	-	-	-	1	-	-
CO2	3	3	1	-	-	-	-	-	-	1	-	-
CO3	3	1	-	-	-	-	-	-	-	-	-	-
CO4	3	1	-	-	-	-	-	-	-	-	-	-
CO5	3	1	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**2**	**1**	-	-	-	-	-	-	**1**	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: MATERIALS STRUCTURE AND CONSTITUTION OF ALLOYS ***(09 Periods)***

Materials Structure: Space lattice, Unit cells and Metallic crystal structures (SC, BCC, FCC and HCP), Crystal defects: Point, Line, Interstitial and Volume, Primary and secondary bonding in materials.

Constitution of Alloys: Necessity of Alloying, Gibbs's phase and Hume Rothery rule, Iron Iron-carbide diagram and its microstructural aspects.

Module 2: HEAT TREATMENT OF STEELS ***(09 Periods)***

Annealing, Normalizing, Tempering, Carburization and Hardening- Austempering, Martempering, Carburizing, Nitriding, Cyaniding, Carbo-Nitriding, Flame and Induction Hardening, Vacuum and Plasma Hardening, Time-Temperature-Transformation Diagrams and Continuous Cooling Transformation Diagrams.

Module 3: FERROUS MATERIALS AND ALLOYS ***(09 Periods)***

Steels: Structure, properties, classifications and applications of plain steels, Specifications of steels, Structure, properties, classifications and applications of low alloy steels, Hadfield manganese steels, Stainless steel and Tool steels.

Cast iron: Structure, properties and applications of Gray cast iron, White cast iron, Malleable cast iron, Nodular cast iron and Alloy cast iron.

Module 4: NON-FERROUS MATERIALS AND ALLOYS ***(09 Periods)***

Structure, properties and applications of Copper and its alloys, Aluminium and its alloys, Titanium and its alloys, Nickel and its alloys, Magnesium and its alloys, Refractory and Precious metals.

Module 5: CERAMICS, POLYMERS AND COMPOSITES MATERIALS ***(09 Periods)***

Ceramics: Classifications, Properties and Applications, Glass-ceramics, Polymers: Classification, Properties and Applications, Polymerization Reaction,

Composites: Classifications, Properties and Applications of Polymer matrix composites, Ceramic matrix composites, Metal matrix composites and Nanocomposites.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Laboratory experiments allow students to apply theoretical concepts and learn how to conduct experiments safely and effectively. Some examples of laboratory experiments include mechanical testing of materials, heat treatment of metals, and microscopy analysis of materials.
2. Materials characterization techniques such as X-ray diffraction, scanning electron microscopy, and transmission electron microscopy can provide valuable insights into the structure and properties of materials. Students can gain hands-on experience with these techniques by conducting experiments and analyzing the results.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXT BOOKS:

1. V. Raghavan, *Materials Science & Engineering*, Prentice Hall of India, 5th edition, 2004.
2. R. Balasubramaniam, Callister's, *Materials Science & Engineering*, John Wiley and sons, 2nd edition, 2014.

REFERENCE BOOKS:

1. Sidney H. Avner, *Introduction to Physical Metallurgy*, Tata McGraw Hill, 2nd edition,1997.
2. George E Dieter, *Mechanical Metallurgy*, Tata McGraw Hill, 3rd edition, 2013.
3. Kodigre V D, *Material Science and Metallurgy*, Everest Publishing House, 31st edition, 2011.

VIDEO LECTURES:

1. https://ocw.mit.edu/courses/materials-science-and-engineering/3-012-fundamentals-of-materials-science-fall-2005/lecture-notes/
2. https://nptel.ac.in/courses/116/104/116104045/
3. https://www.youtube.com/watch?v=tsX-VYvkiJ8&list=PLJV_OG0NLkV8VRNFk-0AyDZz1pZym6V8j
4. https://www.khanacademy.org/science/materials-science

WEB RESOURCES:

1. https://www.doitpoms.ac.uk/tlplib/teachers.php
2. https://www.springer.com/journal/10853
3. http://dmse.mit.edu/
4. http://dmse.mit.edu/

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22LG201701	**PERSONALITY DEVELOPMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course gives awareness to students about the various dynamics of personality development.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Demonstrate knowledge in Self-Management and Planning Career

CO2. Analyze the functional knowledge in attitudes and thinking strategies

CO3. Learn and apply soft skills for professional success.

CO4. Function effectively as an individual and as a member in diverse teams

CO5. Communicate effectively in public speaking in formal and informal situations.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	1	-	-	-	-	-	-	-	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-
CO3	2	2	-	-	3	-	-	-	-	2	-	-
CO4	1	1	-	-	-	-	-	-	3	3	-	-
CO5	-	-	-	-	-	-	-	-	-	3	-	-
Course Correlation Mapping	2	2	3	-	3	-	-	-	3	3	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: SELF-ESTEEM & SELF-IMPROVEMENT ***(09 Periods)***

Know Yourself – Accept Yourself; Self-Improvement: Plan to Improve - Actively Working to Improve Yourself- Exercises- case studies

Module 2: DEVELOPING POSITIVE ATTITUDES ***(09 Periods)***

How Attitudes Develop – Attitudes are Catching – Improve Your Attitudes – Exercises- case studies

Module 3 SELF-MOTIVATION & SELF-MANAGEMENT ***(09 Periods)***

Show Initiative – Be Responsible Self-Management; Efficient Work Habits – Stress Management – Employers Want People Who can Think – Thinking Strategies- Exercises- case studies

Module 4 GETTING ALONG WITH THE SUPERVISOR ***(09 Periods)***

Know your Supervisor – Communicating with your Supervisor – Special Communication with your Supervisor – What Should you Expect of Your Supervisor? – What your Supervisor expe of you - Moving Ahead Getting Along with your Supervisor- Exercises- case studies

Module 5 WORKPLACE SUCCESS ***(09 Periods)***

First Day on the Job – Keeping Your Job – Planning Your Career – Moving Ahead- Exercises- case studies

Total Periods: 45

EXPERIENTIAL LEARNING

1. List out the self-improvements in you on the charts and explain in detail.
2. Discuss different famous personalities and their attitudes.
3. Describe different personalities with respect to self-motivation and self-management.
4. Imagine you are a supervisor and illustrate different special communications.
5. Assume and Interpret different experiences on the first day of your job.

(Note: It's an indicative one. Course instructor may change the activities and the same shall be reflected in course handout)

RESOURCES

TEXTBOOK:

1. Harold R. Wallace and L. Ann Masters, *Personal Development for Life and Work*, Cengage Learning, Delhi, 10th edition Indian Reprint, 2011. (6th Indian Reprint 2015)
2. Barun K. Mitra, *Personality Development and Soft Skills,* Oxford University Press, 2011.

