Bharati Vidyapeeth

(Deemed to be University)

Pune, India

College of Engineering, Pune

B.Tech.(Computer Engineering) (2023 Course)

(Semester- I to VIII)

Program Curriculum

As Per NEP 2020 Guidelines

VISION OF UNIVERSITY:

Social Transformation through Dynamic Education

MISSION OF UNIVERSITY:

- To make available quality education in different areas of knowledge to the students as per their choice and inclination
- To offer education to the students in a conducive ambience created by enriched infrastructure and academic facilities in its campuses.
- To bring education within the reach of rural, tribal and girl students by providing them substantive fee concessions and subsidized hostel and mess facilities
- To make available quality education to the students of rural, tribal and other deprived sections of the population

VISION OF THE INSTITUTE:

To be a World Class Institute for Social Transformation Through Dynamic Education.

MISSION OF THE INSTITUTE:

- To provide quality technical education with advanced equipment, qualified faculty members, and infrastructure to meet the needs of profession and society.
- To provide an environment conducive to innovation, creativity, research and entrepreneurial leadership.
- To practice and promote professional ethics, transparency and accountability for social community, economic and environmental conditions.

VISION OF THE DEPARTMENT

To pursue and excel in the endeavor for creating globally recognized Computer Engineers through quality education.

MISSION OF THE DEPARTMENT

- To impart engineering knowledge and skills confirming to a dynamic curriculum.
- To develop professional, entrepreneurial & research competencies encompassing continuous intellectual growth.
- To produce qualified graduates exhibiting societal and ethical responsibilities in working environment.

PROGRAM EDUCATIONAL OBJECTIVES

The students of B.TECH. (Computer Engineering), after graduating with Bachelor of Technology degree in Computer Engineering, will be able to

- Demonstrate technical and professional competencies by applying Engineering fundamentals, computing principles, and technologies.
- Learn, practice and grow as skilled professionals adapting to the evolving computing landscape.
- Demonstrate professional attitude, ethics, understanding of social context and interpersonal skills leading to a successful career.

PROGRAM SPECIFIC OUTCOMES

- To design, develop and implement computer programs on hardware towards solving problems.
- To employ expertise and ethical practice through continuing intellectual growth and adapting to the working environment.

PROGRAM OUTCOMES

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

PO2: Problem Analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development.

PO3: Design/Development of Solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required.

PO4: Conduct Investigations of Complex Problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions.

PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems.

PO6: The Engineer and The World: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment.

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws.

PO8: Individual and Collaborative Team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-Long Learning: Recognize the need for and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change.

CORRELATION BETWEEN GRADUATE ATTRIBUTES AND PROGRAMME OUTCOMES

Graduate Attributes/ Programme Outcomes	a	b	c	d	e	f	g	h	i	j	k
Engineering Knowledge	✓										
Problem Analysis		✓									
Design/Development of Solutions			✓								
Conduct Investigations of Complex Problems				✓							
Engineering Tool Usage					✓						
The Engineer and The World						✓					
Ethics							✓				
Individual and Collaborative Teamwork								✓			
Communication									✓		
Project Management and Finance										✓	
Life-Long Learning											✓

- **DEFINITION OF CREDITS:**

1 Hour Lecture (L) per week	1 credit
1 Hour Tutorial (T) per week	1 credit
1 Hour Practical (P) per week	0.5 credits

- **STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAMME:**

Sr. No.	Category	Credit Distribution
1	Basic Science Courses	16
2	Engineering Science Course	13
3	Core Courses	97
4	Professional Elective Courses	11
5	Project	08
6	Internship	12
7	Skill Based Courses	08
*8	Value Added Courses	04 (Add on)
9	Humanity/Social Science Courses	2
10.	Massive Open Online Courses (MOOC)	04(Add on)
11.	Extracurricular Activity	02 (Add on)
12.	Audit Course	06(Add on)
13	Research	02
14	Ability Enhancement	05
TOTAL		**174**

- *** Indicates optional credits**

Credits Per Semester

Sr. No.	Semester	Credits
1	I	25
2	II	25
3	III	20
4	IV	20
5	V	20
6	VI	24
7	VII	20
8	VIII	20
Total Credits		**174**

- **Course Code and Definition**

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
TW	Term Work
O	Oral
ESE	Semester End Examination
MJ	Major (Core) Courses
MI	Minor Courses
GE	General Elective Courses
OE	Open Elective Courses
SE	Skill Enhancement Courses
AE	Ability Enhancement Courses
VE	Vocational Enhancement Courses
VS	Vocational Skill Courses
VA	Value Added Courses
CC	Core Courses
EC	Extra-Curricular Courses
ID	Inter-disciplinary Courses
MD	Multidisciplinary Courses
RP	Research / Project Courses
PC	Program Core

BS	Basic Science
ES	Engineering Science
AC	Audit Course
EC	Extracurricular Activities
BM	Basic Mathematics
BP	Basic Physics
BC	Basic Chemistry
PS	Professional Skills
UH	Universal Human Values
PE	Professional Elective Courses
PC	Practical Courses

TRACK-I

B. Tech. (Computer Engineering): Semester –VII (2023 CBCS COURSE)

Sr.No	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1.	MJ	MJ1103701	Artificial Intelligence and Machine Learning	3	2	-	60	40	25	25	-	150	3	1	-	4
2.	PE	PE1103702	Professional Elective Course-II	3	2	-	60	40	25	-	25	150	3	1	-	4
3.	PE	PE1103703	Professional Elective Course-III	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	RP	RP1103704	Major Project	-	16	-	-	-	100	-	50	150	-	8	-	8
			Total	**9**	**22**	-	**180**	**120**	**175**	**25**	**100**	**600**	**9**	**11**	**-**	**20**

Program Elective Course (PEC) List

Professional Elective Course -II		Professional Elective Course -III	
i.	Virtualization and Cloud Computing	i.	Data Visualization
ii.	Agile Technologies	ii.	Cryptography and Network Security
iii.	Image Processing	iii.	Augmented Reality & Virtual Reality
iv.	Deep Learning	iv.	Blockchain

B. Tech. (Computer Engineering): Semester –VIII (2023 CBCS COURSE)

Sr. No	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1.	MJ	MJ1103801	High Performance Computing	3	2	-	60	40	25	25	-	150	3	1	-	4
2.	CC	CC1103802	Seminar	-	4	-		-	50		50	100	-	2	-	2
3.	SE	SE1103803	*Internship (Industry/ In-house)	-	-	-	-	-	150	-	100	250	-	14	-	14
			Total	**3**	**6**	-	**60**	**40**	**225**	**25**	**150**	**500**	**3**	**17**		**20**

TRACK-II

B. Tech. (Computer Engineering): Semester –VII (2023 CBCS COURSE)

Sr. No	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1.	MJ	MJ1103801	High Performance Computing	3	2	-	60	40	25	25	-	150	3	1	-	4
2.	CC	CC1103802	Seminar	-	4	-		-	50		50	100	-	2	-	2
3.	SE	SE1103803	*Internship (Industry/ In-house)	-	-	-	-	-	150	-	100	250	-	14	-	14
			Total	**3**	**6**	-	**60**	**40**	**225**	**25**	**150**	**500**	**3**	**17**		**20**

B. Tech. (Computer Engineering): Semester –VIII (2023 CBCS COURSE)

Sr.No	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1.	MJ	MJ1103701	Artificial Intelligence and Machine Learning	3	2	-	60	40	25	25	-	150	3	1	-	4
2.	PE	PE1103702	Professional Elective Course-II	3	2	-	60	40	25	-	25	150	3	1	-	4
3.	PE	PE1103703	Professional Elective Course-III	3	2	-	60	40	25	-	25	150	3	1	-	4
4.	RP	RP1103704	Major Project	-	16	-	-	-	100	-	50	150	-	8	-	8
			Total	**9**	**22**	-	**180**	**120**	**175**	**25**	**100**	**600**	**9**	**11**	**-**	**20**

Program Elective Course (PEC) List

Professional Elective Course -II		**Professional Elective Course -III**	
v.	Virtualization and Cloud Computing	v.	Data Visualization
vi.	Agile Technologies	vi.	Cryptography and Network Security
vii.	Image Processing	vii.	Augmented Reality & Virtual Reality
viii.	Deep Learning	viii.	Blockchain

Instructions

1. Students shall be permitted to opt for either Track-1 or Track-2.
    A) If the student opts Track-1 then he/she has to perform Major Project in Semester-VII and undergo Internship in Semester-VIII.
    B) If the student opts Track-2 then he/she has to undergo Internship in Semester-VII and perform Major Project in Semester-VIII.

2. Seminar:

Objectives of the Seminar

The Seminar aims to:

- Develop **self-learning ability** and **research orientation**
- Enhance **technical understanding of emerging technologies**
- Improve **presentation and communication skills**

Scope of Topics

Students must select a topic from **Emerging/Recent Technologies, Case Studies, Research-Oriented Topics, Interdisciplinary Topics**

What Students Are Expected to Do

Topic Selection

Literature Survey

Content Preparation

Report Writing

Presentation

3. Major Project:

Objectives of the Major Project

Students are expected to:

- Apply knowledge of Computer/IT engineering to solve **real-world problems**
- Develop **design, implementation, and testing skills**

B.Tech
(Computer Engineering)
Semester- VII

Track I

Artificial Intelligence and Machine Learning

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical	01
		Term Work:	25 Marks		
		Practical:	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

To enable students to understand the fundamentals of Artificial Intelligence and Machine Learning, apply problem-solving and learning algorithms, and develop intelligent systems using knowledge representation, search techniques, logical reasoning, planning, and modern ML models.

Prerequisite:

Students should have knowledge of Discrete Mathematics, Data Structures, Algorithm analysis

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Explain the concepts of AI, intelligent agents, and knowledge representation using classical problems like vacuum world and 8-queens.

CO 2: apply various search and game-playing algorithms to solve AI problems efficiently.

CO 3: Develop knowledge-based agents and perform logical reasoning using propositional and first-order logic.

CO 4: Identify appropriate Learning approach to solve a particular problem

CO 5: Analyze data and apply supervised, semi-supervised, and unsupervised learning techniques.

CO 6: Evaluate machine learning models for classification, regression, clustering, and anomaly detection.

Unit I: Introduction:	(06 Hours)
A.I. Representation, Non-AI & AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, Types of production systems, Turing Test. Intelligent Agents: Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation. Formulation of problems: Vacuum world, 8 queens, Route finding, robot navigation., Case Study: Knowledge Representation in Medical Diagnosis, Intelligent Agents – Smart Home System	
Unit II: Search Methods:	**(06 Hours)**
Search Strategies, Comparison of Uninformed search Strategies. Generate & test, Hill Climbing, Constraint satisfaction, Means Ends Analysis: Minimax Search, Alpha-Beta Cut offs. Case Study: Uninformed Search – Maze Solving Robot	
Unit III: Knowledge Representation, Reasoning and Planning	**(06 Hours)**

Knowledge Representation Methods Propositional Logic, First Order Logic, Forward and Backward Chaining. Planning: Goals, Blocks world, STRIPS, Implementation using goal stack, Components of Planning System, Planning strategies: Expert System: Design, Implementation, Case study of Expert System in PROLOG,Case Study: Propositional Logic in Smart Home Automation	
Unit IV: Introduction to Machine Learning	**(06 Hours)**
Introduction to Machine Learning: Examples of Machine Learning Applications, Learning Types, ML Life cycle, AI & ML, dataset for ML, Data Pre-processing, Training versus Testing, Positive and Negative Class, Cross-validation. Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning. Supervised: Learning a Class from Examples, Types of supervised Machine learning Algorithms, Unsupervised: Types of Unsupervised Learning Algorithm-enforcement learning	
Unit V: Dimensionality Reduction	**(06 Hours)**
Introduction to Dimensionality Reduction, Subset Selection, and Introduction to Principal Component Analysis. Supervised Leaming: leaming a class from examples, leaming multiple classes, model selection and generalization classification: Binary and Multiclass Classification: , Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest. Regression: Assessing performance of Regression – Error measures, Overfitting and Underfitting.	
Unit VI: Multivariate Methods	**(06 Hours)**
Multivariate Methods Multivariate alata, parameter estimation, estimation of missing values, multivariate normal distribution. multi variate classification Dimensionality Reduction: introduction, subset selection, principal Component analysis, singular value decomposition and matrix factorization Clustering: Mixture densities, k-means clustering, expectation-maximization algorithm, mixtures of latent variables., Generative AI, Explainable and Responsible AI.	
Textbooks	
1. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hill 2. Stuart Russell & Peter Norvig: "Artificial Intelligence: A Modern Approach", Pearson Education, 2nd Edition. 3. Deepak Khemani: “A First Course in Artificial Intelligence”, Mc Graw Hill 4. Saroj Kaushik: “Artificial Intelligence” Cengage Publication 5. Machine Learning (McGraw-Hill International Editions Computer Science Series 6. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 7. Machine Learning: A First Course for Engineers and Scientists, by Andreas Lindholm (Author), Niklas Wahlström (Author), Fredrik Lindsten (Author)	

Reference Books

1. Ivan Bratko: "Prolog Programming for Artificial Intelligence", 2nd Edition Addison Wesley,1990.
2. Eugene, Charniak, Drew Mcdermott: "Introduction to Artificial Intelligence.", Addison Wesley
3. Patterson: "Introduction to AI and Expert Systems", PHI
4. Nilsson: "Principles of Artificial Intelligence", Morgan Kaufmann. 5. Carl Townsend, "Introduction to turbo Prolog", Paperback, 1987
5. T.M. Mitchell, "Machine Learning",
6. C.M. Bishop, "Pattern McGraw Hill. Recognition and Machine
7. Ethem Alpaydin, "Introduction to Machine Learning", Learning

Practical Assignment List:

1. Intelligent Traffic Management System
2. Smart Home Automation with Voice Control
3. AI-based Disease Prediction System
4. Autonomous Robot Navigation
5. Chatbot for Student Assistance
6. Recommendation System for E-Commerce
7. Fraud Detection in Online Transactions
8. AI-powered Resume Screening Tool
9. Smart Waste Management System
10. Emotion Recognition from Facial Expressions

Project Based Learning Assignments:

Note: - Students in a group of 3 to 4 shall complete any one project from the following list

1. Implement an 8-Queens solver using AI search techniques and compare algorithm performance.
2. Develop a route-finding system using the A* algorithm for optimal path planning.
3. Apply PCA for dimensionality reduction on a student dataset and visualize feature impact.
4. Perform customer segmentation using K-Means clustering on purchasing behavior data.
5. Develop a multiclass classification model to identify plant species using supervised learning.
6. Create a goal stack planning solution for the Block World problem using STRIPS concepts.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Professional Elective-II : i) Virtualisation and Cloud Computing

TEACHING SCHEME		EXAMINATION SCHEME	CREDIT SCHEME	
Lecture:	03 Hours/Week	End Semester Examination: 60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment: 40 Marks	Practical:	01
		Term Work: 25 Marks		
		Oral: 25 Marks		
Total	05 Hours/Week	Total Marks: 150 Marks	Total	04

Course Objective:

Students will be able to understand concepts of distributed systems, virtualization, cloud computing concepts, service models, migration strategies, and cloud security aspects.

Prerequisite:

Basic knowledge Computer fundamentals, Operating System and computer networks.

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Ability to understand various service delivery models of a cloud computing

CO 2: Ability to understand the ways in which the cloud can be programmed and deployed.

