Program Booklet

Department of Computer Science and Engineering

Birla Institute of Technology, Mesra,

Ranchi, Jharkhand

M.Tech in Computer Science & Engineering

Department of Computer Science & Engineering

Birla Institute of Technology, Mesra, Ranchi - 835215 (India)

M.Tech in Computer Science & Engineering

Institute Vision

To become a Globally Recognized Academic Institution in consonance with the social, economic and ecological environment, striving continuously for excellence in education, research and technological service to the National needs.

Institute Mission

- To educate students at Undergraduate, Postgraduate, Doctoral, and Post-Doctoral levels to perform challenging engineering and managerial jobs in industry.
- To provide excellent research and development facilities to take up Ph.D. programmes and research projects.
- To develop effective teaching and learning skills and state of art research potential of the faculty.
- To build national capabilities in technology, education and research in emerging areas.
- To provide excellent technological services to satisfy the requirements of the industry and overall academic needs of society.

Department Vision

The department strives to be recognized globally for outstanding education and research, leading to excellent professionals and innovators in the field of Computer Science and Engineering, who can positively contribute to the society.

Department Mission

- To impart quality education and equip the students with strong foundation that could make them capable of handling challenges of the new century.
- To maintain state of the art research facilities and facilitate interaction with world's leading universities, industries and research organization for constant improvement in the quality of education and research.

Program Educational Objectives (PEOs) – M. Tech (Computer Science & Engineering)

The program aims that:

PEO1: Students are trained in such a way that makes them capable of exploiting and enhancing theoretical and practical knowledge in various domains of Computer Science.

PEO2: Students are imparted with strong base of knowledge that makes them suitable for both industry teaching and research.

PEO3: Students are trained to develop practical and efficient solutions to the challenges in the growing field of software industry to gain leadership positions in their organization and/or teams.

PEO4: Students are inculcated with the sensitivity towards ethics, public policies and their responsibilities towards the society to gain trust and respect of others as ethical team members.

Program Outcomes (POs)- M.Tech (Computer Science & Engineering)

PO1: An ability to independently carry out research /investigation and development work to solve practical problems.

PO2: An ability to write and present a substantial technical report/document.

PO3: Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program.

BIRLA INSTITUTE OF TECHNOLOGY- MESRA, RANCHI

NEW COURSE STRUCTURE – WEF academic session 2025-26

Based on NEP

Recommended scheme of study for M.Tech. (Computer Science & Engineering)

SEMESTER/ Session of Study (Recommended)	Course Level	Category of Course	Course Code	Courses	Mode of delivery & credits *L-Lecture; T-Tutorial; P- Practicals*			Total Credits *C-Credits*
					L *(Periods/ week)*	T *(Periods /week)*	P *(Periods /week)*	C
	THEORY							
FIRST /Monsoon	Fifth	Programme Core (PC)	CS26501	Advanced Data Structures & Algorithms	3	0	0	3
			AI26509	Machine Learning	3	0	0	3
			CS26503	Image Processing	3	0	0	3
			CS26505	Advanced Networking	3	0	0	3
			CS26507	Advanced Computer Architecture	3	0	0	3
								15
		LABORATORIES						
	Fifth	Programme Core (PC) Lab	CS26502	Advanced Data Structures & Algorithms Lab	0	0	3	1.5
			AI26510	Machine Learning Lab	0	0	3	1.5
			CS26510	Skill Development course- I	0	0	4	2
								5
			TOTAL					**15+5=20**
SECOND	Fifth	Programme Core (PC)	CS26511	Database System Design	3	0	0	3

/ Spring		Programme Elective (PE)		PE I (Pool 1)	3	0	0	3
				PE II (Pool 2)	3	0	0	3
				PE III (Pool 2)	3	0	0	3
				PE IV (Pool 2)	3	0	0	3
			TOTAL					**15**
		LABORATORIES						
	Fifth	Programme Core (PC) Lab	CS26512	Database System Design Lab	0	0	3	1.5
			CS26514	Skill Development course – II	0	0	4	2
		Programme Elective (PE) Lab		PE I Lab (Pool 1)	0	0	3	1.5
								5
			TOTAL					**15+5=20**
TOTAL FOR FIFTH LEVEL								**20+20=40**
THIRD /Monsoon	Sixth	Programme Core (PC)	CS26515	Thesis Part I				14
		Open Elective (OE)	*	OE 1/MOOC-I	3	0	0	3
		Open Elective (OE)	*	OE 2/MOOC-II	3	0	0	3
		TOTAL						**14+6=20**
FOURTH / Spring	Sixth	Programme Core (PC)	CS26517	Thesis Part II				20
		TOTAL						**20**
TOTAL FOR SIXTH LEVEL								**20+20=40**
GRAND TOTAL FOR M.TECH. PROGRAMME								**80**

Open Elective List for M. Tech Program

Course Code	**Courses**	**Mode of delivery & credits *L-Lecture; T-Tutorial; P- Practicals***			**Total Credits *C-Credits***
CS26519	Basics of Python Programming	0	2	2	3

List of Electives

Systems Track

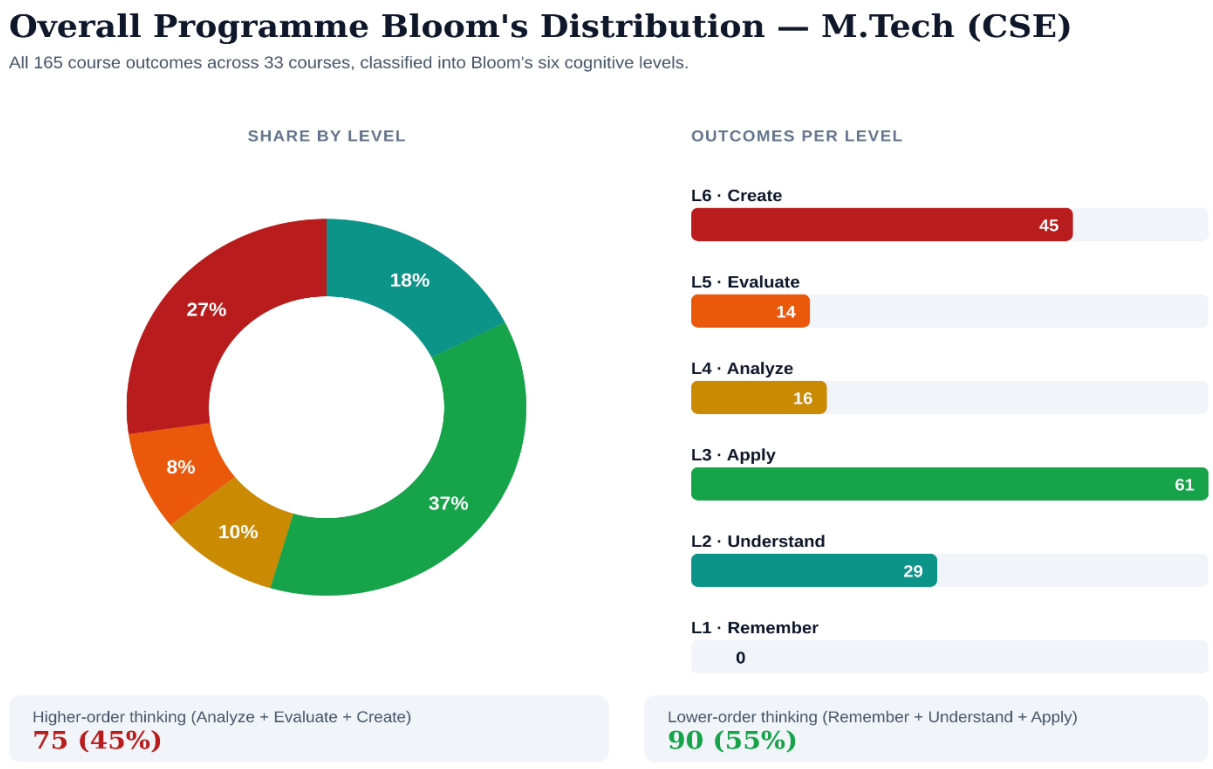
Course Code	Courses	Mode of delivery & credits *L- Lecture; T- Tutorial; P- Practicals*			Total Credits *C-Credits*
	Theory with Lab- Pool 1				
CS26521	Blockchain Technology	3	0	0	3
CS26523	Computer Vision	3	0	0	3
CS26525	Advanced Graphics	3	0	0	3
CS26527	Cyber Security & Digital Forensics	3	0	0	3
CS26522	Blockchain Technology Lab	0	0	3	1.5
CS26524	Computer Vision Lab	0	0	3	1.5
CS26526	Advanced Graphics Lab	0	0	3	1.5
CS26528	Cyber Security & Digital Forensics Lab	0	0	3	1.5
	Theory- Pool 2				
CS26529	Internet of Things (IoT)	3	0	0	3
CS26531	Quantum Computing	3	0	0	3
CS26533	Modern Optimization Techniques	3	0	0	3
CS26535	GPU Computing	3	0	0	3
CS26537	Video Processing	3	0	0	3

Modern Technology Track

Course Code	Courses	Mode of delivery & credits *L- Lecture; T- Tutorial; P- Practicals*			Total Credits *C-Credits*
	Theory with Lab- Pool 1				
AI26513	Deep Learning	3	0	0	3
CS26539	Natural Language Processing	3	0	0	3
AI26514	Deep Learning Lab	0	0	3	1.5
CS26540	Natural Language Processing Lab	0	0	3	1.5
	Theory- Pool 2				
AI26501	Modern Artificial Intelligence	3	0	0	3
AI26525	Large Language Models (LLM)	3	0	0	3
AI26527	Agentic AI Systems	3	0	0	3
CS26541	NoSQL	3	0	0	3

M. Tech CSE COURSE MAPPING WITH BLOOM'S LEVELS

Level	Cognitive level	Description
L1	Remember	Recall facts, terms and basic concepts.
L2	Understand	Explain ideas or concepts in one's own words.
L3	Apply	Use knowledge to solve problems in new situations.
L4	Analyze	Break information into parts and examine how they relate.
L5	Evaluate	Judge or justify a decision based on criteria.
L6	Create	Combine elements to produce new ideas or solutions.