REFERENCE BOOKS:

1. K. Alex, *Soft Skills*, S. Chand & Company Ltd, New Delhi, 2nd Revised Edition, 2011.
2. Stephen P. Robbins and Timothy A. Judge*, Organizational Behaviour*, Prentice Hall, Delhi, 16th edition, 2014

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=6Y5VWBLi1es
2. https://www.youtube.com/watch?v=H9qA3inVMrA

WEB RESOURCES:

1. https://www.universalclass.com/.../the-process-of-perso...
2. https://www.ncbi.nlm.nih.gov/pubmed/25545842
3. https://www.youtube.com/watch?v=Tuw8hxrFBH8

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101703	**PLANNING FOR SUSTAINABLE DEVELOPMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on sustainable development, environmental impact, sustainable policies, governance, theories and strategies, media and education for sustainability.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Compare sustainable development theories in national and global context to protect the society and environment.

CO2 Analyze the unforeseen environmental impacts on sustainable development to protect the society and environment.

CO3 Analyze policies and governance for sustainable development considering ethics, economics, society and environment.

CO4 Analyze systems and strategies for sustainable development using appropriate tools and techniques considering ethics, economics, society and environment.

CO5 Analyze the role of media and education in sustainable development using appropriate tools and techniques considering ethics, society and environment besides communicating effectively.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	2	2	-	-	-	-	-
CO2	3	3	-	-	-	2	2	-	-	-	-	1
CO3	3	3	-	-	-	2	2	2	-	-	1	-
CO4	3	3	-	-	2	2	2	2	-	-	1	-
CO5	3	3	-	-	2	2	2	2	-	1	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**2**	**2**	**2**	**2**	-	**1**	**1**	**1**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: SUSTAINABLE DEVELOPMENT ***(09 Periods)***

Definition and concepts of sustainable development, Capitalization of sustainability-National and global context; Sustainable development goals, Emergence and evolution of sustainability and sustainable development, Theories of sustainability, Case studies.

Module 2: ENVIRONMENTAL IMPACT ***(09 Periods)***

Climate change – Science, Knowledge and sustainability; Unforeseen environmental impacts on development, Challenges of sustainable development, Centrality of resources in sustainable development, Case studies.

Module 3: SUSTAINABLE POLICIES AND GOVERNANCE ***(09 Periods)***

Governance - Democracy and Eco–welfare; Global civil society and world civil politics, Civic environmentalism, Policy responses to sustainable development, Economics of sustainability, Social responsibility in sustainability, National action, ISO 14001: Environmental management system.

Module 4: SUSTAINABLE SYSTEMS AND STRATAGIES ***(09 Periods)***

Need for system innovation, Transition and co–evolution, Theories and methods for sustainable development, Strategies for eco–innovation, Ecological foot print analysis, Socio ecological indicators – Eco labels; Policy programmes for system innovation, Case studies.

Module 5: MEDIA AND EDUCATION FOR SUSTAINABILITY ***(09 Periods)***

Role of emerging media, Remarkable design and communication art, Activism and the public interest, Education for sustainability, Participation in decision making, Critical thinking and reflection, Case studies.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Submit a study report on the importance and implementation of United Nationals sustainable goals 17 among all the ratified nations.
2. Submit a study report on any one case study that the challenges being faced during the sustainable development goals implementation.
3. Submit a study report on the social responsibility in implementation of sustainability concept.
4. Prepare and submit a report on any two case studies that how the eco labels put on their products shall make the consumers feel satisfaction over the sustainable development.
5. Submit a report on the communication art and activism through media which makes the public interest that helps to contribute towards sustainable development.

RESOURCES

TEXT BOOKS:

1. John Blewitt, *Understanding Sustainable Development*, Earth Scan Publications Ltd., 2nd Edition, 2008.
2. Jennifer A. Elliot, *An Introduction to Sustainable Development*, Earth Scan Publications Ltd., 4th Edition, 2006.

REFERENCE BOOKS:

1. Peter Rogers, Kazi F Jalal and John A Boyd, *An Introduction to Sustainable Development*, Earth Scan Publications Ltd., 2006.
2. Simon Dresner, *The Principles of Sustainability*, Earth Scan Publications Ltd., 2nd Edition, 2008.
3. Peter Bartelmus, *Environment Growth and Development: The Concepts and Strategies of Sustainability*, Routledge, 3rd Edition, 2003.
4. Gabriel Moser, Enric Pol, Yvonne Bernard, MiriliaBonnes, Jose Antonio Corraliza and Maria Vittoria Giuliani, *People Places and Sustainability*, Hogrefe& Huber Publishers, 2nd Edition, 2003.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=a5i9RVyhBtc
2. https://www.youtube.com/watch?v=fH_iIVPTujE
3. https://www.youtube.com/watch?v=c2eNrFK5M8I
4. https://www.youtube.com/watch?v=qfOgdj4Okdw
5. https://www.youtube.com/watch?v=_qLqLJq2954

WEB RESOURCES:

1. https://civil.gecgudlavalleru.ac.in/images/admin/pdf/1594706742_III-II-OE-Planning-for-Sustainable-Development.pdf
2. https://www.academia.edu/26950843/Sustainable_Development_in_Practice_Case_Studies_for_Engineers_and_Scientists
3. https://www.academia.edu/24286208/The_Role_of_the_Professional_Engineer_and_Scientist_in_Sustainable_Development
4. https://byjusexamprep.com/liveData/f/2022/8/sustainable_development_goals_upsc_notes_43.pdf
5. https://sdgs.un.org/sites/default/files/2020-10/course%201_Peter_Tarr%20%20-%20%20Compatibility%20Mode.pdf

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101705	PRINCIPLES OF COMMUNICATION ENGINEERING	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Fundamentals of Communications; Analog and digital - modulation and Demodulation Techniques; Information theory and coding.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyze different Analog and Digital Modulation Schemes to improve bandwidth and power efficiency.

CO2. Analyze Pulse Analog modulation Schemes.

CO3. Understand the concepts of Baseband & Passband Digital Transmission.

CO4. Analyze various error detection and correction codes for reliable transmission.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-
CO4	3	3	2	1	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**2**	**1**	**-**	**-**	**-**	-	-	-	-	-

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: ANALOG MODULATION ***(13 Periods)***

Block diagram of Electrical Communication System, Types of Communications, Need for Modulation, Types of Amplitude Modulation- AM, DSBSC, SSBSC, Power and BW requirements, Generation of AM, DSBSC, SSBSC. Detection of AM - Diode detector, Product demodulation for DSBSC & SSBSC. Frequency & Phase Modulations.