CO 3: Ability to understand virtualization and cloud computing concepts

CO 4: Assess the comparative advantages and disadvantages of Virtualization technology

CO 5: Analyse authentication, confidentiality, and privacy issues in cloud computing

CO 6: Identify security implications in cloud computing

Unit I: Cloud Computing Fundamentals	**(06 Hours)**
Cloud Computing Fundamentals: Definition of Cloud computing, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers. Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing. Case Study of AWS-Based Deployment Using IaaS and PaaS Models.	
Unit II: Virtualization	**(06 Hours)**
Virtualization: Introduction to Cloud Computing- Overview, Cloud issues and challenges, Properties, Characteristics, Service models, Deployment models. Cloud resources: Network and API, Virtual and Physical computational resources, Data storage. Virtualization concepts – Types of Virtualizations, Introduction to Various Hypervisors, Advanced Virtualization Techniques - High Availability (HA), Disaster Recovery (DR) using Virtualization, VM Migration/ Moving VMs, Azure or AWS Case Study.	

Unit III: Service Models	(06 Hours)
Service Models: Infrastructure as a Service (IaaS) – Resource Virtualization: Server, Storage, Network, Case studies of Iaas. Platform as a Service (PaaS) – Cloud platform & Management: Computation, Storage devices, Case studies of Paas. Software as a Service (SaaS) – Web services, Web 2.0 , Web OS , Case studies of Saas, Emerging Service Models- Anything as a service (XaaS), Microservices Architecture. Case Study on SaaS for Collaborative Work Using Google Workspace.	
Unit IV: Cloud Programming and Software Environments	**(06 Hours)**
Cloud Programming and Software Environments: Cloud Programming and Software Environments, Parallel and Distributed Programming paradigms, Current cloud technologies, Programming support in Cloud Platforms, Emerging Cloud Software Environment. Case Study on Cloud-Based Application Development Using a Cloud Platform.	
Unit V: Cloud Access	**(06 Hours)**
Cloud Access: Authentication, authorization and accounting(AAA), Cloud Security – data protection, identity management, encryption, and secure access control, Cloud Provenance and meta-data , Cloud Reliability and fault-tolerance , Cloud Security, privacy, policy and compliance, Cloud federation, Interoperability and standards. Case study on implementation of Cloud Security and Access Control in a Healthcare System.	
Unit VI: Cloud Technologies and Advancements And SLA Management	**(06 Hours)**
Cloud Technologies and Tools- Hadoop, MapReduce, Virtual Box, Google App Engine, Programming Environment for Google App Engine, Open Stack . Federation in the Cloud – Four Levels of Federation, Federated Services and Applications, Future of Federation. SLA Management in cloud computing- Traditional Approaches to SLO Management, Types of SLA, Life Cycle of SLA, SLA Monitoring and Management in Cloud. Case study on Big Data Processing Using Hadoop and MapReduce in E-Commerce.	
Textbooks	

Textbooks

1. Cloud Computing Principles and Paradigms, by Rajkumar Buyya, James Broberg, Andrzej M. Goscinski John Wiley & Sons, 17 Dec 2010
2. Essentials of cloud Computing: K. Chandrasekharan, CRC press, 2014
3. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.
4. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH McGraw Hill Professional, 22 Oct 2009

Reference Books

1. Cloud Computing: A Practical Approach, Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Tata McGraw Hill,rp2011.
2. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O‘reilly, SPD, 2011.

3. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp2011
List of Assignments
1. Installation and configuration of own Cloud.
2. Implementation of Virtualization in Cloud Computing to Learn Virtualization Basics, Benefits of Virtualization in Cloud using Open-Source Operating System.
3. Study and implementation of infrastructure as Service using Open Stack.
4. Write a program for Web feed using PHP and HTML.
5. Write a Program to Create, Manage and groups User accounts in own Cloud by Installing Administrative Features.
6. Design and develop custom Application using Salesforce Cloud
7. creating an AMI for Hadoop and implementing short Hadoop programs on the Amazon Web Services platform.
8. Creating an Application in SalesForce.com using Apex programming Language
9. Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store.
Project Based Learning Assignments
Note: - Students in a group of 3 to 4 shall complete any one project from the following list
1. Data Science Assignment Help in Microsoft Azure Specify the necessary environment as a Docker file.
2. Cloud based VM resources for application hosting
3. Configurable deployment of cloud applications using the Docker container
4. Big Data analytics on unstructured text data using Microsoft Azure.
5. Hadoop and MapReduce in Microsoft HDInsight.
6. Azure Machine Learning for sentiment analysis
7. Cloud Computing Mashup/Docker Project
8. Deployment to a publicly hosted Linux VM [Azure or AWS will be appropriate here.]

Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Professional Elective-II : ii) Agile Technologies					
TEACHING SCHEME		**EXAMINATION SCHEME**		**CREDIT SCHEME**	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		Term Work	25 Marks		
		Oral	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

Students will learn to understand Agile principles, apply Agile methodologies, perform Agile-based requirements engineering and testing, and evaluate Agile adoption strategies in organizations.

Prerequisite:

Students should have knowledge of Software Engineering and Software Development Life Cycle (SDLC).

Course Outcomes: On completion of the course, students will have the ability to

- CO 1: Explain Agile philosophy, principles, values, and differences from traditional models.
- CO 2: Describe and apply Agile methodologies such as Scrum, XP, Lean, Crystal, FDD, and ASD.
- CO 3: Apply Agile practices for requirements engineering including story cards and managing changing requirements.
- CO 4: Analyze Agile RE techniques like abstraction models, prioritization, and concurrency for project scenarios.
- CO 5: Apply Agile testing techniques including TDD, CI, regression testing, and automation to ensure quality.
- CO 6: Evaluate Agile adoption strategies, interpret Agile metrics, and propose Agile implementation approaches for organizations.

Unit I: Foundations of Agile	**(06 Hours)**
History of Agile, Theories for Agile Management, Need of Agile Software Development, Traditional Model vs. Agile Model, Classification of Agile Methods, Agile Manifesto and Principles, Agile Project Management, Agile Team Interactions, Ethics in Agile Teams, Agility in Design, Testing, Agile Documentations, Agile Drivers, Capabilities and Values,Case Study: Spotify Agile Model, Tools: Jira, Confluence, Slack, Miro	
Unit II : Agile Methodologies & Frameworks	**(06 Hours)**
Lean Production, SCRUM, Crystal, Feature Driven Development, Adaptive Software Development, Extreme Programming: Method Overview, Lifecycle, Work Products, Roles and Practices, Case Study: Microsoft Scrum Implementation ,Tools: Azure DevOps, Jira, Trello, GitHub	
Unit III : Agile Requirements Engineering – Fundamentals	**(06 Hours)**

Agility & Requirements Engineering (RE), Impact of Agile Processes in RE, Current Agile Practices, Variance in Agile RE, Overview of RE using Agile, Managing Unstable Requirements, Agile Knowledge Sharing, Role of Story Cards, Story Card Maturity Model (SMM), Case Study: Amazon User Story Based Requirements, Tools: Jira, Product board, Miro, Notion	
Unit IV: Agility And Requirements Engineering	**(06 Hours)**
Requirements Elicitation, Agile Requirements Abstraction Model, Requirements Management in Agile Environment, Agile Requirements Prioritization, Agile Requirements Modeling and Generation, Concurrency in Agile Requirements Generation, Case Study: Netflix Agile Requirements Management, Tools: Jira, GitHub, Docker, Kubernetes.	
Unit V : **Agile Testing & Quality Assurance**	**(06 Hours)**
The Agile lifecycle and its impact on testing, Test driven development– Acceptance tests and verifying stories, writing a user acceptance test, Developing effective test suites, Continuous integration, Code refactoring. Risk based testing, Regression tests, Test automation, Case Study: Google Continuous Testing and Integration, Tools: JUnit, Selenium, Jenkins, GitLab	
Unit VI: Agile Adoption, Metrics & Future Trends	**(06 Hours)**
Agile Adoption Strategy in Organizations, Common Challenges in Agile Transformation, Agile Metrics: Lead Time, Cycle Time, Throughput, Quality Metrics, Case Studies of Agile Success (IT services, startups, product companies),Combining Agile with UX Design (Dual-Track Agile),Agile in Non-IT Industries (Manufacturing, Marketing, HR),Future Trends: Agile + AI, Hyper-Agility, Continuous Discovery., Case Study: Tesla Agile Innovation Model ·, Tools: Jira, GitHub, Tableau, TensorFlow	
Textbooks	
1. Agile Practice Guide – Project Management Institute (PMI) & Agile Alliance, 1st Edition, 2017.	
2. Essential Scrum: A Practical Guide to the Most Popular Agile Process – Kenneth S. Rubin, 1st Edition, 2012.	
3. Agile Software Development: Principles, Patterns, and Practices – Robert C. Martin, 1st Edition, 2003.	
4. More Agile Testing: Learning Journeys for the Whole Team – Lisa Crispin & Janet Gregory, 1st Edition, 2015.	
5. Agile Product Management with Scrum: Creating Products Customers Love – Roman Pichler, 1st Edition, 2010.	
Reference Books:	
1. The Scrum Guide – Ken Schwaber & Jeff Sutherland, Latest Version (2020 Update).	
2. Specification by Example: How Successful Teams Deliver the Right Software – Gojko Adzic, 1st Edition, 2011.	

3. Coaching Agile Teams: A Companion for Scrum Masters, Agile Coaches, and Project Managers in Transition – Lyssa Adkins, 1st Edition, 2010.
4. User Stories Applied: For Agile Software Development – Mike Cohn, 1st Edition, 2004.
5. Lean Software Development: An Agile Toolkit – Mary & Tom Poppendieck, 1st Edition, 2003.
Project Based Learning Assignments:
Note:- Students in a group of 3 to 4 shall complete any one project from the following list
1. Design and Development of an E-Commerce System Using Scrum Framework
2. Agile-Based Library Management System with Iterative Releases
3. Implementation of Student Attendance System Using Extreme Programming (XP)
4. Development of Online Food Ordering Application Using Agile Practices
5. Agile Requirements Engineering for a Smart Healthcare Monitoring System
6. Design of Task Management Tool with Continuous Integration and TDD
7. Development of Bug Tracking System Applying Agile Testing Techniques
8. Agile Transformation Strategy for a Traditional Software Project
9. User Story Mapping and Prioritization for a Mobile Banking App
10. Development of Online Examination System Using Scrum Lifecycle

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Professional Elective-II : iii) Image Processing

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
Lecture	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical	02 Hours/Week	Internal Assessment:	40 Marks	Practical	01
Total	05 Hours/Week	Term Work:	25 Marks	Total	04
		Oral:	25 Marks		
		Total:	150 Marks		

Course Objective:

- To become familiar with digital image fundamentals.
- To get exposed to simple image enhancement techniques in spatial and frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods.

Prerequisite:

Students should have knowledge of Linear Algebra, Probability and Statistics.

Course Outcomes:

On completion of the course, students will have the ability to

1. Know and understand the fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
2. Operate on images using the techniques of smoothing, sharpening and enhancement in spatial domain.
3. Learn the basics of compression, digital image and their different types.
4. Understand the restoration concepts and filtering techniques.
5. Learn the basics of segmentation and feature extraction techniques.
6. Apply image processing algorithms for practical object recognition applications.

Unit I: Introduction to Digital Image Processing	(06 Hours)
Introduction: Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images (Data structure), Some Basic Relations, Human Visual System, Representing Digital Images, Spatial & Gray level Resolution, Image File Formats, Basic Relationships between Pixels, Distance Measures. Basic Operations on Images - Image Addition, Subtraction, Logical Operations, Scaling, Translation, Rotation, Image Histogram. Color fundamentals and models – RGB, HSI, YIQ.	
Unit II: Image Enhancement in Spatial Domain	**(06 Hours)**
Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations. Spatial domain enhancement: Point Operations - Log Transformation, Power-law Transformation, Piecewise Linear Transformations, Histogram Equalization.	

Filtering operations - Image Smoothing, Image Sharpening. Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in Frequency Domain. Homomorphic Filtering. Restoration: Noise Models, Restoration using Inverse Filtering and Wiener Filtering. Restoration: Noise Models, Restoration using Inverse Filtering and Wiener Filtering	
Unit III: Image Compression	**(06 Hours)**
Types of Redundancy, Fidelity Criteria Lossless compression – Run Length Coding, Huffman Coding, Biplane Coding, Arithmetic Coding. Introduction to DCT, Wavelet Transform. Lossy compression – DCT based Compression, Wavelet based Compression. Image and Video Compression Standards – JPEG, MPEG.	
Unit IV: Image Segmentation and Morphological Operations	**(06 Hours)**
Image Segmentation: Point Detections, Line Detection, Edge Detection - First order Derivative - Prewitt and Sobel. Second order Derivative – LoG, DoG, Canny. Edge Linking, Hough Transform, Thresholding - Global, Adaptive. Otsu's Method. Region Growing, Region Splitting and Merging. Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Thinning, Thickening, Skeleton.	
Unit V: **Image Restoration and Description**	**(06 Hours)**
Image Restoration, Degradation Model, Properties, Noise Models, Mean Filters, Order Statistics, Adaptive Filters, Band Reject Filters, Band Pass Filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener Filtering. Representation, Chain Codes, Polygonal Approximation, Signatures. Boundary Descriptors, Shape Numbers, Fourier Descriptors, Statistical Moments. Regional Descriptors, Topological, Texture. Principal Components for Description.	
Unit VI: **Object Recognition and Applications**	**(06 Hours)**
Feature extraction, Patterns and Pattern Classes, Representation of Pattern Classes, Types of Classification Algorithms, Minimum distance classifier, Correlation based Classifier, Bayes Classifier. Applications: Biometric Authentication, Character Recognition, Content based Image Retrieval, Remote Sensing, Medical Application of Image Processing.	
Textbooks	
1. Anil K. Jain, Fundamentals of Digital Image Processing 1 Edition, Pearson Education, 2015.	
2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson Education, Fourth Edition, 2010.	
Reference Books	
1. Kenneth R. Castleman, Digital Image Processing, Pearson Education, First Edition, 2007.	
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB, Pearson Education, Second Edition, 2009.	
Project Based Learning:	

1. Build a tool that converts RGB images to HSI and YIQ. Explain why the "I" (Intensity) in HSI is more useful for processing than RGB values.
2. Create a pipeline using Log transformations and Histogram Equalization to make details visible in extremely dark photos.
3. Create a "Hybrid Image" by combining the low frequencies of one face with the high frequencies of another.
4. Implement a simplified DCT-based compression. Show how discarding high-frequency coefficients affects visual quality vs. file size.
5. Use Canny Edge Detection and the Hough Transform to detect the edges of a piece of paper in a photo and "deskew" it.
6. Use Morphological Dilation and Erosion to separate overlapping circles (simulating blood cells) and count them automatically.
7. Build a system that compares two signatures using Correlation-based classification to determine if they belong to the same person.
8. Use texture-based regional descriptors (Unit V) and a Bayes Classifier (Unit VI) to identify healthy vs. diseased leaves in a small dataset.
Laboratory Experiments:
1. Develop a system that takes an underexposed RGB image and its corresponding Infrared (IR) version. Convert the RGB image to the HSI color model, isolate the Intensity (I) component, and fuse it with the IR data using Histogram Equalization to enhance visibility without distorting the color Hue.
2. Implement an Adaptive Median Filter that changes its window size based on local noise density. Compare its performance against a standard 3×3 Median Filter in removing high-density "salt and pepper" noise while preserving edge sharpness.
3. Create a tool to automatically straighten scanned documents. Use Canny Edge
4. Create a "Hybrid Image" that looks like one object from afar and another from up close. This is achieved by combining the Low-Pass filtered (smoothed) version of Image A with the High-Pass filtered (sharpened/edge-heavy) version of Image B using the 2D DFT.
5. Implement a simplified JPEG-style compression pipeline. Divide an image into 8×8 blocks, apply the Discrete Cosine Transform (DCT), and implement a "Quality Slider" that selectively zeros out high-frequency coefficients.
6. Process a medical slide image containing overlapping cells. Use Thresholding (Otsu's Method) to binarize, followed by Watershed Segmentation or Morphological Erosion/Dilation to separate "clumped" cells.
7. Build a biometric verification prototype. Use Thinning/Skeletonization (Unit IV) to normalize two handwritten signatures and apply a Correlation-based classifier to determine if the signatures match a stored template.
8. Simulate a "shaky camera" effect using a Degradation Model. Implement a Wiener Filter to restore the image, assuming the Point Spread Function (PSF) is known, and then attempt restoration where the PSF must be estimated.
9. Using a remote sensing dataset, extract Texture descriptors (like Gray-Level Co-occurrence Matrices) to distinguish between "Forest," "Water," and "Urban" areas. Train a Bayes Classifier to categorize pixels based on these features.