Assessment Tool→ Bloom's level mapping

Legend: L1 Remember L2 Understand L3 Apply L4 Analyze L5 Evaluate L6 Create

Semesters I & II

Evaluation method	Type	L1	L2	L3	L4	L5	L6
		Remember	Understand	Apply	Analyze	Evaluate	Create
Quizzes	Theory	✓	✓	✓			
Assignments	Theory		✓	✓	✓		
Seminar (before committee)	Theory		✓		✓	✓	✓
Semester-End Examination	Theory	✓	✓	✓	✓		
Day-to-day lab evaluation	Lab			✓	✓		
Lab Viva	Lab		✓	✓	✓	✓	
Lab Quiz	Lab	✓	✓	✓			
End-Sem performance	Lab			✓	✓		✓

Semester III — Thesis Part I + MOOC / Open Elective

Evaluation method	Scope	L1	L2	L3	L4	L5	L6
		Remember	Understand	Apply	Analyze	Evaluate	Create
Progressive Evaluation	Thesis Part I				✓	✓	✓
End Semester Presentation	Thesis Part I				✓	✓	✓
MOOC / Open-Elective assessment	MOOC / OE		✓	✓	✓	✓	

Semester IV — Thesis Part II

Evaluation method	Scope	L1	L2	L3	L4	L5	L6
		Remember	Understand	Apply	Analyze	Evaluate	Create
Progressive Evaluation	Thesis Part II				✓	✓	✓
End Semester Presentation	Thesis Part II				✓	✓	✓

Course Code: CS26501

Course Title: Advanced Data Structures & Algorithms
Pre-requisite(s):
Co-requisite(s): CS26502 Advanced Data Structures & Algorithms Lab
Credits: 3 L: 3 T: 0 P: 0
Class Schedule per Week: 3
Class: MTech
Semester / Level: First/Fifth
Branch: CSE/AIML

Course Objectives

This course enables the students to:

1.	Understand the fundamentals of data structures and algorithm analysis, including asymptotic notations and complexity analysis.
2.	Learn the implementation and applications of linear data structures such as arrays, linked lists, stacks, queues, and hashing.
3.	Develop proficiency in non-linear data structures including trees, binary search trees, heaps, tries, skip lists, B-trees, graphs, and union-find structures.
4.	Analyze, design, and implement efficient algorithms using paradigms such as divide-and-conquer, greedy methods, and dynamic programming.
5.	Apply appropriate data structures and algorithms to solve computational problems while evaluating their correctness, efficiency, and computational complexity.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Analyze algorithms, solve recurrence, and implement fundamental linear data structures.
CO2	Design and implement hashing techniques and graph traversal algorithms (BFS and DFS) for solving practical computational problems.
CO3	Construct, traverse, and manipulate binary tree and heap.
CO4	Apply searching, indexing, and connectivity operations with skip lists, B-trees, and union-find structures, respectively.
CO5	Apply various algorithm design techniques and evaluate computational complexity.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Introduction Algorithm and its properties, time and space complexities, O, Ω and Θ notations, solving recurrence; Multidimensional arrays, memory representation of multidimensional arrays; Various operations on singly linked lists, concepts of doubly and circular linked lists; Stack implementations with array and linked-list,	10

applications of stack; Queue implementations with array and linked-list, circular queue (with array);	
Module 2: Hashing and Graphs Hashing, hash functions, open addressing (linear probing, quadratic probing, double hashing), and chaining; Graph representation, traversal (BFS and DFS), and their applications	6
Module 3: Trees Tree, Binary Tree, Traversal (inorder, preorder, postorder), reconstruction of tree from its traversals; Binary Search Tree (BST), height-balanced BST; Heaps, building heap in linear time, applications of heap	8
Module 4: Advance Data Structures Trie and its applications; Skip-list, operations on skip-list; B-Tree, insertion and deletion operations; Application of Union-Find (disjoint set) data structure;	8
Module 5: Algorithm Design Divide and conquer paradigm, common examples, Strassen's Algorithm; Greedy algorithm design paradigm, Huffman coding; Dynamic Programming algorithm design paradigm, Longest Common Subsequence; Efficient string matching (KMP algorithm); Overview of complexity classes, polynomial reduction, computational hardness, list of NP-complete problems	8

Text Books:

1. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms.
2. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, Fundamentals of Data Structures in C.
3. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++.
4. Jeff Erickson, Algorithms (https://jeffe.cs.illinois.edu/teaching/algorithms/)
5. Tim Roughgarden, Algorithms Illuminated (https://www.algorithmsilluminated.org/)

Reference Books:

1. Reema Thareja, Data Structures Using C.
2. Narasimha Karumanchi, Data Structures and Algorithms Made Easy.
3. Jon Kleinberg and Éva Tardos, Algorithm Design.
4. Sanjoy Dasgupta, Christos H. Papadimitriou, and Umesh V. Vazirani, Algorithms.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Classroom Lectures
CD2	Interactive Discussions and Question–Answer Sessions
CD3	Demonstration of Django Concepts and Case Studies
CD4	Laboratory Demonstrations and Hands-on Practice
CD5	Tutorials and Problem-Solving Sessions
CD6	Assignments, Quizzes, and Self-Learning Activities
CD7	Seminar Presentations and Project-Based Learning

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	3
CO2	3	1	3
CO3	2	1	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD4, CD5, CD6
CO2	CD1, CD3, CD4, CD5, CD6
CO3	CD1, CD3, CD4, CD5, CD6
CO4	CD1, CD3, CD4, CD5, CD6, CD7
CO5	CD1, CD2, CD3, CD5, CD6, CD7

Course Code: CS26502

Course Title: Advanced Data Structures & Algorithms Lab
Pre-requisite(s):
Co-requisite(s): CS26501 Advanced Data Structures & Algorithms
Credits: 1.5 L: 0 T: 0 P: 3
Class Schedule per Week: 1
Class: MTech
Semester / Level: First/Fifth
Branch: CSE/AIML

Course Objectives

This course enables the students to:

1.	Develop a strong understanding of fundamental and advanced data structures.
2.	Enable students to design, implement, and analyze efficient data structures and algorithms for solving computational problems.
3.	Provide practical knowledge of searching, sorting, graph traversal, tree operations, and algorithmic techniques through implementation and performance analysis.
4.	Introduce advanced data structures such as Trie, Skip List, and B-Tree and understand their applications in real-world computing systems.
5.	Develop skills in algorithm design techniques including pattern matching, compression algorithms, and optimization approaches for solving complex problems.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Implement and analyze basic data structures for solving computational problems. Evaluate the performance of an algorithm through experimental comparison on large datasets.
CO2	Design and implement hashing and graph algorithms for solving various computational problems.
CO3	Implement and analyze tree-based data structures for efficient data organization and retrieval.
CO4	Apply advanced data structures for efficient searching, indexing, and storage applications.
CO5	Implement and analyze pattern matching, data compression techniques on large datasets. Implement various algorithm design paradigms to solve complex computational problems.

SYLLABUS (A model list of programs to be implemented with C/C++ like programming language)

MODULE	NO. OF LECTURE HOURS
Module 1: Basic Data Structures and Programming 1. Implement Static, dynamic and multidimensional arrays. 2. Menu based operations/applications on arrays.	9

3. Running time comparison of various searching and sorting algorithms on large random input. 4. Operations on linked-lists and its application. 5. Implementation of Stack with arrays and linked-list. 6. Implementation of Queue with arrays and linked-list. 7. Application of Stacks and Queues.	
Module 2: Hashing and Graphs 8. Implement Hash data structure with chaining and its application. 9. Implement various graphs with adjacency matrix and adjacency list. 10. Implement BFS and DFS graph traversal and their application.	6
Module 3: Trees 11. Implement Binary Search Tree and its operations. 12. Implement height balanced tree and its operations. 13. Implement Heap and its applications.	9
Module 4: Advance Data Structures 14. Implement Trie and its operations. 15. Implement Skip List and its operations. 16. Implement B-Tree and its operations.	9
Module 5: Algorithm Design 17. Implement KMP Algorithm and analyze its performance on random input. 18. Implement Huffman Coding and analyze its performance on random input. 19. Applications of different algorithm design techniques.	6

Text Books:

1. Ellis Horowitz, Sartaj Sahni, and Susan Anderson-Freed, Fundamentals of Data Structures in C.
2. Mark Allen Weiss, Data Structures and Algorithm Analysis in C++.
3. Reema Thareja, Data Structures Using C.
4. Narasimha Karumanchi, Data Structures and Algorithms Made Easy.
5. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, Introduction to Algorithms.