Module 2: PULSE MODULATION ***(07 Periods)***

Elements & Advantages of Digital communication systems, PAM, Regeneration of Base band Signal, PWM and PPM, Time Division Multiplexing, Frequency Division Multiplexing.

Module 3: BASE BAND DIGITAL TRANSMISSION ***(07 Periods)***

Pulse Code Modulation- Advantages, Block diagram of PCM, Quantization, effect of Quantization, Quantization error. DM, ADM and Comparison of PCM,DM & ADM.

Module 4: PASS BAND DIGITAL TRANSMISSION ***(10 Periods)***

Digital Binary Schemes-ASK, FSK, PSK, DPSK, QPSK, Modulation and Demodulation - Coherent and Non-coherent techniques.

Module 5: INFORMATION THEORY AND CODING ***(08 Periods)***

Concept of Information, Entropy and Rate of Information, Coding efficiency, Shannon-Fano and Huffman Coding.

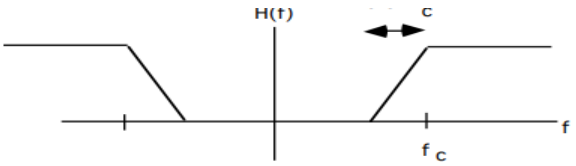
Error Correction and Detection Codes- Linear Block Codes, Cyclic Codes, Convolution Codes.

Total Periods: 45

EXPERIENTIAL LEARNING

1 Suppose that a non-linear device is available for which the output current i0 and the input voltage vi are related by: $i_0(t) = a_1 vi(t) + a_3 v_3 i(t)$ where a_1 and a_3 are constants. Explain how this device may be used to provide(a) a product modulator (b) an amplitude modulator.

2 A voice signal occupying the frequency band 0.3 - 3.4 KHz is to be modulated onto a carrier wave of frequency 11.6 MHz. High pass filters such as the one shown below are available. Design a system to generate the USB wave using DSB modulators and these filters.



3 In a binary PCM system, the output signal to-quantizing noise ratio is to be held to a minimum of 40 dB. Determine the number of required levels, and find the corresponding output signal to quantizing-noise ratio.

4 A bipolar binary signal $S_I(t)$ is a +1V or -1V pulse during the interval (O, T). Additive white noise with power spectral density $\eta/2 = 10^{-5}$ W /kHz. W/Hz is added to the signal. Determine the maximum bit rate that can be sent with a bit error probability of $Pe \leq 10^{-7}$

5 A compact disc (CD) recording system samples each of two stereo signals with a 16-bit analog-to digital converter (ADC) at 44.1 kb/s.

a) Determine the output signal-to-quantizing-noise ratio for a full-scale sinusoid.

b) The bit Stream of digitized data is augmented by the addition of error-correcting bits, clock extraction bits, and display and control bit fields. These additional bits represent 100 percent overhead. Determine the output bit rate of the CD recording system.

c) The CD can record an hour's worth of music. Determine the number of bits recorded on a CD. For a comparison, a high-grade collegiate dictionary may contain 1500 pages, 2 columns per page, 100 lines per column, 8 words per line, 6 letters per word, and 7 b per letter on average. Determine the number

of bits required to describe the dictionary, and estimate the number of comparable books that can be stored on a CD.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. R.P. Singh and S D Sapre, *Communication Systems - Analog and Digital*, TMH, 2nd edition 2007.
2. Simon Haykin, *Communication Systems*, John Wiley, 2nd edition 2007.

REFERENCE BOOKS:

1. Herbert Taub & Donald L Schilling, *Principles of Communication Systems*, Tata McGraw-Hill, 3rd Edition, 2009.
2. Sham Shanmugam, *Digital and Analog Communication Systems*, Wiley-India edition, 2006.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/108/104/108104091/
2. https://onlinecourses.nptel.ac.in/noc19_ee47/preview

WEB RESOURCES:

1. https://studiousguy.com/basic-principles-of-communication/
2. https://www.tutorialspoint.com/principles_of_communication/principles_of_communication_modulation.htm

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101702	RELIABILITY AND SAFETY ENGINEERING	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on the fundamentals of reliability and safety engineering. The course emphasizes on various reliability measures used in assessing the performance of the system, evaluating the critical parameters of the network, and the techniques to assess the reliability of the system. The course also deals with safety management and measures in industrial and other hazardous environments.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. apply the various probability and statistics fundamentals into engineering systems to evaluate performance.
CO2. develop mathematical models for engineering networks/systems to evaluate the critical parameters for the reliability of a network/system.
CO3. analyze the time-dependent/independent characteristics of a repairable system and frequency durations techniques to assess the reliability
CO4. understand various safety management, policy, and planning strategies for personal and industrial safety.
CO5. understand various safety and hazard identification techniques and follow appropriate safety measures in industry and society.

CO-PO Mapping Table

Course Outcome	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	2	-	-	2	1	1	1	-	-	-	-
CO2	3	3	-	-	2	1	1	-	-	-	-	-
CO3	3	2	-	2	1	1	1	-	-	-	-	3
CO4	3	2	-	-	2	1	1	1	-	-	-	-
CO5	3	2	-	-	2	1	1	1	-	-	-	-
Course Correlation Level	**3**	**2**	**--**	**2**	**2**	**1**	**1**	**1**	**--**	**--**	**--**	**3**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: FUNDAMENTALS OF RELIABILITY ENGINEERING ***(09 Periods)***

Random variables, probability concepts, rules for probabilities of events. Probability density and distribution functions. Binomial distribution - Expected value and standard deviation for binomial distribution. Reliability functions, f(t), F(t), h(t) - Relationship between these functions, Exponential density and distribution functions, expected value and standard deviation of exponential distribution. Measures of reliability - MTTF, MTTR, MTBF. Bathtub curve.

Module 2: NETWORK MODELING AND RELIABILITY EVALUATION ***(09 Periods)***

Basic concepts - Evaluation of network reliability/unreliability, series systems, parallel systems, series - Parallel configuration systems. Redundant systems and its types. Evaluation of network reliability/unreliability using conditional probability method, tie-set and cut-set based approach, complete event tree and reduced event tree methods.

Module 3: MARKOV CHAIN AND MARKOV PROCESSES ***(09 Periods)***

Basic concepts, stochastic transitional Probability matrix, time dependent probability evaluation, Limiting State Probability, Absorbing states. Modelling concepts – State space diagrams, time dependent reliability evaluation of single component repairable model, two component repairable model. Frequency and duration techniques.