10. Extract Fourier Descriptors or Shape Numbers from various 2D objects (circles, squares, triangles). Implement a Minimum Distance Classifier to identify these shapes in a live video feed, regardless of their scale or rotation.

Syllabus for Unit Tests:	
Unit Test 1	**Unit I, Unit II, Unit III**
Unit Test 2	**Unit IV, Unit V, Unit VI**

Professional Elective-II : iv) Deep Learning

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		Term Work:	25 Marks		
		Oral:	25 Marks		
Total	05 Hours/Week	Total Marks:	150 Marks	Total	04

Course Objective:

Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.

Prerequisite: Linear Algebra, Statistics, probability, Machine learning

Course Outcomes: On completion of the course, students will have the ability to

1. Classify learning algorithms based on their approaches and applications.
2. To study the concepts of deep learning
3. To enable the students to know deep learning techniques to support real-time applications
4. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
5. Design and implement various deep supervised learning architectures for text & image data and design and implement various deep learning models and architectures
6. Apply various deep learning techniques to design efficient algorithms for real-world applications

Unit	Hours
Unit I: Basics of Neural Networks	**(06 Hours)**
Introduction to Machine Learning and Deep Learning Neural Networks basics – Binary Classification, Logistic Regression, Gradient Descent, Derivatives, Computation graph, Vectorization, Vectorizing logistic regression – **Shallow neural networks:** Activation functions, non-linear activation functions, Backpropagation, Data classification with a hidden layer.	
Unit II: Deep Neural Networks:	**(06 Hours)**
Deep L-layer neural network, Forward and Backward propagation, Deep representations, Parameters vs Hyperparameters, Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization, Building a Deep Neural Network (Application).	
Unit III: Supervised Learning with Neural Networks	**(06 Hours)**
Practical aspects of Deep Learning: Train/Dev / Test sets, Bias/variance, Overfitting and regularization, Linear models and optimization, Vanishing/exploding gradients, Gradient checking.	
Unit IV: Convolutional Neural Networks (CNN)	**(06 Hours)**

Introduction, CNN Architecture Overview, The Basic Structure of a Convolutional Network – Padding, Strides, Typical Settings, the ReLU Layer, Pooling, Fully Connected Layers, The Interleaving between Layers, Local Response Normalization, Training a Convolutional Network.	
Unit V: Neural Network Architectures	**(06Hours)**
Recurrent Neural Networks, Adversarial NN, Spectral CNN, Self-Organizing Maps, Restricted Boltzmann Machines, Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN etc.	
Unit VI Long Short-Term Memory Networks (LSTM) and Deep Reinforcement Learning	**(06 Hours)**
TensorFlow, Keras or MatConvNet for implementation. Generative Modeling with DL, Variational Autoencoder, Generative Adversarial Network Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam.	
Textbooks	
1. Aaron Courville, Ian Goodfellow, and Yoshua Bengio "Deep Learning (Adaptive Computation and Machine Learning series) ",1st edition, published by The MIT Press in hardcover format in 2016.	
2. Jon Krohn "Deep Learning for Natural Language Processing: Applications of Deep Neural Networks to Machine Learning Tasks", 1st edition, published by Pearson/Addison-Wesley Professional in November 2017	
3. Rowel Atienza "Advanced Deep Learning with Keras" 1st edition, published by Packt Publishing in October 2018.	
4. François Chollet "Deep Learning with Python",1st edition published by Paperback by Manning Publications on 22 December 2017.	
Reference Books	
1. Aurélien Géron "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow",3rd edition published by O'Reilly Media, Inc. in November 2022 .	
2. Suresh Samudrala "Machine Intelligence: Demystifying Machine Learning, Neural Networks and Deep Learning",1st edition was published by Notion Press in January 2019.	
List of Assignments	
1. Implement binary classification using Logistic Regression with Gradient Descent in Python.	
2. Design and train a shallow neural network with one hidden layer for data classification.	
3. Build a multi-layer neural network for classification using TensorFlow/Keras.	
4. Apply Dropout and Batch Normalization and analyse their effect on model performance.	
5. Perform dataset splitting and study bias–variance trade-off.	
6. Implement a CNN for handwritten digit or image recognition (MNIST/CIFAR-10).	
7. Develop an RNN/LSTM model for text or time-series prediction.	
8. Build an autoencoder for dimensionality reduction or noise removal.	
9. Design and train a basic GAN for image generation.	
10. Compare SGD, Momentum, RMSProp, and Adam on a selected dataset.	
Project Based Learning Assignments	
Note: - Students in a group of 3 to 4 shall complete any one project from the following list	

1. KNN (K - nearest neighbour) method	
2. Artificial Neural Network (ANN)	
3. Convolutional Neural Network (CNN)	
4. Recurrent Neural Network (RNN)	
5. Deep Neural Network (DNN)	
6. Deep Belief Network (DBN)	
7. Back Propagation	
8. Stochastic Gradient Descent	
Syllabus for Internal Assessment:	
Internal Assessment -1	Unit – I, Unit – II, Unit - III
Internal Assessment-2	Unit – IV, Unit – V, Unit - VI

Professional Elective-III : i) Data Visualization

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		TermWork :	25 Marks		
		Oral:	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

To enable students to apply data analysis, visualization techniques, and business intelligence tools to solve real-world problems and support informed decision-making.

Prerequisite:

Engineering Mathematics (Probability & Statistics), Programming for Problem Solving (C, Python), Data Structures Database Management Systems (DBMS)

Course Outcomes: On completion of the course, students will have the ability to

CO 1: To Understand fundamentals of data visualization and basic data analysis.

CO 2: To apply techniques to clean, transform, and organize data for analysis.

CO 3: To create and interpret basic and advanced data visualizations for effective analysis.

CO 4: To analyse and transform data using Power BI for effective reporting and visualization

CO 5: To create effective data visualizations and reports by integrating prepared datasets into Power BI dashboards.

CO 6: To demonstrate the ability to connect to various data sources and perform filtering, cleaning, and data preparation in Tableau.

Unit I: Foundations of Data Visualization & Data Understanding	**(06 Hours)**
Importance of data visualization and analytics. Role in engineering, analytics, and decision-making. Visualization in data science pipeline and workflow: acquisition, preparation, exploration, communication. Data sources, types, observations, variables, and scales. Descriptive statistics: central tendency, dispersion, distribution, variability. Data quality, wrangling, and exploratory data analysis. Population, sampling, uncertainty, confidence intervals, and hypothesis testing.	
Unit II: Data Manipulation	**(06 Hours)**

Importing data from CSV, Excel, JSON, and relational databases. Data selection, filtering, sorting, and indexing. Handling missing values and duplicates. Data transformation includes scaling, normalization, type conversion, and derived attributes. Aggregation, grouping, merging, joining, concatenation, reshaping, and pivoting datasets using Python (pandas) or equivalent tools. Modern data platforms: Introduction to Snowflake (basic architecture and SQL querying) and Databricks (Spark environment overview and notebook-based data processing concepts).	
Unit III: Data Visualization	**(06 Hours)**
Introduction to visualizing data. Basic charts: line, bar, column, pie, and area charts. Advanced charts: scatter, bubble, candlestick, heatmap, and map charts. Choosing appropriate chart types for different data. Visual encoding: color, size, shape, position. Introduction to dashboards and interactive visualizations. Using Python (Matplotlib, Seaborn, Plotly) or equivalent tools for chart creation. Principles of effective visualization and storytelling with data.	
Unit IV: Advanced Data Visualization	**(06 Hours)**
Interactive dashboards and storyboards. Advanced charts including heatmaps, tree maps, waterfall, funnel, radial gauge, scatter, and bubble plots. Drill-down, drill-through, cross-filtering, and use of slicers, filters, and KPIs. Custom and third-party visuals. Mapping and geospatial visualizations. Principles of visual design: color, shape, size, position. Hands-on creation of dashboards using Power BI, Tableau, or Python visualization libraries.	
Unit V: Data Analysis with Power BI	**(06 Hours)**
Overview of Power BI: components, building blocks, Desktop interface, Power BI Service, and Power BI Apps. Connecting to data from CSV, Excel, Text, SQL Server, Web pages, and direct SQL queries. Cleaning and transforming data. Using Power BI Desktop and Service for data preparation and analysis. Performing basic data operations and preparing datasets for visualization and reporting. Case study: Student Academic Performance Analysis using Power BI.	
Unit VI: Advanced Data Visualization with Tableau	**(06 Hours)**
Overview and architecture of Tableau. File types and extensions. Connecting, filtering, and preparing data in Tableau. Creating dashboards, combined-axis charts, geocoding, and geographic mapping. Data simplification using scatter plots, text/highlight tables, heatmaps, histograms, pie charts, bullet charts, and advanced chart types. Tableau Server: architecture, user access, site roles, groups, schedules, tasks, server interface, and content management. Hands-on creation of reports, dashboards, and visualizations using Tableau. Case Study: Weather Data Analysis Dashboard using Tableau	
Textbooks	
1. Data Visualization: A Practical Introduction, Healy, Kieran. Data Visualization: A Practical Introduction. Princeton University Press, 2018.	

2. Data Visualization with Python, Dobler, Mario. Data Visualization with Python: Create an Impact with Meaningful Data Insights Using Interactive and Engaging Visuals. Packt Publishing, 2019.
3. Learning Tableau 2022, Monsey, Molly, and Ann Jackson. Learning Tableau 2022: Create Effective Data Visualizations, Build Interactive Visual Analytics, and Deliver Impactful Business Insights. Packt Publishing, 2022.
4. Mastering Microsoft Power BI, Deckler, Greg, Brett Powell, and Mitchell Pearson. Mastering Microsoft Power BI: Expert Techniques for Effective Data Analytics and Business Intelligence. 2nd ed., Packt Publishing, 2021.
Reference Books
1. Handbook of Data Visualization, Chen, Chun-houh, Wolfgang Karl Härdle, and Antony Unwin, editors. Handbook of Data Visualization. Reprint ed., Springer Science & Business Media, 2016.
2. Learning Tableau 2025, Milligan, Joshua N. Learning Tableau 2025. 6th ed., Packt Publishing, 2025.
3. Practical Tableau, Sleeper, Ryan. Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master. 1st ed., O'Reilly Media, 2018.
Project Based Learning Assignments
Note: - Students in a group of 3 to 4 shall complete any one project from the following list
1. Analyze a real dataset (e.g., weather, sales, student performance) to understand data types, distribution, sampling, and summary statistics.
2. Build a reusable data-cleaning pipeline for messy data files (CSV/Excel).
3. Compare trends across categories or time using multiple chart types.
4. Tell a story about a real issue (e.g., air pollution, road traffic, rainfall, sales drop).
5. Design a Power BI dashboard to analyze the chosen dataset.
6. Develop a business analytics dashboard for management decision-making.
7. Create a Tableau workbook that connects multiple data sources.
8. Visualize location-based data such as accident locations, rainfall by state, or retail stores.
9. Publish dashboards online and manage user access.
10. Build a complete analytics project integrating Python, Power BI, and Tableau.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Professional Elective-III : ii) Cryptography and Network Security

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		TermWork :	25 Marks		
		Oral:	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

This course aims to provide an understanding of cryptography and network security principles, including encryption techniques, hash functions, digital signatures, and key management to ensure secure communication. It also covers network security protocols, security mechanisms such as firewalls and intrusion detection systems, and emerging areas like cloud and IoT security to prepare students for real-world cybersecurity challenges.

Prerequisite:

Basic knowledge of computer networks, data communication, discrete mathematics, and operating systems.

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Explain fundamental concepts of cryptography, security services, threats, and attacks.

CO 2: Apply symmetric key cryptographic algorithms for secure data encryption and decryption.

CO 3: Analyze asymmetric cryptographic techniques and key management mechanisms

CO 4: Implement hash functions and digital signatures for authentication and data integrity.

CO 5: Evaluate network security protocols and mechanisms such as IPSec, SSL/TLS, firewalls, and IDS.

CO 6: Assess emerging security challenges and solutions in areas such as cloud, IoT, and cyber security.

Unit I: Foundations of Cryptography and Security Concepts	(06 Hours)
Introduction to Cryptography and Network Security, Security Services and Mechanisms, CIA Triad, Security Attacks (Passive and Active), Cryptanalysis, Mathematical Foundations (Modular Arithmetic, Prime Numbers, GCD, Euler's Totient Function), Finite Fields, Random Number Generation, Classical Encryption Techniques (Substitution and Transposition Ciphers), Shannon's Theory of Secrecy Systems.	
Unit II: Symmetric Key Cryptography	**(06 Hours)**
Block Cipher Principles, Feistel Structure, Data Encryption Standard (DES), Triple DES, Advanced Encryption Standard (AES), Stream Ciphers, RC4, Block Cipher Modes of Operation (ECB, CBC, CFB, OFB, CTR), Padding Techniques, Cryptographic Strength and Attacks on Symmetric Ciphers, Lightweight Cryptography for Embedded Systems.	
Unit III: Asymmetric Key Cryptography and Key Management	**(06 Hours)**

Public Key Cryptography Principles, RSA Algorithm, Diffie–Hellman Key Exchange, ElGamal Cryptosystem, Elliptic Curve Cryptography (ECC), Key Distribution and Key Management Techniques, Hybrid Cryptosystems, Public Key Infrastructure (PKI), Digital Certificates, Certificate Authorities (CA), X.509 Standard, trends in modern cryptography including post-quantum cryptography and lightweight cryptography.	
Unit IV: Cryptographic Hash Functions and Digital Signatures	**(06 Hours)**
Hash Function Properties, Message Authentication Codes (MAC), HMAC, Secure Hash Algorithms (SHA family), Digital Signature Schemes, RSA Signatures, DSS (Digital Signature Standard), Authentication Protocols, Time Stamping, Non-repudiation Services, Applications in Secure Communications. Case study on digital signature vulnerabilities or hash function attacks.	
Unit V: Network Security Protocols and System Security	**(06 Hours)**
Secure Communication Protocols: IP Security (IPSec) Architecture, Authentication Header (AH), Encapsulating Security Payload (ESP), Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Shell (SSH), Email Security (PGP, S/MIME), Firewalls (Types and Architectures), Intrusion Detection and Prevention Systems (IDS/IPS), Virtual Private Networks (VPNs), Wireless Security (WPA2/WPA3), Case study on network security vulnerabilities such as SSL/TLS attacks or ransomware incidents.	
Unit VI: Emerging Trends and Applications in Security	**(06 Hours)**
Security in Cloud Computing, IoT Security Challenges, Blockchain Security Fundamentals, Zero Trust Architecture, Cyber Threat Intelligence and threat analysis techniques, Biometric Authentication Systems, Cyber Security Frameworks, Malware and Ransomware Concepts, Ethical Hacking Overview, Case Studies using Tools (Wireshark, OpenSSL, Snort), Security in E-Commerce Systems, Case study on modern cyber threats, threat intelligence, or enterprise cybersecurity incidents.	
Textbooks	

1. Cryptography and Network Security — Behrouz A. Forouzan, Debdeep Mukhopadhyay, McGraw-Hill Education (India), 3rd Edition (Reprint), 2015 / latest Indian reprint 2020–2023.
2. Cryptography and Network Security — Atul Kahate, McGraw-Hill Education (India), 3rd Edition (Reprint), 2019 / latest reprint 2021–2024.
3. Cryptography and Network Security — C. K. Shyamala, N. Harini, T. R. Padmanabhan, Wiley India Pvt. Ltd., 1st Edition (Reprint), latest reprint 2020–2022.