Reference Books:

1. Jeff Erickson, Algorithms (https://jeffe.cs.illinois.edu/teaching/algorithms/)
2. Tim Roughgarden, Algorithms Illuminated (https://www.algorithmsilluminated.org/)
3. Jon Kleinberg and Éva Tardos, Algorithm Design.
4. Sanjoy Dasgupta, Christos H. Papadimitriou, and Umesh V. Vazirani, Algorithms.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Online Materials
CD7	Video Lectures for Self-Studies

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	2	3
CO2	2	2	3
CO3	2	2	3

CO	PO1	PO2	PO3
CO4	3	2	3
CO5	3	3	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD4, CD5, CD6, CD7
CO2	CD1, CD2, CD4, CD5, CD6, CD7
CO3	CD1, CD2, CD4, CD5, CD6, CD7
CO4	CD1, CD2, CD4, CD5, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD6, CD7

Course code: AI26509

Course title: Machine Learning
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class schedule per week: 03
Class: M. Tech
Semester / Level: First/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Formulate machine learning problems corresponding to different applications.
2.	Understand various supervised, semi-supervised and unsupervised machine learning algorithms.
3.	Understand the theory related to building and training machine learning models.
4.	Develop machine learning based systems for various real-world problems.
5.	Assess how the choice of a machine-learning algorithm impacts the accuracy of a system.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Understand the basics of linear algebra, probabilities and problem formulation.
CO2	Demonstrate understanding of a range of supervised learning mechanisms.
CO3	Develop an understanding of the neural networks, and the role of backpropagation in training the networks.
CO4	Demonstrate understanding of the unsupervised and semi-supervised learning mechanisms.
CO5	Design and implement various machine learning algorithms in a range of real-world applications.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module I: Introduction to Machine Learning Role of machine learning in computer science and problem solving, Data Matrix, PCA and Dimensionality Reduction, Prior probabilities and Bayes Rule, Problem formulations (classification and regression), Introduce paradigms of Learning (primarily supervised and unsupervised). Linear Regression and K-Nearest Neighbours algorithm.	8
Module II: Supervised Learning Basics of Feature Selection and Evaluation, Decision Tree, Overfitting and Pruning, Logistic regression, Support Vector Machine and Kernel; Noise, bias-variance trade-off, under-fitting and over-fitting concepts.	8

Module III: Neural Network Gradient Descent and Perceptron/Delta Learning, Loss functions, Multilayer Perceptron, Feed forward networks and backpropagation, Overfitting and regularization.	8
Module IV: Unsupervised and Semi Supervised Learning Introduction to clustering, Hierarchical Agglomerative Clustering, K-means partitional clustering using kernel functions, Expectation maximization (EM) for soft clustering, Semi-supervised learning with EM using labeled and unlabeled data.	8
Module V: Ensemble Overview of ensemble learning, Bagging (Bootstrap Aggregating), Boosting, Stacking. ML models with applications in real-world use cases.	8

Text Books: Tom Mitchell, "Machine Learning", Latest Edition, Mc-Graw Hill.

Reference Books:

1. Shai Shalev-Shwartz, and Shai Ben-David, "Understanding Machine Learning", Cambridge University Press, 2017.
2. Christopher Bishop, "Pattern Recognition and Machine Learning", Springer, 2006.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	**% Distribution**
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Classroom Lectures
CD2	Interactive Discussions and Question–Answer Sessions
CD3	Demonstration of Django Concepts and Case Studies
CD4	Laboratory Demonstrations and Hands-on Practice
CD5	Tutorials and Problem-Solving Sessions
CD6	Assignments, Quizzes, and Self-Learning Activities
CD7	Seminar Presentations and Project-Based Learning

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	3	3
CO2	3	3	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD4, CD5, CD6
CO2	CD1, CD3, CD4, CD5, CD6
CO3	CD1, CD3, CD4, CD5, CD6
CO4	CD1, CD3, CD4, CD5, CD6, CD7
CO5	CD1, CD2, CD3, CD5, CD6, CD7

Course Code: AI26510

Course Title: Machine Learning Lab
Pre-requisite(s):
Co- requisite(s):
Credits: 3 L: 0 T: 0 P: 3
Class schedule per week:
Class: M. Tech
Semester / Level: First/Fifth
Branch: CSE

Course Objectives

This course envisions to impart to students to:

1.	Understand the foundational concepts and types of Machine Learning including supervised and unsupervised learning.
2.	Develop regression models using linear and regularized approaches and evaluate them using suitable metrics.
3.	Explore and implement various classification algorithms and understand their theoretical foundations.
4.	Apply clustering techniques and dimensionality reduction methods to analyze unlabeled data.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Preprocess and visualize data for machine learning tasks
CO2	Understand and implement basic supervised learning algorithms
CO3	Explore dimensionality reduction techniques
CO4	Design and apply unsupervised learning techniques
CO5	Analyze performance metrics of supervised and unsupervised models

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module – I Introduction to Machine Learning Programs based on Linear Regression, Gradient Descent, and implementation of different evaluation metrics like MSE, RMSE, MAE, R^2 Score. Programs on K-Nearest Neighbor technique.	6
Module – II Supervised Learning Programs based on Logistic Regression. Programs on Support Vector Machines (SVMs) using linear different kernel approaches. Programs based on implementing Decision Trees.	9
Module – III Neural Networks Programs based on understanding the concept of linear separability. Programs based on Multilayer Perceptron (MLP) and Back Propagation Algorithm.	9
Module – IV Unsupervised Learning Programs based on K-Means Clustering. Programs based on Hierarchical clustering methods	6
Module – V Ensemble learning Programs based on Bagging and Boosting. Mini project on real data set.	9

Text Books:

1. Aurelien Géron - Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow, 2nd September 21019, O'Reilly Media, Inc., ISBN: 9781492032649.

Reference Books:

1. Tom M. Mitchell, "Machine Learning ", Tata McGraw Hill, New Delhi, 2017
2. Shalev-Shwartz Shai and Ben-David Shai, Understanding Machine Learning, Cambridge University Press, 2017.
3. Christopher Bishop, Pattern Recognition and Machine Learning, Springer.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	**% Distribution**
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	**Course Delivery Method**
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Concept based Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini projects
CD5	Interactive Lectures, Flipped Classroom Activities
CD6	Self- learning through NPTEL materials and internets
CD7	Case Studies via Research Papers

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	**PO1**	**PO2**	**PO3**
CO1	1	3	3
CO2	3	3	3
CO3	3	2	3
CO4	3	2	3

CO	PO1	PO2	PO3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD5, CD6
CO2	CD1, CD2, CD3, CD5, CD6
CO3	CD1, CD2, CD3, CD4, CD5, CD6
CO4	CD1, CD2, CD3, CD4, CD5 CD6, CD7
CO5	CD1, CD2, CD5, CD6, CD7

Course Code: CS26510/ AI26512

COURSE OPTIONS

1.
Course Title: Skill Development I- Python programming
Pre-requisite(s): Data Structure, Basic concepts of any Programming language.
Co-requisite(s): None
Credits: 2 L: 0 T:0 P: 4
Class Schedule per Week: 4
Class: M.Tech
Semester / Level: First/Fifth
Branch: CSE/ AIML

Course Objectives

This course enables the students to:

1.	Understand the fundamentals of Python programming, including syntax, data types, operators, and control structures.
2.	Develop Python programs using functions, modules, and object-oriented programming concepts.
3.	Apply appropriate data structures such as lists, tuples, dictionaries, and sets to solve computational problems.
4.	Utilize NumPy and other Python libraries for numerical computation, data manipulation, and scientific computing.
5.	Analyse, manipulate, clean, and transform data using Pandas Data Frames and related data structures. Visualize and interpret data using Matplotlib and Pandas plotting tools to support data analysis and decision-making.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Demonstrate proficiency in Python programming fundamentals, including variables, expressions, control structures, functions, strings, lists, tuples, and dictionaries.
CO2	Develop Python applications involving file handling, data processing, and web-based data access using appropriate programming techniques.
CO3	Design and implement object-oriented solutions using classes, objects, attributes, methods, and other OOP concepts in Python.
CO4	Apply NumPy for numerical computing and efficient manipulation of multidimensional arrays through indexing, slicing, and array operations.
CO5	Perform data analysis, transformation, and visualization using Pandas and Matplotlib to extract insights from structured datasets and present them effectively.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Variables, Expressions and Statements, Iteration, Functions with arguments and return values, Strings, Tuples, Lists, Objects and references, Aliasing, cloning lists, Lists and for loops, List parameters.	10
Module 2: Dictionaries: Dictionary operations, dictionary methods, aliasing and copying. files, writing our first file, reading a file line-at-a-time, turning a file into a list of lines, Reading the whole file at once, working with binary files, Directories, fetching something from the Web.	10
Module 3: Object oriented programming: Classes and Objects — The Basics, Attributes, Adding methods to our class, Instances as arguments and parameters, Converting an instance to a string, Instances as return values.	10
Module 4: Array manipulation using Numpy: **Numpy array:** Creating Numpy arrays; various data types of Numpy arrays, indexing and slicing, swapping axes, transposing arrays, data processing using Numpy arrays.	10
Module 5: Data Manipulation using Pandas: **Data Structures in Pandas:** Series, DataFrame, Index objects, Loading data into Pandas data frame, Working with DataFrames: Arithmetics, Statistics, Binning, Indexing, Filtering, Handling missing data, Hierarchical indexing, Data cleaning, transforming, merging and reshaping, Using Matplotlib to plot data: figures, subplots, markings, color and line styles, labels and legends, Plotting functions in Pandas: Line, bar, Scatter plots, histograms, stacked bars, Heatmap, 3D Plotting	12

Text Books:

1. Peter Wentworth, Jeffrey Elkner, Allen B. Downey and Chris Meyers- How to think like a computer scientist: learning with python 3. Green Tea Press, Wellesley, Massachusetts,2020 https://media.readthedocs.org/pdf/howtothink/latest/howtothink.pdf.

2. McKinney W. Python for Data Analysis: Data Wrangling with Pandas, NumPy and IPython, 2nd edition, O'Reilly Media, 2018.

3. Molin S. Hands-On Data Analysis with Pandas, Packt Publishing, 2019. 3. Gupta S.C., Kapoor V.K. Fundamentals of Mathematical Statistics,12 th edition, Sultan Chand & Sons, 2020.

