Bharati Vidyapeeth

(Deemed to be University) Pune, India

College of Engineering, Pune

B.Tech. Computer Science & Engineering

(2023 Course)

Program Curriculum

As Per NEP Guidelines

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)

COLLEGE OF ENGINEERING, PUNE

B. Tech. (CSE): Semester –I (NEP 2020 COURSE)

Sr. No	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	Internal Assessment	TW	OR	PR	Total	Th	Pr/ Or	Tut	Total
1.	BM	BM1113101	Engineering Mathematics- I	3	-	1	60	40	-	-	-	100	3	0	1	4
2.	BC	BC1113102	Engineering Chemistry	3	2	-	60	40	50	-	-	150	3	1	0	4
3.	ES	ES1108103	Digital Electronics	4	2	-	60	40	25		-	125	4	1	0	5
4.	MJ	MJ1113104	Probability and Statistics	4	2	-	60	40	25	-	-	125	4	1	0	5
5.	MJ	MJ1104105	Programming and Problem Solving	4	2	-	60	40	25	-	25	150	4	1	0	5
6.	AE	AE1113106	Communication Skills	-	2	-	-	-	50	-	-	50	0	1	0	1
7.	SE	SE1111107	Skill Base Course -I (Computer-Aided Drawing & Design)	-	2	-	-	-	25	25	-	50	0	1	0	1
			Total	**18**	**12**	**1**	**300**	**200**	**200**	**25**	**25**	**750**	**18**	**6**	**1**	**25**

**** indicate this is mandatory but the credits will not be considered in SGPA/CGPA**

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
B. Tech. (CSE): Semester – II (NEP 2020 COURSE)

Sr. No	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	Internal Assessment	TW	OR	PR	Total	Th	Pr/ Or	Tut	Total
1.	BM	BM1113201	Engineering Mathematics- II	3	-	1	60	40	-	-	-	100	3	0	1	4
2.	BP	BP1113202	Engineering Physics	3	2	-	60	40	50	-	-	150	3	1	0	4
3.	ET	ET1107203	Electrical Technology	4	2	-	60	40	25	-	-	125	4	1	0	5
4.	MJ	MJ1104204	Discrete Mathematical Structures	4	-	1	60	40	25	-	-	125	4	0	1	5
5.	MJ	MJ1104205	Linear Data Structures	4	2	-	60	40	25	-	25	150	4	1	0	5
6.	UH	UH1113206	Universal Human Values	-	2	-	-	-	50	-	-	50	0	1	0	1
7.	SE	SE1111207	Skill Base Course-II (Computer Workshop Technology)	-	2	-	-	-	25	25	-	50	0	1	0	1
			Total	**18**	**10**	**2**	**300**	**200**	**175**	**25**	**25**	**750**	**18**	**5**	**2**	**25**

*** indicate this is mandatory but the credits will not be considered in SGPA/CGPA**

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
B. Tech. (CSE): Semester – III (NEP 2020 COURSE)

Sr. No	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks							Credits		
				L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	L	Pr/ Or	T	Total
1.	MJ	MJ1104301	Database Systems	3	2	-	60	40	25	25	-	150	3	1	0	4
2.	MJ	MJ1104302	Non-Linear Data Structures	3	2	-	60	40	25	25	-	150	3	1	0	4
3.	MJ	MJ1104303	Software Engineering	3	-	1	60	40	25	-	-	125	3	-	1	4
4	MJ	MJ1104304	Machine Organization and Microprocessors	3	-	-	60	40	-	-	-	100	3	-	0	3
5.	MJ	MJ1104305	Object Oriented Methodology	3	2	-	60	40	25	-	-	125	3	1	-	4
6.	SE	SE1104306	Skill Base Course-III (Computer Skill Lab- I) Web Programming	-	2	-	-	-	25	25	-	50	0	1	0	1
			Total	**15**	**8**	**1**	**300**	**200**	**125**	**75**	**-**	**700**	**15**	**4**	**1**	**20**
7.	Audit Course-I	AC1113307	Indian Knowledge System	2	-	-	-	100	-	-	-	-	-	-	-	2
8.	*Value Added Course	VA1104308	VAC- I	2	-	-	-	100	-	-	-	-	-	-	-	2

***Indicate this is mandatory but the credits will not be considered in SGPA/CGPA.(As and when the students complete the course and submit the certificate, it should be reflected in the mark sheet. The student should clear the subject up to 7th Sem of his/her coursework.)**

BHARATI VIDYAPEETH (DEEMED TO BE UNIVERSITY)
COLLEGE OF ENGINEERING, PUNE
B.Tech. (CSE): Semester – IV (NEP 2020 COURSE)

Sr. No	Category	Subject Code	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
				L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	L	Pr/ Or	T	Total
1.	MJ	MJ1104401	Theory of Computing	3	-	1	60	40	25	-	-	125	3	0	1	4
2.	MJ	MJ1104402	System Programming and Operating Systems	3	2		60	40	25		25	150	3	1	-	4
3.	MJ	MJ1104403	Computer Organization and Architecture	3	-	-	60	40	-	-	-	100	3	0	0	3
4.	MJ	MJ1104404	Computer Graphics and Multimedia	3	2	-	60	40	25	-		125	3	1	0	4
5.	MJ	MJ1104405	Computer Networks	3	2	-	60	40	25	25		150	3	1	-	4
6.	SE	SE1104406	Skill Base Course-IV (Python)	-	2	-	-	-	25	25		50	0	1	0	1
			Total	**15**	**8**	**1**	**300**	**200**	**125**	**75**	**25**	**700**	**15**	**4**	**1**	**20**
7.	*MOOC/ Swayam NPTEL	AE1104407	MOOC-I	-	-	-	-	-	-	-	-	-	-	-	-	2
8	*Social Activity	EC1104408	Social Activity	-	-	-	-	-	-	-	-	-	-	-	-	2

*** Indicate this is mandatory but the credits will not be considered in SGPA/CGPA.(As and when the students complete the course and submit the certificate, it should be reflected in the mark sheet. The student should clear the subject up to 7th Sem of his/her coursework.)**

B.Tech.(Computer Science and Engineering):Semester– V(2023COURSE)

Sr. No.	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
		L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1.	Design and Analysis of Algorithm	3	2	-	60	40	25	25	-	150	3	1	-	**4**
2.	Artificial Intelligence	3	2	-	60	40	25	-	25	150	3	1	-	**4**
3.	Design Thinking	3	-	-	60	40	-	-	-	100	3	-	-	**3**
4.	Internet of Things	3	-	-	60	40	-	-	-	100	3	-	-	**3**
5.	Course – 5 (PEC- I)	3	2	-	60	40	25	-	25	150	3	1	-	**4**
6.	Skill based Course –V (Advance Java Programming)	-	4	-	-	-	25	25	-	50	-	2	-	**2**
	Total	**15**	**10**	**-**	**300**	**200**	**100**	**75**	**25**	**700**	**15**	5	**-**	**20**
8.	**Value Added Course- II	-	2	-	-	40	-	-	-	-	-	2	-	2
9.	MOOC - II	-	-	-	-	-	-	-	-	-	-	-	-	2

Program Elective Course (PEC) / Open Elective Course List

Semester-V
PEC-I
Image Processing
Software Testing and Quality Assurance
Compiler Design

B.Tech.(Computer Science and Engineering):Semester–VI(2023COURSE)

Sr. No	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
		L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	Th	Pr/ Or	Tut	Total
1.	Machine Learning	3	2	-	60	40	25	25	-	150	3	1	-	**4**
2.	Enterprise Software Development	3	2	-	60	40	25	25	-	150	3	1	-	**4**
3.	Cloud Computing	3	-	-	60	40	-	-	-	100	3	-	-	**3**
4.	Natural Language Processing	3	-	-	60	40	-	-	-	100	3	-	-	**3**
5.	Course – 5 (PEC-II)	3	2	-	60	40	25	-	-	125	3	1	-	**4**
6.	Professional Skills	-	2	-	-	-	25	-	-	25	-	1	-	**1**
7.	Skill based Course–VI (GenAI)	-	2	-	-	-	25	-	25	50	-	1	-	**1**
	Total	**15**	**10**		**300**	**300**	**125**	**50**	**25**	**800**	**-**	**-**	**-**	**24**
7.	Environmental Studies	4	-	-	-	100	-	-	-	100	4	-	-	**4**

Program Elective Course (PEC) / Open Elective Course List

Semester -VI
PEC-II
Data Mining and Analytics
Computer Security and Digital Forensics
Business Intelligence

B.Tech.(Computer Science and Engineering):Semester–VII(2023COURSE)
TRACK -01

Sr. No	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
		L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1.	*Internship	-	-	-	-	100	100	-	50	150	-	12	-	12
2.	Deep Learning	3	2	-	60	40	25	25	-	150	3	1	-	04
3.	Blockchain Technology	3	2	-	60	40	25	-	25	150	3	1	-	04
	Total	**-**	**-**	**-**	**120**	**180**	**150**	**25**	**75**	**450**	**6**	**14**	**-**	**20**

***Internship of one semester It should be done after VIth Semester Examination is over.**

TRACK -02

Sr. No	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
		L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	Th	Pr/ Or	Tut	Total
1.	In-house Internship	-	-	-	-	100	100		50	150	-	12	-	12
2.	Deep Learning	3	2	-	60	40	25	25	-	150	3	1	-	04
3	Blockchain Technology	3	2	-	60	40	25		25	150	3	1	-	04
	Total	**-**	**-**	**-**	**120**	**180**	**150**	**25**	**75**	**450**	**-**	**-**	**-**	**20**

TRACK -03
B.Tech.(Computer Science and Engineering):Semester–VIII (2023COURSE)

Sr.No	Subject	Teaching Scheme			Examination Scheme-Marks						Credits			
		L	P	T	ESE	Internal Assessment	TW	PR	OR	Total	Th	Pr/Or	Tut	Total
1.	Major project	-	-	-	-	-	100	-	100	200	-	-	-	08
2.	Paper publication	-	-	-	-	100	-	-	-	100	-	-	-	02
3.	Computer Vision	3	2	-	60	40	25	25	-	150	3	1	-	04
4	IT Project Management(DevOPS)	3	2	-	60	40	25		25	150	3	1	-	03
5.	Course – 3 (Open Elective)	3	-	-	60	40	-	-	-	100	3	-	-	03
	Total	**-**	**-**	**-**	**160**	**220**	**150**	**25**	**125**	**--**	**-**	**-**	**-**	**20**

Note : A student can choose either Track-1 or Track-2 in any semester. Track-3 must be taken in the semester where Track-1 or Track-2 is not selected.

Program Elective Course (PEC) / Open Elective Course List

Semester -VIII
Open Elective
Robotic Process Automation
AR-VR
Information Storage and Retrieval

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 ambiance 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 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 needs of the 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 be focused on innovative and quality education in computer science and engineering that prepares professionals for development of society.

MISSION OF THE DEPARTMENT

- To provide academic environment for the development of skilled professionals
- To cultivate research culture that contributes to the sustainable development of the society.
- To enhance academic and industry collaborations for global exposure.

PROGRAM EDUCATIONAL OBJECTIVES

The students of B.TECH. (Computer Science and Engineering), after graduating will able to,

1. Demonstrate technical and professional competencies by applying Engineering Fundamentals, knowledge of computing and technologies.
2. Exhibit effective personality, good communication and team building skills
3. Adopt to the latest trends in the field of computer science and engineering.

PROGRAM SPECIFIC OUTCOMES

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

PROGRAM OUTCOMES

1. Apply the knowledge of mathematics, science, engineering, and computing to provide a solution of complex engineering problems.
2. Identify, analyse complex engineering problems to derive conclusions using computer science and engineering knowledge.
3. Outline resolutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration, societal, and environmental considerations.
4. Use existing research knowledge and research techniques including design of experiments, data analysis, and synthesis to provide valid inferences.
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools.
6. Apply inferences obtained by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the subsequent responsibilities relevant to the professional engineering practice.
7. Recognize the impact of the professional engineering solutions in societal and environmental contexts to demonstrate the knowledge for sustainable development.
8. Apply ethical principles and execute professional ethics and responsibilities and norms of the engineering practice.
9. Work effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary surroundings.
10. Talk effectively on complex engineering activities with the engineering community such as being able to comprehend and write effective reports and design documentation, make effective presentations.
11. Prove knowledge and understanding of the engineering and management principles and apply these to one's work, as a member and leader in a team.
12. Recognise the need for and have the preparation and ability to engage in independent and life-long learning in context of technological change.

A. 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
2 Hours Practical (Lab)/week	1 credit

B. STRUCTURE OF UNDERGRADUATE ENGINEERING PROGRAMME:

Sr.No.	Category	Breakup of Credits
1	Basic Science Courses	16
2	Engineering Science Course	13
2	Core Courses and Lab	99
4	Professional Elective Courses	17
5	Project	09
6	Internship	06
7	Skill based Courses	16
**8	Value based Courses	08(Optional Credit)
9	Humanity/Social	06
TOTAL		180

- **** Indicates optional credits**

C. COURSE CODE AND DEFINITION

Course Code	Definitions
L	Lecture
T	Tutorial
P	Practical
TW	Term Work
O	Oral
SEE	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	Co-curricular Courses
EC	Extra-Curricular Courses
ID	Inter-disciplinary Courses
MD	Multidisciplinary Courses
RP	Research I Project Courses
PC	Practical Courses
ES	Engineering Science

AC	Audit Course
EC	Extracurricular Activities
BM	Basic Mathematics
BP	Basic Physics
BC	Basic Chemistry
UH	Universal Human Values

Semester wise Credits

Sr. No.	Semester	Credits
1	I	25
2	II	25
3	III	20
4	IV	20
5	V	23
6	VI	22
7	VII	23
8	VIII	22

B. TECH (Computer Science & Engineering)

SEMESTER – V

COURSE SYLLABUS

Design and Analysis of Algorithm					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination:**	**60 Marks**	**Lecture**	**03**
Practical	**02 Hour/Week**	**Internal Assessment:**	**40 Marks**		
		Term work:	**25 Marks**		
		Practical:	**25 Mark**		**01**
		Total	**150 Marks**	**Total**	**04**

Course Objective:

To introduce the concept of algorithmic efficiency by analyzing various algorithms such as Searching, Sorting, Divide-and-Conquer algorithms and to know detail about Greedy Paradigm, Principle of Dynamic Programming, Back Tracking, Branch and Bound, and Computational Complexity.