Module 4: BASICS OF SAFETY CONCEPTS ***(08 Periods)***

Introduction, goals, need for safety, history of safety movement – the evolution of modern safety concept, general concepts of safety management. Planning for safety-productivity, quality and safety, line and staff functions, budgeting for safety, safety policy.

Module 5: SAFETY TECHNIQUES AND APPLICATIONS ***(10 Periods)***

Introduction to safety techniques, Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of the performance of supervisors on safety. Hazard identification techniques, components of safety audit, types of audit, audit methodology, and process of safety reporting. Applications of industrial Safety, environmental safety, health safety, electrical safety, fire safety.

Total Periods: 45

EXPERIENTIAL LEARNING

1. The students shall understand various IEEE reliability standards to be followed in the engineering systems for the evaluation of reliability and asses performance.
2. Should collect various engineering components assembled and their network models for evaluations of network reliability indices.
3. The students to visit a nearby power or process industry to know about various types of failures and repair performance of various engineering components and cause of replacements.
4. Should collect information about various safety/alert sign boards and the relative measures for a particular situation.
5. Should understand the standard practices followed during the maintenance/commissioning of the electrical apparatus in any industry following the various safety precautions.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Roy Billinton and Ronald N Allen, *Reliability Evaluation of Engineering Systems*, 2nd Edition, Springer, New York, 2013.
2. Frank R. Spellman, Nancy E. Whiting, *Safety Engineering: Principles and Practices*, 3rd Edition, Rowman & Littlefield, 2018.

REFERENCE BOOKS:

1. Charles E. Ebeling, *An introduction to reliability and maintainability engineering*, 2nd Edition Tata McGraw-Hill Education, 2010.
2. Dan Petersen, *Techniques of Safety Management: A Systems Approach*, 4th Edition American society of safety engineers, 2003.
3. Ajit Kumar Verma , Srividya Ajit , Durga Rao Karanki*, Reliability and Safety Engineering,* Springer London, 2016.

VIDEO LECTURES:

1. https://nptel.ac.in/courses/105/108/105108128/
2. https://nptel.ac.in/courses/110/105/110105094/
3. https://www.youtube.com/watch?v=uutg8jKrL9w
4. https://www.youtube.com/watch?v=_c-iZ2BAXPw
5. https://www.youtube.com/watch?v=GeMCF3s5EDk
6. https://www.youtube.com/watch?v=xYWyype7cxE

WEB RESOURCES:

1 https://ieeexplore.ieee.org/document/9353567

2 https://www.ualberta.ca/engineering/mechanical-engineering/research/reliability-and-safety.html

3 https://ieeexplore.ieee.org/document/9353567

4 https://www.taylorfrancis.com/books/edit/10.1201/9781003140092/industrial-liability-safety-engineering-dilbagh-panchal-mangey-ram-prasenjit-chatterjee-anish-kumar-sachdeva

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101704	**REMOTE SENSING, GIS AND GPS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on photogrammetry, remote sensing, geographic information system, GIS spatial analysis. This course also examines remote sensing and GIS applications, global positioning system and its real-time applications.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Analyze photogrammetry and remote sensing to solve complex surveying problem using appropriate tools and techniques following the relevant guidelines and lates developments considering society and environment besides communicating effectively in graphical form.

CO2 Analyze GIS to solve complex surveying problems using appropriate tools and techniques following latest developments besides communicating effectively in graphical form.

CO3 Analyze GIS spatial analysis to solve complex surveying problems using appropriat tools and techniques following latest developments besides communicating effectively in graphical form.

CO4 Analyze remote sensing and GIS applications to solve complex civil engineering problems using appropriate tools and techniques following the relevant guidelines and latest developments considering society, environment, sustainability and management principles besides communicating effectively in graphical form.

CO5 Analyze global positioning system to solve complex surveying problems using appropriate tools and techniques considering society and environment besides communicating effectively in graphical form.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	2	3	-	2	2	1	1	1	-	1	-	1
CO2	2	3	-	-	2	1	1	-	-	1	-	1
CO3	2	3	-	2	2	1	1	-	-	1	-	1
CO4	2	3	-	-	2	1	1	1	-	1	1	1
CO5	2	3	-	-	2	1	1	-	-	1	-	-
Course Correlation Mapping	**3**	**3**	**-**	**2**	**2**	**1**	**1**	**1**	-	**1**	**1**	**1**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: PHOTOGRAMMETRY AND REMOTE SENSING (10 Periods)

Photogrammetry: Principle of photogrammetry, Types of aerial photographs, Planning and execution of photographic flights, Geometry of aerial photographs, Scale of aerial photographs and its determination, Stereoscopy, Ground control, Mosaics, Parallax measurements for height determinations, Latest developments in photogrammetry.

Remote Sensing: Elements of remote sensing, Electromagnetic spectrum, Energy resources, Physics of radiant energy, Energy interactions with earth surface features and atmosphere, Data acquisition platforms Spectral reflectance curves, Resolution; Spectral properties of water bodies, soil and vegetation; Sensors and platforms, Visual interpretation techniques.

Module 2: GEOGRAPHIC INFORMATION SYSTEM (09 Periods)

GIS categories, Components of GIS, Fundamental operations of GIS, Spatial and non spatial data, Raster data and vector data, File management, Layer based GIS, Feature based GIS, Map projections, Latest developments.

Module 3: GIS SPATIAL ANALYSIS (08 Periods)

Database models, Data storage, Vector data storage, Attribute data storage, Data manipulation and analysis, Integrated analysis of the spatial and attribute data - DTM/DEM, Softwares – Arc GIS, QGIS and Global mapper, Latest developments in GIS software.

Module 4: REMOTE SENSING AND GIS APPLICATIONS (09 Periods)

Land use/Land cover classification, Rainfall-runoff studies, Flood and drought impact assessment and monitoring, Drainage morphometry, Watershed management for sustainable development, GIS based precision farming, GIS based natural resources management, Inland water quality survey and management, Regional and urban planning and management, GIS based highway alignment, GIS based traffic congestion analysis, GIS for public health – Case Studies.