Reference Books

1. Cryptography and Network Security: Principles and Practice — William Stallings, Pearson Education, 7th Edition (Global Edition), 2017 / latest reprint 2020–2023.
2. Network Security Essentials: Applications and Standards — William Stallings, Pearson Education, 6th Edition, 2017 / latest reprint 2020–2023.
3. Computer Security: Principles and Practice — William Stallings, Lawrie Brown, Pearson Education, 4th Edition, 2018 / latest reprint 2021–2024.

Practical Assignment List:	
1. Implementation of Classical Ciphers: Write a program to implement Caesar Cipher and Monoalphabetic Substitution Cipher for encryption and decryption.	
2. Transposition Cipher Program: Implement Columnar Transposition Cipher and demonstrate encryption and decryption of a given message.	
3. Symmetric Encryption using AES: Develop a program (Python/Java) to encrypt and decrypt text using the AES algorithm.	
4. Stream Cipher Demonstration: Implement RC4 (or use a library) to perform secure data encryption and analyze output.	
5. Public Key Cryptography — RSA: Implement RSA algorithm to generate keys, encrypt a message, and decrypt it.	
6. Diffie–Hellman Key Exchange Simulation: Write a program to demonstrate secure key exchange between two parties using Diffie–Hellman.	
7. Hash Function and Message Integrity: Generate message digests using SHA-256 and verify integrity by modifying the message.	
8. Digital Signature Implementation: Create and verify a digital signature using RSA or available cryptographic libraries.	
9. Packet Analysis using Wireshark Tool, Capture and analyse network packets using Wireshark.	
10. Intrusion Detection using Snort Tool, Study and demonstrate basic intrusion detection using Snort IDS.	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Professional Elective-III : iii) Augmented Reality and Virtual Reality					
TEACHING SCHEME		**EXAMINATION SCHEME**		**CREDIT SCHEME**	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		TermWork :	25 Marks		
		Oral:	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

Develop skills in computer vision, 3D graphics, and immersive environment design.

Prerequisite:

Students should have knowledge of Data structures and algorithms, Discrete mathematics, Computer graphics

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Identify the role of AR in immersive technologies.

CO 2 Evaluate AR hardware ecosystem.

CO 3: Apply computer vision techniques in AR.

CO 4: Design immersive VR environments.

CO 5: Apply geometric principles in VR design.

CO 6: Integrate AI into AR/VR applications.

Unit	Hours
Unit I: Introduction to Augmented Reality	**(06 Hours)**
Definition and history of AR, Relationship between AR and related concepts (VR, MR, XR), How AR works: core principles and workflow, Ingredients of an AR experience (hardware, software, interaction) Case study: Pokémon Go, IKEA AR app	
Unit II: Augmented Reality Hardware	**(06 Hours)**
Displays: visual, audio, haptic, sensory, Visual perception requirements, spatial display models, Processors: architecture, specifications, role in AR systems, Tracking & sensors: calibration, registration, stationary vs. mobile, optical tracking, sensor fusion.	
Unit III: Computer Vision for Augmented Reality & A.R. Software	**(06 Hours)**
Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.Tools: Unity, Vuforia, ARCore, ARKit	
Unit IV: Introduction to Virtual Reality	**(06 Hours)**

Defining VR, history and evolution, Human physiology and perception in VR, Elements of VR experience: immersion, presence, interaction VR systems: input/output devices (visual, aural, haptic) Applications in gaming, healthcare, training, education.	
Unit V The Geometry of Virtual Worlds &The Physiology of Human Vision	**(06 Hours)**
Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.	
Unit VI: AI Integration in AR/VR	**(06 Hours)**
Personalized AR/VR environments by analyzing user behavior and adjusting content dynamically using AI. Object recognition, spatial mapping, and gesture tracking in AR. NPCs & Virtual Agents, Content Generation using AI, AR/VR in the Metaverse Persistent virtual worlds, interoperability, social interaction, digital economy	
Textbooks	

1. Understanding Virtual Reality: Interface, Application and Design", William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, (Second Edition)
2. Virtual Reality Technology" Grigore C. Burdea, Philippe Coiffet,John Wiley & Sons, 11 Sept 2024(Third Edition)
3. Augmented Reality: Principles and Practice" Dieter Schmalstieg, Tobias Hollerer
4. Addison-Wesley Professional (First Edition)

Reference Books

1. Augmented Reality: Where We Will All Live" by Jon Peddie, Springer (Second Edition)
2. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", Springer (Second Edition)

Project Based Learning Assignments

Note: - Students in a group of 3 to 4 shall complete any one project from the following list

1. Create an AR navigation system for guiding new students around campus using marker less AR.
2. Design AR business cards to reveal interactive contact info or portfolio.
3. Design a treasure hunt game where clues appear in AR at different locations.
4. Design AR Home Decorator to place furniture virtually in your room before buying.
5. Design AR Educational flashcards that show 3D models of planets
6. Design AR Colouring Book where the drawing comes alive in 3D when scanned.

7. Create a small 3D room where users can walk around.
8. Design VR Meditation Space with calming environment for relaxation.
9. Explore a small neighborhood or street in VR.
10. Design Virtual classroom with interactive boards and objects.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Professional Elective-III : iv) Blockchain

TEACHING SCHEME		**EXAMINATION SCHEME**		**CREDIT SCHEME**	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		TermWork :	25 Marks		
		Oral:	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

To provide a comprehensive understanding of blockchain and distributed ledger technology, underlying cryptographic principles, major platforms such as Bitcoin, Ethereum, and Hyperledger, and to enable students to analyze real-world applications, security issues, performance challenges, and limitations of blockchain systems.

Prerequisite:

Basic knowledge of data structures, computer networks, databases, cryptography fundamentals, and proficiency in at least one programming language.

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Explain blockchain evolution, architecture, types, applications, and trends.

CO 2: Apply cryptographic concepts and security practices in blockchain systems.

CO 3: Analyse consensus mechanisms and scalability solutions.

CO 4: Design and deploy smart contracts and decentralized applications.

CO 5: Examine Web3, DeFi, NFTs, DAOs, and their applications.

CO 6: Evaluate enterprise blockchain solutions, regulations, and future trends.

Unit I: Blockchain Foundations & Industry Landscape	**(06 Hours)**
Evolution of blockchain: Bitcoin, Ethereum, and Web3, Blockchain architecture: blocks, transactions, nodes, and ledgers, Types of blockchains: public, private, consortium, and hybrid, Permissioned and permissionless blockchains, Industry adoption and use cases, Limitations, challenges, and current trends, Decentralization vs Centralization, Peer-to-Peer (P2P) networks.	
Unit II: Cryptography, Wallets & Blockchain Security	**(06 Hours)**
Cryptographic hash functions (SHA-256, Keccak-256), Digital signatures and public-key cryptography, Wallets: hot wallets, cold wallets, and hardware wallets, multi-signature wallets Blockchain security threats and vulnerabilities, best practices and real-world security incidents	
Unit III: Consensus Mechanisms & Scalability	**(06 Hours)**
Need for consensus in decentralized networks, Proof of Work and Proof of Stake, Delegated Proof of Stake (DPoS), Byzantine Fault Tolerance (PBFT), Layer-2 scalability solutions: sidechains, rollups, Performance, energy efficiency, and scalability challenges , Hybrid and energy-efficient consensus mechanisms (e.g., Proof of Authority)	

Unit IV: Smart Contracts & Decentralized Application Development	(06 Hours)
Smart contracts: definition and applications, Ethereum architecture and Ethereum Virtual Machine (EVM), Solidity programming fundamentals, Smart contract deployment and testing, Gas concepts and optimization techniques, Smart contract vulnerabilities and security considerations, Smart contract development frameworks (e.g., Truffle, Hardhat overview), Case study: Smart contract implementation in decentralized applications.	
Unit V: Web3, DeFi & NFTs	**(06 Hours)**
Web3 architecture and ecosystem, Decentralized applications (DApps), Decentralized Finance (DeFi): exchanges, lending, staking, Non-Fungible Tokens (NFTs): standards and use cases, Decentralized Autonomous Organizations (DAOs), Applications in gaming, metaverse, and digital economy, Case study: DeFi or NFT-based platform in the digital economy	
Unit VI: Enterprise Blockchain, Cloud Platforms & Future Trends	**(06 Hours)**
Enterprise blockchain concepts, Hyperledger Fabric architecture, Blockchain as a Service(BaaS), Cloud-based blockchain platforms, Cross-chain interoperability, Regulatory, legal, and ethical issues, Career opportunities and future scope, Central Bank Digital Currencies (CBDC) and government initiatives, Case study: Enterprise blockchain adoption in supply chain or finance.	
Textbooks	
1.Mastering Blockchain, 4th Edition, Packt Publishing, 2023 — Imran Bashir.	
2.Mastering Bitcoin: Programming the Open Blockchain, 2nd Edition, O’Reilly Media, 2017 — Andreas M. Antonopoulos.	
Reference Books	
1.Bitcoin and Cryptocurrency Technologies, Princeton University Press, 2016 — Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder.	
2.Mastering Ethereum: Building Smart Contracts and DApps, O’Reilly Media, 2018 — Andreas M. Antonopoulos and Gavin Wood.	
PBL (Project Based Learning)	
1. Implement a simple blockchain to demonstrate block creation and validation.	
2.Develop a basic cryptocurrency wallet with key generation and transaction signing.	
3.Simulate public, private, and consortium blockchain networks for comparison.	
4.Implement Proof of Work or Proof of Stake consensus simulation.	
5. Design and deploy a simple smart contract using Solidity.	
6.Develop a basic DApp that interacts with a smart contract.	
7.Build a blockchain-based supply chain tracking prototype.	
8.Implement a multi-signature wallet requiring multiple approvals.	
9.Analyze a blockchain security attack and propose mitigation measures.	
10.Design a conceptual blockchain solution for a real-world domain.	

Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

B.Tech
(Computer Engineering)
Semester- VIII

Track I

High Performance Computing

TEACHINGSCHEME		EXAMINATIONSCHEME		CREDITSCHEME	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		TermWork :	25 Marks		
		Practical :	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

Students will learn to provide a thorough understanding of parallel computing principles, computer architecture, and high-performance algorithms to solve complex, large-scale computational problems.

Prerequisite: Students should have knowledge of

Microprocessor, Principles of Programming Languages, Computer Networks and Security

Course Outcomes: On completion of the course, students will have the ability to:

CO1: Understand the various aspects of Parallel Paradigm.

CO2: Design and develop an efficient parallel algorithm to solve given problem.

CO3: Illustrate data communication operations on various parallel architecture using MPI.

CO4: Analyze and measure performance of modern parallel computing systems.

CO5: Apply CUDA architecture for parallel programming.

CO6: Summarize the advanced trends and techniques in Parallel Computing.

Unit I: Introduction to Parallel Computing	**(06Hours)**
Parallel Processing Concepts, Motivating Parallelism, Levels of Parallelism, Need of High-performance computing (HPC), HPC Cluster, Models: SIMD, MIMD, SIMT, SPMD, Processor Architecture.	
Unit II: Parallel Algorithm Design	**(06Hours)**
Principles of Parallel Algorithm Design**:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models: Data, Task, Work Pool and Master Slave Model, Sequential and Parallel Computational Complexity, Anomalies in Parallel Algorithms.	
Unit III: Parallel Communication	**(06Hours)**
One-to-All Broadcast, All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Point-to-point Communication ,Collective Communication using MPI: Scatter, Gather, Broadcast, Blocking and	

non-blocking MPI, Circular Shift, Topologies and embeddings, Groups and Computators, Parallel IO, SLURM batch system.	
Unit IV: Analytical Modeling of Parallel Programs	**(06Hours)**
Performance Measures and Analysis: Sources of Overhead in Parallel Programs, Amdahl's and Gustafson's Laws, Speedup Factor and Efficiency, Cost and Utilization, Execution Rate and Redundancy, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost, Optimal Execution Time, Asymptotic Analysis of Parallel Programs. Matrix Computation: Matrix-Vector Multiplication, Matrix-Matrix Multiplication.	
Unit V: CUDA Architecture	**(06Hours)**
Introduction to GPU architecture, CUDA architecture, C-CUDA programming model, write and launch a CUDA kernel, Handling Errors, CUDA memory model, Manage GPU memory, communication and synchronization, Parallel programming in CUDA- C, HPC with Python library Numba , Introduction to OpenACC, Data Management, Loop Optimizations with OpenACC,	
Unit VI: High Performance Computing Applications	**(06 Hours)**
Scope of Parallel Computing, Parallel Search Algorithms: Depth First Search (DFS), Breadth First Search(BFS), Parallel Sorting: Bubble and Merge, Distributed Computing: Document classification, Frameworks – Kubernetes, GPU Applications, Parallel Computing for AI/ ML, HPC applications, Exascale computing, Quantum Computing, Grid Computing, Case study of Supercomputer - Param Utkarsh	
Textbooks	

1. Pacheco, Peter S., “An Introduction to Parallel Programming”, Morgan Kaufmann Publishers ,2nd edition, October 27,2021, ISBN 978-0-12-374260-
2. Ananth Grama, Anshul Gupta, George Karypis, and Vipin Kumar, "Introduction to Parallel Computing", 2nd edition, Addison-Wesley, 2003, ISBN: 0-201-64865-2
3. Seyed H. Roosta, “Parallel Processing and Parallel Algorithms Theory and Computation‖”, Springer-Verlag 2000, ISBN 978-1-4612-7048-5 ISBN 978-1-4612-1220-1
4. John Cheng, Max Grossman, and Ty McKercher, “Professional CUDA C Programming”, John Wiley & Sons, Inc., ISBN: 978-1-118-73932-7
Reference Books
1. Kai Hwang, "Scalable Parallel Computing", McGraw Hill 1998.
2. George S. Almasi and Alan Gottlieb, "Highly Parallel Computing", The Benjamin and Cummings Pub. Co., Inc.
3. Jason sanders, Edward Kandrot, “CUDA by Example”, Addison-Wesley, ISBN-13: 978-0-13-138768-3

4. Rieffel WH.EG, Polak, "Quantum Computing: A gentle introduction", MIT Press, 2011, ISBN 978-0-262-01506-6
5. Ajay D. Kshemkalyani, Mukesh Singhal, "Distributed Computing: Principles, Algorithms, and Systems", Cambridge March 2011, ISBN: 9780521189842
Project Based Learning Assignments
Note: - Students in a group of 3 to 4 shall complete any one project from the following list
1. Parallel Matrix Multiplication using MPI
2. Parallel Sorting Algorithms Quick Sort, Merge Sort Compare performance
3. Image Convolution using GPU**.** Apply filters (blur, sharpen) using CUDA / OpenCL and compare CPU vs GPU performance.
4. HPC for Weather Simulation.
5. Parallel Fast Fourier Transform (FFT).

Syllabus for Unit Tests:

UnitTest-1	Unit–I,Unit–II,Unit-III
UnitTest-2	Unit–IV,Unit–V,Unit–VI

2.Seminar:

Objectives of the Seminar

The Seminar aims to:

- Develop **self-learning ability** and **research orientation**
- Enhance **technical understanding of emerging technologies**
- Improve **presentation and communication skills**

Scope of Topics

Students must select a topic from **Emerging/Recent Technologies, Case Studies, Research-Oriented Topics, Interdisciplinary Topics**

What Students Are Expected to Do

Topic Selection

Literature Survey

Content Preparation

Report Writing

Presentation

3.Internship

Objectives of Internship

- To provide real-world exposure to professional environments
- To enhance technical, problem-solving, and teamwork skills
- To bridge the gap between academics and industry expectations
- To develop professional ethics, communication, and responsibility

Guidelines

4) The students who receive internship in the industry (through institute or own efforts), will do it for **one complete semester** in the industry.
5) Those students who do not receive the internship in the industry, will have to **perform it in-house**. The Department will prepare modules for in-house internship based on recent domains/technology. The Department faculty plus external experts from industry for the selected domain will deliver the sessions. In this case, the entire internship of one complete semester will be held in the institute itself.
6) The projects and the required computational facilities for these projects are available at HPC Lab/FAIR Lab. The students may use facilities in IDEA and Intel Unnati Lab for this purpose.