Prerequisite: Concepts of Data Structures and programming language

Course Outcomes: On Completion of the course, students will have the Ability To:

1. Identify various Time and Space complexities of various algorithms.
2. Understand Tree Traversal method and Greedy Algorithms.
3. Apply Dynamic Programming and Graphs concepts to solve various problems.
4. Apply Backtracking, Branch and Bound concept to solve various problems.
5. Demonstrate string matching and network flow algorithms relating to real-life problems.
6. Implement different performance analysis methods for non-deterministic algorithms.

Unit I: Introduction	**06 Hours**
Time complexity of an algorithm, Pseudo code for expressing algorithms, Performance analysis (Space complexity and Time complexity), Asymptotic notations, Growth of functions, Recurrence methods (Substitution, Recursion tree and Master's method).	
Unit II: Divide-and-Conquer & Greedy Strategy	**06 Hours**
Divide and Conquer: Binary search, Merge sort, Quick sort, Performance Measurement: Best Case and Worst-Case Analysis. Greedy Strategy: Overview of the greedy paradigm, Huffman coding, Activity selection problem, Fractional knapsack problem.	
Unit III: Dynamic Programming and Graphs-Trees	**06 Hours**
Dynamic Programming: Principles of dynamic programming, Matrix multiplication,	

longest common sequence. Graphs-Trees: Single source shortest path algorithm, All pair shortest path, algorithm, Minimum spanning tree.	
Unit IV: Back Tracking and Branch-Bound	**06 Hours**
Back Tracking: Overview, 8-queen problem, and Knapsack problem, Traveling Salesman problem. Branch-Bound: LC searching Bounding, FIFO branch and bound, LC branch and bound.	
Unit V: String Matching	**06 Hours**
String Matching: Naïve String-matching Algorithms, KMP algorithm, Rabin-Karp Algorithm, String matching with Finite Automata.	
	06 Hours
Unit VI: NP-Complete and Approximation Algorithms	
NP Complete: The Class P, Class NP-Reducibility, NP-Hard class, NP-complete class, Circuit Satisfiability problem-SAT 3CNF, Hamiltonian Cycle, Clique.	
Textbooks:	
1. T .H . Cormen, C . E . Leiserson, R .L . Rivest "Introduction to Algorithms". 2. E. Horowitz, S. Sahni, and S. Rajsekaran, "Fundamentals of Computer Algorithms," Galgotia Publication	
Reference Books: 1. Sara Basse, A. V. Gelder, " Computer Algorithms," Addison Wesley 2. Aho ,Ullman "Principles of Algorithms"	
List of Practical:	
1. Calculate the space complexity of various algorithms.	
2. Implement Merge Sort.	
3. Implement fractional Knapsack algorithm.	
4. Implement Minimum spanning tree algorithms.	
5. Study and analysis of the 8-Queens Problem.	
6. Implement single source shortest path algorithm.	
7. Implement Longest Common Sequence algorithm.	
8. Implement String Matching algorithms.	
Project Based Learning:	
1. Design a Sudoku using Recursion.	
2. Design a Phonebook.	
3. Simulate 15 Puzzle Problem.	
4. Design Tic Tac Toe.	

5. Travelling Salesman Problem.	
6. Design a board for simulating the N-Queen Problem.	
Syllabus for Unit Tests:	
Unit Test -1	Unit – I, Unit – II, Unit - III
Unit Test -2	Unit – IV, Unit – V, Unit - VI

Artificial Intelligence					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination:**	**60 Marks**	**Lecture**	**03**
Practical:	**02 Hour/Week**	**Internal Assessment:**	**40 Marks**		
		Oral	**25 Marks**		**01**
		Term work:	**25 Marks**		
		Total	**150 Marks**	**Total**	**04**

Course Objective:

To provide insight to the students about basic knowledge representation, problem solving, and learning methods of artificial intelligence.

Prerequisite: Discrete mathematics, Data structures,

Course Outcomes: On Completion of the Course, Students Will Have the Ability To:

1. Describe the concept of Artificial Intelligence, Intelligent agents and Learning agents
2. Identify issues in problem solving and apply the appropriate search methods identify the constraints
3. Describe and select the different knowledge representation methods
4. Implement AI planning techniques, decision-making models for solving real-world problems.
5. Use appropriate domain knowledge and develop an Expert system
6. Explore AI applications across various domains, ethical challenges, societal impact, and emerging trends shaping the future of AI

Unit I: Introduction to intelligence and Problem Solving	**06 Hours**
Problems of AI, AI technique, Tic - Tac - Toe problem. Intelligent Agents, Agents & environment, nature of environment, structure of agents, goal based agents, utility based agents, learning agents, Introduction to Basic concept of Machine Learning (ML), Deep Learning (DL)and Data Science. (DS). AI vs ML vs DL vs DS, Case Study- 1 : AI for everyone/ Building AI Projects Case Study- 2 : AI and Society / Ethics for AI	

Unit II: Problem Solving and Search Strategies	**06 Hours**
Problem-Solving as State Space Search, Production Systems and Problem Characteristics, Problem solving agents, uniform search strategies: breadth first search, depth first search, depth limited search, bidirectional search, comparing uniform search strategies. Inform Search strategies/Heuristic search strategies:	

Greedy best-first search, A* search, AO* search, memory bounded heuristic search: local search algorithms & optimization problems: Hill climbing search, local beam search,Constraint Satisfaction Problems (CSP),Game Playing: Minimax Algorithm, Alpha-Beta Pruning.	
Unit III: Knowledge & reasoning	**06 Hours**
Knowledge representation methods: Propositional Logic, First-Order Logic (FOL), Semantic Networks, Frames, Ontologies, Reasoning Techniques: resolution, natural deduction. forward and backward reasoning, Probabilistic Reasoning: Bayesian Networks, Dempster-Shafer theory, Markov Models, Handling Uncertainty: Fuzzy Logic, Non-Monotonic Reasoning.	
Unit IV: Automated Planning & Decision Making	**06 Hours**
Introduction to Planning in AI, Components of a planning system, Goal stack planning, Hierarchical planning, other planning techniques, State-Space and STRIPS Representation, Classical Planning Algorithms: Forward State-Space Planning, Backward State-Space Planning, Graph Plan Algorithm, Decision-Making in AI: Markov Decision Processes (MDPs), Reinforcement Learning Basics	
Unit V: Expert Systems & AI Applications	**06 Hours**
Introduction to Expert Systems, Components of Expert Systems, Rule-Based Expert Systems, Fuzzy Expert Systems, Decision Support Systems and AI-Based Decision Making, expert system shells, and knowledge acquisition.	
Unit VI: AI Ethics, Applications, and Future Trends	**06 Hours**
AI in Healthcare, Finance, Robotics, Autonomous Vehicles, AI and Society, Ethical Issues in AI, AI and Society, Emerging Trends: Explainable AI (XAI), Quantum AI, Generative AI, Case Studies: Successful AI Implementations and Real-World Impact	
Textbooks:	
1. Artificial Intelligence: A Modern Approach by Peter and Norvig, Reference Books: 2. Artificial Intelligence by Elaine Rich, Kevin Knight and Nair, TMH 3. Artificial Intelligence by Patrick Henry Winston, Addison-Wesley Publishing Company	
Reference Books:	
1. Prolog Programming for A.I. by Bratko, TMH 3. Artificial Intelligence by Saroj Kausik 2. Artificial Intelligence and Intelligent Systems by Padhy, Oxforfd University Press 3. Deepak Khemani, “A First Course in Artificial Intelligence”, McGraw Hill Education(India) 4. Expert Systems, Giarranto, VIKAS	
List Practical Assignments:	

1. Implement Water Jug Problem.
2. Implement concept of Bredth First Search for given graph
3. Implement concept of Depth First Search for given graph.
4. Implemnet concept of Best First Search(Sest Solution But not always Optimal) for given Tree.
5. Consider given given graph to find the most cost-effective path to reach from start state to final state usind A* Algorithm.
6. To solve Travelling Salesman Problem Using Hill Climbing Algorithm.
7. To Implement Graph Coloring Algorithm using Constraint Satisfaction Problems.
8. Implement given Cryptarithmatic addition problem using constraint satisfaction problem
9. Implementation of MinMax search Procedure with alpha beta pruning for finding the solution of tic-tac-toe games
10. Discuss the expert system in domain of medicine using suitable case study.
Project Based Learning:
1. Build a machine learning model to predict diseases 2. Develop a system for detecting anomalies in X-rays or MRI scans using computer vision. 3. Create an AI-powered chatbot to provide basic mental health support and resources. 4. Design an AI system to analyze real-time traffic data and optimize traffic light patterns. 5. Use AI to predict waste collection schedules based on usage patterns. 6. Build a predictive model to optimize energy usage in smart homes or buildings. 7. Develop a system to detect phishing emails or malware attacks. 8. Create an AI system that explains its decision-making process to users. 9. Develop an AI model to predict the risk of chronic diseases 10. Build a system to predict the type of cancer 11. Create an AI tool to detect retinal diseases 12. Build a system to analyze X-rays and detect bone fractures automatically.

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

Design Thinking					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination** :	**60 Marks**	**Lecture**	**03**
		Internal Assessment:	**40 Marks**		
		Total	**100 Marks**	**Total**	**03**

Course Objective:

1. Recognize the importance of DT
2. Explain the phases in the DT process
3. Apply each phase in the DT process
4. Create value proposition statements as part of their presentations

Prerequisite: Students should be well versed Completion of all units from Semesters 1, 2, 3 and 4

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Implement the Phases in the DT process
2. Identify the steps required to conduct an immersion activity
3. Design personas to create problem statements in the define phase of DT
4. Apply the steps in the ideate phase of DT
5. Design a prototype to create a value proposition statement
6. Test a prototype created through a DT process

Unit I: Introduction	**06 Hours**
What is Design Thinking? Recognize the importance of Design Thinking , Why is Design Thinking important for business and for you?Identify the steps in the DT process, Empathize (search for rich stories and find some love), Define (user need and insights — their POV), Ideate (ideas, ideas, ideas), Prototype (build to learn), Test (show, don't tell).	
Unit II: Empathy Phase	**06 Hours**
What is empathy?Ask What ? How ? Why ? Recognize the steps in the empathize phase of DT, Different types to developing Empathy towards People, Introduction to Immersion Activity,Identify the steps required to conduct an immersion activity, How to empathize?,Conduct an immersion activity and fill up the DT question template.	
Unit III: Define Phase	**06 Hours**
What is a persona and how do I create one? Creating personas: Recognize the	

steps to create personas in the define phase of DT, Four Different Perspectives on Personas 1) Goal-directed Personas 2) Role-Based Personas 3) Engaging Personas 4) Fictional Personas, 10 steps to Create Engaging Personas , User Persona- BAG Framework, Value Proposition Canvas, Define the problem statements in the define phase ofDT, Recognize the steps to create problem statements in the define phase of DT	
Unit IV: Ideate Phase	**06 Hours**
How to Ideate? What is the purpose of ideation? Recognize the steps in the ideate phase of DT, Ideation games: Game 1: Six Thinking Hats, Game 2: Million-dollar idea, Ideate to find solutions, Characteristics Required for Successful Ideation, Recognize how doodling can help to express ideas,What is Storytelling in DT? Recognize the importance of storytelling in presenting ideas and prototypes.	
Unit V: Prototype Phase	**06 Hours**
What is the prototype phase in DT, Purpose of Prototyping, Prototype your idea, Create a prototype: Types of Prototyping l)Low-Fidelity Prototyping 2)Medium Fidelity Prototyping 3)High-Fidelity Prototyping,Activities in Prototyping, Classification of Prototyping, Guidelines for Prototyping, Recognize the importance of service value proposition, Create a value proposition statement.	
Unit VI: Testing Phase	**06 Hours**
Testing in Design Thinking, Test the Prototype, Role of DT in your work, discuss How DT can help me to become a better coder?, Steps of conducting a user test, How Agile and DT complement each other to deliver customer satisfaction.	

Textbooks:

1. "Designing for growth: A design thinking tool kit for managers", by Jeanne Liedtka and Tim Ogilvie., 2011, ISBN 978-0-231-15838-1
2. "Design Thinking: New Product Development Essentials from the PDMA", by Abbie Griffin, Michael G. Luchs, Scott Swan, Wiley Publications

Reference Books:

1. Hooked by Nir Eyal
2. The Art of Creative Thinking by Rod Judkins
3. Start Up nation by Dan Senor and Saul singer
4. Start with Why by Simon Sinek

List Of Assignments:

1. Identify problems using DT.

2. Use design tool for development of the idea.
3. Use DT to develop the solution
4. Develop a prototype using DT
5. Study the challenges faced during implementing DT in an Organization
Project Based Learning:
1. Use of DT to improve classroom education. 2. Use of DT to improve cab services. 3. Use of DT to improve banking system. 4. Use of DT to identify and give solution to a society related problem 5. Use of DT to improve medical services 6. Case study on Airbnb 7. Case study on Pill pack 8. Case study on Clean Team 9. Case study on IBM 10. Case study on Stanford hospital

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

Internet of Things					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination** :	**60 Marks**	**Lecture**	**03**
Tutorial	**00 Hour/Week**	**Internal Assessment:**	**40 Marks**		
		Total	**100 Marks**	**Total**	**03**

Course Objective:

1. To understand fundamentals of Internet of Things (IoT).
2. To learn the IoT protocols, cloud platforms and security issues in IoT.
3. To understand advances in IoT.
4. To learn real world application scenarios of IoT along with its societal and economic impact using case studies and real time examples.