Reference Books:

1.Al Sweigart, "Automate the Boring Stuff with Python, 2nd Edition: Practical Programming for Total Beginners",2nd Edition, No Starch Press, 2022. (Available under CC-BY-NC-SA license at https://automatetheboringstuff.com/)

2. Kyla McMullen, Elizabeth Matthews and June Jamrich Parsons, Programming with Python, Cengage, 2023.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Lab Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Seminars
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	3	2	2
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	3	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD7
CO2	CD1, CD2, CD3, CD4, CD6, CD7
CO3	CD2, CD3, CD4, CD6, CD7
CO4	CD2, CD3, CD4, CD7
CO5	CD2, CD3, CD4, CD5, CD7

2.
Course Title: Skill Development I- Latex and Slide Preparation
Pre-requisite(s): None
Co-requisite(s): None
Credits: 2 L: 0 T:0 P: 4
Class Schedule per Week: 3
Class: M.Tech
Semester / Level: First/Fifth
Branch: CSE/ AIML

Course Objectives

This course enables the students to:

1.	Understand the fundamentals of LaTeX for professional scientific and technical document preparation.
2.	Develop skills in formatting mathematical equations, tables, figures, references, and bibliographies.
3.	Learn advanced document structuring techniques for research papers, reports, theses, and dissertations.
4.	Create professional presentation slides using the Beamer class in LaTeX.
5.	Design and deliver high-quality academic and research presentations using Beamer templates and visualization tools.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Create professionally formatted technical documents using LaTeX.
CO2	Develop scientific documents incorporating equations, figures, tables, and references.
CO3	Prepare research papers, technical reports, and thesis documents using standard publication templates.
CO4	Apply skills to design academic and professional presentations using Beamer.

CO5	Create scientific documents into effective presentation formats and communicate technical content efficiently.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Overview of TeX and LaTeX ecosystem, Installation and setup of TeX distributions and editors, Structure of a LaTeX document, Document classes, Basic text formatting, Compiling LaTeX documents.	10
Module 2: Mathematical equations and symbols, Tables and figures, Cross-referencing, Hyperlinks, Bibliography management using BibTeX, Citation styles and reference formatting.	10
Module 3: IEEE, ACM and Springer templates, Formatting research papers, Reports and thesis preparation, Algorithm and code insertion, Multi-file document management, Best practices in scientific writing.	10
Module 4: Beamer document class, Themes and templates, Frame structure, Title pages, Lists and blocks, Mathematical content in slides, Navigation and overlays.	10
Module 5: Figures, tables, charts and multimedia in Beamer, Animations and overlays, Custom themes and branding, Conference and seminar presentations, Converting LaTeX reports into Beamer presentations, Presentation design best practices.	12

Text Books:

1. Stefan Kottwitz, *LaTeX Beginner's Guide*, Packt Publishing, 2022.
2. Till Tantau, *The Beamer Class User Guide*, Version 3.76.

Reference Books:

1. https://www.latex-project.org/

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day progressive evaluation	30
Lab Quiz 1	10

Continuous Internal Assessment	% Distribution
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Lab Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Seminars
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	3	1	3
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	3	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD7

Course Outcomes	Course Delivery Method
CO2	CD1, CD2, CD3, CD4, CD6, CD7
CO3	CD2, CD3, CD4, CD6, CD7
CO4	CD2, CD3, CD4, CD7
CO5	CD2, CD3, CD4, CD5, CD7

3.
Course Title: Skill Development I- Introduction to Power BI
Pre-requisite(s): Data Mining
Co-requisite(s):
Credits: 2 L: T: P: 4
Class Schedule per Week: 3
Class: MTech
Semester / Level: First/Fifth
Branch: CSE/ AIML

Course Objectives

This course enables the students to:

1.	Understand the architecture, interface, and workflow of Microsoft Power BI for business intelligence applications.
2.	Import, clean, transform, and model data from multiple sources using Power Query.
3.	Develop interactive dashboards and visualizations using Power BI's charts and reporting tools.
4.	Apply DAX functions, calculated columns, calculated tables, and measures for business data analysis.
5.	Design advanced business intelligence reports using AI-powered visuals, what-if analysis, and storytelling features.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Explain the architecture, interface, and workflow of Microsoft Power BI for business intelligence applications.
CO2	Import, transform, and model data from multiple sources using Power Query and establish relationships among datasets.
CO3	Create interactive dashboards and visualizations using Power BI charts, reports, and analytical tools.
CO4	Apply DAX functions, calculated columns, calculated tables, and measures for business data analysis.
CO5	Develop advanced business intelligence reports using AI-powered visuals, what-if analysis, and reporting features.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Introduction to Power BI and the Power BI interface, Report and Data Views, Importing and modelling data, basic data manipulation	10
Module 2: Data visualization in Power BI, Different plots and charts in Power BI	10
Module 3: Aggregation, measures and introduction to DAX, Calculated columns and Calculated Tables, Implicit and explicit measures, DAX syntax and applications	10
Module 4: Importing data from multiple files, Transformations in Power Query, Building Relationships between tables	10
Module 5: Advanced reporting, AI powered Visuals, Key influencers, Decomposition tree, smart narratives, What If analysis	12

Text Books:

1. Arnold J., Learning Microsoft Power BI – Transforming Data into Insights, 1st Edition, O'Reilly, 2025

Reference Books:

1. Deckler G., Powell B., Microsoft Power BI Cookbook, 3rd Edition, Packt Publishing, 2024

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Online Materials
CD7	Video Lectures for Self-Studies

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	2
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	3	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6, CD7
CO2	CD1, CD2, CD5, CD6
CO3	CD1, CD2, CD3, CD5, CD6
CO4	CD2, CD4, CD5, CD6
CO5	CD3, CD4, CD5, CD6, CD7

4.
Course Title: Skill Development I- MATLAB Programming
Pre-requisite(s): None
Co-requisite(s): None
Credits: 2 L: 0 T:0 P: 4
Class Schedule per Week: 3
Class: M.Tech
Semester / Level: First/Fifth

Branch: CSE/ AIML

Course Objectives

This course enables the students to:

1.	Understand the MATLAB programming environment and develop programs using fundamental programming constructs, data structures, and built-in functions.
2.	Apply control structures, user-defined functions, and file handling techniques for solving computational and engineering problems.
3.	Develop data visualization skills using MATLAB graphical tools for effective analysis and interpretation of data.
4.	Utilize MATLAB toolboxes for data preprocessing, statistical analysis, machine learning, and predictive modeling.
5.	Design and implement MATLAB-based solutions for engineering, scientific, artificial intelligence, and machine learning applications.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Apply MATLAB programming fundamentals, including variables, matrices, operators, control structures, and built-in functions to solve computational problems.
CO2	Develop modular MATLAB programs using user-defined functions, file operations, and debugging techniques for efficient software development.
CO3	Analyze and visualize data using 2D/3D graphical tools and perform basic data processing and interpretation tasks.
CO4	Apply MATLAB-based data analytics and machine learning techniques, including preprocessing, feature engineering, classification, regression, clustering, and model evaluation.
CO5	Design and implement MATLAB solutions for engineering and AI/ML applications involving signal processing, image analysis, optimization, and simulation.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: MATLAB environment, command window, workspace, help system. Variables, constants, data types, operators. Input/output functions (input, disp, fprintf). Vectors, matrices, indexing, slicing. Built-in mathematical functions. Script files and live scripts. Relational and logical operations. Simple engineering computations.	10
Module 2: Control Structures and User-Defined Functions: if, if-else, nested conditions. switch-case statements. for loops. while loops. Break, continue, and loop optimization. User-defined functions. Function arguments, return values, scope of variables. Recursive functions and debugging basics.	10

Module 3: Data Visualization and File Handling: 2D plotting: plot, fplot. Plot formatting: titles, labels, legends, grids. Multiple plots and subplots. 3D plotting: mesh, surf, contour. Import/export of data files. Text file handling. CSV and spreadsheet operations. Basic data analysis and visualization.	10
Module 4: Data Analytics and Machine Learning using MATLAB: Introduction to MATLAB Toolboxes for Data Analytics. Data Preprocessing and Data Cleaning. Descriptive Statistics and Data Visualization. Feature Extraction and Feature Selection. Classification using MATLAB Classification Learner App. Regression Analysis using MATLAB. Clustering using K-Means Clustering. Model Evaluation and Performance Metrics	10
Module 5: MATLAB for Engineering Applications: Signal generation and analysis. Image processing basics (reading, displaying, filtering). Curve fitting and regression. Introduction to Simulink. Optimization using built-in solvers. Performance measurement and code profiling.	12

Text Books:

1. MATLAB Programming for Engineers, Stephen J. Chapman | 7th Edition, 2025
2. Basics of MATLAB Programming, R. Balaji, 2020

Reference Books:

1. Mastering MATLAB: A Practical Guide for Engineers, Scientists, and Programmers to Learn Programming, Simulation, and Data Analysis with Hands-On Examples, 2025

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	**% Distribution**
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Lab Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini Projects
CD5	Seminars
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	3	2	2
CO2	3	3	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD7
CO2	CD1, CD2, CD3, CD4, CD6, CD7
CO3	CD2, CD3, CD4, CD6, CD7
CO4	CD2, CD3, CD4, CD7
CO5	CD2, CD3, CD4, CD5, CD7

Course Code: CS26503

Course Title: Image Processing
Pre-requisite(s):
Co-requisite(s):
Credits: 3 L: 3 T:0 P: 0
Class Schedule per Week: 3
Class: M. Tech
Semester / Level: First/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Understand the fundamentals of Image Processing
2.	Apply Image processing operations in real world problems
3.	Develop algorithms for Image processing applications
4.	Design solutions for Image processing projects
5.	Analyze different methods and techniques of Image processing

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Apply Image processing techniques on problems
CO2	Design and Develop Image processing applications for real world problems
CO3	Integrate AI with Image Processing
CO4	Developing Image processing AI applications
CO5	Describe Image processing engineering applications