Module 5: GLOBAL POSITIONING SYSTEM (09 Periods)

Global Positioning System (GPS) – Fundamental concepts, Components of GPS – Space segment, Control segment, User segment, Reference systems, Satellite orbits; Classification of GPS receivers, GPS observations, GPS measurements and accuracy of GPS, Applications.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Sound composing project: In this assignment, Select area and collect the geometry of aerial photographs and analyze the views.
2. Visit any meteorological department and understand about rain gauges and collect, analyse the data
3. Visit Geographical Information Systems Laboratory and understand about GIS and GPS Systems

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Shivam, P. and Shashikanth, T., *A Text Book of Basic Concept of Remote Sensing*, *GPS and GIS*, Sankalp Publication, 2020.
2. Anji Reddi, M., *A Text Book of Remote Sensing and Geographical Information Systems*, B. S. Publications, 2nd Edition, 2012.

REFERENCE BOOKS:

1. Bhatta, B., *Remote Sensing and GIS*, Oxford University Press, 2nd Edition, 2011.
2. Lillesand, T. M., Kiefer, R. W. and Chipman, J. W., *Remote Sensing and Image Interpretation*, John Willey and Sons (Asia) Pvt. Ltd., 7th Edition, 2014.
3. Chandra, A. M. and Ghosh, S. K., *Remote Sensing and Geographic Information System*, Narosa Publishing House, 2nd Edition, 2015.
4. Panigrahi, N., *Geographical Information Science*, University Press, 2nd Edition, 2013.
5. Peter A. Burragh and Rachael Mc Donnell, *Principles of Geographical Information Systems*, Oxford University Press, 2nd Edition, 2014.

VIDEO LECTURES:

1. http://nptel.ac.in/courses/105/107/105107206/
2. https://syslab.ceu.edu/videos/geospatial-technologies

WEB RESOURCES:

1. Digital Audio Signal Processing: https://www.udemy.com/course/introduction-to-geospatial-technologies-and-arcgis-interface/
2. Learn Audio Editing - for Beginners: https://www.youtube.com/ watch?v=xGgaV9r_kH8
3. https://storymaps.arcgis.com/stories/47e984aae614442cb80aa40d121b5fe

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CE101705	**SMART CITIES**	3	-	-	-	3

Pre-Requisite -

COURSE DESCRIPTION: This course provides a discussion on smart city and infrastructure, smart governance, smart mobility, smart economy, smart environment, smart buildings, smart energy, smart water, smart living, smart people and case studies.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the concept of smart cities and its infrastructure for ensuring safety and sustainability using appropriate techniques and management principles in India besides lifelong learning.

CO2 Analyse smart cities to solve problems associated with mobility and governance for the growing population by ensuring safety and sustainability, management using appropriate standards in India besides lifelong learning.

CO3 Analyse smart cities to solve problems associated with economy and environment for ensuring safety and sustainability, management using appropriate techniques and standards in India besides lifelong learning.

CO4 Analyse buildings, energy and water resource systems in smart cities to solve problems associated with the growing population for ensuring safety and sustainability, management using appropriate standards in India besides lifelong learning.

CO5 Analyse the smart cities to solve complex problems associated with people and living systems for ensuring safety and sustainability, management using appropriate techniques in India besides lifelong learning.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	2	3	1	2	-	1	1	2
CO2	3	3	-	1	2	3	3	2	-	1	1	2
CO3	3	3	-	1	2	3	3	2	-	1	1	2
CO4	3	3	-	1	2	3	3	3	-	-	1	2
CO5	3	3	-	1	2	3	3	2	-	-	1	2
Course Correlation Mapping	**3**	**3**	**-**	**3**	**2**	**2**	**2**	**2**	**-**	**1**	**1**	**2**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: SMART CITY AND INFRASTRUCTURE ***(09 Periods)***

Smart city - Concept, Objectives, History, Need; Key trends in smart city development, Government of India – Policy for smart city.

Infrastructure: Smart city infrastructure – Components, Challenges; Managing - Principle stake holders, Infrastructure in India and World, Dimensions of smart cities, Global standards and performance benchmarks, Practice codes, Infrastructure development, Integrated infrastructure management systems for smart city, Infrastructure management system applications for existing smart city, Various types of infrastructure systems, Infrastructure assessment.

Module 2: SMART GOVERNANCE AND SMART MOBILITY ***(09 Periods)***

Smart Governance: Definition, smart governance to citizens, Industries and commerce, Smart governance within government, Emerging trends in smart governance, Future of smart governance, Guidelines and standards for smart governance; IOT and ICT Application – Broadband city, Use of sensors, Intelligent city governance.

Smart Mobility: Intelligent transportation systems, Accessibility, Smart vehicles and fuels, GIS, GPS, Navigation system, Public transport, Traffic safety management, Logistics flows in cities, Mobility services, E-ticketing.

Module 3: SMART ECONOMY AND SMART ENVIRONMENT ***(09 Periods)***

Smart Economy: City branding, Market places and crowd funding, Innovation, entrepreneurship – E-business, E-commerce, Online integrated business platforms and networks; Local and global interconnectedness, Productivity, Flexibility of labour market.

Smart Environment: Network and environmental monitoring, Energy efficiency, Urban planning and urban refurbishment, Smart buildings and building renovation, Resource management, Environmental protection.

Module 4: SMART BUILDINGS, SMART ENERGY AND SMART WATER ***(09 Periods)***

Smart Buildings: Definition, Sustainable city – A green approach, Housing, Sustainable green building - Solar energy for smart city, Waste water management, solid waste management, 3Rs Policy, Green ratings.

Smart Energy: Current energy demand, Alternate energy sources, Renewable energy, Production, Solar energy, Wind energy, Energy from solid waste, Applications, Challenges in smart energy

Smart Water: Storage and conveyance system of water, Sustainable water and sanitation, Sewage systems, Flood management, Conservation system.

Module 5: SMART LIVING, SMART PEOPLE AND CASE STUDIES ***(09 Periods)***

Smart Living: Definition, Cultural facilities, World-class education, Tourist attractions, World-class hospitals, Latest technologies, Quality housing, Community and urban life management, Social cohesion.

Smart People: Definition, Human development index, Level of qualification, Graduate enrolment ratio, Lifelong learning, ICT Skills, Quality of smart people – Flexibility, Creativity to contribute to education, Democratic nature; Personality dimensions – Extroversion, Agreeableness, Consciousness, Emotional Stability, Open to experience.

Case Studies: Helsinki – Finland; Zurich - Switzerland; Oslo - Norway; Amsterdam - The Netherlands; New York - United States; Seoul (World's first Smart City) - South Korea.