Track II

B.Tech
(Computer Engineering)
Semester- VII

High Performance Computing

TEACHINGSCHEME		EXAMINATIONSCHEME		CREDITSCHEME	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		TermWork :	25 Marks		
		Practical :	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

Students will learn to provide a thorough understanding of parallel computing principles, computer architecture, and high-performance algorithms to solve complex, large-scale computational problems.

Prerequisite: Students should have knowledge of

Microprocessor, Principles of Programming Languages, Computer Networks and Security

Course Outcomes: On completion of the course, students will have the ability to:

CO1: Understand the various aspects of Parallel Paradigm.

CO2: Design and develop an efficient parallel algorithm to solve given problem.

CO3: Illustrate data communication operations on various parallel architecture using MPI.

CO4: Analyze and measure performance of modern parallel computing systems.

CO5: Apply CUDA architecture for parallel programming.

CO6: Summarize the advanced trends and techniques in Parallel Computing.

Unit I: Introduction to Parallel Computing	**(06Hours)**
Parallel Processing Concepts, Motivating Parallelism, Levels of Parallelism, Need of High-performance computing (HPC), HPC Cluster, Models: SIMD, MIMD, SIMT, SPMD, Processor Architecture.	
Unit II: Parallel Algorithm Design	**(06Hours)**
Principles of Parallel Algorithm Design**:** Preliminaries, Decomposition Techniques, Characteristics of Tasks and Interactions, Mapping Techniques for Load Balancing, Methods for Containing Interaction Overheads, Parallel Algorithm Models: Data, Task, Work Pool and Master Slave Model, Sequential and Parallel Computational Complexity, Anomalies in Parallel Algorithms.	
Unit III: Parallel Communication	**(06Hours)**
One-to-All Broadcast, All-to-One Reduction, All-to-All Broadcast and Reduction, All-Reduce and Prefix-Sum Operations, Point-to-point Communication ,Collective Communication using MPI: Scatter, Gather, Broadcast, Blocking and	

non-blocking MPI, Circular Shift, Topologies and embeddings, Groups and Computators, Parallel IO, SLURM batch system.	
Unit IV: Analytical Modeling of Parallel Programs	**(06Hours)**
Performance Measures and Analysis: Sources of Overhead in Parallel Programs, Amdahl's and Gustafson's Laws, Speedup Factor and Efficiency, Cost and Utilization, Execution Rate and Redundancy, The Effect of Granularity on Performance, Scalability of Parallel Systems, Minimum Execution Time and Minimum Cost, Optimal Execution Time, Asymptotic Analysis of Parallel Programs. Matrix Computation: Matrix-Vector Multiplication, Matrix-Matrix Multiplication.	
Unit V: CUDA Architecture	**(06Hours)**
Introduction to GPU architecture, CUDA architecture, C-CUDA programming model, write and launch a CUDA kernel, Handling Errors, CUDA memory model, Manage GPU memory, communication and synchronization, Parallel programming in CUDA- C, HPC with Python library Numba , Introduction to OpenACC, Data Management, Loop Optimizations with OpenACC,	
Unit VI: High Performance Computing Applications	**(06 Hours)**
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9. Rieffel WH.EG, Polak, "Quantum Computing: A gentle introduction", MIT Press, 2011, ISBN 978-0-262-01506-6
10. Ajay D. Kshemkalyani, Mukesh Singhal, "Distributed Computing: Principles, Algorithms, and Systems", Cambridge March 2011, ISBN: 9780521189842
Project Based Learning Assignments
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9. HPC for Weather Simulation.
10. Parallel Fast Fourier Transform (FFT).

Syllabus for Unit Tests:

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UnitTest-2	Unit–IV,Unit–V,Unit–VI

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Objectives of the Seminar

The Seminar aims to:

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Objectives of Internship

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9) The projects and the required computational facilities for these projects are available at HPC Lab/FAIR Lab. The students may use facilities in IDEA and Intel Unnati Lab for this purpose.

Track II

B.Tech
(Computer Engineering)
Semester- VIII

Artificial Intelligence and Machine Learning					
TEACHING SCHEME		**EXAMINATION SCHEME**		**CREDIT SCHEME**	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical	01
		Term Work:	25 Marks		
		Practical:	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

To enable students to understand the fundamentals of Artificial Intelligence and Machine Learning, apply problem-solving and learning algorithms, and develop intelligent systems using knowledge representation, search techniques, logical reasoning, planning, and modern ML models.

Prerequisite:

Students should have knowledge of Discrete Mathematics, Data Structures, Algorithm analysis

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Explain the concepts of AI, intelligent agents, and knowledge representation using classical problems like vacuum world and 8-queens.

CO 2: apply various search and game-playing algorithms to solve AI problems efficiently.

CO 3: Develop knowledge-based agents and perform logical reasoning using propositional and first-order logic.

CO 4: Identify appropriate Learning approach to solve a particular problem

CO 5: Analyze data and apply supervised, semi-supervised, and unsupervised learning techniques.

CO 6: Evaluate machine learning models for classification, regression, clustering, and anomaly detection.

Unit I: Introduction:	**(06 Hours)**
A.I. Representation, Non-AI & AI Techniques, Representation of Knowledge, Knowledge Base Systems, State Space Search, Production Systems, Problem Characteristics, Types of production systems, Turing Test. Intelligent Agents: Agents and Environments, concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation. Formulation of problems: Vacuum world, 8 queens, Route finding, robot navigation., Case Study: Knowledge Representation in Medical Diagnosis, Intelligent Agents – Smart Home System	
Unit II: Search Methods:	**(06 Hours)**
Search Strategies, Comparison of Uninformed search Strategies. Generate & test, Hill Climbing, Constraint satisfaction, Means Ends Analysis: Minimax Search, Alpha-Beta Cut offs. Case Study: Uninformed Search – Maze Solving Robot	
Unit III: Knowledge Representation, Reasoning and Planning	**(06 Hours)**

Knowledge Representation Methods Propositional Logic, First Order Logic, Forward and Backward Chaining. Planning: Goals, Blocks world, STRIPS, Implementation using goal stack, Components of Planning System, Planning strategies: Expert System: Design, Implementation, Case study of Expert System in PROLOG,Case Study: Propositional Logic in Smart Home Automation	
Unit IV: Introduction to Machine Learning	**(06 Hours)**
Introduction to Machine Learning: Examples of Machine Learning Applications, Learning Types, ML Life cycle, AI & ML, dataset for ML, Data Pre-processing, Training versus Testing, Positive and Negative Class, Cross-validation. Types of Learning: Supervised, Unsupervised and Semi-Supervised Learning. Supervised: Learning a Class from Examples, Types of supervised Machine learning Algorithms, Unsupervised: Types of Unsupervised Learning Algorithm-enforcement learning	
Unit V: Dimensionality Reduction	**(06 Hours)**
Introduction to Dimensionality Reduction, Subset Selection, and Introduction to Principal Component Analysis. Supervised Leaming: leaming a class from examples, leaming multiple classes, model selection and generalization classification: Binary and Multiclass Classification: , Assessing Classification Performance, Handling more than two classes, Multiclass Classification-One vs One, One vs Rest. Regression: Assessing performance of Regression – Error measures, Overfitting and Underfitting.	
Unit VI: Multivariate Methods	**(06 Hours)**
Multivariate Methods Multivariate alata, parameter estimation, estimation of missing values, multivariate normal distribution. multi variate classification Dimensionality Reduction: introduction, subset selection, principal Component analysis, singular value decomposition and matrix factorization Clustering: Mixture densities, k-means clustering, expectation-maximization algorithm, mixtures of latent variables., Generative AI, Explainable and Responsible AI.	
Textbooks	
8. Elaine Rich and Kevin Knight: "Artificial Intelligence." Tata McGraw Hill 9. Stuart Russell & Peter Norvig: "Artificial Intelligence: A Modern Approach", Pearson Education, 2nd Edition. 10. Deepak Khemani: "A First Course in Artificial Intelligence", Mc Graw Hill 11. Saroj Kaushik: "Artificial Intelligence" Cengage Publication 12. Machine Learning (McGraw-Hill International Editions Computer Science Series 13. Python Machine Learning: Machine Learning and Deep Learning with Python, scikit-learn, and TensorFlow 14. Machine Learning: A First Course for Engineers and Scientists, by Andreas Lindholm (Author), Niklas Wahlström (Author), Fredrik Lindsten (Author)	

Reference Books

8. Ivan Bratko: "Prolog Programming for Artificial Intelligence”, 2nd Edition Addison Wesley,1990.
9. Eugene, Charniak, Drew Mcdermott: "Introduction to Artificial Intelligence.", Addison Wesley
10. Patterson: “Introduction to AI and Expert Systems”, PHI
11. Nilsson: “Principles of Artificial Intelligence”, Morgan Kaufmann. 5. Carl Townsend, “Introduction to turbo Prolog”, Paperback, 1987
12. T.M. Mitchell, “Machine Learning”,
13. C.M. Bishop, “Pattern McGraw Hill. Recognition and Machine
14. Ethem Alpaydin, “Introduction to Machine Learning”, Learning

Practical Assignment List:

11. Intelligent Traffic Management System
12. Smart Home Automation with Voice Control
13. AI-based Disease Prediction System
14. Autonomous Robot Navigation
15. Chatbot for Student Assistance
16. Recommendation System for E-Commerce
17. Fraud Detection in Online Transactions
18. AI-powered Resume Screening Tool
19. Smart Waste Management System
20. Emotion Recognition from Facial Expressions

Project Based Learning Assignments:

Note: - Students in a group of 3 to 4 shall complete any one project from the following list

7. Implement an 8-Queens solver using AI search techniques and compare algorithm performance.
8. Develop a route-finding system using the A* algorithm for optimal path planning.
9. Apply PCA for dimensionality reduction on a student dataset and visualize feature impact.
10. Perform customer segmentation using K-Means clustering on purchasing behavior data.
11. Develop a multiclass classification model to identify plant species using supervised learning.
12. Create a goal stack planning solution for the Block World problem using STRIPS concepts.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Professional Elective-II : i) Virtualisation and Cloud Computing

TEACHING SCHEME		EXAMINATION SCHEME	CREDIT SCHEME	
Lecture:	03 Hours/Week	End Semester Examination: 60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment: 40 Marks	Practical:	01
		Term Work: 25 Marks		
		Oral: 25 Marks		
Total	05 Hours/Week	Total Marks: 150 Marks	Total	04

Course Objective:

Students will be able to understand concepts of distributed systems, virtualization, cloud computing concepts, service models, migration strategies, and cloud security aspects.

Prerequisite:

Basic knowledge Computer fundamentals, Operating System and computer networks.

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Ability to understand various service delivery models of a cloud computing

CO 2: Ability to understand the ways in which the cloud can be programmed and deployed.

CO 3: Ability to understand virtualization and cloud computing concepts

CO 4: Assess the comparative advantages and disadvantages of Virtualization technology

CO 5: Analyse authentication, confidentiality, and privacy issues in cloud computing

CO 6: Identify security implications in cloud computing

Unit I: Cloud Computing Fundamentals	(06 Hours)
Cloud Computing Fundamentals: Definition of Cloud computing, Roots of Cloud Computing, Layers and Types of Clouds, Desired Features of a Cloud, Cloud Infrastructure Management, Infrastructure as a Service Providers, Platform as a Service Providers. Computing Paradigms: High-Performance Computing, Parallel Computing, Distributed Computing, Cluster Computing, Grid Computing. Case Study of AWS-Based Deployment Using IaaS and PaaS Models.	
Unit II: Virtualization	**(06 Hours)**
Virtualization: Introduction to Cloud Computing- Overview, Cloud issues and challenges, Properties, Characteristics, Service models, Deployment models. Cloud resources: Network and API, Virtual and Physical computational resources, Data storage. Virtualization concepts – Types of Virtualizations, Introduction to Various Hypervisors, Advanced Virtualization Techniques - High Availability (HA), Disaster Recovery (DR) using Virtualization, VM Migration/ Moving VMs, Azure or AWS Case Study.	

Unit III: Service Models	**(06 Hours)**
Service Models: Infrastructure as a Service (IaaS) – Resource Virtualization: Server, Storage, Network, Case studies of Iaas. Platform as a Service (PaaS) – Cloud platform & Management: Computation, Storage devices, Case studies of Paas. Software as a Service (SaaS) – Web services, Web 2.0 , Web OS , Case studies of Saas, Emerging Service Models- Anything as a service (XaaS), Microservices Architecture. Case Study on SaaS for Collaborative Work Using Google Workspace.	
Unit IV: Cloud Programming and Software Environments	**(06 Hours)**
Cloud Programming and Software Environments: Cloud Programming and Software Environments, Parallel and Distributed Programming paradigms, Current cloud technologies, Programming support in Cloud Platforms, Emerging Cloud Software Environment. Case Study on Cloud-Based Application Development Using a Cloud Platform.	
Unit V: Cloud Access	**(06 Hours)**
Cloud Access: Authentication, authorization and accounting(AAA), Cloud Security – data protection, identity management, encryption, and secure access control, Cloud Provenance and meta-data , Cloud Reliability and fault-tolerance , Cloud Security, privacy, policy and compliance, Cloud federation, Interoperability and standards. Case study on implementation of Cloud Security and Access Control in a Healthcare System.	
Unit VI: Cloud Technologies and Advancements And SLA Management	**(06 Hours)**
Cloud Technologies and Tools- Hadoop, MapReduce, Virtual Box, Google App Engine, Programming Environment for Google App Engine, Open Stack . Federation in the Cloud – Four Levels of Federation, Federated Services and Applications, Future of Federation. SLA Management in cloud computing- Traditional Approaches to SLO Management, Types of SLA, Life Cycle of SLA, SLA Monitoring and Management in Cloud. Case study on Big Data Processing Using Hadoop and MapReduce in E-Commerce.	
Textbooks	
5. Cloud Computing Principles and Paradigms, by Rajkumar Buyya, James Broberg, Andrzej M. Goscinski John Wiley & Sons, 17 Dec 2010	
6. Essentials of cloud Computing: K. Chandrasekharan, CRC press, 2014	
7. Michael Miller, Cloud Computing: Web-Based Applications That Change the Way You Work and Collaborate Online, Que Publishing, August 2008.	
8. Cloud Computing, A Practical Approach, Anthony T Velte, Toby J Velte, Robert Elsenpeter, TMH McGraw Hill Professional, 22 Oct 2009	
Reference Books	
4. Cloud Computing: A Practical Approach, Anthony T.Velte, Toby J.Velte, Robert Elsenpeter, Tata McGraw Hill,rp2011.	
5. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O'reilly, SPD, 2011.	

6. Cloud Security and Privacy: An Enterprise Perspective on Risks and Compliance, Tim Mather, Subra Kumaraswamy, Shahed Latif, O'Reilly, SPD, rp2011

List of Assignments

10. Installation and configuration of own Cloud.
11. Implementation of Virtualization in Cloud Computing to Learn Virtualization Basics, Benefits of Virtualization in Cloud using Open-Source Operating System.
12. Study and implementation of infrastructure as Service using Open Stack.
13. Write a program for Web feed using PHP and HTML.
14. Write a Program to Create, Manage and groups User accounts in own Cloud by Installing Administrative Features.
15. Design and develop custom Application using Salesforce Cloud
16. creating an AMI for Hadoop and implementing short Hadoop programs on the Amazon Web Services platform.
17. Creating an Application in SalesForce.com using Apex programming Language
18. Design an Assignment to retrieve, verify, and store user credentials using Firebase Authentication, the Google App Engine standard environment, and Google Cloud Data store.