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Introduction to Image Processing, Digital Imaging System, Elements of Visual Perception, Image Sensing & Acquisition, Sampling and Quantization, Basic Relationships between Pixels, Basic Image processing operations, Image Transforms, Intensity Transformations, Histogram Processing.	8
Module 2: Spatial Convolution & Correlation, Smoothing Spatial Filters, Sharpening Spatial Filters, Order Statistic Filters, Introduction to the Fourier Transform, Discrete Fourier Transform, Fast Fourier Transform, Properties of the Two-Dimensional Fourier Transform, Image Smoothing and Sharpening using Frequency Introduction to: Walsh- Hadamard Transform; K-L Transform; Discrete Cosine Transform.	8

Module 3: Image Compression Fundamentals – Coding Redundancy, Interpixel Redundancy, Psychovisual Redundancy, Fidelity Criteria, Image Compression Models– Source Encoder and Decoder, Channel Encoder and Decoder, Elements of Information Theory, Error-Free Compression– Variable-Length Coding, Bit-Plane Coding, Lossless Predictive Coding. Lossy Compression– Lossy Predictive Coding, Transform Coding. Point, Line and Edge Detection: Different classical techniques like Sobel, canny, Roberts, and others.	8
Module 4: Foundation and Classical Image Segmentation: Variational Methods, Level Set Methods, Graph Based Methods, Concepts of Super pixel. Color Image Processing, Different Color spaces and relationships among them, Color Constancy, Color Deconvolution, Low light Enhancement.	8
Module 5: Image Morphology and basic operations. Image features representation and description, Blob like features: SIFT, SURF, BRISK, Object Recognition, Use of AI in Image features representation and Object Detection case studies	8

Text books:

1. Digital Image Processing, Rafel C Gonzalez and Richard E Woods, 4th Global Edition, Person Education, 2018

Reference Books:

1. Digital Image Processing, S Sridhar, Oxford University Press, Seventh Impressions, 2015

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Concept based Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini projects
CD5	Interactive Lectures, Flipped Classroom Activities
CD6	Self- learning through NPTEL materials and internets
CD7	Case Studies via Research Papers

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	2	3
CO2	3	2	3
CO3	3	2	2
CO4	3	2	3
CO5	3	3	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD4, CD5, CD6
CO2	CD1, CD3, CD4, CD5, CD6
CO3	CD1, CD3, CD4, CD5, CD6
CO4	CD1, CD3, CD4, CD5, CD6, CD7
CO5	CD1, CD2, CD3, CD5, CD6, CD7

Course Code:CS26505

Course Title: Advanced Networking
Pre-requisite(s):
Co-requisite(s):
Credits: 3 L: 3 T:0 P: 0
Class Schedule per Week: 3
Class: MTECH
Semester / Level: First/Fifth
Branch: CS

Course Objectives

This course enables the students to:

1.	Recognize directly linked networks and assess their performance
2.	Develop an understanding of basic internetworking and its techniques.
3.	Understand multicasting protocols and involved routing
4.	Understand end to end connections and their challenges.
5.	Evaluate congestion control and understand data presentation

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Understand how directly linked networks function.
CO2	Understand and analyse routing algorithms.
CO3	Analyse multicast protocols.
CO4	Understand and analyze end to end packet transfers.
CO5	Understand data presentation and congestion control techniques.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Foundations, Applications, Requirements, Architecture, Software, Performance, Direct Links, Encoding, Framing, Error Detection, Reliable Transmission, Multi-Access Networks, Wireless Networks, Access Networks	10
Module 2: Internetworking, Switching Basics, Switched Ethernet, Internet (IP), Routing, Implementation, Global Internet	8
Module 3: IP Version 6, Multicast, Multiprotocol Label Switching, Routing Among Mobile Devices	8

Module 4: Simple Demultiplexer (UDP), Reliable Byte Stream (TCP), Remote Procedure Call, 5.4 Transport for Real-Time (RTP)	8
Module 5: Congestion Control, Issues in Resource Allocation, Queuing Disciplines, TCP Congestion Control, Advanced Congestion Control, Quality of Service, End to End data, Presentation Formatting, Multimedia Data	6

Text Books:

1. Peterson, L. L., Davie, B. Computer Networks: A Systems Approach, Morgan Kauffman, 2022

Reference Books:

1. Stallings W., Data and Computer Communication, 10th Edition, Pearson, 2014
2. Forouzan B., Data Communications and Networking with TCP/IP Protocol Suits, Mcgraw-Hill, 2022

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	20
Assignment(s)	10
Seminar before a committee	20
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)
CD4	Mini projects/Projects

Code	Course Delivery Method
CD5	Laboratory experiments/teaching aids
CD6	Online Materials
CD7	Video Lectures for Self-Studies

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	2
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	2	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6, CD7
CO2	CD1, CD2, CD3, CD6
CO3	CD1, CD3, CD4, CD6
CO4	CD1, CD2, CD4, CD5, CD6
CO5	CD1, CD2, CD3, CD6, CD7

Course Code: CS26507

Course Title: Advanced Computer Architecture
Pre-requisite(s): Computer Architecture, Parallel Computing
Co-requisite(s): Nil
Credits: 3 L: 3 T:0 P: 0
Class Schedule per Week: 03
Class: M. Tech
Semester / Level: First/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Understand different terminologies in High Performance Computer Architecture
2.	Interpret Parallel Program and Network Properties requirements
3.	Decide selection criteria for parallelism and evaluate Performance metrics, scalability
4.	Create superscalar architecture and memory requirements
5.	Apply advanced speed up features like pipelining for system interconnects

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Describe different terminologies in High Performance Computer Architecture
CO2	Determine Program and Network Properties for parallelism
CO3	Evaluate Performance metrics, scalability and selection criteria for parallelism
CO4	Design superscalar architecture and memory requirements
CO5	Implement advanced speed up features like pipelining for system interconnects

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Parallel Computer Models: The State of Computing, Flynn's Taxonomy of Computer Architecture, Multiprocessors and Multicomputer, Multi-vector and SIMD Computers, PRAM and VLSI Models, Architectural Development Tracks.	8
Module 2: Program and Network Properties: Conditions for Parallelism, Program Partitioning and Scheduling, Program Flow Mechanism, System Interconnect Architectures.	8
Module 3: Principles of Scalable Performance: Performance Metrics and Measures, Parallel Processing Applications, Speedup Performance Laws, Scalability Analysis and Approaches.	8
Module 4: Processors and Memory Hierarchy: Advanced Processor Technology, Super Scaler and Vector Processors, Memory Hierarchy Technology, Virtual Memory Technology. Cache Memory Organizations, Shared-Memory Organizations.	8

Module 5: Pipelining and Superscalar Techniques: Instruction Pipeline Design, Arithmetic Pipeline Design, Superscalar Pipeline Design, Multiprocessor System Interconnects, Message-Passing Mechanisms, Vector Processing Principles, CASE STUDIES: Fijitsu VP 2000, MasPar MP-1 and CM 5.	8

Text Books:

1. Hwang K., Jotwani N., Advanced Computer Architecture, 2nd Edition, Tata Mc-Graw Hill, India, 2010

Reference Books:

1. Stone, H. S., High Performance Computer Architecture, 3rd Edition, Addison Wesley Publishing Company, USA

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Concept based Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini projects
CD5	Interactive Lectures, Flipped Classroom Activities
CD6	Self- learning through NPTEL materials and internets

Code	Course Delivery Method
CD7	Case Studies via Research Papers

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	1	3
CO2	2	1	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD5, CD6
CO2	CD1, CD2, CD3, CD5, CD6, CD7
CO3	CD1, CD2, CD3, CD4, CD5, CD6, CD7
CO4	CD1, CD2, CD3, CD4, CD5, CD6, CD7
CO5	CD1, CD2, CD5, CD6, CD7

Course Code: CS26511

Course Title: Database System Design
Pre-requisite(s): Database Management System
Co-requisite(s):
Credits: 3 L: 3 T:0 P: 0
Class Schedule per Week: 3
Class: M.Tech
Semester / Level: Second/Fifth
Branch: CS

Course Objectives

This course enables the students to:

1.	Understand the fundamental concepts of transaction processing, including transaction properties, scheduling, recoverability, serializability, and SQL transaction support.
2.	Analyze and compare various concurrency control techniques used to ensure correctness, consistency, and performance in multi-user database systems.
3.	Apply database recovery mechanisms and backup strategies to maintain data integrity and ensure fault tolerance under different failure scenarios.
4.	Examine the principles, architecture, and transaction management techniques of distributed database systems, including data fragmentation, replication, and distributed concurrency control.
5.	Evaluate database security mechanisms and privacy-preserving techniques to protect database systems against unauthorized access, SQL injection, and other security threats.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Explain transaction processing concepts and scheduling techniques.
CO2	Analyze concurrency control methods for database consistency.
CO3	Apply database recovery and backup techniques.
CO4	Analyze distributed database design and transaction management.
CO5	Evaluate database security and privacy protection mechanisms.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Transaction Processing Concepts and Theory: Review of basic concepts, Transaction and System Concepts, Desirable Properties of Transactions, Characterizing Schedules Based on Recoverability, Characterizing Schedules Based on Serializability, Transaction Support in SQL.	8
Module 2: Concurrency Control Techniques: Two-Phase Locking Techniques for Concurrency Control, Concurrency Control Based on Timestamp Ordering, Multiversion Concurrency Control Techniques, Validation (Optimistic) Concurrency Control Techniques, Granularity of Data Items and Multiple Granularity Locking.	8

Module 3: Database Recovery Techniques: Recovery Concepts, NO-UNDO/REDO Recovery Based on Deferred Update, Recovery Techniques Based on Immediate Update, Shadow Paging, Recovery in Multidatabase Systems, Database Backup and Recovery from Catastrophic Failures.	8
Module 4: Distributed Database Concepts: Distributed Databases and Client-Server Architectures, Distributed Database Concepts, Data Fragmentation, Replication and Allocation Techniques for Distributed Database Design, Concurrency Control and Recovery in Distributed Databases, Transaction Management in Distributed Databases, Types of Distributed Database Systems, General Architecture of Pure Distributed Databases.	8
Module 5: Database Security: Introduction to Database Security Issues, Discretionary Access Control Based on Granting and Revoking Privileges, SQL Injection, Encryption and Public Key Infrastructures, Privacy Issues and Preservation.	8