Total Periods: 45

EXPERIENTIAL LEARNING

LIST OF EXERCISES:

1. Prepare a report on smart city infrastructure for south Indian cities.
2. Prepare a review on need for changes in transportation and governing policies in India.
3. Write a report on energy conservation and economy stability in world's first smart city.
4. Write a report on need and technologies to be adopted for green buildings in a smart city.
5. Prepare a case study report on Hyderabad, Telangana.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Li Xian Yi, *Smart City on Future Life - Scientific Planning and Construction*, Posts and Telecom Press, 2012.
2. Arpan Kumar Kar, Manmohan Prasad Gupta, P. Vigneswara Ilavarasan and Yogesh K. Dwivedi, *Advances in Smart Cities*, CRC Press, Taylor & Francis Group, Boca Raton, 2017.

REFERENCE BOOKS:

1. Nicos Komninos, *The Age of Intelligent Cities: Smart Environments and Innovation-for-all Strategies (Regions and Cities)*, Routledge Taylor & Francis Group, London, 2015.
2. Eleonora Riva Sanseverino, *Smart Rules for Smart Cities – Managing Efficient Cities in Euro-Mediterranean Countries*, springer for innovation, Springer, Italy, 2014.
3. Smart Cities Mission: A Step Towards Smart India, National Portal of India
4. Anthony M. Townsend, *Smart Cities – Big Data, Civic Hackers and The Quest for a New Uthopia*, W. W. Norton & Company, Inc., New York, 2013.
5. IoT Technician (Smart City) – MHRD, Govt. of India, 2nd Edition, 2022.

VIDEO LECTURES:

1. City of the Future: Singapore – Full Episode | National Geographic - YouTube
2. Integrated Waste Management for a Smart City - Course (nptel.ac.in)

WEB RESOURCES:

1. Smart Cities (nationalgeographic.org)
2. NPTEL :: Civil Engineering - NOC: Sustainable Materials and Green Buildings
3. Smart cities (europa.eu)
4. Top 7 Smart Cities in the World in 2023 (earth.org)

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EC101706	**SMART SENSORS FOR ENGINEERING APPLICATIONS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course provides a detailed discussion on Basics of sensors, characteristics of sensors and their responses; Smart sensors for Engineering, Science and Health Monitoring Applications; Applications of smart sensors and advancements in sensing Techniques.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Analyse the characteristics of transducers and estimate the response of sensors.

CO2. Understanding the working of various sensors in the context of their specialised domains.

CO3. Apply smart sensors for real time applications.

CO4. Apply the advanced techniques to smart sensors to provide solution to real time applications.

CO-PO-PSO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	-	-	-	-	-	-	-	-	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-
CO3	3	-	-	-	-	-	-	-	-	-	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-
Course Correlation Mapping	**3**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	-	**-**	**-**	**-**

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CONCEPTS OF SENSORS ***(08 Periods)***

Introduction to sensors and transducers. Need for sensors in the modern world. Different fields of sensors based on the stimuli, various schematics for active and passive sensors. Static and dynamic characteristics of sensors. ***zero, I and II order sensors:*** Response to impulse, step, ramp and sinusoidal inputs. Environmental factors and reliability of sensors.

Module 2: SENSORS IN ENGINEERING ***(07 Periods)***

Physical principles of sensors, Electric Sensors: Resistive, Capacitive, Inductive. Piezoelectric sensor. Photo elastic sensors, Fluid Mechanic sensors.

Module 3: HUMAN AND BIOMIMETIC SENSORS ***(10 Periods)***

Human sensors: vision, Taste and smell, Hearing, Somatic, Biomimetic Sensors, Electrochemical, Thermoelectric sensors, Optic sensors.

Module 4: APPLICATIONS OF SMART SENSORS ***(11 Periods)***

WSN Based Physiological Parameters Monitoring System: Measurement of Human Body Temperature. Intelligent Sensing System for Emotion Recognition: Aim of the Emotion Recognition System, Development of Intelligent Sensing System for Emotion Recognition. WSN Based Smart Power Monitoring System.

Module 5: ADVANCEMENTS IN SENSING TECHNOLOGY ***(09 Periods)***

Ecological Monitoring Using Wireless Sensor Networks: Overview, Challenges, and Opportunities. Development of an Embedded System-Based Gateway for Environmental Monitoring in Wild Fields. Advancements in Structural Health Monitoring.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Build a wireless sensor system for Environmental pollution monitoring.
2. Design a smart temperature measurement system using required accessories.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Patrick F Dunn, *Fundamentals of sensors For engineering and science*, CRC Press,2012.
2. Subhas C. Mukhopadhyay, Krishanthi P. Jayasundera, and Anton Fuchs, *Smart Sensors, Measurement and Instrumentation*, Springer,2013.

REFERENCE BOOKS:

1. Subhas Chandra Mukhopadhyay*, Intelligent Sensing, Instrumentation and Measurements*, Springer, Kluwer Academic Publishers,2013.
2. Henry Bolte, *Sensors – A Comprehensive Sensors,* John Wiley.

VIDEO LECTURES:

1. https://www.youtube.com/watch?v=oRydUfgMdgA
2. https://onlinecourses.nptel.ac.in/noc22_ee36/

Web Resources:

1. https://digitalcommons.unl.edu/cgi/viewcontent.cgi?article=1199&context=nasapub#:~:text=The%20smart%20materials%20examined%20include,%2C%20magneto%2Doptical%20materials%2C%20and
2. https://www.youtube.com/watch?v=q8UuRkOQ9A0
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8433768/
4. https://www.mdpi.com/1424-8220/21/17/5890

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22EE101703	**SUSTAINABLE ENERGY SYSTEMS**	3	-	-	-	3

Pre-Requisite -
Anti-Requisite -
Co-Requisite -

COURSE DESCRIPTION: This course designed emphasizes the operating principle of a range of non-conventional energy resources, energy harvesting and conversion principles and key performance characteristics. The energy conversion technologies will include energy conversion from, Solar, Wind, Ocean, Biomass, Geothermal and Fuel cells. The course also emphasizes on various types of hybrid energy storage systems with their relative advantages and disadvantages.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Understand the fundamental concepts of renewable energy sources and their endurance for sustainability.

CO2 Understand the various methods of harvesting solar energy, energy conversion principles, and operational aspects and environmental impacts of solar technologies.

CO3 Understand the various methods of harvesting wind energy, conversion principles, operational aspects, and environmental impacts of wind energy systems.

CO4 Understand the various methods of harvesting ocean energy, Biomass energy and geothermal energy, energy conversion technologies, operational aspects, and their impacts on the environment.

CO5 Understand the principle of harvesting energy from fuel cells and the operational aspects of hybrid energy storage systems.