Project Based Learning Assignments

Note: - Students in a group of 3 to 4 shall complete any one project from the following list

9. Data Science Assignment Help in Microsoft Azure Specify the necessary environment as a Docker file.
10. Cloud based VM resources for application hosting
11. Configurable deployment of cloud applications using the Docker container
12. Big Data analytics on unstructured text data using Microsoft Azure.
13. Hadoop and MapReduce in Microsoft HDInsight.
14. Azure Machine Learning for sentiment analysis
15. Cloud Computing Mashup/Docker Project
16. Deployment to a publicly hosted Linux VM [Azure or AWS will be appropriate here.]

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Professional Elective-II : ii) Agile Technologies					
TEACHING SCHEME		**EXAMINATION SCHEME**	**CREDIT SCHEME**		
Lecture:	03 Hours/Week	End Semester Examination: 60 Marks	Theory	03	
Practical:	02 Hours/Week	Internal Assessment: 40 Marks	Practical:	01	
		Term Work 25 Marks			
		Oral 25 Marks			
Total	05 Hours/Week	Total 150 Marks	Total	04	

Course Objective:

Students will learn to understand Agile principles, apply Agile methodologies, perform Agile-based requirements engineering and testing, and evaluate Agile adoption strategies in organizations.

Prerequisite:

Students should have knowledge of Software Engineering and Software Development Life Cycle (SDLC).

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Explain Agile philosophy, principles, values, and differences from traditional models.

CO 2: Describe and apply Agile methodologies such as Scrum, XP, Lean, Crystal, FDD, and ASD.

CO 3: Apply Agile practices for requirements engineering including story cards and managing changing requirements.

CO 4: Analyze Agile RE techniques like abstraction models, prioritization, and concurrency for project scenarios.

CO 5: Apply Agile testing techniques including TDD, CI, regression testing, and automation to ensure quality.

CO 6: Evaluate Agile adoption strategies, interpret Agile metrics, and propose Agile implementation approaches for organizations.

Unit I: Foundations of Agile	**(06 Hours)**
History of Agile, Theories for Agile Management, Need of Agile Software Development, Traditional Model vs. Agile Model, Classification of Agile Methods, Agile Manifesto and Principles, Agile Project Management, Agile Team Interactions, Ethics in Agile Teams, Agility in Design, Testing, Agile Documentations, Agile Drivers, Capabilities and Values,Case Study: Spotify Agile Model, Tools: Jira, Confluence, Slack, Miro	
Unit II : Agile Methodologies & Frameworks	**(06 Hours)**
Lean Production, SCRUM, Crystal, Feature Driven Development, Adaptive Software Development, Extreme Programming: Method Overview, Lifecycle, Work Products, Roles and Practices, Case Study: Microsoft Scrum Implementation ,Tools: Azure DevOps, Jira, Trello, GitHub	
Unit III : Agile Requirements Engineering – Fundamentals	**(06 Hours)**

Agility & Requirements Engineering (RE), Impact of Agile Processes in RE, Current Agile Practices, Variance in Agile RE, Overview of RE using Agile, Managing Unstable Requirements, Agile Knowledge Sharing, Role of Story Cards, Story Card Maturity Model (SMM), Case Study: Amazon User Story Based Requirements, Tools: Jira, Product board, Miro, Notion	
Unit IV: Agility And Requirements Engineering	**(06 Hours)**
Requirements Elicitation, Agile Requirements Abstraction Model, Requirements Management in Agile Environment, Agile Requirements Prioritization, Agile Requirements Modeling and Generation, Concurrency in Agile Requirements Generation, Case Study: Netflix Agile Requirements Management, Tools: Jira, GitHub, Docker, Kubernetes.	
Unit V : **Agile Testing & Quality Assurance**	**(06 Hours)**
The Agile lifecycle and its impact on testing, Test driven development– Acceptance tests and verifying stories, writing a user acceptance test, Developing effective test suites, Continuous integration, Code refactoring. Risk based testing, Regression tests, Test automation, Case Study: Google Continuous Testing and Integration, Tools: JUnit, Selenium, Jenkins, GitLab	
Unit VI: Agile Adoption, Metrics & Future Trends	**(06 Hours)**
Agile Adoption Strategy in Organizations, Common Challenges in Agile Transformation, Agile Metrics: Lead Time, Cycle Time, Throughput, Quality Metrics, Case Studies of Agile Success (IT services, startups, product companies),Combining Agile with UX Design (Dual-Track Agile),Agile in Non-IT Industries (Manufacturing, Marketing, HR),Future Trends: Agile + AI, Hyper-Agility, Continuous Discovery., Case Study: Tesla Agile Innovation Model ·, Tools: Jira, GitHub, Tableau, TensorFlow	
Textbooks	
6. Agile Practice Guide – Project Management Institute (PMI) & Agile Alliance, 1st Edition, 2017.	
7. Essential Scrum: A Practical Guide to the Most Popular Agile Process – Kenneth S. Rubin, 1st Edition, 2012.	
8. Agile Software Development: Principles, Patterns, and Practices – Robert C. Martin, 1st Edition, 2003.	
9. More Agile Testing: Learning Journeys for the Whole Team – Lisa Crispin & Janet Gregory, 1st Edition, 2015.	
10. Agile Product Management with Scrum: Creating Products Customers Love – Roman Pichler, 1st Edition, 2010.	
Reference Books:	
6. The Scrum Guide – Ken Schwaber & Jeff Sutherland, Latest Version (2020 Update).	
7. Specification by Example: How Successful Teams Deliver the Right Software – Gojko Adzic, 1st Edition, 2011.	

8. Coaching Agile Teams: A Companion for Scrum Masters, Agile Coaches, and Project Managers in Transition – Lyssa Adkins, 1st Edition, 2010.	
9. User Stories Applied: For Agile Software Development – Mike Cohn, 1st Edition, 2004.	
10. Lean Software Development: An Agile Toolkit – Mary & Tom Poppendieck, 1st Edition, 2003.	
Project Based Learning Assignments:	
Note:- Students in a group of 3 to 4 shall complete any one project from the following list	
11. Design and Development of an E-Commerce System Using Scrum Framework	
12. Agile-Based Library Management System with Iterative Releases	
13. Implementation of Student Attendance System Using Extreme Programming (XP)	
14. Development of Online Food Ordering Application Using Agile Practices	
15. Agile Requirements Engineering for a Smart Healthcare Monitoring System	
16. Design of Task Management Tool with Continuous Integration and TDD	
17. Development of Bug Tracking System Applying Agile Testing Techniques	
18. Agile Transformation Strategy for a Traditional Software Project	
19. User Story Mapping and Prioritization for a Mobile Banking App	
20. Development of Online Examination System Using Scrum Lifecycle	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Professional Elective-II : iii) Image Processing

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
Lecture	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical	02 Hours/Week	Internal Assessment:	40 Marks	Practical	01
Total	05 Hours/Week	Term Work:	25 Marks	Total	04
		Oral:	25 Marks		
		Total:	150 Marks		

Course Objective:

- To become familiar with digital image fundamentals.
- To get exposed to simple image enhancement techniques in spatial and frequency domain.
- To learn concepts of degradation function and restoration techniques.
- To study the image segmentation and representation techniques.
- To become familiar with image compression and recognition methods.

Prerequisite:

Students should have knowledge of Linear Algebra, Probability and Statistics.

Course Outcomes:

On completion of the course, students will have the ability to

1. Know and understand the fundamentals of digital image processing, such as digitization, sampling, quantization, and 2D-transforms.
2. Operate on images using the techniques of smoothing, sharpening and enhancement in spatial domain.
3. Learn the basics of compression, digital image and their different types.
4. Understand the restoration concepts and filtering techniques.
5. Learn the basics of segmentation and feature extraction techniques.
6. Apply image processing algorithms for practical object recognition applications.

Unit I: Introduction to Digital Image Processing	(06 Hours)
Introduction: Fundamental Steps in Digital Image Processing, Components of an Image Processing System, Sampling and Quantization, Representing Digital Images (Data structure), Some Basic Relations, Human Visual System, Representing Digital Images, Spatial & Gray level Resolution, Image File Formats, Basic Relationships between Pixels, Distance Measures. Basic Operations on Images - Image Addition, Subtraction, Logical Operations, Scaling, Translation, Rotation, Image Histogram. Color fundamentals and models – RGB, HSI, YIQ.	
Unit II: Image Enhancement in Spatial Domain	**(06 Hours)**
Some Basic Gray Level Transformations, Histogram Processing, Enhancement Using Arithmetic/Logic Operations. Spatial domain enhancement: Point Operations - Log Transformation, Power-law Transformation, Piecewise Linear Transformations, Histogram Equalization.	

Filtering operations - Image Smoothing, Image Sharpening. Frequency domain enhancement: 2D DFT, Smoothing and Sharpening in Frequency Domain. Homomorphic Filtering. Restoration: Noise Models, Restoration using Inverse Filtering and Wiener Filtering. Restoration: Noise Models, Restoration using Inverse Filtering and Wiener Filtering	
Unit III: Image Compression	**(06 Hours)**
Types of Redundancy, Fidelity Criteria Lossless compression – Run Length Coding, Huffman Coding, Biplane Coding, Arithmetic Coding. Introduction to DCT, Wavelet Transform. Lossy compression – DCT based Compression, Wavelet based Compression. Image and Video Compression Standards – JPEG, MPEG.	
Unit IV: Image Segmentation and Morphological Operations	**(06 Hours)**
Image Segmentation: Point Detections, Line Detection, Edge Detection - First order Derivative - Prewitt and Sobel. Second order Derivative – LoG, DoG, Canny. Edge Linking, Hough Transform, Thresholding - Global, Adaptive. Otsu's Method. Region Growing, Region Splitting and Merging. Morphological Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss Transform, Boundary Detection, Thinning, Thickening, Skeleton.	
Unit V: **Image Restoration and Description**	**(06 Hours)**
Image Restoration, Degradation Model, Properties, Noise Models, Mean Filters, Order Statistics, Adaptive Filters, Band Reject Filters, Band Pass Filters, Notch Filters, Optimum Notch Filtering, Inverse Filtering, Wiener Filtering. Representation, Chain Codes, Polygonal Approximation, Signatures. Boundary Descriptors, Shape Numbers, Fourier Descriptors, Statistical Moments. Regional Descriptors, Topological, Texture. Principal Components for Description.	
Unit VI: **Object Recognition and Applications**	**(06 Hours)**
Feature extraction, Patterns and Pattern Classes, Representation of Pattern Classes, Types of Classification Algorithms, Minimum distance classifier, Correlation based Classifier, Bayes Classifier. Applications: Biometric Authentication, Character Recognition, Content based Image Retrieval, Remote Sensing, Medical Application of Image Processing.	
Textbooks	
1. Anil K. Jain, Fundamentals of Digital Image Processing 1 Edition, Pearson Education, 2015.	
2. Rafael C. Gonzalez, Richard E. Woods, Digital Image Processing, Pearson Education, Fourth Edition, 2010.	
Reference Books	
1. Kenneth R. Castleman, Digital Image Processing, Pearson Education, First Edition, 2007.	
2. Rafael C. Gonzalez, Richard E. Woods, Steven Eddins, Digital Image Processing using MATLAB, Pearson Education, Second Edition, 2009.	
Project Based Learning:	

9. Build a tool that converts RGB images to HSI and YIQ. Explain why the "I" (Intensity) in HSI is more useful for processing than RGB values.
10. Create a pipeline using Log transformations and Histogram Equalization to make details visible in extremely dark photos.
11. Create a "Hybrid Image" by combining the low frequencies of one face with the high frequencies of another.
12. Implement a simplified DCT-based compression. Show how discarding high-frequency coefficients affects visual quality vs. file size.
13. Use Canny Edge Detection and the Hough Transform to detect the edges of a piece of paper in a photo and "deskew" it.
14. Use Morphological Dilation and Erosion to separate overlapping circles (simulating blood cells) and count them automatically.
15. Build a system that compares two signatures using Correlation-based classification to determine if they belong to the same person.
16. Use texture-based regional descriptors (Unit V) and a Bayes Classifier (Unit VI) to identify healthy vs. diseased leaves in a small dataset.
Laboratory Experiments:
11. Develop a system that takes an underexposed RGB image and its corresponding Infrared (IR) version. Convert the RGB image to the HSI color model, isolate the Intensity (I) component, and fuse it with the IR data using Histogram Equalization to enhance visibility without distorting the color Hue.
12. Implement an Adaptive Median Filter that changes its window size based on local noise density. Compare its performance against a standard 3×3 Median Filter in removing high-density "salt and pepper" noise while preserving edge sharpness.
13. Create a tool to automatically straighten scanned documents. Use Canny Edge
14. Create a "Hybrid Image" that looks like one object from afar and another from up close. This is achieved by combining the Low-Pass filtered (smoothed) version of Image A with the High-Pass filtered (sharpened/edge-heavy) version of Image B using the 2D DFT.
15. Implement a simplified JPEG-style compression pipeline. Divide an image into 8×8 blocks, apply the Discrete Cosine Transform (DCT), and implement a "Quality Slider" that selectively zeros out high-frequency coefficients.
16. Process a medical slide image containing overlapping cells. Use Thresholding (Otsu's Method) to binarize, followed by Watershed Segmentation or Morphological Erosion/Dilation to separate "clumped" cells.
17. Build a biometric verification prototype. Use Thinning/Skeletonization (Unit IV) to normalize two handwritten signatures and apply a Correlation-based classifier to determine if the signatures match a stored template.
18. Simulate a "shaky camera" effect using a Degradation Model. Implement a Wiener Filter to restore the image, assuming the Point Spread Function (PSF) is known, and then attempt restoration where the PSF must be estimated.
19. Using a remote sensing dataset, extract Texture descriptors (like Gray-Level Co-occurrence Matrices) to distinguish between "Forest," "Water," and "Urban" areas. Train a Bayes Classifier to categorize pixels based on these features.

20. Extract Fourier Descriptors or Shape Numbers from various 2D objects (circles, squares, triangles). Implement a Minimum Distance Classifier to identify these shapes in a live video feed, regardless of their scale or rotation.	
Syllabus for Unit Tests:	
Unit Test 1	**Unit I, Unit II, Unit III**
Unit Test 2	**Unit IV, Unit V, Unit VI**

Professional Elective-II : iv) Deep Learning					
TEACHING SCHEME		**EXAMINATION SCHEME**		**CREDIT SCHEME**	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		Term Work:	25 Marks		
		Oral:	25 Marks		
Total	05 Hours/Week	Total Marks:	150 Marks	Total	04

Course Objective:

Introduce major deep learning algorithms, the problem settings, and their applications to solve real world problems.