Prerequisite: MOM, COA.

Course Outcomes: On Completion of The Course, Students Will Have the Ability To:

1. Understand the fundamentals and need of Internet of Things
2. Apply design methodology for designing and implementing IoT applications
3. Analyze IoT protocols for making IoT devices communication
4. Illustrate cloud based IoT systems.
5. Understand & Analyze Security in IoT.
6. Outline the Concepts of IIOT.

Unit I: Introduction Internet of Things	**06 Hours**
Introduction to Internet of Things (IoT): Definition, Characteristics of IoT, Vision, Trends in Adoption of IoT, IoT Devices, IoT Devices Vs Computers, Societal Benefits of IoT, Technical Building Blocks, Applications in IoT.	
Unit II: IoT: Design Methodology	**06 Hours**
IoT Design Methodology: Steps, Basics of IoT Networking, Networking Components, Internet Structure, Connectivity Technologies, IoT Communication Models and IoT Communication APIs, Sensor Networks, Four pillars of IoT: M2M, SCADA, WSN, RFID.	
Unit III: IoT Protocols	**06 Hours**
Protocol Standardization for IoT, M2M and WSN Protocols, RFID Protocol, Modbus Protocol, Zigbee Architecture. IP based Protocols: MQTT (Secure), 6LoWPAN, LoRa.	
Unit IV: Cloud Platforms for IoT	**06 Hours**

Introduction to Cloud Storage Models, Communication API, Python Web Application Framework: Django Architecture and application development with Django, Amazon Web Services for IoT, SkyNet IoT Messaging Platform, RESTful Web Service.	
Unit V: Security in IoT	**06 Hours**
Introduction, Vulnerabilities of IoT, Security Requirements, Challenges for Secure IoT, Threat Modeling. Key elements of IoT Security: Identity establishment, Access control, Data and message security, Security model for IoT, Challenges in designing IOT applications.	
Unit VI: Introduction to Industrial IoT (IIoT)	**06 Hours**
Evolution of Industrial IoT ,Key differences between IoT and Industrial IoT, Components of IIoT, IIoT Architecture, Benefits and Challenges of IIoT, Applications of IIoT in Various Industries.	

Textbooks:

1. Arshdeep Bahga, Vijay Madisetti, "Internet of Things – A hands-on approach", Universities Press, ISBN: 0: 0996025510, 13: 978-0996025515
2. Olivier Hersent, David Boswarthick, Omar Elloumi, "The Internet of Things: Key Applications and Protocols", 2nd Edition,Wiley Publication, ISBN: 978-1-119-99435-0

Reference Books:

1. Dawoud Shenouda Dawoud, Peter Dawoud, "Microcontroller and Smart Home Networks", ISBN: 9788770221566, e-ISBN: 9788770221559 Charles Crowell,
2. "IoT-Internet of Things for Beginners: An Easy-to-Understand Introduction to IoT",ISBN-13 : 979-8613100194
3. David Hanes, Gonzalo Salgueiro, Robert Barton, Jerome Henry, "IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things", Cisco Press, ISBN-13: 978-1-58714-456-1 ISBN-10: 1-58714-456-5

List Of Experiments:

1. Case Study on IOT Smart Cities, Agriculture, Health and Lifestyle etc
2. Introduction to IoT & Arduino/Raspberry Pi(Installing Arduino IDE/Python for Raspberry Pi)
3. Writing a simple program to turn an LED on/off
4. Understanding Sending Sensor Data to Cloud (ThingSpeak, Firebase, MQTT)
5. Installation of Real Time Operating System

Project Based Learning:

1. Presentation of CaseStudies – Home Automation using IOT.
2. Presentation of CaseStudies – Smart Agriculture using IOT.
3. Presentation of CaseStudies – HealthCare Services using IOT.
4. Presentation of CaseStudies – Smart City using IOT.

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

Skill Lab (Advance Java Programming)					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**-**	**End Semester Examination** :	**-**	**Lecture**	**-**
Practical:	**04 Hour/Week**	**Practical:**	**25 Marks**		**02**
		Term work:	**25 Marks**		
		Total	**50 Marks**	**Total**	**02**

Course Objective:

1. To Prepare Students to Excel and Succeed in Industry / Technical Profession Through Global, Rigorous Education.
2. Excellence Through Application Development.
3. To Provide Students with A Solid Foundation on Tools, Technology and Framework
4. To Learn Server-Side Programming Using Servlets and Java Server Pages.

Prerequisite: Understanding Of the Java Programming Language

Course Outcomes: On Completion of The Course, Students Will Have the Ability To:

1. Understand The Concepts Related to Java Technology
2. Manipulate Window Interfaces Using Swing Objects
3. Learn to access databases through Java programs, using Java Database Connectivity (JDBC)
4. Apply The Concepts of Server-Side Technologies for Dynamic Web Applications
5. Develop program for client /server communication using Java Networking classes
6. Explore And Understand Use of Java Server Programming

Unit I: GUI Programming	**06 Hours**
Basics of Components, Using Containers, Layout Managers, AWT Components, Introduction to JFC and Swing, Features of the Java Foundation Classes, Swing API Components, JComponent Class, Windows, Dialog Boxes, and Panels, Labels, Buttons, Check Boxes, Menus, Pane, JScrollPane, Desktop pane, Scrollbars, Lists and Combo Boxes, Text-Entry Components.	

Unit II: Event handling using AWT/Swing components	**06 Hours**
Events, Event sources, Event classes, Event Listeners, Delegation event model, handling mouse and keyboard events, Adapter classes, inner classes. The AWT class hierarchy, user interface.	

Unit III: Database Programming using JDBC	**06 Hours**
JDBC Introduction, JDBC Architecture, Types of JDBC Drivers, The Connectivity Model, The java.sql package, Navigating the ResultSet object's contents, Manipulating records of a ResultSet object through User Interface , The JDBC Exception classes, Database Connectivity, Data Manipulation (using Prepared Statements, Joins, Transactions, Stored Procedures), Data navigation.	
Unit IV: Servlets	**06 Hours**
Introduction, Web Application Architecture, Http Protocol & Http Methods, Web Server & Web Container, Servlet Interface, Genericservlet, Httpservlet, Servlet Life Cycle, Servletconfig, Servletcontext, Servlet Communication, Session Tracking Mechanisms JSP: Introduction, JSP Lifecycle, JSP Implicit Objects & Scopes, JSP Directives, JSP Scripting Elements, JSP Actions: Standard Actions And Customized Actions	
Unit V: Java Beans	**06 Hours**
Introduction, Javabeans Properties, Examples Struts 2: Basic MVC Architecture, Struts 2 Framework Features, Struts 2 MVC Pattern, Request Life Cycle, Examples, Configuration Files, Actions, Interceptors, Results & Result Types, Value Stack/OGNL JSON: Overview, Syntax, Datatypes, Objects, Schema, Comparison With XML, JSON With Javainterfaces.	
Unit VI: Networking With JAVA	**06 Hours**
Overview Of Networking, Working With URL, Connecting To A Server, Implementing Servers, Serving Multiple Clients, Sending E-Mail, Socket Programming, Internet Addresses, URL Connections. Accessing Network Interface Parameters, Posting Form Data, Cookies, Overview Of Understanding The Sockets Direct Protocol. Introduction To Distributed Object System, Distributed Object Technologies, RMI For Distributed Computing, RMI Architecture, RMI Registry Service, Parameter Passing In Remote Methods, Creating RMI Application, Steps Involved In Running The RMI Application,	

Textbooks:

1. Advanced Java Programming, Uttam K. Roy, Oxford University Press.
2. JDBC, Servlets, And JSP, New Edition, Santhosh Kumar K , Kogent Learning Solutions Inc, Dreamtech Press

Reference Books:

1. Cay S. Horstmann, Gary Cornell, Core Java™ 2: Volume II–Advanced Features Prentice Hall PTR,9th Edition
2. Herbert Schildt, Java2: The Complete Reference, Tata Mcgraw-Hill,5th Edition

3. Joe Wigglesworth And Paula Mcmillan, Java Programming: Advanced Topics, Thomson Course Technology (SPD) ,3rd Edition
4. Core Servlets And Java Server Pages Volume 1 Core Technologies , Marty Hall And Larry Brown Pearson

List Of Laboratory Exercises:

1. Write A Database Application That Uses Any JDBC Driver
2. Write A Simple JSP Program for User Login Form With Static & Dynamic Database
3. Write A Program to Demonstrate the Use of AWT Components.
4. Write A Program Using Swing to Display a Scrollpane And Jcombobox In An Japplet With The Items- English, Marathi, Hindi, Sanskrit.
5. Write A Program to Create a Jtree
6. Develop A Program Which Will Implement Special Keys Such as Function Keys and Arrow Keys.
7. Write A Program to Change The Background Color Of Applet When User Performs Events Using Mouse.
8. Write A Program Using Jtextfield to Perform The Addition Of Two Numbers
9. Write A Program to Implement Chat Server Using Server Socket And Socket Class.

Image Processing					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination** :	**60 Marks**	**Lecture**	**03**
		Internal Assessment:	**40 Marks**		
		Oral :	**25 Marks**		**01**
		Term work:	**25 Marks**		
		Total	**150 Marks**	**Total**	**04**

Course Objective:

To introduce fundamental concepts of image processing, covering image representation, enhancement, restoration, segmentation, compression, and feature extraction, along with practical applications in computer vision and AI.

Prerequisite:

Basic knowledge of linear algebra, probability and statistics, and signal processing.
Familiarity with programming (Python, MATLAB, or OpenCV).

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Understand traditional and AI-driven approaches to Image Processing
2. Apply spatial and frequency domain techniques for image enhancement.
3. Analyze image degradations and implement restoration and denoising techniques.
4. Perform image segmentation and morphological processing for feature extraction.
5. Implement image compression and key feature extraction methods.
6. Develop AI and computer vision applications in face recognition, OCR, and medical imaging.

Unit I: Fundamentals of Digital Image Processing and Recent Trends	**06 Hours**
Introduction to Image Processing, Digital Image Representation, Image Formation and Acquisition, Sampling and Quantization: Nyquist Theorem, Aliasing, Interpolation Techniques, Image Histogram and Statistical Properties: Probability Density Function, Cumulative Density Function, Histogram Equalization and Specification, Recent Trends: Hyperspectral & Multispectral Imaging for remote sensing & agriculture, HDR (High Dynamic Range) Imaging for enhanced visualization, Computational Photography	
Unit II: Image Enhancement Techniques	**06 Hours**

Spatial Domain Techniques: Point Processing: Log Transform, Power-Law Transform, Contrast Stretching, Histogram Equalization, Image Smoothing: Averaging, Gaussian, Median Filters, Image Sharpening: Laplacian, High-Boost Filtering, Frequency Domain Techniques: Fourier Transform and Frequency	
Spectrum, Low-pass and High-pass Filtering, Homomorphic Filtering for Dynamic Range Compression Adaptive Image Enhancement: Adaptive Histogram Equalization (AHE), Contrast Limited Adaptive Histogram Equalization (CLAHE), Deep Learning for Image Enhancement, Neural Style Transfer for artistic transformations, AI-based Image Upscaling	
Unit III: Image Restoration and Noise Removal	**06 Hours**
Types of Image Degradations: Motion Blur, Defocus Blur, Noise Models: Gaussian, Salt & Pepper, Speckle Noise, Restoration Techniques: Inverse Filtering, Wiener Filtering, Blind Deconvolution, Denoising Techniques: Spatial Filtering: Mean, Median, Adaptive Filters, Frequency Filtering: Notch Filters for Periodic Noise Removal, Non-Local Means and Total Variation Denoising, Image Interpolation & Reconstruction: Super-Resolution using Deep Learning, Image Inpainting, Deep Learning-Based Denoising Neural Radiance Fields (NeRF) for Image Reconstruction, Self-Supervised Learning for Denoising.	
Unit IV: Image Segmentation & Morphological Processing	**06 Hours**
Edge Detection, First Order Derivative Operators: Sobel, Prewitt, Roberts, Second Order Derivative Operators: Laplacian, LoG, Canny Edge Detector, Thresholding Techniques: Global & Adaptive Thresholding, Otsu's Method, Region-Based Segmentation: Region Growing, Region Splitting and Merging, Watershed Algorithm, Morphological Image Processing: Basic Operations: Dilation, Erosion, Opening, Closing, Hit-or-Miss Transform, Applications: Noise Removal, Skeletonization, Boundary Extraction, Deep Learning for Segmentation, Self-Supervised Learning for Object Detection, Superpixel-Based Segmentation.	
Unit V: Image Compression & Feature Extraction and Emerging AI Techniques	**06 Hours**

Lossless Compression: Huffman Coding, Run-Length Encoding, LZW, Lossy Compression: JPEG, Wavelet Transform, Fractal Compression, Feature Extraction Techniques, Shape Features, Texture Features, Color Features, Keypoint Detection and Feature Matching: SIFT, SURF, ORB, Object Detection Basics: Haar Cascades, HOG + SVM Classifier, Introduction to Deep Learning-based Object Detection (YOLO, Faster R-CNN), Deep Learning-Based Image Compression, Vision Transformers (ViTs) for Feature Learning, Self-Supervised Learning for Feature Extraction	
Unit VI: Applications of Image Processing in AI & Computer Vision	**06 Hours**
Face Recognition & Biometric Applications: Eigenfaces, Fisherfaces, Deep Learning-based Face Recognition (FaceNet, OpenFace), Tesseract OCR, Handwritten Character Recognition using CNN, Medical Image Processing, Autonomous Vehicles & Satellite Imaging, Neural Radiance Fields for 3D Scene Reconstruction, Deep Learning for Image Processing, Quantum Image Processing	

Textbooks:

1. Rafael C. Gonzalez, Richard E. Woods. *Digital Image Processing*, 4th Edition, Pearson, 2018
2. Richard Szeliski, Computer Vision: Algorithms and Application, 2nd Edition, Springer, 2022
3. Mohmed Elgendy, deep Learning for Vision System, Manning Publications,2020

Reference Books:

1. William K. Pratt – *Digital Image Processing: PIKS Scientific Inside*, 4th Edition, Wiley, 2007 Bernd Jähne – Digital Image Processing, 6th Edition, Springer, 2005
2. Milan Sonka, Vaclav Hlavac, Roger Boyle – Image Processing, Analysis, and Machine Vision, Cengage Learning, 2014.
3. Richard Hartley and Andrew Zisserman, Multiple view Geometry in Computer Vision, 2nd Edition Cambridge University Press, 2004
4. Christoper M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

List of Practical Assignments:

1. Implement a contrast enhancement algorithm by applying histogram equalization to a grayscale image. Then, perform spatial domain filtering using a Gaussian filter to smooth the image and reduce noise. Display the original, enhanced, and filtered images.
2. Impelemt HDR imaging using explosure fusion technique.
3. Use Super Resolution GANs to upscale low-resolution images.
4. Implemnt Neural Style Transfer to transform an image's style using deep learning
5. Image Denosing using Traditional &AI based methods.