CO-PO Mapping Table:

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	-	-	-	-	2	2	-	-	-	-	1
CO2	3	-	-	-	2	2	2	-	-	-	-	1
CO3	3	-	-	-	2	2	2	-	-	-	-	1
CO4	3	-	-	-	2	2	2	-	-	-	-	1
CO5	3	-	-	-	2	2	2	-	-	-	-	1
Course Correlation Mapping	**3**	-	-	-	**2**	**2**	**2**	-	-	-	-	**1**

Correlation Levels: **3: High;** **2: Medium;** **1: Low**

COURSE CONTENT

Module 1: INTRODUCTION TO SUSTAINABLE ENERGY SOURCES ***(07 Periods)***

Impact of conventional sources on Environment—acid rain, ozone layer depletion, Global warming, greenhouse effect and nuclear waste; Limitation of fossil fuels; Renewable energy sources; Renewable sources and their sustainable development.

Module 2: ENERGY FROM SOLAR ***(10 Periods)***

Introduction, solar radiation, Measurement of solar radiation—Pyranometer; Solar energy collectors; Flat plate collectors— Liquid and air (non-porous) types; Focusing type— Parabolic and Point types; Solar photovoltaic system— PV cell and its types, Configuration of solar panel, PV system; Applications: Solar pump, Solar water heater

Module 3: ENERGY FROM WIND ***(08 Periods)***

Introduction, power extraction from the wind, Wind turbines— Horizontal axis wind turbine—Propeller type and Vertical axis wind turbine— Darrieus rotor type; Basic components of wind energy conversion systems, Applications: Energy storage, Water pumping; Environmental impacts.

Module 4: ENERGY FROM OCEAN, BIOMASS AND GEOTHERMAL RESOURCES ***(12 Periods)***

Energy from ocean: Introduction, ocean thermal energy conversion (OTEC): Open and closed cycle power plants; Tidal energy: Schematic diagram of tidal power plant; Advantages and disadvantages.

Energy from Biomass: Introduction, biomass conversion technologies-direct, Thermochemical and Biochemical conversions; Biogas generation—Anaerobic digestion process.

Geothermal energy: Introduction, Geothermal resources, Geothermal power plants— Vapour dominated and liquid dominated; Environmental issues.

Module 5: FUEL CELLS AND HYBRID ENERGY SYSTEMS ***(08 Periods)***

Fuel Cells: Introduction, principle and operation of fuel cell, classification of fuel cells, advantages and disadvantages of fuel cells.

Hybrid energy systems: Need for hybrid systems, configuration and coordination, Block diagram approach of Stand-alone PV-wind system, PV-Diesel and Wind-diesel; energy storage systems — Ultra capacitors, SMES, Battery.

Total Periods: *45*

EXPERIENTIAL LEARNING

1. The students shall visit a solar power plant, understand the operational aspects and should prepare a technical report on the plant visited.
2. The students shall visit a wind farm, understand the operational aspects, and should prepare a technical report on the plant visited.
3. The students shall visit a bio-mass energy conversion plant, understand the operational aspects and should prepare a technical report on the plant visited.
4. The students shall prepare a technical report on the need of a hybrid plant and find new avenues for a new hybrid system.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXT BOOKS:

1. Rai, G.D., *Non-conventional Energy Sources*, Khanna Publishers, New Delhi, 2017.
2. G.N. Tiwari and M.K. Ghosal, *Renewable energy resources: Basic principles and applications*, Alpha Science International Ltd., 2005.

REFERENCE BOOKS:

1. JhonTwidell and Tony Wier, *Renewable Energy Resources*, Taylor & Francis, 2nd edition, London and Newyork, 2006.
2. K.M. Mittal,*Non-conventional Energy Systems-Principles*, Progress and Prospects, Wheeler Publications, 1997.
3. S.Rao, Dr.B.B. Parulekar, *Energy Technology*, Third edition, Khanna Publications, 2013.
4. R. K. Rajput, *A textbook of power system engineering*, Laxmi publications (P) Ltd, 2016

VIDEO LECTURES:

1. https://nptel.ac.in/courses/103103206
2. https://nptel.ac.in/courses/121106014
3. https://youtu.be/mh51mAUexK4
4. https://youtu.be/UW4HYJ36q0Y

WEB RESOURCES:

1. www.mnre.gov.in
2. www.ireda.in

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22CS101702	**WEB DESIGN FUNDAMENTALS**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: This course is designed to introduce the student to the technologies and facilities of web design: CSS, javascript, and jquery. Students will understand the web design process and use these software technologies together to produce web design projects.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1. Understand the fundamentals of HTML 5 and the principles of web design.

CO2. Construct basic websites using HTML and Cascading Style Sheets.

CO3. Build dynamic web pages with validation using Java Script objects and by applying different event handling mechanisms.

CO4. Learn how to use HTML5 and other Web technologies to develop interactive and responsive web pages.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	3	3	-	-	-	-	-	-	-	-	-
CO2	3	3	-	-	-	-	2	-	-	-	-	-
CO3	3	3	3	-	-	-	-	-	-	-	2	-
CO4	2	3	3	-	-	-	-	2	-	-	-	-
Course Correlation Mapping	**3**	**3**	**3**	**-**	**-**	**-**	**2**	**2**	-	**-**	**2**	**-**

Correlation Levels: ***3: High;*** ***2: Medium;*** ***1: Low***

COURSE CONTENT

Module 1: INTRODUCTION ***(09 Periods)***

Elements – Data types - Working with Text - Arranging Text - Displaying Lists - VAR Element - BDO Element - SPAN Element – DIV Element.

Module 2: LINKS AND URLS ***(09 Periods)***

Hyperlinks – URLs - Linking to a Mail System - Creating Tables - Inserting Images in a Web Page – Colors – Form Elements - Multiple-Choice Elements – Multimedia

Module 3: DYNAMIC HTML ***(09 Periods)***

Features of JavaScript - Programming Fundamentals - JavaScript Functions, Events, Image Maps, and Animations – JS Objects - Document Object - Validation, Errors, Debugging, Exception Handling, and Security

Module 4: CASCADING STYLE SHEET ***(09 Periods)***

CSS Syntax - CSS Selectors - Backgrounds and Color Gradients - Fonts and Text Styles - Creating Boxes and Columns - Displaying, Positioning, and Floating an Element - Table Layouts - : Effects, Frames, and Controls in CSS

Module 5: ADVANCED FEATURES OF HTML5 ***(09 Periods)***

Creating Editable Content - Checking Spelling Mistakes - Custom Data Attributes - Client-Side Storage - Drag and Drop Feature - Web Communication –**jQuery -** Fundamentals of jQuery - Callback Functions - jQuery Selectors - jQuery Methods to Access HTML Attributes.