Text Books:

1. Elmasri R., Navathe S.B., "Fundamentals of Database Systems", 7th Edition, Pearson Education/Addison Wesley, 2007.

Reference Books:

1. C.J. Date, "An introduction to Database Systems", 7th Edition.,Pearson Education, New Delhi, 2004.
2. H. Korth et al., "Database Management System Concepts", 3rd Edition, TMH, New Delhi, 2002.
3. B.Desai, "Database Management Systems", Galgotia Publications, New Delhi, 1998.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors

Code	Course Delivery Method
CD2	Concept based Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini projects
CD5	Interactive Lectures, Flipped Classroom Activities
CD6	Self- learning through NPTEL materials and internets
CD7	Case Studies via Research Papers

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	0	3
CO2	3	2	3
CO3	3	1	3
CO4	2	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD5, CD6
CO2	CD1, CD2, CD3, CD5, CD6
CO3	CD1, CD2, CD3, CD4, CD5, CD6
CO4	CD1, CD2, CD3, CD4, CD5 CD6, CD7
CO5	CD1, CD2, CD5, CD6, CD7

Course Code: CS26512

Course Title: Database System Design Lab
Pre-requisite(s):
Co-requisite(s): Database Management System
Credits: 1.5 L: 0 T: 0 P: 3
Class Schedule per Week: 3
Class: MTech
Semester / Level: Second/Fifth
Branch: CS

Course Objectives

This course enables the students to:

1.	Develop practical skills in implementing transaction processing and SQL transaction management.
2.	Apply concurrency control techniques and analyze their impact on database consistency.
3.	Perform database backup, recovery, and fault tolerance operations using DBMS tools.
4.	Design and implement distributed database concepts, including fragmentation, replication, and distributed transactions.
5.	Implement database security mechanisms, access control, and protection against common security threats.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Implement transaction processing and SQL transaction management techniques.
CO2	Demonstrate concurrency control mechanisms for maintaining database consistency.
CO3	Perform database backup, recovery, and restoration procedures.
CO4	Design and implement basic distributed database operations and transaction management.
CO5	Apply database security, access control, encryption, and SQL injection prevention techniques.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: SQL transaction management using COMMIT, ROLLBACK, SAVEPOINT, and transaction isolation levels.	6
Module 2: Implementation and analysis of concurrency control techniques such as locking, timestamp ordering, and deadlock handling.	9
Module 3: Database backup, recovery, log management, and restoration using DBMS utilities.	6
Module 4: Implementation of distributed database concepts including fragmentation, replication, distributed transactions, and two-phase commit (simulation/tools where applicable).	9

Module 5: Database security implementation including user privilege management (GRANT/REVOKE), encryption, and SQL injection prevention techniques.	9

Text Books

1. Elmasri, R. and Navathe, S. B., *Fundamentals of Database Systems*, 7th Edition, Pearson Education.

Reference Books

1. C. J. Date, *An Introduction to Database Systems*, 7th Edition, Pearson Education.
2. Korth, H. F., Silberschatz, A., and Sudarshan, S., *Database System Concepts*, McGraw-Hill.
3. B. Desai, *Database Management Systems*, Galgotia Publications.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/Assignments
CD3	Seminars/ Quiz (s)

Code	Course Delivery Method
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Online Materials
CD7	Video Lectures for Self-Studies

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	3
CO2	3	2	3
CO3	3	2	3
CO4	2	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD7
CO2	CD1, CD2, CD3, CD4, CD6, CD7
CO3	CD2, CD3, CD4, CD6, CD7
CO4	CD2, CD3, CD4, CD7
CO5	CD2, CD3, CD4, CD5, CD7

Course Code: CS26514/ AI26516

Course Title: Skill Development course – II
Pre-requisite(s):
Co-requisite(s):
Credits: 2 L: 0 T: 0 P: 4
Class Schedule per Week: 4
Class: MTech
Semester / Level: Second/Fifth
Branch: CSE/AIML

Course Objectives

This course enables the students to:

1.	Inculcate professional ethics, legal compliance and quality-assurance practices essential for responsible and accountable engineering practice.
2.	Expose students to management models, production systems and holistic-technology case studies that connect computing solutions with real organisational and societal contexts.
3.	Nurture an entrepreneurial mindset that enables students to identify opportunities and select problems worth solving through design thinking.
4.	Enable students to translate CSE research and technology into a market-validated, sellable product or application supported by a sound business model.
5.	Develop teamwork, communication, pitching and commercial-documentation competencies required to take an idea from concept to a fundable venture.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Demonstrate ethical judgement and professional responsibility when building and deploying computing solutions.
CO2	Interpret the legal, regulatory and contractual obligations that govern software and data, and uphold recognised assurance and integrity standards.
CO3	Plan, organise and track technical work while managing people, resources, cost and risk, and communicate progress clearly.
CO4	Investigate a real-world need and establish its viability through structured enquiry and evidence from prospective users.
CO5	Transform a technical idea into a workable offering with a sound business case and present it persuasively to stakeholders.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Professional Practices Professional codes of conduct and the engineer's responsibility (IEEE/ACM codes), Ethics in AI and data: privacy, bias and accountability, Self/time management, professional communication and documentation, IT, cyber and data-protection law, Software licensing, contracts, NDAs and IP basics, Software-quality models (ISO 9001, CMMI) and QA/audit processes, Project and product management: Agile, Scrum, Lean, Production/operations systems and resource, cost and risk management.	26
Module 2: Entrepreneurial Skills The entrepreneurial mindset and types of innovation, Creativity and idea-generation techniques, Design thinking, Market validation, Business Model Canvas, pricing and unit economics, Technology readiness and productization, Product roadmap, prototyping and scaling, The startup ecosystem: incubators, accelerators, IPR for startups: patents, copyright, trademarks, Funding pathways and government/support schemes, Team building, roles and communication, The pitch deck, storytelling and investor Q&A.	26

Text Books:

1. The Lean Startup — Eric Ries.
2. Business Model Generation — Osterwalder & Pigneur.
3. Value Proposition Design — Osterwalder et al.
4. Zero to One — Peter Thiel.

Reference Books:

1. Design Thinking resources — Stanford d.school / IDEO.
2. A Guide to the Project Management Body of Knowledge (PMBOK) — PMI.
3. IEEE / ACM Codes of Ethics and relevant ISO/CMMI quality standards.
4. Startup India, MSME and DST/DPIIT scheme documentation and IPR (patent/copyright) guidelines.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment -1 Quiz (10) -2 Group Assignment(s) (50) -Milestone 1- Literature review & problem/opportunity validation -Milestone 2- Proof-of-Concept Review	60

Assessment Tool	% Contribution during CO Assessment
End Semester Examination -Lab-to-Launch Report (10) -Milestone 3- Final product presentation before a committee (30)	40

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Interactive lectures- concept sessions with in-class questioning and discussion.
CD2	Group activities & group performance- collaborative tasks, role-plays and reflective activities.
CD3	Invited expert talks- sessions by entrepreneurs, incubation leads, IPR/legal experts and industry practitioners.
CD4	Project-based (experiential) learning- team building of a product/app under faculty mentorship, with milestone reviews.
CD5	Presentations & investor-style pitching- periodic pitch sessions culminating in a final demo-day pitch.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	0	1	1
CO2	1	1	1
CO3	2	3	3
CO4	3	3	3
CO5	3	3	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD3, CD4
CO2	CD1, CD2, CD3
CO3	CD1, CD2, CD3, CD4, CD5
CO4	CD2, CD3, CD4, CD5
CO5	CD1, CD2, CD3, CD4, CD5

Course Code: CS26519

Course Title: Basics of Python Programming
Pre-requisite(s): Logical Ability
Co-requisite(s):
Credits: 3 L: 0 T: 2 P: 2
Class Schedule per Week:
Class: M. Tech
Semester / Level: Third/Sixth
Branch: CSE/AIML
Name of the Teacher:

Course Objectives

This course enables the students to:

1.	Familiarize students with the Python programming environment and fundamental programming constructs required for developing simple Python applications.
2.	Develop problem-solving skills through the use of decision-making and iterative programming constructs in Python.
3.	Introduce modular programming concepts and enable efficient storage, organization, and manipulation of data using Python data structures.
4.	Equip students with techniques for managing external data through files and developing robust programs using exception-handling mechanisms.
5.	Introduce object-oriented programming principles and enable students to design simple, reusable, and maintainable Python applications.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Understand Python syntax and programming environment. Write simple Python programs using variables and expressions.
CO2	Develop programs involving decision-making and repetition. Apply logical constructs to solve computational problems.
CO3	Develop modular programs using functions. Manipulate and process data using Python data structures.
CO4	Perform file-based data processing and develop reliable programs using exception-handling techniques.
CO5	Understand fundamental object-oriented programming concepts.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Python Fundamentals- Introduction to programming and computation, Python installation and development environment, Variables and Data types, Operators, Expressions, Evaluation of Expressions, Input and output operations, Type conversion, Comments and documentation	6
Module 2: Control Structures and Program Logic- Conditional statements, Nested conditional statements, Iterative statements, Loop control statements (break, continue, pass), Pattern generation and simple problem-solving	9
Module 3: Functions and Python Data Structures- Built-in functions, User-defined functions, Function arguments and return values, Scope of variables, Strings and string operations, Lists, tuples, sets, and dictionaries, Basic list comprehensions	9
Module 4: File Handling and Exception Handling- Reading and writing text files, File modes and operations, working with directories, Introduction to exceptions, Exception handling using try, except, else, and finally, User-defined exceptions	9
Module 5: Object-Oriented Programming (OOP)- Classes and objects, Attributes and methods, Constructors, Encapsulation, Introduction to inheritance, Modules and packages	6