6. AI- Based Image Segmentation
   - Training U-Net or DeepLabV3+Model for medical image segmentation
   - Implement Mask R-CNN for Object Detection and instance segmentation.
7. Implement an OCR system using Tesseract OCR on a scanned document image. Extract text from the image and evaluate the accuracy of the text extraction compared to the original document.
8. Implement a face detection system using Haar Cascade Classifiers or a Convolutional Neural Network (CNN) model. Detect faces in real-time from a live webcam feed or pre-captured image.
9. Implement vision Transformer (ViTs) for feature Extraction.
10. Implement NeRF- based AI for reconstructiong 3D scencde from 2D Images.

Project Based Learning:

1. Image Super-Resolution
2. Satelllite Image Processing and change Detection
3. Automated Medical Imaging Diagnosis
4. Object Detection and Tracking in Videos
5. Image-to-Text (Optical Character Recognition - OCR) System
6. Augmented Reality (AR) for Object Recognition
7. Traffic Sign Recognition for Autonomous Vehicles
8. Image-Based Age and Gender Prediction
9. Colorization of Black and White Images
10. Real-Time Image Filtering and Enhancement for Mobile Apps

Syllabus for Unit Tests:

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

Software Testing and Quality Assurance					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination:**	**60 Marks**	**Lecture**	**03**
		Internal Assessment:	**40 Marks**		
		Oral :	**25 Marks**		**01**
		Term work:	**25 Marks**		
		Total	**150 Marks**	**Total**	**04**

Course Objective:

1. To study the basics of testing, various types of tests in the life cycle of the software product.
2. To build design concepts for system testing and execution
3. To learn the software quality assurance, metrics, defect prevention techniques
4. To learn the techniques for quality assurance and applying for applications.

Prerequisite: Software Engineering.

Course Outcomes: On Completion of the Course, Students Will Have the Ability To:

1. Perform functional and nonfunctional tests in the life cycle of the software product.
2. Understand system testing and test execution process
3. Identify defect prevention techniques and software quality assurance metrics.
4. Apply techniques of quality assurance for typical applications.
5. Choose appropriate quality assurance models and develop quality.
6. Ability to conduct formal inspections, record and evaluate results of inspections

Unit I: SOFTWARE TESTING -CONCEPTS, ISSUES, AND TECHNIQUES	**06 Hours**
Quality revolution, verification and validation, failure, error, fault, and defect, objectives of testing, testing activities, test case selection white-box and black, test planning and design, test tools and automation, Power of test. Test team organization and management-test groups, software quality assurance group, system test team hierarchy, team building	
Unit II: SYSTEM TESTING	**06 Hours**
System testing - system integration techniques-incremental, top down bottom up sandwich and big bang, software and hardware integration, hardware design verification tests, hardware and software compatibility matrix test plan for system integration. Built- in testing. Functional testing - testing a function in context. Boundary value analysis, decision tables.Acceptance testing selection of acceptance criteria, acceptance test plan, test execution test. Softwarereliability fault and failure, factors influencing software, reliability models.	
Unit III: SYSTEM TEST CATEGORIES	**06 Hours**

System test categories taxonomy of system tests, interface tests functionality tests. Gui tests, security tests feature tests, robustness tests, boundary value tests power cycling tests interoperability tests, scalability tests, stress tests, load and stability tests, reliability tests, regression tests, regulatory tests. Test generation from fsm models- state-oriented model. Finite-state machine transition tour method, testing with state verification. Test architectures- local,distributed, coordinated, remote. System test design- test design factors requirement identification, modeling a test design process test design preparedness,metrics, test case design effectiveness. System test execution- modeling defects, metrics for monitoring test execution .defect reports, defect causal analysis, beta testing, measuring test effectiveness.	
Unit IV: SOFTWARE QUALITY	**06 Hours**
Software quality - People's Quality Expectations, Frameworks and ISO-9126, McCall's Quality Factors and Criteria – Relationship. Quality Metrics. Quality Characteristics ISO 9000:2000 Software Quality Standard. Maturity models- Test Process Improvement, Testing Maturity Model.	
Unit V: SOFTWARE QUALITY ASSURANCE	**06 Hours**
Quality Assurance - Root Cause Analysis, modeling, technologies, standards and methodologies for defect prevention. Fault Tolerance and Failure Containment - Safety Assurance and Damage Control, Hazard analysis using fault-trees and event-trees. Comparing Quality Assurance Techniques and Activities. QA Monitoring and Measurement	
Unit VI: SOFTWARE TEST AUTOMATION	**06 Hours**
What is Test Automation.Terms used in automation, Skills needed for automation. What to automate, scope of automation .Design and Architecture of automation. Generic requirements for a test tool. Process Model for Automation Selecting test tool. Automation for XP/Agile model, challenges in automation, Data-driven Testimg Automation Tools like JUnit, Jmeter	
Textbooks:	
1. Software Testing And Quality Assurance-Theory and Practice, Kshirasagar Nak Priyadarshi Tripathy, John Wiley & Sons Inc,2008 2. Software Quality Engineering: Testing, Quality Assurance, and Quantifiable Improvement, Jeff Tian, John Wiley & Sons, Inc., Hoboken, New Jersey. 2005.	
Reference Books:	
1. Software Quality Assurance - From Theory to Implementation, Daniel Galin, Pearson Education Ltd UK, 2004 2. Software Quality Assurance, Milind Limaye, TMH, New Delhi, 2011	

List Of Assignments:

1. Prepare Test Plan for the implemented system under test. The Test Plan shall be based on System Requirement Specification. The Test plan consists of the following issues. a. Purpose of the test. /Location and schedule of the test. b. Test descriptions. /Pass and Fail Criteria.
2. To identify and narrate Test cases, Test scripts/procedures and Test incident Report identifier for the system under test. Refer Use case analysis document to prepare mentioned/identified test documents. The expected specifications/ behaviors can be stated with the help of Test Oracle
3. To perform Unit testing especially indicating the traced independent data paths, Control paths and Error handling paths. Prepare control flow graphs for the unit under test. Compute the Cyclomatic complexity of the unit.
4. To perform Data Flow testing for the Program Segments by identifying the Definition-Use chain and type of data flow anomaly
5. To perform Mutation Analysis of the Program Segments along with mutant history, mutation score and type of mutation by using any Code analysis Tool / Mutation Testing Tool (JUNIT, MuJava)
6. To perform BlackBox Testing for all the units contained in the architectural segments using Equivalence Partitioning, Boundary Value Analysis and Orthogonal Array testing methods. To study exploratory testing for the module under test and Merits/demerits of this technique.
7. To perform Regression Testing / GUI Testing of the System under construction with Unit and Integration profiles by using any Functional Testing Tool.
8. To perform Automated Testing using suitable CASE tool addressing Higher-Order testing strategies.
9. To perform Web Based Testing for Web Application incorporating any Open-Source Tool. To study Performance Testing, Load Testing, Security Testing,Stress Testing, Demonstrate on link Test expectation.
10. To perform Software Audit (Checklist and Template-based) for the software developed and improved the Code Quality

Project Based Learning:

1. Every Student should select different websites/Applications and perform the each phase of STLC.
2. E-commerce Website Testing
3. Mobile App Testing
4. Test Case Development
5. Test Automation Tool Comparison

Syllabus for Unit Tests:

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

Compiler Design					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination** :	**60 Marks**	**Lecture**	**03**
		Internal Assessment:	**40 Marks**		
		Oral :	**25 Marks**		**01**
		Term work:	**25 Marks**		
		Total	**150 Marks**	**Total**	**04**

Course Objective:

1. To study Compiler Design Tools.
2. To understand the Compiler for various Programming Languages.

Prerequisite: Theory of Computation, Basics of Computer organization and Assembly Language Programming.

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Recognize compiler and various phases in compilation.
2. Summarize Parser and its various techniques.
3. Understand Syntax Directed Translation, Symbol Tables and their applications.
4. Analyse the techniques of Code Optimization
5. Learn the techniques of Code improvement.
6. Identify compilation of Object-Oriented features.

Unit I: Introduction	**06 Hours**
Phases of compilation and overview. Lexical Analysis (scanner): Regular languages, finite automata, regular expressions, relating regular expressions and finite automata, scanner generator (lex, flex).	
Unit II: Syntax Analysis (Top-down Parser)	**06 Hours**
Context-free languages and grammars, push-down automata, Elimination of Left recursion, Elimination of Left factoring, Top down parsing, FIRST and FOLLOW, Non-Recursive Predictive Parsing, LL (1) grammars.	
Unit III: Syntax Analysis (Bottom Up Parser)	**06 Hours**
Operator grammars, Bottom-up parsing, Shift Reduce Parser, LR(O), SLR (1), LR(1), CLR,LALR(1) grammars, ambiguity and LR parsing, LALR(1) parser generator (yacc, bison)	
Unit IV: Semantic Analysis	**06 Hours**

Attribute grammars, syntax directed definition, evaluation, and flow of attribute in a syntax tree.Symbol Table: Basic structure, symbol attributes and management. Run-time environment: Procedure activation, parameter passing, value return, memory allocation, scope.	
Unit V: Intermediate Code Generation & Code Improvement (optimization)	**06 Hours**
Translation of different language features, different types of intermediate forms, Control-flow, data-flow dependence etc, local optimization, global optimization, loop optimization, peep-hole optimization etc.	
Unit VI: Architecture dependent code improvement	**06 Hours**
Instruction scheduling (for pipeline), loop optimization (for cache memory) etc. Register allocation and target code generation.Advanced topics: Type systems, data abstraction, compilation of Object-Oriented features and non- imperative programming languages.	

Textbooks:

Compilers: Principles, Techniques and Tools, V. Aho, R. Sethi and J. Ullman

Reference Books:

The Design and Evolution of C++, Bjarne Stroustrup.

List Of Experiments:

1. Design a lexical analyzer for given language and the lexical analyzer should ignore redundant spaces, tabs and new lines. It should also ignore comments. Although the syntax specification states that identifiers can be arbitrarily long, you may restrict the length to some reasonable value. Simulate the same in C language.
2. Design an application to recognize strings under 'a*', 'a*b+', 'abb'.
3. Develop an application to test whether a given identifier is valid or not.
4. Develop an application to simulate lexical analyzer for validating operators.
5. Implement the lexical analyzer using JLex, flex or other lexical analyzer generating tools.

Project Based Learning:

1.Optimization Techniques in Modern Compilers

2. Intermediate Code Generation

3. Just-in-Time (JIT) Compilation

4. Error Detection and Recovery in Compilers

5. Role of Lexical Analysis in Modern Programming Languages

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 Science & Engineering)

SEMESTER – VI

COURSE SYLLABUS

Machine Learning					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination:**	**60 Marks**	**Lecture**	**03**
Practical :	**02 Hour/Week**	**Internal Assessment:**	**40 Marks**		
		Term work:	**25 Marks**		
		Practical :	**25 Marks**		**01**
		Total	**150 Marks**	**Total**	**04**

Course Objective:

To understand ML fundamentals, explore learning techniques, apply classification and ensemble methods, and analyze trends, ethics, and future directions.

Prerequisite:

Basic concepts of statistics, Knowledge of fundamentals of AI

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Understand the fundamentals of machine learning
2. Implement and evaluate supervised learning classification models
3. Implement and evaluate supervised learning regression models.
4. Utilize unsupervised learning techniques, including clustering and anomaly detection, to analyze unlabeled data.
5. Evaluate the performance of deep learning models and optimize their hypermeters to achieve desired results.
6. Analyze current trends and ethical considerations in machine learning, discussing future research directions and applications.