Total Periods: 45

EXPERIENTIAL LEARNING

1. Design a blog layout that includes header, navigation menu, content area, sidebar. Apply appropriate styling to each section.
2. Develop a java script based quiz that presents MCQs to the user and provides immediate feedback on their answers. Keep track of the score and display the final results at the end.
3. Build a web page that displays and image gallery. Each image should be a clickable link that opens the image in a larger view when clicked.

(Note: It's an indicative one. The course instructor may change the activities and the same shall be reflected in course handout.)

RESOURCES

TEXTBOOKS

1. DT Editorial Services, *HTML 5 Black Book*, Dreamtech Press, 2nd Edition, 2016.

REFERENCE BOOKS

1. Jennifer Niederst Robbins, *HTML5 Pocket Reference,* O'Reilly, 5th Edition, 2018.
2. Ben Frain, *Responsive Web Design with HTML5 and CSS3*, Packt, 2nd Edition, 2020.

VIDEO RESOURCES

1. https://www.youtube.com/watch?v=h_RftxdJTzs
2. https://www.youtube.com/watch?v=dlkWNdnO8ek

WEB RESOURCES

1. https://www.w3schools.com/html/
2. https://www.w3schools.com/css/
3. https://www.geeksforgeeks.org/web-technology/
4. https://www.smashingmagazine.com/2021/03/complete-guide-accessible-front-end-components/
5. https://css-tricks.com/
6. https://davidwalsh.name/css-optional

UNIVERSITY ELECTIVE

Course Code	Course Title	L	T	P	S	C
22SS101706	**WOMEN EMPOWERMENT**	3	-	-	-	3

Pre-Requisite -

Anti-Requisite -

Co-Requisite -

COURSE DESCRIPTION: Concept & Framework, Status of Women, Women's Right to Work, International Women's Decade, and Women Entrepreneurship.

COURSE OUTCOMES: After successful completion of the course, students will be able to:

CO1 Demonstrate the knowledge of the characteristics and achievements of empowered women and women's empowerment techniques by analyzing women's legal and political status.

CO2 Apply the knowledge of women's rights by analyzing various societal issues and obstacles in different fields, including science and technology.

CO3 Demonstrate the knowledge of the significance of women's participation in policy debates, National conferences, and common forums for equality and development by identifying and analyzing issues.

CO4 Analyze the concept of women's entrepreneurship, government schemes, and entrepreneurial challenges and opportunities.

CO-PO Mapping Table

Course Outcomes	Program Outcomes											
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	1	-	-	1	3	-	1	–	–	-	-
CO2	3	1	-	-	-	2	-	-	-	–	-	-
CO3	3	1	-	-	-	2	-	-	-	3	-	-
CO4	3	1	-	-	-	-	-	-	-	-	2	-
Course Correlation Mapping	3	1	-	-	1	3	-	1	–	3	2	-

Correlation Levels: 3: High; 2: Medium; 1: Low

COURSE CONTENT

Module 1: CONCEPT & FRAMEWORK ***(09 Periods)***

Introduction– Empowered Women's Characteristics – Achievements of Women's Empowerment **Concept of Empowerment:** Meaning & Concept – Generalizations about Empowerment – Empowerment Propositions – Choices women can make for empowerment – Women's participation in decision making, development process & in Governance. **Framework for Empowerment** – Five levels of equality – Tenets of Empowerment– Elements – Phases and aspects – Techniques – Categories and Models
– Approaches.

Module 2: STATUS OF WOMEN ***(09 Periods)***

Legal Status: Present Scenario – Call for Social Change – Significant Trends – Legal & Schemes – Personal Law – Joint Family – Criminal Law – Shift towards Dowry –

Deterrent Punishment – Criminal Law (II Amendment) – Discrimination in Employment.

Political Status: Present Scenario – Political Participation & its NatureSocio–economic Characteristics – Political Mobilization: Mass Media – Campaign Exposure – Group Orientation – Awareness of issues and participation – Progress & Future Thrust.

Module 3: WOMEN'S RIGHT TO WORK ***(09 Periods)***

Introduction – Present Scenario – Changes in Policy & Programme – National Plan of Action– Women's Cells and Bureau – Increase in the work participation rate – Discrimination in the labour market – Women in unorganized sector – Issues and Obstacles– Women in Education – Women in Science & Technology – Case Study: Linking Education to Women's Access to resources.

Module 4: WOMEN'S PARTICIPATORY DEVELOPMENT ***(09 Periods)***

Dynamics of social change – conscious participation – Information Explosion – Organized Articulation – National Conference – Common Forums – Participatory Development – New Issues Identified – Role of other Institutions.

Module 5: WOMEN ENTREPRENEURSHIP ***(09 Periods)***

Introduction – Definition – Concept – Traits of women Entrepreneurs – Role of Women Entrepreneurs in India – Reasons for Women Entrepreneurship – Government schemes & Financial Institutions to develop Women Entrepreneurs – Key policy recommendations – Project Planning – Suggestions and measures to strengthen women entrepreneurship – Growth & Future challenges – Training and Opportunities – Case Study: Training Women as Hand–pump Mechanics– Case Study: Literacy for Empowering Craftswomen

Total Periods: 45

EXPERIENTIAL LEARNING

1. Prepare poster presentation on "impact of women's self-help groups on their empowerment and socio-economic development."
2. Prepare a comparative analysis chart on the status of women in various countries.
3. Prepare a presentation on women and cultural responsibilities in different societies.
4. Prepare a presentation on the women of the past, present and future in terms of responsibilities and duties.
5. Prepare a presentation on the great women entrepreneurs of India.

(Note: It's an indicative one. Course Instructor may change activities and shall be reflected in course Handout)

RESOURCES

TEXT BOOKS:

1. SahaySushama, *Women and Empowerment,* Discovery Publishing House, New Delhi,2013.
2. NayakSarojini, Jeevan Nair, *Women's Empowerment in India*, Pointer Publishers, Jaipur, 2017.

REFERENCE BOOKS:

1. Baluchamy. S, *Women's Empowerment of Women*, Pointer Publishers, Jaipur, 2010.
2. Khobragade Grishma, *Women's Empowerment: Challenges and Strategies Empowering Indian Women*, Booksclinic Publishing, Chhattisgarh, 2020.

Web Resources:

1. https://www.economicsdiscussion.net/entrepreneurship/women–entrepreneurs–in–india
2. https://www.businessmanagementideas.com/entrepreneurship–2/women entrepreneurs