Text Books:

1. Python Crash Course, Eric Matthes, No Starch Press, 3rd Edition, 2023.

Reference Books:

1. Learning Python, 5th Edition, O'Reilly Media.
2. Introduction to Computation and Programming Using Python, MIT Press.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Concept based Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini projects
CD5	Interactive Lectures, Flipped Classroom Activities
CD6	Self- learning through NPTEL materials and internets
CD7	Case Studies via Research Papers

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	1	3
CO2	3	1	3
CO3	3	2	3
CO4	3	2	3
CO5	2	1	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD5, CD6
CO2	CD1, CD2, CD3, CD5, CD6, CD7
CO3	CD1, CD2, CD3, CD4, CD5, CD6, CD7
CO4	CD1, CD2, CD3, CD4, CD5, CD6, CD7
CO5	CD1, CD2, CD5, CD6, CD7

Course Code: CS26521

Course Title: Blockchain Technology
Pre-requisite(s):
Co-requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class Schedule per Week: 3
Class: M. Tech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Provide an overview of the different blockchain technologies.
2.	Provide the knowledge of cryptocurrency design and its security against scam, fraud, hacking.
3.	Provide the ability to design and implement new ways of using blockchain for applications other than cryptocurrency.
4.	Able to apply the knowledge gained through the course in actual blockchain development or blockchain contract development.
5.	Provide the knowledge of the applications of blockchains in various industries.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Learn and explain the difference between centralized, decentralized network and blockchain.
CO2	Explain fundamental concepts of blockchain using hashes and consensus.
CO3	Understand the concept of mining in blockchains.
CO4	Understand the working of Bitcoin and its security.
CO5	Know about the different platforms for implementing blockchain and its varied application.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Introduction to Blockchain Technology Introduction to Blockchain, History of Blockchain, Trusted Third party for transactions, Difference between Centralized, Decentralized and Distributed peer to peer networks, Types of Blockchain (Permission Blockchain vs. Permissionless Blockchain), Components and limitations of Blockchain. **Cryptographic Primitives:** Hash functions, Puzzle friendly Hash, Collison resistant hash, Digital Signatures, Public Key Cryptosystems, Zero-Knowledge Systems**.**	**8**
Module 2: Fundamental concepts of Blockchain **I**ntroduction to Bitcoins, Concepts of Block, Transactions: Recording transactions, Digital Signature, Verifying and confirming transactions, Blocks and blockchain: Gensis Block, Hash pointers, Consensus building, Bitcoin downsides.	**8**

Distributed consensus, Byzantine general problems, Consensus mechanism: POW, POS, POB, POA, Hybrid, etc. Blockchain Architecture, Markle Root Tree	
Module 3: Mining and Simulating Blockchain Mining and simulating blockchain: Game theory behind competitive mining. Incentives: mining and transaction fees, Energy expended in mining, Identity Management **Smart Contracts:** Definition, Lifecycle, History, Features, Types and Working, Contract deployment, access control, Smart contract vulnerability, Advantages and Challenges.	**8**
Module 4: Cryptocurrency Bitcoin creation, exchanges. Wallets, Types of Wallets, and Cryptocurrencies (Monero, Zcash). Protecting blockchain from attackers. Forks – soft and hard, Blockchain security, Key Management in Bitcoin, Litecoin, Altcoins, **Security:** Common attacks on Blockchain: 51% Attack, Sybil Attack, Replay attack, Double spending attack.	**8**
Module 5: Platforms and Applications Introduction to Blockchain platform: Interoperability, PAXOS, Ethereum, Hyperledger Fabric, EVM, IOTA, EOS, Multichain, Bigchain, CORDA, SOLIDITY, designing a new blockchain, Distributed Application (DAPP) Plug and Play Blockchain mechanism. **Applications:** Cybersecurity, E-Governance, Elections, Medical Information Systems, File sharing, Supply-Chain management, Payment channels.	**8**

Text Books:

1. Bitcoin and Cryptocurrency technologies: a comprehensive introduction. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Princeton University Press, First edition,2016
2. Blockchain Applications: A Hands-On Approach. Arshdeep Bahga, Vijay Madisetti. VPT Publisher. First edition, 2018.
3. Blockchain: Step – by – Step Guide to Understand by Paul Laurence, Createspace Independent Pub.

Reference Books:

1. Introducing Ethereum and Solidity Foundations of Cryptocurrency and Blockchain Programming for Beginners by Chris Dannen, Apress
2. Blockchain: The comprehensive beginner's guide by Frank Walrtin

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	20
Assignment(s)	10
Seminar before a committee	20
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	√	√	√		√
Semester End Examination	√	√	√	√	√

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/assignments
CD3	Mini projects/projects
CD4	Self- learning such as use of NPTEL materials and internets

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	1	3
CO2	2	1	3
CO3	2	1	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1
CO2	CD1, CD2
CO3	CD1, CD2, CD3
CO4	CD1, CD4
CO5	CD1, CD4

Course Code: CS26522

Course Title: Blockchain Technology Lab
Pre-requisite(s):
Co-requisite(s):
Credits: 1.5 L: 0 T: 0 P: 3
Class Schedule per Week: 3
Class: M. Tech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Learn how to set up a MetaMask wallet, fund it with Ether, and perform basic blockchain transactions.
2.	Gain hands-on experience with Remix IDE and Solidity programming for creating smart contracts.
3.	Understand and implement deployment of smart contracts on Ganache using Truffle framework.
4.	Develop competence in full stack blockchain application development using Web3 and Truffle.
5.	Apply blockchain concepts to design and implement small-scale real-time applications.

COURSE OUTCOMES (COs)

After the completion of this course, students will be able to:

CO1	Design and implement smart contracts using Solidity on Remix IDE.
CO2	Create and configure crypto wallets (e.g., MetaMask) and perform transactions with accounts from Ganache.
CO3	Deploy smart contracts on Ganache using Truffle.
CO4	Develop full stack blockchain applications integrating Web3 and blockchain frameworks.
CO5	Design and implement small-scale real-time blockchain applications.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Introduction **Metamask and Ethereum:** Creating accounts and Crypto wallets, depositing Ethers, making a transaction.	**6**
Module 2: Solidity Programming Remix, Solidity and Smart Contracts: Introduction to Solidity Programming, Address Binding, Error Handling, Remix IDE.	**6**
Module 3: Smart Contracts Smart Contract Deployment: Compile and deploy smart contracts in Remix.	**9**

Module 4: Smart Contracts Interactions Full Stack Blockchain: Configuration of peers, transferring Ethers from one account to another, interacting with smart contracts.	**9**
Module 5: Implementation Designing one Full-fledged Blockchain Application.	**9**

Text Books:

1. Bitcoin and Cryptocurrency technologies: a comprehensive introduction. Arvind Narayanan, Joseph Bonneau, Edward Felten, Andrew Miller, and Steven Goldfeder. Princeton University Press, First edition,2016
2. Blockchain Applications: A Hands-On Approach. Arshdeep Bahga, Vijay Madisetti. VPT Publisher. First edition,2018.
3. Blockchain: Step – by – Step Guide to Understand by Paul Laurence, Createspace Independent Pub.

Reference Books:

1. Introducing Ethereum and Solidity Foundations of Cryptocurrency and Blockchain Programming for Beginners by Chris Dannen, Apress
2. Blockchain: The comprehensive beginner's guide by Frank Walrtin

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	**% Distribution**
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors
CD2	Tutorials/assignments
CD3	Mini projects/projects
CD4	Self- learning such as use of NPTEL materials and internets

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	3
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1
CO2	CD1, CD2
CO3	CD1, CD2, CD3
CO4	CD1, CD4
CO5	CD1, CD4

Course Code: CS26523

Course Title: Computer Vision
Pre-requisite(s): Linear Algebra, Vector Calculus
Co-requisite(s):
Credits: L: 3 T: 0 P:
Class Schedule per Week: 03
Class: M. Tech
Semester / Level: Second/Fifth
Branch: M. Tech in CSE/ AIML

Course Objectives

This course enables the students to:

1.	Understand the fundamentals of image formation, acquisition, and visual representation.
2.	Apply computer vision techniques for image analysis and object recognition.
3.	Develop feature extraction and matching methods for visual understanding.
4.	Analyze motion, alignment, and scene reconstruction from images and videos.
5.	Explore depth estimation and 3D vision techniques for real-world applications.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Explain image formation, filtering, and transformation techniques used in computer vision.
CO2	Apply recognition and classification methods for visual content analysis.
CO3	Implement feature detection, matching, and contour-based image analysis techniques.
CO4	Develop solutions for image alignment, stitching, and motion estimation.
CO5	Construct 3D scene representations using depth estimation and correspondence analysis.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Introduction to Computer Vision Computer Vision What and why? Image Formation, Digital Camera, Linear and Non-Linear Filtering, Fourier and Geometric Transforms, Pyramid and Wavelets.	8
Module 2: Model Fitting and Recognition Scattered data interpolation, Variational methods and regularization, Instance Recognition, Image Classification, Object Detection, Semantic Segmentation, Video Understanding, Vision Language.	8

Module 3: Feature Detection and Matching Points and Patches, Edge and Contours, Contour Tracking, Lines and Vanishing point, Segmentation.	8
Module 4: Image alignment, Stitching and Motion Estimation Pairwise, Global and Translational alignment, Image Stitching, Compositing, Parametric, Optical, Layered Motion	8
Module 5: Depth Estimation and 3D Construction Epi polar Geometry, Sparse and Dense Correspondence, Deep networks, Monocular depth estimation, 3D scanning, Point, Surface, Volumetric Representations	8