Unit I: Introduction	**06 Hours**
Introduction to statistics, Definition and scope of Machine Learning, Comparison of Machine learning with traditional programming, ML vs AI vs Data Science. Bias variance,Data Modelling: Overfitting and Underfitting,Data Modelling: Training and testing;Supervised Learning,Unsupervised Learning, Reinforcement Learning, Applications of Machine Learning: Real-world applications across various industries.	
Unit II: Supervised Learning-Classification	**06 Hours**

Introduction to Classification: Binary vs. Multi-class. Linear Models: Logistic Regression, Perceptron. Support Vector Machines (SVMs): Linear and Kernel SVMs. Decision Trees: ID3, C4.5, CART. Ensemble Methods: Bagging (Random Forests), Boosting (AdaBoost, Gradient Boosting). Evaluation Metrics: Accuracy, Precision, Recall, F1-score, ROC curves, AUC.	
Unit III: Supervised Learning - Regression	**06 Hours**
Introduction to Regression. Linear Regression: Simple and Multiple Linear Regression. Polynomial Regression. Regularization Techniques: L1 (Lasso), L2 (Ridge) Regularization. Support Vector Regression (SVR). Decision Tree Regression. Evaluation Metrics: Mean Squared Error (MSE), Root Mean Squared Error (RMSE), R-squared.	
Unit IV: Unsupervised Learning	**06 Hours**
Introduction to Unsupervised Learning. Clustering: K-means, Hierarchical Clustering, DBSCAN. Dimensionality Reduction: Principal Component Analysis (PCA), Linear Discriminant Analysis (LDA).Association Rule Mining: Apriori algorithm.	
Unit V: Neural Networks and Deep Learning	**06 Hours**
Introduction to Neural Networks: Perceptron, Multilayer Perceptron (MLP). Activation Functions. Backpropagation Algorithm. Deep Learning Architectures: Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs). Introduction to Deep Learning frameworks (TensorFlow, Keras, PyTorch).	
Unit VI: Trends and Future Directions in Machine Learning	**06 Hours**
Reinforcement Learning: Basics, Q-learning. Natural Language Processing (NLP) with ML. Computer Vision with ML. Ethical Considerations in Machine Learning. Model Deployment and Productionization. Case studies and real-world applications.	
Textbooks:	
1. C. M. Bishop ," Pattern Recognition and Machine Learning", Springer 1st Edition-2013. 2. K.P. Soman, R. Loganathan, V. Ajay, "Machine Learning with SVM and Other Kernel Methods" 3. Ethem Alpaydin, "Introduction to Machine Learning	
Reference Books:	

1. Tom Mitchell, ―Machine learning‖, McGraw-Hill series in Computer Science,
2. Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems, Third Edition
3. Machine Learning: A Probabilistic Perspective: MIT Press, Kevin P. Murphy ,2012

List Of Assignments:

1. Data Preprocessing and Visualization: Load a dataset (e.g., Iris or Titanic), perform data cleaning, normalization, and visualize the data using plots (e.g., scatter plots, histograms).
2. Implement simple and multiple linear regression models on a housing dataset, evaluate performance using RMSE and R^2 metrics, and visualize the regression line.
3. Build a decision tree classifier on a dataset (e.g., Breast Cancer dataset), visualize the tree, and evaluate performance using accuracy and confusion matrix.
4. Apply KNN on a dataset (e.g., MNIST digits), analyze the impact of different values of K, and evaluate model performance using precision and recall.
5. Train an SVM classifier on a dataset (e.g., Handwritten Digits Recognition).Use different kernel functions (linear, polynomial, RBF) and compare performance.
6. Implement a Naïve Bayes classifier for spam detection using the SMS Spam dataset. Evaluate using a Confusion Matrix.
7. Apply K-Means clustering on an image dataset for color quantization. Visualize cluster centroids and segmented images.
8. Use DBSCAN or Isolation Forest to detect outliers in a dataset (e.g., network intrusion detection).
9. Implement Random Forest (Bagging) and AdaBoost (Boosting) classifiers. Compare their performance on a dataset
10. Use Google AutoML or TPOT to train a simple classification model on the Iris dataset. Compare AutoML's model selection with manually chosen models.

Project Based Learning:

1. AI-Driven Personalized Learning Assistant
2. Intelligent Waste Management System
3. Personalized Health Monitoring System
4. Smart Parking System with AI-Based Space Prediction
5. AI-Powered Traffic Flow Optimization System
6. Fraud Detection System in Financial Transactions
7. Emotion Recognition System Using Facial Expressions

Syllabus for Unit Tests:

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

Enterprise Software Development					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination** :	**60 Marks**	**Lecture**	**03**
Practical :	**02 Hour/Week**	**Internal Assessment:**	**40 Marks**		
		Term work:	**25 Marks**		
		Practical :	**25 Marks**		**01**
		Total	**150 Marks**	**Total**	**04**

Course Objective:

1. To familiarize students with Web Programming basic concepts
2. To learn and understand Web scripting languages.
3. To explore the Front end& Backend web programming skills.
4. To understand and learn Mobile web development.
5. To understand and learn Web application deployment

Prerequisite: Programming languages C++, Java

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. CO1: Develop Static and Dynamic website using technologies like HTML, CSS, Bootstrap
2. CO2: Demonstrate the use of web scripting languages.
3. CO3: Develop web application with Front End & Back End Technologies.
4. CO4: Develop mobile website using JQuery Mobile.
5. CO5: Deploy web application on cloud using AWS

Unit I: INTRODUCTION TO WEB TECHNOLOGIES	**06 Hours**
HTML: Getting started with HTML, Why HTML, Tags and Elements, Attributes, Properties, Headings list, Links, Tables, Images, HTML Form, Media (Audio, Video), Semantic HTML5 Elements. CSS: Why CSS, Types of CSS, How to use CSS, Properties, Classes, Child-Class (Nested CSS), Colors, Text, Background, Border, Margin, Padding, Positioning (flex, grid, inline, block), Animation, Transition. BOOTSTRAP: Why Bootstrap, CSS over Bootstrap, How to Use Bootstrap, Bootstrap Grid System, Bootstrap Responsive, Bootstrap Classes, Bootstrap Components (i.e., Button, Table, List, etc.), Bootstrap as a Cross Platform. W3C: What is W3C , How W3C handles/Supports Web Technologies.	
Unit II: WEB SCRIPTING LANGUAGES	**06 Hours**

JavaScript: Introduction to Scripting languages, Introduction to JavaScript (JS), JS Variables and Constants, JS Variable Scopes, JS Data Types, JS Functions, JS Array, JS Object, JS Events. Advanced JavaScript: JSON - JSON Create, Key-Value Pair, JSON Access, JSON Array, JS Arrow Functions, JS Callback Functions, JS Promises,JS Async- Await Functions, JS Error Handling. AJAX: Why AJAX, Call HTTP Methods Using AJAX, Data Sending, Data Receiving, AJAX Error Handling. JQUERY :Why JQuery, How to Use, DOM Manipulation with JQuery, Dynamic Content Change with JQuery, UI Design Using JQuery.	
Unit III: FRONT END TECHNOLOGIES	**06 Hours**
Front-End Frameworks: What is web framework? Why Web Framework? Web Framework Types. MVC: What is MVC, MVC Architecture, MVC in Practical, MVC in Web Frameworks. TypeScript: Introduction to TypeScript (TS), Variables and Constants, Modules in TS. AngularVersion 10+: Angular CLI, Angular Architecture, Angular Project Structure, Angular Lifecycle, Angular Modules, Angular Components, Angular Data Binding, Directives and Pipes, Angular Services and Dependency Injections (DI), Angular Routers, Angular Forms. ReactJS: Introduction to ReactJS, React Components, Inter Components Communication, Components Styling, Routing, Redux- Architecture, Hooks- Basic hooks, useState() hook, useEffect() hook useContext() hook.	
Unit IV: BACK END TECHNOLOGIES	**06 Hours**
Node.JS: Introduction to Node.JS, Environment Setup, Node.JS Events, Node.JS Functions, Node.JS Builtin Modules, File System, NPM, Install External Modules, Handling Data I/O in Node.JS, Create HTTP Server, Create Socket Server, Microservices- PM2. ExpressJS: Introduction to ExpressJS, Configure Routes, Template Engines, ExpressJS as Middleware, Serving Static Files, REST HTTP Method APIs, Applying Basic HTTP Authentication, Implement Session Authentication. MongoDB: NoSQL and MongoDB Basics, MongoDB-Node.JS Communication, CRUD Operations using Node.JS, Mongoose ODM for Middleware, Advanced MongoDB.	
Unit V: MOBILE WEB DEVELOPMENT	**06 Hours**
Mobile-First: What is Mobile-First? What is Mobile Web? Understanding Mobile Devices and Desktop. JQuery Mobile: Introduction to the jQuery Mobile Framework, Set-up jQuery Mobile, Pages, Icons, Transitions, Layouts Widgets, Events, Forms, Themes, Formatting Lists, Header and Footer, CSS Classes, Data Attributes, Building a Simple Mobile Webpage.	

Unit VI: WEB APPLICATION DEPLOYMENT	06 Hours
Cloud: AWS Cloud, AWS Elastic Compute, AWS Elastic Load Balancer and its types, AWS VPC and Component of VPC, AWS storage, Deploy Website or Web Application on AWS, Launch an Application with AWS Elastic Beanstalk	

Textbooks:

1. Kogent Learning Solutions Inc, Web Technologies: HTML, JAVASCRIPT, PHP, JAVA, JSP, XML and AJAX, Blackbook, Dreamtech Press, Second Edition, ISBN: 9788177228496.
2. Raymond Camden, Andy Matthews, JQuery Mobile Web Development Essentials, Packt Publishing, Second Edition, 9781782167891

Reference Books:

1. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81- 265-1635-3
2. Dr.Hiren Joshi, Web Technology and Application Development, DreamTech, First,ISBN:978- 93-5004-088-1
3. Steven M. Schafer, "HTML, XHTML and CSS", Wiley India Edition, Fourth Edition,978- 81-265-1635-3
4. Ivan Bayross, "Web Enabled Commercial Application Development Using HTML, JavaScript,DHTML and PHP, BPB Publications,4th Edition, ISBN:978-8183330084.
5. Brain Fling, Mobile Design and Development, O'REILLY, First Edition, ISBN: 13:978-81- 8404-817-9
6. Adam Bretz& Colin J Ihrig, Full Stack Javascript Development with MEAN, SPD, First Edition, ISBN:978-0992461256.
7. JavaScript: The Definitive Guide - Master The World's Most-Used Programming Language, Seventh Edition
8. Java Script, D.Flanagan, O'Reilly, SPD.
9. Programming Typescript: Making YourJavaScript Applications Scale, Boris Cherny

List Of Assignments:

1. Create a responsive web page which shows the ecommerce/college/exam admin dashboard with sidebar and statistics in cards using HTML, CSS and Bootstrap
2. Write a JavaScript Program to get the user registration data and push to array/local storage with AJAX POST method and data list in new page
3. Create version control account on GitHub and using Git commandsto create repository and push your code to GitHub.
4. Create an Angular application which will do following actions: Register User, Login User, Show User Data on Profile Component
5. . Create a Node.JS Application which serves a static website
6. Create a simple Mobile Website using jQuery Mobile.

7. Develop a web application using fullstack development technologies in any of the following domains:
    a. Social Media
    b. ecommerce
    c. Restaurant
    d. Medical
    e. Finance
    f. Education
    g. Any other

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

Cloud Computing					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination:**	**60 Marks**	**Lecture**	**03**
		Internal Assessment:	**40 Marks**		
		Total	**100 Marks**	**Total**	**03**

Course Objective:

1. To study fundamental concepts of cloud computing
2. To learn various data storage methods on cloud
3. To understand the implementation of Virtualization in Cloud Computing
4. To learn the application and security on cloud computing
5. To study risk management in cloud computing
6. To understand the advanced technologies in cloud computing

Prerequisite:

Computer Networks and Security, Distributed System

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Understand the different Cloud Computing environment
2. Use appropriate data storage technique on Cloud, based on Cloud application
3. Analyze virtualization technology and install virtualization software
4. Develop and deploy applications on Cloud
5. Apply security in cloud applications.
6. Use advance techniques in Cloud Computing.

Unit I:Introduction to Cloud Computing	**06 Hours**
Importance of Cloud Computing, Characteristics, Pros and Cons of Cloud Computing, Migrating into the Cloud, Seven-step model of migration into a Cloud, Trends in Computing. Cloud Service Models: SaaS, PaaS, IaaS, Storage. Cloud Architecture: Cloud Computing Logical Architecture, Developing Holistic Cloud Computing Reference Model, Cloud System Architecture, Cloud Deployment Models.	

Unit II: Data Storage and Cloud Computing	**06 Hours**
Data Storage: Introduction to Enterprise Data Storage, Direct Attached Storage, Storage Area Network, Network Attached Storage, Data Storage Management, File System, Cloud Data Stores, Using Grids for Data Storage. Cloud Storage:	

Data Management, Provisioning Cloud storage, Data Intensive Technologies for Cloud Computing. Cloud Storage from LANs to WANs: Cloud Characteristics, Distributed Data Storage.	
Unit III: Virtualization in Cloud Computing	**06 Hours**
Introduction: Definition of Virtualization, Adopting Virtualization, Types of Virtualization, Virtualization Architecture and Software, Virtual Clustering, Virtualization Application, Pitfalls of Virtualization. Grid, Cloud and Virtualization: Virtualization in Grid, Virtualization in Cloud, Virtualization and Cloud Security. Virtualization and Cloud Computing: Anatomy of Cloud Infrastructure, Virtual infrastructures, CPU Virtualization, Network and Storage Virtualization.	
Unit IV: Cloud Platforms and Cloud Applications	**06 Hours**
Amazon Web Services (AWS): Amazon Web Services and Components, Amazon Simple DB, Elastic Cloud Computing (EC2), Amazon Storage System, Amazon Database services (Dynamo DB). Microsoft Cloud Services: Azure core concepts, SQL Azure, Windows Azure Platform Appliance. Cloud Computing Applications: Healthcare: ECG Analysis in the Cloud, Biology: Protein Structure Prediction, Geosciences: Satellite Image Processing, Business and Consumer Applications: CRM and ERP, Social Networking, Google Cloud Application: Google App Engine. Overview of OpenStack architecture.	
Unit V: Security in Cloud Computing	**06 Hours**
Risks in Cloud Computing: Risk Management, Enterprise-Wide Risk Management, Types of Risks in Cloud Computing. Data Security in Cloud: Security Issues, Challenges, advantages, Disadvantages, Cloud Digital persona and Data security, Content Level Security. Cloud Security Services: Confidentiality, Integrity and Availability, Security Authorization Challenges in the Cloud, Secure Cloud Software Requirements, Secure Cloud Software Testing.	
Unit VI: Advanced Techniques in Cloud Computing	**06 Hours**
Future Tends in cloud Computing, Mobile Cloud, Automatic Cloud Computing: Comet Cloud. Multimedia Cloud: IPTV, Energy Aware Cloud Computing, Jungle Computing, Distributed Cloud Computing Vs Edge Computing, Containers, Docker, and Kubernetes, Introduction to DevOps. IOT and Cloud Convergence: The Cloud and IoT in your Home, The IOT and cloud in your Automobile, PERSONAL: IoT in Healthcare.	
Textbooks:	