Prerequisite: Linear Algebra, Statistics, probability, Machine learning

Course Outcomes: On completion of the course, students will have the ability to

7. Classify learning algorithms based on their approaches and applications.
8. To study the concepts of deep learning
9. To enable the students to know deep learning techniques to support real-time applications
10. Identify the deep learning algorithms which are more appropriate for various types of learning tasks in various domains.
11. Design and implement various deep supervised learning architectures for text & image data and design and implement various deep learning models and architectures
12. Apply various deep learning techniques to design efficient algorithms for real-world applications

Unit I: Basics of Neural Networks	**(06 Hours)**
Introduction to Machine Learning and Deep Learning Neural Networks basics – Binary Classification, Logistic Regression, Gradient Descent, Derivatives, Computation graph, Vectorization, Vectorizing logistic regression – **Shallow neural networks:** Activation functions, non-linear activation functions, Backpropagation, Data classification with a hidden layer.	
Unit II: Deep Neural Networks:	**(06 Hours)**
Deep L-layer neural network, Forward and Backward propagation, Deep representations, Parameters vs Hyperparameters, Effective training in Deep Net- early stopping, Dropout, Batch Normalization, Instance Normalization, Group Normalization, Building a Deep Neural Network (Application).	
Unit III: Supervised Learning with Neural Networks	**(06 Hours)**
Practical aspects of Deep Learning: Train/Dev / Test sets, Bias/variance, Overfitting and regularization, Linear models and optimization, Vanishing/exploding gradients, Gradient checking.	
Unit IV: Convolutional Neural Networks (CNN)	**(06 Hours)**

Introduction, CNN Architecture Overview, The Basic Structure of a Convolutional Network – Padding, Strides, Typical Settings, the ReLU Layer, Pooling, Fully Connected Layers, The Interleaving between Layers, Local Response Normalization, Training a Convolutional Network.	
Unit V: Neural Network Architectures	**(06Hours)**
Recurrent Neural Networks, Adversarial NN, Spectral CNN, Self-Organizing Maps, Restricted Boltzmann Machines, Recent Trends in Deep Learning Architectures, Residual Network, Skip Connection Network, Fully Connected CNN etc.	
Unit VI Long Short-Term Memory Networks (LSTM) and Deep Reinforcement Learning	**(06 Hours)**
TensorFlow, Keras or MatConvNet for implementation. Generative Modeling with DL, Variational Autoencoder, Generative Adversarial Network Revisiting Gradient Descent, Momentum Optimizer, RMSProp, Adam.	
Textbooks	
5. Aaron Courville, Ian Goodfellow, and Yoshua Bengio "Deep Learning (Adaptive Computation and Machine Learning series) ",1st edition, published by The MIT Press in hardcover format in 2016.	
6. Jon Krohn "Deep Learning for Natural Language Processing: Applications of Deep Neural Networks to Machine Learning Tasks", 1st edition, published by Pearson/Addison-Wesley Professional in November 2017	
7. Rowel Atienza "Advanced Deep Learning with Keras" 1st edition, published by Packt Publishing in October 2018.	
8. François Chollet "Deep Learning with Python",1st edition published by Paperback by Manning Publications on 22 December 2017.	
Reference Books	
3. Aurélien Géron "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow",3rd edition published by O'Reilly Media, Inc. in November 2022 .	
4. Suresh Samudrala "Machine Intelligence: Demystifying Machine Learning, Neural Networks and Deep Learning",1st edition was published by Notion Press in January 2019.	
List of Assignments	
11. Implement binary classification using Logistic Regression with Gradient Descent in Python.	
12. Design and train a shallow neural network with one hidden layer for data classification.	
13. Build a multi-layer neural network for classification using TensorFlow/Keras.	
14. Apply Dropout and Batch Normalization and analyse their effect on model performance.	
15. Perform dataset splitting and study bias–variance trade-off.	
16. Implement a CNN for handwritten digit or image recognition (MNIST/CIFAR-10).	
17. Develop an RNN/LSTM model for text or time-series prediction.	
18. Build an autoencoder for dimensionality reduction or noise removal.	
19. Design and train a basic GAN for image generation.	
20. Compare SGD, Momentum, RMSProp, and Adam on a selected dataset.	
Project Based Learning Assignments	
Note: - Students in a group of 3 to 4 shall complete any one project from the following list	

9. KNN (K - nearest neighbour) method	
10. Artificial Neural Network (ANN)	
11. Convolutional Neural Network (CNN)	
12. Recurrent Neural Network (RNN)	
13. Deep Neural Network (DNN)	
14. Deep Belief Network (DBN)	
15. Back Propagation	
16. Stochastic Gradient Descent	
Syllabus for Internal Assessment:	
Internal Assessment -1	Unit – I, Unit – II, Unit - III
Internal Assessment-2	Unit – IV, Unit – V, Unit - VI

Professional Elective-III : i) Data Visualization					
TEACHING SCHEME		**EXAMINATION SCHEME**		**CREDIT SCHEME**	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		TermWork :	25 Marks		
		Oral:	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

To enable students to apply data analysis, visualization techniques, and business intelligence tools to solve real-world problems and support informed decision-making.

Prerequisite:

Engineering Mathematics (Probability & Statistics), Programming for Problem Solving (C, Python), Data Structures Database Management Systems (DBMS)

Course Outcomes: On completion of the course, students will have the ability to

CO 1: To Understand fundamentals of data visualization and basic data analysis.

CO 2: To apply techniques to clean, transform, and organize data for analysis.

CO 3: To create and interpret basic and advanced data visualizations for effective analysis.

CO 4: To analyse and transform data using Power BI for effective reporting and visualization

CO 5: To create effective data visualizations and reports by integrating prepared datasets into Power BI dashboards.

CO 6: To demonstrate the ability to connect to various data sources and perform filtering, cleaning, and data preparation in Tableau.

Unit I: Foundations of Data Visualization & Data Understanding	**(06 Hours)**
Importance of data visualization and analytics. Role in engineering, analytics, and decision-making. Visualization in data science pipeline and workflow: acquisition, preparation, exploration, communication. Data sources, types, observations, variables, and scales. Descriptive statistics: central tendency, dispersion, distribution, variability. Data quality, wrangling, and exploratory data analysis. Population, sampling, uncertainty, confidence intervals, and hypothesis testing.	
Unit II: Data Manipulation	**(06 Hours)**

Importing data from CSV, Excel, JSON, and relational databases. Data selection, filtering, sorting, and indexing. Handling missing values and duplicates. Data transformation includes scaling, normalization, type conversion, and derived attributes. Aggregation, grouping, merging, joining, concatenation, reshaping, and pivoting datasets using Python (pandas) or equivalent tools. Modern data platforms: Introduction to Snowflake (basic architecture and SQL querying) and Databricks (Spark environment overview and notebook-based data processing concepts).	
Unit III: Data Visualization	**(06 Hours)**
Introduction to visualizing data. Basic charts: line, bar, column, pie, and area charts. Advanced charts: scatter, bubble, candlestick, heatmap, and map charts. Choosing appropriate chart types for different data. Visual encoding: color, size, shape, position. Introduction to dashboards and interactive visualizations. Using Python (Matplotlib, Seaborn, Plotly) or equivalent tools for chart creation. Principles of effective visualization and storytelling with data.	
Unit IV: Advanced Data Visualization	**(06 Hours)**
Interactive dashboards and storyboards. Advanced charts including heatmaps, tree maps, waterfall, funnel, radial gauge, scatter, and bubble plots. Drill-down, drill-through, cross-filtering, and use of slicers, filters, and KPIs. Custom and third-party visuals. Mapping and geospatial visualizations. Principles of visual design: color, shape, size, position. Hands-on creation of dashboards using Power BI, Tableau, or Python visualization libraries.	
Unit V: Data Analysis with Power BI	**(06 Hours)**
Overview of Power BI: components, building blocks, Desktop interface, Power BI Service, and Power BI Apps. Connecting to data from CSV, Excel, Text, SQL Server, Web pages, and direct SQL queries. Cleaning and transforming data. Using Power BI Desktop and Service for data preparation and analysis. Performing basic data operations and preparing datasets for visualization and reporting. Case study: Student Academic Performance Analysis using Power BI.	
Unit VI: Advanced Data Visualization with Tableau	**(06 Hours)**
Overview and architecture of Tableau. File types and extensions. Connecting, filtering, and preparing data in Tableau. Creating dashboards, combined-axis charts, geocoding, and geographic mapping. Data simplification using scatter plots, text/highlight tables, heatmaps, histograms, pie charts, bullet charts, and advanced chart types. Tableau Server: architecture, user access, site roles, groups, schedules, tasks, server interface, and content management. Hands-on creation of reports, dashboards, and visualizations using Tableau. Case Study: Weather Data Analysis Dashboard using Tableau	
Textbooks	
5. Data Visualization: A Practical Introduction, Healy, Kieran. Data Visualization: A Practical Introduction. Princeton University Press, 2018.	

6. Data Visualization with Python, Dobler, Mario. Data Visualization with Python: Create an Impact with Meaningful Data Insights Using Interactive and Engaging Visuals. Packt Publishing, 2019.
7. Learning Tableau 2022, Monsey, Molly, and Ann Jackson. Learning Tableau 2022: Create Effective Data Visualizations, Build Interactive Visual Analytics, and Deliver Impactful Business Insights. Packt Publishing, 2022.
8. Mastering Microsoft Power BI, Deckler, Greg, Brett Powell, and Mitchell Pearson. Mastering Microsoft Power BI: Expert Techniques for Effective Data Analytics and Business Intelligence. 2nd ed., Packt Publishing, 2021.

Reference Books

4. Handbook of Data Visualization, Chen, Chun-houh, Wolfgang Karl Härdle, and Antony Unwin, editors. Handbook of Data Visualization. Reprint ed., Springer Science & Business Media, 2016.
5. Learning Tableau 2025, Milligan, Joshua N. Learning Tableau 2025. 6th ed., Packt Publishing, 2025.
6. Practical Tableau, Sleeper, Ryan. Practical Tableau: 100 Tips, Tutorials, and Strategies from a Tableau Zen Master. 1st ed., O'Reilly Media, 2018.

Project Based Learning Assignments

Note: - Students in a group of 3 to 4 shall complete any one project from the following list

11. Analyze a real dataset (e.g., weather, sales, student performance) to understand data types, distribution, sampling, and summary statistics.
12. Build a reusable data-cleaning pipeline for messy data files (CSV/Excel).
13. Compare trends across categories or time using multiple chart types.
14. Tell a story about a real issue (e.g., air pollution, road traffic, rainfall, sales drop).
15. Design a Power BI dashboard to analyze the chosen dataset.
16. Develop a business analytics dashboard for management decision-making.
17. Create a Tableau workbook that connects multiple data sources.
18. Visualize location-based data such as accident locations, rainfall by state, or retail stores.
19. Publish dashboards online and manage user access.
20. Build a complete analytics project integrating Python, Power BI, and Tableau.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Professional Elective-III : ii) Cryptography and Network Security

TEACHING SCHEME		EXAMINATION SCHEME		CREDIT SCHEME	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		TermWork :	25 Marks		
		Oral:	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

This course aims to provide an understanding of cryptography and network security principles, including encryption techniques, hash functions, digital signatures, and key management to ensure secure communication. It also covers network security protocols, security mechanisms such as firewalls and intrusion detection systems, and emerging areas like cloud and IoT security to prepare students for real-world cybersecurity challenges.

Prerequisite:

Basic knowledge of computer networks, data communication, discrete mathematics, and operating systems.

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Explain fundamental concepts of cryptography, security services, threats, and attacks.

CO 2: Apply symmetric key cryptographic algorithms for secure data encryption and decryption.

CO 3: Analyze asymmetric cryptographic techniques and key management mechanisms

CO 4: Implement hash functions and digital signatures for authentication and data integrity.

CO 5: Evaluate network security protocols and mechanisms such as IPSec, SSL/TLS, firewalls, and IDS.

CO 6: Assess emerging security challenges and solutions in areas such as cloud, IoT, and cyber security.

Unit	Hours
Unit I: Foundations of Cryptography and Security Concepts	**(06 Hours)**
Introduction to Cryptography and Network Security, Security Services and Mechanisms, CIA Triad, Security Attacks (Passive and Active), Cryptanalysis, Mathematical Foundations (Modular Arithmetic, Prime Numbers, GCD, Euler's Totient Function), Finite Fields, Random Number Generation, Classical Encryption Techniques (Substitution and Transposition Ciphers), Shannon's Theory of Secrecy Systems.	
Unit II: Symmetric Key Cryptography	**(06 Hours)**
Block Cipher Principles, Feistel Structure, Data Encryption Standard (DES), Triple DES, Advanced Encryption Standard (AES), Stream Ciphers, RC4, Block Cipher Modes of Operation (ECB, CBC, CFB, OFB, CTR), Padding Techniques, Cryptographic Strength and Attacks on Symmetric Ciphers, Lightweight Cryptography for Embedded Systems.	
Unit III: Asymmetric Key Cryptography and Key Management	**(06 Hours)**

Public Key Cryptography Principles, RSA Algorithm, Diffie–Hellman Key Exchange, ElGamal Cryptosystem, Elliptic Curve Cryptography (ECC), Key Distribution and Key Management Techniques, Hybrid Cryptosystems, Public Key Infrastructure (PKI), Digital Certificates, Certificate Authorities (CA), X.509 Standard, trends in modern cryptography including post-quantum cryptography and lightweight cryptography.	
Unit IV: Cryptographic Hash Functions and Digital Signatures	**(06 Hours)**
Hash Function Properties, Message Authentication Codes (MAC), HMAC, Secure Hash Algorithms (SHA family), Digital Signature Schemes, RSA Signatures, DSS (Digital Signature Standard), Authentication Protocols, Time Stamping, Non-repudiation Services, Applications in Secure Communications. Case study on digital signature vulnerabilities or hash function attacks.	
Unit V: Network Security Protocols and System Security	**(06 Hours)**
Secure Communication Protocols: IP Security (IPSec) Architecture, Authentication Header (AH), Encapsulating Security Payload (ESP), Secure Socket Layer (SSL), Transport Layer Security (TLS), Secure Shell (SSH), Email Security (PGP, S/MIME), Firewalls (Types and Architectures), Intrusion Detection and Prevention Systems (IDS/IPS), Virtual Private Networks (VPNs), Wireless Security (WPA2/WPA3), Case study on network security vulnerabilities such as SSL/TLS attacks or ransomware incidents.	
Unit VI: Emerging Trends and Applications in Security	**(06 Hours)**
Security in Cloud Computing, IoT Security Challenges, Blockchain Security Fundamentals, Zero Trust Architecture, Cyber Threat Intelligence and threat analysis techniques, Biometric Authentication Systems, Cyber Security Frameworks, Malware and Ransomware Concepts, Ethical Hacking Overview, Case Studies using Tools (Wireshark, OpenSSL, Snort), Security in E-Commerce Systems, Case study on modern cyber threats, threat intelligence, or enterprise cybersecurity incidents.	
Textbooks	
4. Cryptography and Network Security — Behrouz A. Forouzan, Debdeep Mukhopadhyay, McGraw-Hill Education (India), 3rd Edition (Reprint), 2015 / latest Indian reprint 2020–2023.	
5. Cryptography and Network Security — Atul Kahate, McGraw-Hill Education (India), 3rd Edition (Reprint), 2019 / latest reprint 2021–2024.	
6. Cryptography and Network Security — C. K. Shyamala, N. Harini, T. R. Padmanabhan, Wiley India Pvt. Ltd., 1st Edition (Reprint), latest reprint 2020–2022.	
Reference Books	
4. Cryptography and Network Security: Principles and Practice — William Stallings, Pearson Education, 7th Edition (Global Edition), 2017 / latest reprint 2020–2023.	
5. Network Security Essentials: Applications and Standards — William Stallings, Pearson Education, 6th Edition, 2017 / latest reprint 2020–2023.	
6. Computer Security: Principles and Practice — William Stallings, Lawrie Brown, Pearson Education, 4th Edition, 2018 / latest reprint 2021–2024.	