1. A. Srinivasan, J. Suresh, “Cloud Computing: A Practical Approach for Learning and Implementation”, Pearson, ISBN: 978-81-317-7651-3
2. 2. Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, “Mastering Cloud Computing”, McGraw Hill Education, ISBN-13:978-1-25-902995-0

Reference Books:

1. James Bond ,“The Enterprise Cloud”, O'Reilly Media, Inc. ISBN: 9781491907627
2. Dr. Kris Jamsa, “Cloud Computing: SaaS, PaaS, IaaS, Virtualization and more”, Wiley Publications, ISBN: 978-0-470-97389-9
3. Anthony T. Velte Toby J. Velte, Robert Elsenpeter, “Cloud Computing: A Practical Approach”, 2010, The McGraw-Hill.
4. Gautam Shrof, “ENTERPRISE CLOUD COMPUTING Technology Architecture, Applications”, Cambridge University Press, ISBN: 9780511778476
5. Tim Mather, Subra K, Shahid L.,”Cloud Security and Privacy”, Oreilly, ISBN-13 978-81-8404-815-5

Project Based Learning:

1. Cloud-Based File Storage System
2. Cloud Resource Management and Auto-Scaling
3. Serverless Web Application
4. Cloud-Based IoT Data Analytics
5. Multi-Cloud Deployment System
6. Cloud-Based Video Streaming Service
7. Cloud-Based Chatbot Using AI Services
8. Cloud-Based DevOps Pipeline
9. Disaster Recovery as a Service (DRaaS) Simulation
10. Cloud-Based Virtual Desktop Infrastructure (VDI)

Syllabus for Unit Tests:

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

Natural Language Processing					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination** :	**60 Marks**	**Lecture**	**03**
		Internal Assessment:	**40 Marks**		
		Total	**100 Marks**	**Total**	**03**

Course Objective:

To equip students with foundational and advanced techniques in Natural Language Processing (NLP), enabling them to process, analyze, and generate human language using rule-based, statistical, and deep learning approaches for real-world applications.

Prerequisite:

Students should have knowledge of:
Probabilities and statistics, Algorithms and programming experience.

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Understand the models, methods, and algorithms of statistical Natural Language Processing (NLP)
2. Understand the basic NLP techniques, including syntactic parsing, semantic interpretation, lexical and morphological analysis
3. Apply machine learning techniques used in NLP, including hidden Markov models and probabilistic context-free grammars.
4. Choose appropriate solutions for solving typical NLP sub problems (tokenizing, tagging, parsing)
5. Understand concept of matrix factorization, topic modeling, word/document embeddings, and apply NLP techniques.
6. Apply pretrained language models, explore Explainable AI, evaluate ethical considerations, and analyze real-world NLP advancements.

Unit I: Introduction to NLP and Language Modelling	**06 Hours**
Basics of Natural Language Processing (NLP), Components of NLP, Challenges in NLP, NLP Applications, Overview of NLP Techniques, Language Modeling: N-Gram Model(Uni-Gram, Bi Gram, Tri-Gram, and Four Gram Model), Statistics for Language Modelling: Entropy, perplexity, Cross Entropy	

Unit II: Text Processing and Morphology	**06 Hours**
Regular Expressions in NLP, Finite Automata, NFSA, Regular Language and FSAs, Text Normalization Techniques, Morphological Analysis: Inflectional vs. Derivational Morphology, Vector Space Representation and Normalization: Bag of Words (BoW) and Term Frequency (TF), TF-IDF, Word Embeddings	

(Word2Vec, GloVe, FastText – introduction), Normalization techniques in vector representation, Similarity Computation in Text: Cosine Similarity, Euclidean Distance, Jaccard Similarity, Named Entity Recognition (NER).	
Unit III: Part-of-Speech Tagging, Speech recognition and Hidden Markov Models	**06 Hours**
Part-of-Speech (POS) Tagging, POS Tagsets Rule-Based, Statistical, and Neural Approaches to POS Tagging, Morphology and its impact on POS Tagging, Speech Recognition: Speech Recognition Architecture, Probabilistic (Weighted) Finite-State Automata, Hidden Markov Models (HMMs), Advanced Speech Recognition Techniques: Viterbi Algorithm, Acoustic Processing of Speech, Acoustic Probabilities, Training and Synthesis in Speech Recognition: Training a Speech Recognizer, Waveform Generation for Speech Synthesis, Human Speech Recognition Mechanisms	
Unit IV: Grammars & Parsing Algorithms	**06 Hours**
Dependency Grammar & Universal Dependencies, Constituency vs. Dependency Parsing, Treebank-Based Parsing, Neural Approaches to Syntax and Parsing: Transition-Based Parsing (Shift-Reduce, Arc-Standard, Arc-Eager), Graph-Based Dependency Parsing , Top-Down Parsing (Recursive Descent), Bottom-Up Parsing (CYK Algorithm, Earley Parser), Probabilistic Parsing: Probabilistic Context-Free Grammars (PCFGs).	
Unit V: Matrix Factorization, Topic Modeling, and NLP Applications	**06 Hours**
Matrix Factorization Techniques: Singular Value Decomposition (SVD), Nonnegative Matrix Factorization (NMF), Topic Modeling: Probabilistic Latent Semantic Analysis (PLSA), Latent Dirichlet Allocation (LDA), Word and Document Embeddings: Word2Vec (CBOW & Skip-Gram), Doc2Vec, Character-Level Embeddings & Sentence Embeddings, Advanced NLP Applications: Improving User Queries, Machine Translation: Overview & Evolution, Spell-Checking & Auto-Correction, Text Summarization	
	06 Hours
Unit VI: Advanced NLP and Future Trends	
Recurrent Neural Networks (RNN), Long Short Term Memory (LSTM), Transformers, Pretrained Language Models: BERT, GPT, T5, XLNet, Explainable AI in NLP, Ethical Considerations in NLP: Bias, Fairness, Privacy, Case Studies: Recent NLP Advancements in Industry and Research.	
Textbooks:	

1. Allen, J. “Natural Language Understanding”, The Benajmins/Cummings Publishing Company ,Inc. 1994. ISBN 0-8053-0334-0.
2. Daniel Jurafsky and James H Martin. “Speech and Language Processing”, 2e, Pearson Education, 2009

Reference Books:

1. James A, “Natural language Understanding” 2e, Pearson Education, 1994
2. Bharati A., Sangal R., Chaitanya V.”Natural language processing: a Paninian perspective”, PHI, 2000.
3. Siddiqui T., Tiwary U. S. “Natural language processing and Information retrieval”, OUP, 2008 NLTK – Natural Language Tool Kit - http://www.nltk.org/
4. Journals: Computational Linguistics, Natural Language Engineering, Machine Learning, Machine Translation, Artificial Intelligence.

List Of Assignments:

1. To Study Preprocessing of Text using NLTK package.
2. Implement N-Gram Model to check most probable word in sentence. Also calculate Perplexity and Entropy of model.
3. Compute word and N-Gram frequency in given text Corpus.
4. Study and Implement Stemming and Lemmatization.
5. Implement Part-od-speech-tag using NLTK or Spacy
6. Study and Implement Regular Expression and Pattern
7. Implement DFA and NFA to check given string is accepted or not
8. Implement Shift Reduce Parser
9. Implementation of HMM Algorithm
10. Implementation of Veterbi Algorithm

Project Based Learning:

1. Automatically classify documents into categories like sports, politics, or entertainment.
2. NLP to detect toxic, abusive, or inappropriate language in online comments.
3. Create a chatbot that provides automated responses to common customer queries.
4. Design a conversational agent that offers support for mental health issues.
5. Combine NLP with computer vision to analyze text and images together
6. Automate the extraction of clauses, obligations, and rights from legal documents.
7. Build a conversational agent to assist doctors by retrieving medical literature.
8. Summarize lengthy research papers into a few key points.
9. Analyze social media hashtags to identify trends and predict future popularity.
10. Match resumes to job descriptions by analyzing textual data for relevancy.
11. Cluster research papers into topics based on abstract and title content.
12. Combine text and image processing to describe images in natural language.
13. Build an NLP tool to suggest investment strategies based on market reports.
14. Convert handwritten prescriptions into structured text data.
15. Create an NLP model that works on encrypted data without accessing sensitive user.

Syllabus for Unit Tests:

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

Skill Lab (GenAI)

Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Practical :	**02 Hour/Week**	**Term work:**	**25 Marks**		
		Oral :	**25 Marks**		**01**
		Total	**50 Marks**	**Total**	**01**

Course Objective:

1. Develop proficiency in Python and TensorFlow 2 for preprocessing and cleaning data in generative AI applications.
2. Implement and optimize GANs and VAEs for image generation, including training, fine-tuning, and advanced techniques.
3. Master text generation techniques using LSTM and Transformer models, with a focus on fine-tuning language models for various applications.
4. Explore music generation through different models like LSTM and Transformer, evaluating and fine-tuning compositions for diverse music applications.

Prerequisite: Prior knowledge of Calculus, Linear Algebra, Probability Theory, and Python programming, Introduction to Generative AI, AI models are essential.

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Understand generative AI principles and word embeddings for text representation.
2. Apply Large Language Models effectively, including pre training and transfer learning.
3. Evaluate Generative AI models using appropriate metrics.
4. Implement Generative Adversarial Networks (GANs) for image generation tasks using TensorFlow.
5. Identify different types of generative AI models suitable for music generation.
6. Analyze ethical consideration for music composition using GenAI

Unit I: Python and TensorFlow 2 in Generative AI:	**06 Hours**
Overview of Python and TensorFlow 2, Preprocessing and cleaning data for Generative AI applications. Visualizing data distributions and patterns in Generative AI datasets. Introduction to TensorFlow's computation graph and eager execution.	

Unit II: Image Generation with Generative AI:	**06 Hours**
Introduction to Image Generation, Implementing GANs for Image Generation Training and Fine-Tuning GANs , Generating Images with VAEs, Advanced Techniques in Image Generation, and Image and Video Generation Applications.	

Unit III: Text Generation with Generative AI:	**06 Hours**
Introduction to Text Generation, LSTM-based Text Generation, Transformer-based Text Generation, Fine-Tuning Language Models, and Text Generation Applications	
Unit IV: Music Generation with Generative AI:	**06 Hours**
Introduction to Music Generation, Music Representation, and LSTM-based Music Generation. Transformer-based Music Generation, Evaluation and Fine-Tuning, Music Composition Applications	
Unit V: MuseGAN:	**06 Hours**
Overview of MuseGAN architecture, Multi-track music generation using MuseGAN , Training MuseGAN on polyphonic music datasets, Generating complex music compositions with MuseGAN	
	06 Hours
Unit VI: Advanced Techniques and Applications	
Transfer learning in music generation , Fine-tuning generative models for specific music genres or styles , Ethical considerations in AI-generated music, Future directions and emerging trends in AI-driven music composition.	

Textbooks:

1. Generative AI with Python and TensorFlow 2: Create images, text, and music with VAEs, GANs, LSTMs, Transformer models" , Joseph Babcock and Raghav Bali , 2024
2. Generative AI for everyone: Understanding the essentials and applications of this breakthrough technology". Altaf Rehmani .
3. "Deep Learning" by Ian Goodfellow, Yoshua Bengio, and Aaron Courville.
4. "Neural Networks and Deep Learning: A Textbook" by Charu C. Aggarwal

Reference Books:

1. Generative Adversarial Networks Cookbook: Over 100 recipes to build generative models using Python, TensorFlow, and Keras" by Josh Kalin.
2. "Generative AI in Software Development: Beyond the Limitations of Traditional Coding" Jesse Sprinter, 2024.

List Of Assignments:

1. Implement a Generative Adversarial Network (GAN) architecture using TensorFlow
2. Train the GAN model on a dataset such as MNIST or CIFAR-10 for image generation tasks.
3. Train a GAN model on a custom dataset for image generation. Experiment with hyperparameters, loss functions, and optimization techniques to optimize GAN training

4. Explore advanced techniques such as Wasserstein GANs, Progressive GANs, or StyleGANs for image generation. Implement and compare these techniques for generating high-quality images
5. Develop applications for image and video generation using trained Generative AI models. Use the models to generate art, create deep fakes, or synthesize video content.
6. **Text Generation: I**mplement a Long Short-Term Memory (LSTM) network using TensorFlow 2 for text generation tasks. Train the LSTM model on a dataset of text sequences and generate new text samples
7. Text generation: Implement a Transformer-based language model (e.g., GPT) using TensorFlow 2 for text generation. Fine-tune the model on a text corpus and generate coherent and contextually relevant text.
8. Text generation: Fine-tune a pre-trained language model (e.g., GPT, BERT) using transfer learning techniques. Fine-tune the model on a domain-specific dataset and evaluate its performance for text generation tasks
9. **Text generation**: Develop applications for text generation tasks such as story generation, dialogue generation, or code generation using trained Generative AI models
10. Music Generation: Preprocess music data and represent it in a suitable format for music generation tasks.Explore MIDI or audio representations for training Generative AI models.
11. Music Generation: Implement a Long Short-Term Memory (LSTM) network using TensorFlow 2 for music generation. Train the LSTM model on a dataset of music sequences and generate new musical compositions
12. Generate Novel Music Compositions: Transformer-based Music Generation: Implement a Transformer-based architecture (e.g., MusicBERT, MusicGPT) using TensorFlow 2 for music generation. Fine-tune the model on a music dataset and generate novel music compositions.

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

Data Mining and Analytics					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination** :	**60 Marks**	**Lecture**	**03**
Practical:	**02 Hour/Week**	**Internal Assessment:**	**40 Marks**		
		Term work:	**25 Marks**		**01**
		Total	**125Marks**	**Total**	**04**

Course Objective:

To make statistical foundation, followed by various machine learning and data mining algorithms. This course will also give coverage to practical systems and software used in data analytics.

Prerequisite: Student should possess a strong mathematical background in Probability and Statistics. Also should have programming proficiency with algorithmic approach.

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Understand basic concepts and techniques of Data Mining
2. Evaluate different models used for OLAP and data preprocessing.
3. lassify and differentiate between situations for applying data-mining techniques such as frequent pattern mining, association, correlation, classification, prediction, cluster, and outlier analysis.
4. Apply knowledge for understanding data and select suitable linear, nonlinear data model and time series analysis model.
5. Develop skills of using data mining software for solving practical problems.
6. Understand and apply several statistical analysis techniques: regression, ANOVA, data reduction.

Unit I: Introduction to Data Mining:	**06 Hours**
Definition, significance, challenges, and benefits. Related Technologies: Machine Learning, Database Management Systems (DBMS), Online Analytical Processing (OLAP), and Statistics,Stages of the Data Mining Process, Data Mining Techniques,Knowledge Representation Methods, Applications of Data Mining	

Unit II: Data preprocessing:	**06 Hours**
Data preprocessing: Data cleaning, Data transformation, Data reduction, Discretization and generating concept hierarchies Data mining knowledge representation: Task relevant data, Background knowledge, Representing input data and output knowledge, Visualization techniques Attribute-oriented analysis: Attribute generalization, Attribute relevance, Class comparison, Statistical measures	

Unit III: Data mining algorithms	**06 Hours**

• **Association Rule Mining:**
  o Motivation, terminology, applications in market basket analysis
  o Frequent pattern mining algorithms: Apriori, FP-Growth Correlation analysis
• **Classification Algorithms:**
  o Decision Trees
  o Rule-Based Classification
  o Naïve Bayes Classifier
  o k-Nearest Neighbors (k-NN)
• **Prediction Algorithms:**
  o Bayesian Classification (Naïve Bayes, Bayesian Networks)	

Unit IV: Descriptive analytics and Prescriptive Analytics	**06 Hours**
Descriptive analytics: Data Modeling, Trend Analysis, Simple Linear Regression Analysis Forecasting models: Heuristic methods, predictive modeling and pattern discovery, Logistic Regression: Logit transform, ML estimation, Tests of hypotheses,Interpreting Regression Models, Implementing Predictive Models Prescriptive Analytics: Mathematical optimization, Networks modeling-Multi-objective optimization- Stochastic modeling, Decision and Risk analysis, Decision trees	
Unit V: Advanced Regression Model	**06 Hours**
Generalized Linear model: link functions such as Poisson, binomial, inverse binomial, inverse Gaussian, Gamma. Non Linear Regression (NLS): Linearization transfo1ms, their uses & limitations, examination of non- linearity, initial estimates, iterative procedures for NLS, grid search, Newton-Raphson, steepest descent, Marquardt's methods. Introduction to semiparametric regression models, additive regression models. Introduction to nonparametric regression methods	
	06 Hours
Unit VI: Data Mining Tools and Technologies	

Data Mining Tools- Weka,.Orange,R,scikit-learn, Apache Hadoop, RapidMiner

Case Studies – 1. Predicting disease outbreaks using patient records and social media data

2. Early detection of cancer using machine learning and data mining
3. Stock market trend prediction using historical data
4. Pricing optimization using competitive market data
5. Biometric authentication using data mining techniques
6. Accident risk prediction using historical driving
7. Smart parking systems using data analysis

Textbooks:

1. Textbooks: Jiawei Han and Micheline Kamber, "Data Mining: Concepts and Techniques", Morgan Kaufmann Publishers, 3rd ed, 2010.
2. Lior Rokach and Oded Maimon, "Data Mining and Knowledge Discovery Handbook", Springer, 2nd edition, 2010
3. Box, G.E.P and Jenkins G.M. (1970) Time Series Analysis, Forecasting and Control, Holden-Day.

Reference Books:

1. Draper, N. R. and Smith, H. (1998). Applied Regression Analysis (John Wiley) Third Edition. Hosmer, D. W. and Lemeshow, S. (1989). Applied Logistic Regression (Wiley).

List of Experiments:

1. Installation and experiments with WEKA 3
2. Apriori Algorithm for Frequent Itemset Mining
3. FP-Growth Algorithm for Association Rule Mining
4. Decision Tree Algorithm
5. Linear Regression
6. Multiple Linear Regression
7. Logistic Regression

Project Based Learning:

1. Stock Market Prediction using Machine Learning
2. Customer Churn Prediction for Telecom Companies
3. Email Spam Detection using Naïve Bayes
4. Credit Card Fraud Detection using Random Forest
5. Customer Segmentation for E-Commerce Platforms
6. Crime Hotspot Detection using K-Means Clustering
7. Market Basket Analysis for Retail Stores (Using Apriori Algorithm)
8. Product Recommendation System for Online Shopping
9. Network Intrusion Detection System (IDS) using Data Mining
10. Cyberbullying Detection on Social Media

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

Computer Security and Digital Forensics					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination** :	**60 Marks**	**Lecture**	**03**
Practical :	**02 Hour/Week**	**Internal Assessment:**	**40 Marks**		
		Term work:	**25 Marks**		**01**
		Total	**125 Marks**	**Total**	**04**

Course Objective:

1. To enhance awareness cyber forensics.
2. To understand issues in cyber crime and different attacks
3. To understand underlying principles and many of the techniques associated with the digital forensic practices
4. To know the process and methods of evidence collection
5. To analyze and validate forensic data collected.
6. To apply digital forensic knowledge to use computer forensic tools and investigation report writing.

Prerequisite: Computer Network

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Analyze threats in order to protect or defend it in cyberspace from cyber-attacks.
2. Build appropriate security solutions against cyber-attacks.
3. Underline the need of digital forensic and role of digital evidence
4. Explain rules and types of evidence collection
5. Analyze, validate and process crime scenes
6. Identify the methods to generate legal evidence and supporting investigation reports.

Unit I: Introduction to Cyber Security	**06 Hours**
Introduction and Overview of Cyber Crime, Nature and Scope of Cyber Crime, Types of Cyber Crime: crime against an individual, Crime against property, Cyber extortion, Drug trafficking, cyber terrorism. Need for Information security, Threats to Information Systems, Information Assurance, Cyber Security, and Security Risk Analysis	

Unit II: Cyber Crime Issues and Cyber attacks	**06 Hours**
Unauthorized Access to Computers, Computer Intrusions, Viruses, and Malicious Code, Internet Hacking and Cracking, Virus and worms, Software Piracy, Intellectual Property, Mail Bombs, Exploitation, Stalking and Obscenity in Internet, Cybercrime prevention methods, Application security (Database, E-mail, and Internet), Data Security Considerations-Backups, Archival Storage and Disposal of Data, Security Technology-Firewall and VPNs, Hardware protection mechanisms, OS Security	

Unit III: Introduction to Digital Forensics	**06 Hours**
What is Computer Forensics?, Use of Computer Forensics in Law Enforcement, Computer Forensics Assistance to Human Resources/Employment Proceedings, Computer Forensics Services, Benefits ofProfessional Forensics Methodology, Steps taken by Computer Forensics Specialists Types of Computer Forensics Technology: Types of Military Computer Forensic Technology, Types of Law Enforcement — Computer Forensic Technology, Types of Business Computer Forensic Technology Computer Forensics Evidence and Capture: Data Recovery Defined, Data Back-up and Recovery, The Role of Back-up in Data Recovery, The Data-Recovery Solution	
Unit IV: Evidence Collection and Data Seizure	**06 Hours**
Why Collect Evidence? Collection Options ,Obstacles, Types of Evidence — The Rules of Evidence, Volatile Evidence, General Procedure, Collection and Archiving, Methods of Collection, Artifacts, Collection Steps, Controlling Contamination: The Chain of Custody Duplication and Preservation of Digital Evidence: Preserving the Digital Crime Scene — Computer Evidence Processing Steps, Legal Aspects of Collecting and Preserving Computer Forensic Evidence Computer Image Verification and Authentication: Special Needs of Evidential Authentication, Practical Consideration, Practical Implementation.	
Unit V: Computer Forensics analysis and validation	**06 Hours**
Determining what data to collect and analyze, validating forensic data, addressing data-hiding techniques, and performing remote acquisitions Network Forensics: Network forensics overview, performing live acquisitions, developing standard procedures for network forensics, using network tools, examining the honeynet project. Processing Crime and Incident Scenes: Identifying digital evidence, collecting evidence in private-sector incident scenes, processing law enforcement crime scenes, preparing for a search, securing a computer incident or crime scene, seizing digital evidence at the scene, storing digital evidence, obtaining a digital hash,reviewing a case	
Unit VI: Implementation And Maintenance	**06 Hours**
Evaluating computer forensic tool needs, computer forensics software tools, computer forensics hardware tools, validating and testing forensics software E-mail Investigations: Exploring the role of e-mail in investigation, exploring the roles of the client and server in e-mail, investigating e-mail crimes and violations, understanding e-mail servers, using specialized e-mail forensic tools.	
Textbooks:	
1. John R. Vacca, “Computer Forensics”,Computer Crime Investigation Firewall Media, New Delhi. 2. Nelson, Phillips Enfinger, Steuart, “Computer Forensics and Investigations”, CENGAGE	
Reference Books:	

1. Keith J. Jones, Richard Bejtiich, Curtis W. Rose, “Real Digital Forensics”, Addison-Wesley Pearson Education
2. Tony Sammes and Brian Jenkinson, “Forensic Compiling”, A Tractitioneris Guide, Springer International edition.
3. Christopher L.T. Brown, “Computer Evidence Collection & Presentation”, Firewall Media.
4. Jesus Mena, “Homeland Security, Techniques & Technologies”, Firewall Media.

List Of Assignments:

1. Write a program for Tracking Emails & Investigating Email Crimes. i.e. Write a program to analyze e–mail header
2. Implement a program to generate & verify CAPTCHA image
3. A person on a nearby road is trying to enter into a WiFi network by trying to crack the
4. Password to use the IP Printer resource; write a program detect such attempt and prohibit the access. Develop the necessary scenario by Using an IEEE 802.11, configure a Wi-Fi adapter and Access Point
5. Write a computer forensic application program for Recovering permanent Deleted Files and Deleted Partitions
6. Write a program for Log Capturing and Event Correlation
7. Configure and demonstrate use of vulnerability assessment tool like Wireshark or SNORT
8. Study of Honeypot

Project Based Learning:

1. Password Strength Checker
2. Detecting Malicious URLs
3. Steganography: Hiding Text in Images
4. Metadata Extractor for Digital Forensics
5. Keylogger Detection Tool

Syllabus for Unit Tests:

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

Business Intelligence					
Teaching Scheme		**Examination Scheme**		**Credit Scheme**	
	Hours/Week		**Marks**		**Credits**
Lecture:	**03 Hours/Week**	**End Semester Examination** :	**60 Marks**	**Lecture**	**03**
Practical :	**02 Hour/Week**	**Internal Assessment:**	**40 Marks**		
		Term work:	**25 Marks**		**01**
		Total	**125Marks**	**Total**	**04**

Course Objective:

1. Understand the Fundamentals of BI.
2. Analyze the BI Implementation & Best Practices.

Prerequisite: Basic information about the business, its model and structure of business administrative policies.

Course Outcomes: On Completion of The Course, Students Will Have The Ability To:

1. To Explain the fundamental concepts, architecture, and components of Business Intelligence (BI) systems.
2. To Describe the Elements of Business Intelligence Solutions.
3. To Understanding the Building the BI Project.
4. To Analyse the BI building process.
5. To Understand the BI reports and visualisations.
6. To deploy and administer BI in the real-life scenario.

Unit I: Introduction to Business Intelligence	**06 Hours**
Understanding the scope of today's BI solutions and how they fit into existing infrastructure, Assessing new options such as SaaS and cloud-based technology, Describe BI, its components & architecture, previewing the future of BI Crafting a better experience for all business users, End User Assumptions, Setting up Data for BI, The Functional Area of BI Tools, Techniques of ETL and Data Scrubbing.	
Unit II: Elements of Business Intelligence Solutions	**06 Hours**
Reports & ad hoc queries, Analyse OLAP data, Dashboards & Scorecards development, Metadata Models, Automated tasks & events, Mobile & disconnected BI, Collaboration capabilities, Real time monitoring capabilities, Software development kit, Consume BI through portals, web applications, Desktop applications.	
Unit III: Data Management in BI	**06 Hours**
Data Integration Tools(Talend, Informatica, or Microsoft SSIS), Data Storage(Snowflake, Amazon Redshift, Google BigQuery), Data Lifecycle Management.	
Unit IV: Building the BI Project	**06 Hours**

Planning the BI project, Project Resources; Project Tasks, Risk Management and Mitigation, Cost-justifying BI solutions and measuring success, Integrating BI	
with AI & ML, Concept of Data storytelling.	
Unit V: BI Reporting	**06 Hours**
Building reports with relational vs Multidimensional data models, Types of Reports – List, crosstabs, Statistics, Chart, map, financial etc,Data Grouping & Sorting, Filtering Reports, Adding Calculations to Reports, Conditional formatting, Adding Summary Lines to Reports. Drill up, drill- down, drill-through capabilities, Run or schedule report, different output forms – PDF, excel, csv, xml etc.	
Unit VI: Data Governance & Security	**06 Hours**
Centralized Versus Decentralized Architecture, BI Architecture Alternatives, phased & incremental BI roadmap, System Sizing, Measurements and Dependencies, System Sizing, Measurements, and Dependencies. Setting Early Expectations and Measuring the Results. End-User Provisos, Expanding BI Authentication & Authorization, Access Permissions, Groups and Roles, Single-sign on Server Administration, Manage Status & Monitoring, Audit, Mail server & Portal integration, Back Up and Restore.	