Practical Assignment List:	
11. Implementation of Classical Ciphers: Write a program to implement Caesar Cipher and Monoalphabetic Substitution Cipher for encryption and decryption.	
12. Transposition Cipher Program: Implement Columnar Transposition Cipher and demonstrate encryption and decryption of a given message.	
13. Symmetric Encryption using AES: Develop a program (Python/Java) to encrypt and decrypt text using the AES algorithm.	
14. Stream Cipher Demonstration: Implement RC4 (or use a library) to perform secure data encryption and analyze output.	
15. Public Key Cryptography — RSA: Implement RSA algorithm to generate keys, encrypt a message, and decrypt it.	
16. Diffie–Hellman Key Exchange Simulation: Write a program to demonstrate secure key exchange between two parties using Diffie–Hellman.	
17. Hash Function and Message Integrity: Generate message digests using SHA-256 and verify integrity by modifying the message.	
18. Digital Signature Implementation: Create and verify a digital signature using RSA or available cryptographic libraries.	
19. Packet Analysis using Wireshark Tool, Capture and analyse network packets using Wireshark.	
20. Intrusion Detection using Snort Tool, Study and demonstrate basic intrusion detection using Snort IDS.	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Professional Elective-III : iii) Augmented Reality and Virtual Reality					
TEACHING SCHEME		**EXAMINATION SCHEME**		**CREDIT SCHEME**	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		TermWork :	25 Marks		
		Oral:	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

Develop skills in computer vision, 3D graphics, and immersive environment design.

Prerequisite:

Students should have knowledge of Data structures and algorithms, Discrete mathematics, Computer graphics

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Identify the role of AR in immersive technologies.

CO 2   Evaluate AR hardware ecosystem.

CO 3: Apply computer vision techniques in AR.

CO 4: Design immersive VR environments.

CO 5: Apply geometric principles in VR design.

CO 6: Integrate AI into AR/VR applications.

Unit I: Introduction to Augmented Reality	**(06 Hours)**
Definition and history of AR, Relationship between AR and related concepts (VR, MR, XR), How AR works: core principles and workflow, Ingredients of an AR experience (hardware, software, interaction) Case study: Pokémon Go, IKEA AR app	
Unit II: Augmented Reality Hardware	**(06 Hours)**
Displays: visual, audio, haptic, sensory, Visual perception requirements, spatial display models, Processors: architecture, specifications, role in AR systems, Tracking & sensors: calibration, registration, stationary vs. mobile, optical tracking, sensor fusion.	
Unit III: Computer Vision for Augmented Reality & A.R. Software	**(06 Hours)**
Computer Vision for Augmented Reality - Marker Tracking, Multiple-Camera Infrared Tracking, Natural Feature Tracking by Detection, Simultaneous Localization and Mapping, Outdoor Tracking, Major Software Components for Augmented Reality Systems, Software used to Create Content for the Augmented Reality Application.Tools: Unity, Vuforia, ARCore, ARKit	
Unit IV: Introduction to Virtual Reality	**(06 Hours)**

Defining VR, history and evolution, Human physiology and perception in VR, Elements of VR experience: immersion, presence, interaction VR systems: input/output devices (visual, aural, haptic) Applications in gaming, healthcare, training, education.	
Unit V The Geometry of Virtual Worlds &The Physiology of Human Vision	**(06 Hours)**
Geometric Models, Changing Position and Orientation, Axis-Angle Representations of Rotation, Viewing Transformations, Chaining the Transformations, Human Eye, eye movements & implications for VR.	
Unit VI: AI Integration in AR/VR	**(06 Hours)**
Personalized AR/VR environments by analyzing user behavior and adjusting content dynamically using AI. Object recognition, spatial mapping, and gesture tracking in AR. NPCs & Virtual Agents, Content Generation using AI, AR/VR in the Metaverse Persistent virtual worlds, interoperability, social interaction, digital economy	
Textbooks	

5. Understanding Virtual Reality: Interface, Application and Design", William R Sherman and Alan B Craig, (The Morgan Kaufmann Series in Computer Graphics)". Morgan Kaufmann Publishers, San Francisco, CA, (Second Edition)
6. Virtual Reality Technology" Grigore C. Burdea, Philippe Coiffet,John Wiley & Sons, 11 Sept 2024(Third Edition)
7. Augmented Reality: Principles and Practice" Dieter Schmalstieg, Tobias Hollerer
8. Addison-Wesley Professional (First Edition)

Reference Books

1. Augmented Reality: Where We Will All Live" by Jon Peddie, Springer (Second Edition)
2. Gerard Jounghyun Kim, "Designing Virtual Systems: The Structured Approach", Springer (Second Edition)

Project Based Learning Assignments

Note: - Students in a group of 3 to 4 shall complete any one project from the following list

11. Create an AR navigation system for guiding new students around campus using marker less AR.
12. Design AR business cards to reveal interactive contact info or portfolio.
13. Design a treasure hunt game where clues appear in AR at different locations.
14. Design AR Home Decorator to place furniture virtually in your room before buying.
15. Design AR Educational flashcards that show 3D models of planets
16. Design AR Colouring Book where the drawing comes alive in 3D when scanned.

17. Create a small 3D room where users can walk around.
18. Design VR Meditation Space with calming environment for relaxation.
19. Explore a small neighborhood or street in VR.
20. Design Virtual classroom with interactive boards and objects.

Syllabus for Unit Tests:

Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Professional Elective-III : iv) Blockchain					
TEACHING SCHEME		**EXAMINATION SCHEME**		**CREDIT SCHEME**	
Lecture:	03 Hours/Week	End Semester Examination:	60 Marks	Theory	03
Practical:	02Hours/Week	Internal Assessment:	40 Marks	Practical:	01
		TermWork :	25 Marks		
		Oral:	25 Marks		
Total	05 Hours/Week	Total	150 Marks	Total	04

Course Objective:

To provide a comprehensive understanding of blockchain and distributed ledger technology, underlying cryptographic principles, major platforms such as Bitcoin, Ethereum, and Hyperledger, and to enable students to analyze real-world applications, security issues, performance challenges, and limitations of blockchain systems.

Prerequisite:

Basic knowledge of data structures, computer networks, databases, cryptography fundamentals, and proficiency in at least one programming language.

Course Outcomes: On completion of the course, students will have the ability to

CO 1: Explain blockchain evolution, architecture, types, applications, and trends.

CO 2: Apply cryptographic concepts and security practices in blockchain systems.

CO 3: Analyse consensus mechanisms and scalability solutions.

CO 4: Design and deploy smart contracts and decentralized applications.

CO 5: Examine Web3, DeFi, NFTs, DAOs, and their applications.

CO 6: Evaluate enterprise blockchain solutions, regulations, and future trends.

Unit I: Blockchain Foundations & Industry Landscape	**(06 Hours)**
Evolution of blockchain: Bitcoin, Ethereum, and Web3, Blockchain architecture: blocks, transactions, nodes, and ledgers, Types of blockchains: public, private, consortium, and hybrid, Permissioned and permissionless blockchains, Industry adoption and use cases, Limitations, challenges, and current trends, Decentralization vs Centralization, Peer-to-Peer (P2P) networks.	
Unit II: Cryptography, Wallets & Blockchain Security	**(06 Hours)**
Cryptographic hash functions (SHA-256, Keccak-256), Digital signatures and public-key cryptography, Wallets: hot wallets, cold wallets, and hardware wallets, multi-signature wallets Blockchain security threats and vulnerabilities, best practices and real-world security incidents	
Unit III: Consensus Mechanisms & Scalability	**(06 Hours)**
Need for consensus in decentralized networks, Proof of Work and Proof of Stake, Delegated Proof of Stake (DPoS), Byzantine Fault Tolerance (PBFT), Layer-2 scalability solutions: sidechains, rollups, Performance, energy efficiency, and scalability challenges , Hybrid and energy-efficient consensus mechanisms (e.g., Proof of Authority)	

Unit IV: Smart Contracts & Decentralized Application Development	(07 Hours)
Smart contracts: definition and applications, Ethereum architecture and Ethereum Virtual Machine (EVM), Solidity programming fundamentals, Smart contract deployment and testing, Gas concepts and optimization techniques, Smart contract vulnerabilities and security considerations, Smart contract development frameworks (e.g., Truffle, Hardhat overview), Case study: Smart contract implementation in decentralized applications.	
Unit V: Web3, DeFi & NFTs	**(06 Hours)**
Web3 architecture and ecosystem, Decentralized applications (DApps), Decentralized Finance (DeFi): exchanges, lending, staking, Non-Fungible Tokens (NFTs): standards and use cases, Decentralized Autonomous Organizations (DAOs), Applications in gaming, metaverse, and digital economy, Case study: DeFi or NFT-based platform in the digital economy	
Unit VI: Enterprise Blockchain, Cloud Platforms & Future Trends	**(06 Hours)**
Enterprise blockchain concepts, Hyperledger Fabric architecture, Blockchain as a Service(BaaS), Cloud-based blockchain platforms, Cross-chain interoperability, Regulatory, legal, and ethical issues, Career opportunities and future scope, Central Bank Digital Currencies (CBDC) and government initiatives, Case study: Enterprise blockchain adoption in supply chain or finance.	
Textbooks	
1.Mastering Blockchain, 4th Edition, Packt Publishing, 2023 — Imran Bashir.	
2.Mastering Bitcoin: Programming the Open Blockchain, 2nd Edition, O'Reilly Media, 2017 — Andreas M. Antonopoulos.	
Reference Books	
1.Bitcoin and Cryptocurrency Technologies, Princeton University Press, 2016 — Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, Steven Goldfeder.	
2.Mastering Ethereum: Building Smart Contracts and DApps, O'Reilly Media, 2018 — Andreas M. Antonopoulos and Gavin Wood.	
PBL (Project Based Learning)	
1. Implement a simple blockchain to demonstrate block creation and validation.	
2.Develop a basic cryptocurrency wallet with key generation and transaction signing.	
3.Simulate public, private, and consortium blockchain networks for comparison.	
4.Implement Proof of Work or Proof of Stake consensus simulation.	
5. Design and deploy a simple smart contract using Solidity.	
6.Develop a basic DApp that interacts with a smart contract.	
7.Build a blockchain-based supply chain tracking prototype.	
8.Implement a multi-signature wallet requiring multiple approvals.	
9.Analyze a blockchain security attack and propose mitigation measures.	
10.Design a conceptual blockchain solution for a real-world domain.	

Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit – VI

Bharati Vidyapeeth

(Deemed to be University)

College of Engineering, Pune

B.Tech. Programme- Rules and Regulations

B. Tech. – 2023 Course

Rules and Regulations

(I) Theory

(A) Theory Examination

Theory examination consists of: (i) End semester examination (ESE), and (ii) Internal assessment (IA).

(i) ESE is of 60 marks for theory courses.

(ii) IA is of 40 marks. Out of 40 marks, 20 marks will be for Unit Tests and 20 marks will be for Project Based Learning for a given course. Two Unit Tests, each of 20 marks, will be conducted. Average of marks obtained in these two unit tests will be considered as UT marks. Roll numbers allotted to the students shall be the examination numbers for the conduction of unit tests.

(B) Standard of Passing

(i) There is a separate passing of 40% of 60 marks, i.e. 24 marks, for ESE for a given course.

(ii) There is a separate passing of 40% of 40 marks, i.e. 16, for IA for a given course.

(iii) A student who fails at ESE in a given course has to reappear only at ESE as a backlog student and clear the head of passing. Similarly, a student who fails at IA in a given course has to reappear only at IA as a backlog student and clear the head of passing

(II) Practical

(A) Practical Examination

Practical examination consists of: (i) Term work, and (ii) Practical/Oral examination for a given course based on term work.

(i) Term work (TW): TW marks are as mentioned in the curriculum structure.

(ii) Practical/Oral (PR/OR): PR/OR marks are as mentioned in the curriculum structure.

(B) Conduction of practical/oral examination

(i) A student will be permitted to appear for practical/oral examination only if he/she submits term work of a given course.

(ii) Practical/oral examination shall be conducted in the presence of internal and external examiners appointed by university.

(C) Standard of Passing

(i) A student shall pass both heads TW and PR/OR separately with minimum 40% of total marks of respective head.

(III) MOOC and Social Activity Course

(i) If a student completes one MOOC during a programme, he/ she will earn additional TWO credits, subjected to submission of the certificate of completion of the respective course. It is mandatory for a student to complete at least two MOOC to obtain degree in a given discipline. Students shall register to MOOCs which are offered by any one the following agencies:

(a) SWAYAM : www.swayam.gov.in
(b) NPTEL : www.onlinecourse.nptel.ac.in
(c) Course Era : www.coursera.org
(d) edX online learning : www.edx.org
(e) MIT Open Course ware : www.ocw.mit.edu
(f) Udemy : www.udemy.com
(g) Spoken tutorial : www.spoken-tutorial.org

(ii) If a student completes social activity, he/she will earn additional TWO credits, subjected to submission of the certificate of completion of the respective course/ activity from the relevant authorities. It is mandatory for a student to complete at least one social activities to obtain degree in a given discipline.

(iii) The additional credits for MOOC and Social Activity will be given only after verification of the authentic document by the Head of the Department and a separate mark-sheet will be submitted by the Head of the Department along with the course examiner.

(IV) Value Added Course (VAC) and Indian Knowledge System (IKS) Course

(i) The VAC and IKS courses are mandatory and must be passed by students during the designated semester to earn two credits.

(ii) These courses have an internal assessment worth 100 marks, which are distributed as follows: (a) three assignments, each worth 20 marks, and (b) two case studies, presentations, or quizzes, each worth 20 marks. Faculty members have the flexibility to choose between conducting two case studies, two presentations, two quizzes, or any combination thereof.

(V) Minor Programme

(i) A students shall receive a MINOR degree when he/she acquires additional 20 credits in a given specialization defined by the UG programmes offered at the institute.

(ii) The theory and practical/oral components for a given course are mentioned in curriculum structure. The theory and examination for a given course are mentioned in Section I and II.

(iii) The grade point, grade letter and equivalent marks system for MINOR programme is mentioned in Section V.

(iv) The MINOR DEGREE programme is OPTIONAL. The interested students may opt MINOR programme.

(v) A student shall complete the MINOR program prior to his/her graduation.

(VI) A. T. K. T

(i) A student who is granted term for B. Tech. Semester-I, III, V, VII will be allowed to keep term for his/her B. Tech. Semester-II, IV, VI, VIII examination, respectively even if he/she appears and fails or does not appear at B. Tech. Semester-I,III, V, VII examination respectively.

(ii) A student shall be allowed to keep term for the B. Tech. Semester-III course if he/she has a backlog of any number of Heads of passing at B. Tech. Semester-I & II taken together.

(iii) A student shall be allowed to keep term for the B. Tech. Semester-V of respective course if he/she has no backlog of B. Tech. Semester-I & II and he/she has a backlog of any number of Heads of passing at B. Tech. Semester-III & IV taken together.

(iv) A student shall be allowed to keep term for the B. Tech. Semester- VII of respective course if he/she has no backlog of B. Tech. Semester-I, II, III, IV and he/she has a backlog of any number of Heads of passing at B. Tech. Semester-V & VI taken together.

(VII) Grade Point, Grade Letter and Equivalent Marks

The student must obtain a minimum Grade Point of 5.0 (40% marks) in ESE and also in combined ESE + IA. A student who fails in ESE of a course has to reappear only to ESE as a backlog student and clear that head of passing.

Award of the Class for the Degree considering CGPA: A student who has completed the minimum credits specified for the programme shall be declared to be passed in the programme. The CGPA will be computed every year of all the courses of that year. The grade will be awarded according to the CGPA of every year.

Range of CGPA	**Final Grade**	**Performance Descriptor**	**Equivalent range of Marks (%)**
$9.50 \leq CGPA \leq 10.00$	O	Outstanding	$80 \leq Marks \leq 100$
$9.00 \leq CGPA \leq 9.49$	A+	Excellent	$70 < Marks < 80$

8.00 ≤ CGPA ≤ 8.99	A	Very Good	60 < Marks < 70
7.00 ≤ CGPA ≤ 7.99	B+	Good	55 < Marks < 60
6.00 ≤ CGPA ≤ 6.99	B	Average	50 < Marks < 55
5.00 ≤ CGPA ≤ 5.99	C	Satisfactory	40 ≤ Marks < 50
CGPA below 5.00	F	Fail	Marks Below 40