Textbooks:

1. Business Intelligence (IBM ICE Publication)

Reference Books:

1. "Business Intelligence Guidebook: From Data Integration to Analytics" – Rick Sherman
2. "Business Intelligence: A Managerial Perspective on Analytics" – Ramesh Sharda, Dursun Delen, Efraim Turban
3. "Delivering Business Intelligence with Microsoft SQL Server" – Brian Larson
4. "The Data Warehouse Toolkit: The Definitive Guide to Dimensional Modeling" – Ralph Kimball & Margy Ross

List Of Experiments:

1. Introduction to BI tools, their pros and cons and limitations.
2. Demonstration of BI techniques ETL on Application Financial Analysis.
3. Demonstration of BI techniques ETL on Application Student result pattern and ranking analysis
4. Demonstration of BI modelling preparation and its analysis
5. Demonstration of measuring techniques and their analysis
6. Demonstration of BI various BI reports
7. Demonstration of Sorting and modelling techniques
8. Demonstration of Exploring Excel Modelling capabilities to solve business problems
9. Demonstration of decision tree
10. Demonstration of BI authentication, mail server and portal integration

Project Based Learning:

1. Problem definition, identifying which data sorting task is needed.

2. Identify and use a standard methods of data sorting and measuring available for the problem.	
3. Prepare a case study on the significance of the BI in light of any business organization.	
4. Prepare a case study on the process of building a BI	
5. Prepare a case study on the requirement of BI	
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 Science & Engineering)
Minor Degree Course-Blockchain
Semester- V

Smart Contracts & Cryptocurrency

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Lecture:	03 Hours/Week	University Examination:	60 Marks	Lecture	03
Practical:	02 Hours/Week	Internal Assessment:	40 Marks	Practical	01
		Term Work:	25 Marks		
		Practical:	25 Marks		
		Total	125 Marks	Total	04

Course Objective:

To Understand The Mechanism Of Blockchain Smart Contracts And Cryptocurrency.

To Understand The Functionality Of Current Implementation Of Blockchain Technology.

To Understand The Required Cryptographic Background.

To Explore The Applications Of Blockchain To Cryptocurrencies And Understanding Limitations Of Current Blockchain.

An Exposure Towards Recent Research

Prerequisite:

Computer Networks; Operating Systems; Cryptography And Network Security.

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Recall Key Concepts In Cryptocurrency And Smart Contracts.
2. Understand The Principles Underlying Blockchain Technology And The Function Of Smart Contracts.
3. Apply Knowledge Of Smart Contracts To Solve Real-World Scenarios.
4. Analyze The Security Features And Potential Vulnerabilities Of Existing Smart Contracts.
5. Evaluate The Impact Of Decentralized Finance (Defi) On Traditional Financial Systems.
6. Create A Decentralized Application (Dapp) Using Smart Contracts.

Unit I: Introduction To Cryptocurrency And Blockchain Basics **06 Hours**

Overview Of Cryptocurrencies, Evolution Of Blockchain Technology, Understanding Bitcoin, Basics Of Blockchain Consensus Mechanisms

Unit II: Altcoins, Tokenization, And Cryptocurrency Ecosystem **06 Hours**

Introduction To Altcoins (E.G., Ethereum, Litecoin), Tokenization And Its Applications, Initial Coin Offerings (Icos) And Security Token Offerings (Stos), Cryptocurrency Wallets And Exchanges

Unit-III: Smart Contracts Development With Ethereum **06 Hours**

Introduction To Smart Contracts, Ethereum And Solidity Programming Language, Writing And Deploying Smart Contracts, Ethereum Ecosystem And Decentralized, Applications (Dapps)

Unit-IV: Smart Contract Security And Auditing **06 Hours**

Common Vulnerabilities In Smart Contracts, Best Practices For Secure Smart Contract Development, Auditing And Testing Smart Contracts

Unit-V: Decentralized Finance (Defi) And Non-Fungible Tokens (Nfts) **06 Hours**

Overview Of Defi, Decentralized Exchanges (DEX), Yield Farming, Lending, And Borrowing In Defi, Understanding Non-Fungible Tokens (Nfts)

Unit VI: Cryptocurrency Regulations, Future Trends **06 Hours**

Legal And Regulatory Considerations In Cryptocurrency, Future Trends In Cryptocurrency And Blockchaincase Study And Project: Application Of Smart

Contracts And Cryptocurrency Concept

Textbooks:

1. Mastering Ethereum: Building Smart Contracts And Dapps" By Andreas M. Antonopoulos And Gavin Wood
2. Smart Contracts: The Essential Guide To Using Blockchain Smart Contracts For Cryptocurrency Exchange" By Jeff Reed
3. Solidity Programming Essentials: A Beginner's Guide To Build Smart Contracts For Ethereum And Blockchain" By Ritesh Modi

Reference Books:

Blockchain: A Practical Guide To Developing Business, Law, And Technology Solutions, Joseph Bambara, Paul R. Allen, Mc Graw Hill.

Building Ethereum Dapps: Decentralized Applications On The Ethereum Blockchain" By Roberto Infante

Token Economy: How The Web3 Reinvents The Internet" By Shermin Voshmgir

List Of Practicals:

1. Installation Of Metamask And Study Spending Ether Per Transaction.
2. Create Your Own Wallet Using Metamask For Crypto Transactions
3. Write A Smart Contract On A Test Network, For Bank Account Of A Customer For Following Operations:
   - Deposit Money
   - Withdraw Money
   - Show Balance
4. Write A Program In Solidity To Create Student Data. Use The Following Constructs:
   - Structures
   - Arrays
   - Fallback
   - Deploy This As Smart Contract On Ethereum And Observe The Transaction Fee And Gas Values
5. Write A Survey Report On Types Of Blockchains And Its Real Time Use Cases
6. Write A Program To Create A Business Network Using Hyperledger
7. **Mini Project -** Develop A Blockchain Based Application Dapp (De-Centralized App) For E-Voting System.

Project Based Learning

1. Trusted Crowdfunding Platform Using A Smart Contract.
2. Exact Shipment Location Data.
3. Peer To Peer Ridesharing.
4. A Fake Product Identification System.
5. Transparent And Genuine Charity Application.
6. Blockchain-Based Voting System.
7. Anti-Money Laundering System Using Blockchain

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 Science & Engineering)
Minor Degree Course-
Blockchain
Semester- VI

Blockchain Solutions

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
Lecture:	3 Hrs	University Examination:	60	Lecture	3
Practical:	2 Hrs	Internal Assessment:	40	Practical	1
		Term Work:	25		
		Oral:	25		
		Total	125	Total	4

Course Objective:

1. Understand The Fundamental Concepts Of Blockchain Technology
2. Evaluate The Suitability Of Various Blockchain Platforms For Enterprise Applications
3. Learn How To Design And Architect Blockchain Solutions For Enterprise Use Cases
4. Understand The Funding Sources, Costs, And Cost Models Associated With Enterprise Blockchain Projects
5. Investigate Blockchain As A Service (Baas) Offerings And Providers
6. Address Legal Concerns, Compliance Requirements, And Security Considerations Associated With Enterprise Blockchain Adoption

Prerequisite:

Decentralize & Blockchain Technologies

Course Outcomes: On Completion Of The Course, Students Will Have The Ability To:

1. Define Blockchain Technology And Articulate Its Significance In Decentralized Systems
2. Compare And Contrast Different Enterprise Blockchain Platforms, Including Hyperledger Project, Hyperledger Fabric, R3 Corda, Quorum, And Ethereum
3. Identify Key Technology Focus Areas In Blockchain Development And Understand Their Relevance In Enterprise Applications
4. Assess The Economic Implications Of Blockchain Technology On Various Industries And Business Models
5. Deploy And Manage Blockchain Solutions Using Cloud Platforms Such As Amazon Web Services (AWS) And IBM Cloud
6. Explore Industry-Specific Use Cases For Blockchain Technology, Including Financial Services, Logistics, Government, And Healthcare

Unit I : Introduction **Hours**

Three Definitions Of Blockchain, Blockchain Vs Traditional Database, Permissionless Blcokchain, Blockchain Principle, Blockchain Transaction Basics **6**

Unit II: Enterprise Blockchains **Hours**

Comparing Enterprise Blockchain, Hyperledger Project, Hyperledger Fabric, R3 Corda, Introducing Quorum, Ethereum, **6**

Unit III: Architecting Your Enterprise Blockchains **Hours**

Blockchain Technology Focus Areas, Architecting Blockchain Solutions, Blockchain Decision Tree, Bloackchain Structure And Components, Enterprise Blockchain Architecture, Enterprise Blockchain Adoption Challenge, Enterprise Blockchain Design Principles, Hyperledger Fabric, R3 Corda, Ethereum, Quorum **6**

Unit IV: Enterprise Blockchains Consensus And Economics **Hours**

Blockchain Consensus Methods, Blockchain Consensus Evaluation, Introduction To Enterprise Blockchains Economics, Blockchain Funding And Costs, Enterprise Blockchain Cost Models, **6**

Unit V: Deploying Your Blockchain On Baas **Hours**

Blockchain As A Service, Baas Providers, Amazon Web Service Option, Deploying Hyperledger On AWS, IBM Cloud Blockchain Platforms, **6**

Unit VI: Enterprise Blockchain Usecase And Blockchain Governance, Risk And Compliance (GRC) **Hours**

Merits Of Blockchain Acceptance, Financial Sector Use Case, Logistics Use Case, Government Use Cases, Healthcare Use Cases , Governance, Risk And Compliance (GRC), Personally Identifying Information (PII), Common Compliance Requirement**,** Payment Card Industry Data Security Standard, Smart Contract Legal Concerns, Smart Contract Legal Concerns, Financial Sector Compliance, Auditing And Logging 6

Textbooks:

1. Joseph Holbrook, "Architecting Enterprise Blockchains" Wily Publication.

Reference Books:

1. Sathvik Vishwnath "Architecting Blockchain Solutions" Bpb Publication.

List Of Assignments:

1. Exploring Key Concepts In Blockchain Technology.
2. Comparative Analysis Of Enterprise Blockchain Platforms.
3. Comprehensive Study On Enterprise Blockchain Technologies.
4. Exploring Blockchain Consensus Methods And Enterprise Blockchain Economics.
5. Exploring Blockchain As A Service (Baas) And Cloud Deployment Options.
6. Exploring Blockchain Applications And Regulatory Considerations.

List Of Laboratory Exercises :

1. Case Study On Permissionless Blockchain And Blockchain Transactions.
2. Provide Recommendations For Organizations Seeking To Implement Blockchain Solutions Based On Their Specific Requirements And Use Cases.
3. Provide Comprehensive Overviews Of Hyperledger Fabric, R3 Corda, Ethereum, And Quorum, Including Their Features, Architecture, Consensus Mechanisms, Use Cases, And Adoption Trends.
4. Research And Identify Different Consensus Methods Used In Blockchain Networks, Such As Proof Of Work (Pow), Proof Of Stake (Pos), Practical Byzantine Fault Tolerance (PBFT), And Delegated Proof Of Stake (Dpos).
5. Provide A Step-By-Step Guide On Deploying A Hyperledger Fabric Network On AWS.
6. Research And Identify The Merits And Advantages Of Blockchain Acceptance In Various Industries, Such As Transparency, Efficiency, Security, And Trust.

Project Based Learning:

1. Create A Simple Smart Contract For A Specific Use Case, Such As Token Creation Or Decentralized Finance (Defi) And Deploy And Test The Smart Contract On The Ethereum Blockchain Using A Test Network.

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 Science & Engineering)
Minor Degree Course-
Blockchain
Semester- VII

PROJECT

Teaching Scheme		Examination Scheme		Credit Scheme	
	Hours/Week		Marks		Credits
		University Examination:	NA		
Practical:	8 Hrs	Internal Assessment:	NA		
		Term work	50	Term work	2
		Oral	50	Practical	2
		Total	100	Total	4

Course Objective:

To develop problem solving abilities using mathematics.

- To apply algorithmic strategies while solving problems.
- To develop time and space efficient algorithms.
- To develop software engineering documents and testing plans.
- To use algorithmic solutions using distributed, Embedded, concurrent and parallel environments.

Prerequisite:

Basics of Software engineering, Software testing and knowledge of core computer engineering subjects.

Course Outcomes:

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

1. Review and understand how previous experiences had an impact on affective states and intellectual performance
2. Identify and define the problem.
3. Decide critically to solve the problem.
4. Demonstrate the ability to synthesize complex information from a variety of sources in decision-making.
5. Predict and develop a group process and desired outcomes.
6. Plan and perform collaboratively towards a common purpose.

1. The project will be undertaken preferably by a group of at least3- 4 students who will jointly work and implement the project over the academic year. The work will involve the design of a system or subsystem in the area of Computer Engineering.

2. If the project is chosen a hardware project it will involve the designing a system or subsystem or upgrading an existing system. The design must be implemented into a working model with necessary software interfacing and a user manual.

3. If the project is chosen in the pure Software Application it must involve the detail Software Design Specifications, Data Structure Layout, File Design, Testing with complete documentation and user interface, with life cycle testing and as an executable package.

4. The group will select a project with the approval of the guide (Staff members assigned) and submit the name of the project with a synopsis of 2 or 3 pages in the month of August in the academic year. A preliminary study report by the group must be submitted and certified at the end of seventh Semester.

5. It is expected that at least one research paper is published by each group with guide.The project report stage-I will contain the details.

Problem definition and requirement specification, acceptance test procedure (ATP).

a) System definition, requirement analysis.

b) System design with UML.

c) Documentation and references.

Documentation will use UML approach with Presentation, Category, Use Case, Class Diagrams, etc