Text Books:

1. Computer Vision: Algorithms and Applications by Richard Szeliski , Second Edition, Springer, 2021

Reference Books:

1. Deep Learning, by Goodfellow, Bengio, and Courville., 2018
2. Dictionary of Computer Vision and Image Processing, by Fisher et al., 2015
3. Computer Vision A Modern Approach David A forsyth etc. Pearson Education Second Indian Reprint 2015

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	**% Distribution**
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	√	√	√	√	√
Semester End Examination	√	√	√	√	√

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Board / Slides
CD2	Tutorial / Assignments
CD3	Self-Learning through NPTEL / online materials
CD4	Coding demonstration in class
CD5	Mini projects

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0**-** No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	1	3
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD4
CO2	CD1, CD2, CD3, CD4
CO3	CD1, CD2, CD4
CO4	CD1, CD2, CD3, CD4, CD5
CO5	CD1, CD2, CD3, CD4, CD5

Course Code: CS26524

Course Title: Computer Vision Lab
Pre-requisite(s): Python, Design and Analysis of Algorithms
Co-requisite(s): Computer Vision
Credits: 1.5 L: 0 T: 0 P: 3
Class Schedule per Week: 3
Class: M. Tech
Semester / Level: Second/Fifth
Branch: M. Tech in CSE / AIML

Course Objectives

This course enables the students to:

1.	Provide hands-on experience with fundamental image processing operations and camera systems.
2.	Enable the development of intelligent visual recognition systems using modern deep learning models.
3.	Introduce feature-based approaches for object localization and scene understanding.
4.	Develop competency in motion analysis and image registration techniques.
5.	Familiarize learners with 3D scene understanding and advanced vision applications.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Implement image acquisition, preprocessing, enhancement, and transformation techniques for computer vision applications.
CO2	Analyze and apply feature extraction, matching, segmentation, and tracking techniques for visual scene understanding.
CO3	Develop visual recognition systems using machine learning, deep learning, and vision-language models for classification, detection, and image captioning tasks.
CO4	Evaluate and implement advanced computer vision techniques for motion analysis, depth estimation, face recognition, image restoration, and human pose estimation.
CO5	Design and develop a real-world computer vision application by integrating appropriate algorithms, tools, and performance evaluation methods.

SYLLABUS

MODULE	NO. OF LECTURE SESSIONS
Module 1: Introduction to Computer Vision Experiment: Image Acquisition and Camera Fundamentals Experiment: Image Filtering Experiment: Fourier Transform Analysis Experiment: Geometric Transformations Experiment: Image Pyramids	9

Module 2: Model Fitting and Recognition Experiment: Image Classification using Transfer Learning Experiment: Object Detection Experiment: Vision-Language Modelling Experiment: Image Caption Generation using Vision-Language Models	6
Module 3: Feature Detection and Matching Experiment: Feature matcher Experiment: Feature Tracker Experiment: Contour matching Experiment: Region segmentation	6
Module 4: Image alignment, Stitching and Motion Estimation Experiment: Feature-based image alignment for flip-book animations Experiment: Featured-based stitching Experiment: Optical Flow Estimation Experiment: Motion Tracking	9
Module 5: Depth Estimation and 3D Construction Experiment: Stereo Vision Experiment: Monocular Depth Estimation Experiment: Face Detection and Face Recognition Experiment: Image Inpainting and Object Removal Experiment: Human Pose Estimation	9

Text Books:

1. Computer Vision: Algorithms and Applications by Richard Szeliski , Second Edition, Springer, 2021

Reference Books:

1. Deep Learning, by Goodfellow, Bengio, and Courville., 2018
2. Dictionary of Computer Vision and Image Processing, by Fisher et al., 2015
3. Computer Vision A Modern Approach David A forsyth etc. Pearson Education Second Indian Reprint 2015

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	**% Distribution**
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Board / Slides
CD2	Tutorial / Assignments
CD3	Self-Learning through NPTEL / online materials
CD4	Coding demonstration in class
CD5	Mini projects

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	3	2	2
CO2	3	2	2
CO3	3	3	2
CO4	3	3	2
CO5	3	3	2

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD4
CO2	CD1, CD2, CD3, CD4
CO3	CD1, CD2, CD4
CO4	CD1, CD2, CD3, CD4
CO5	CD1, CD2, CD3, CD4, CD5

Course Code: CS26525

Course Title: Advanced Graphics
Pre-requisite(s): Data Structure, Programming, Design and Analysis of Algorithm
Co-requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class Schedule per Week: 3
Class: M. Tech
Semester / Level: Second/Fifth
Branch: CSE
Name of the Teacher:

Course Objectives

This course enables the students to:

1.	Perform visual computations for geometrical drawings.
2.	Develop the practical skills for CG.
3.	Display 3D objects in a 2D display device using projection techniques.
4.	Learn Mathematical Foundations behind Computer Graphics.
5.	Create realistic images using color and shading techniques.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Acquire the knowledge of fundamental algorithms, data structures, and mathematical concepts used in computer graphics.
CO2	Design, modify, and create graphical content using tools and techniques.
CO3	Evaluate and compare different algorithms for CG enabled tasks.
CO4	Create content using 2D and 3D graphics.
CO5	Able to produce realism in the target object/ objects in a scene.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Introduction: Image Processing as Picture Analysis, The Advantages of Interactive Graphics, Representative Uses of Computer Graphics, Classification of Applications, Development of Hardware and Software for Computer Graphics, Conceptual Framework for Interactive Graphics. **Basic Raster Graphics Algorithms for Drawing 2D Primitives:** Overview, Scan Converting Lines, Scan Converting Circles, Scan Converting Ellipses, Filling Rectangles, Filling Polygons, Filling Ellipse Arcs, Pattern Filling, Thick Primitives, Line Style and Pen Style, Clipping in a Raster	8

World, Clipping Lines, Circles and Ellipses, Clipping Polygons, Generating Characters, SRGP_copyPixel, Antialising.	
Module 2: Graphics **Hardware:** Hardcopy Technologies, Display Technologies, Raster-Scan Display Systems, The Video Controller, Random-Scan Display Processor, Input Devices for Operator Interaction, Image Scanners. **Geometrical Transformations:** 2D Transformations, Homogeneous Coordinates and Matrix Representation of 2D Transformations, Composition of 2D Transformations, The Window-to- View port Transformation, Efficiency, Matrix Representation of 3D Transformations, Composition of 3D Transformations, Transformations as a Change in Coordinate System.	8
Module 3: Viewing in 3D: Projections, Specifying an Arbitrary 3D View, Examples of 3D Viewing, The Mathematics of Planar geometric Projections, Implementing Planar Geometric Projections, Coordinate Systems.	8
Module 4: Input Devices, Interaction Techniques, and Interaction Tasks: Interaction Hardware, Basic Interaction Tasks, Composite Interaction Tasks. **Representation Curves and Surfaces:** Polygon Meshes, Parametric Cubic Curves, Parametric Bicubic Surfaces, Quadric Surfaces. **Achromatic and Colored Light:** Achromatic Light, Chromatic Color, Color Models for Raster Graphics, Reproducing Color, Using Color in Computer Graphics.	8
Module 5: The Quest for Visual Realism: Why Realism? Fundamental Difficulties, Rendering Techniques for Line Drawings, Rendering Techniques for Shaded Images, Improved Object Models, Dynamics, Stereosis, Improved Displays, Interacting with Our Other Senses, Aliasing and Antialiasing. **Visible-Surface Determination:** Functions of Two Variables, Techniques for Efficient Visible- Surface Algorithms, Algorithms for Visible-Line Determination, The z-Buffer Algorithms, List- Priority Algorithms, Area-Subdivision Algorithms, Algorithms for Octress, Algorithms for Curved Surfaces, Visible-Surface Ray Tracing. **Illumination and Shading:** Illumination Models, Shading Models for Polygons, Surface Detail, Shadows, Transparency, Inter object Reflections, Physically Based Illumination Models, Extended Light Sources, Spectral Sampling.	8

Text Books:

1. Foley, Dam Van, Feiner, Hughes “Computer Graphics Principles & Practice”, 11th Edition., Pearson Education, New Delhi, 2004.

Reference Books:

1. Hearn D. & Baker M.P. “Computer Graphics”, PHI, New Delhi, 2006.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10

Continuous Internal Assessment	% Distribution
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	1	3
CO2	2	2	3
CO3	3	2	3
CO4	3	2	3
CO5	2	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3,
CO4	CD1, CD3, CD6, CD7

Course Code: CS26526

Course Title: Advanced Graphics Lab
Pre-requisite(s):
Co-requisite(s):
Credits: 1.5 L: 0 T: 0 P: 1.5
Class Schedule per Week: 3
Class: M.Tech
Semester / Level: Second/Fifth
Branch: CSE
Name of the Teacher:

Course Objectives

This course enables the students to:

1.	Learn Computer Graphics Programming Skills
2.	Drawing fundamental pictures.
3.	Learning different visual transformations
4.	Visualize 2D and 3D Model Objects
5.	Learn Graphical Applications

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Create Pictures using 2D and 3D Graphics
CO2	Develop techniques for rendering, clipping and transformations
CO3	Implement Algorithms for 2D and 3D Model
CO4	Create dynamic scenes to represent Animation
CO5	Develop Computer Graphics based solutions for different Applications

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module – I Programs based different geometrical figures. Programs based on Computer Graphics Foundations	9
Module – II Programs based on Transformations, Clipping and Viewing Algorithms	9
Module – III Programs based on Projection and 3D Graphics	6
Module – IV Programs based on Curves, Surfaces	6

Module – V Programs based on 2D and 3D Geometry, Programs based on Graphical Applications	9

Text Books:

1. Graphics Using C, by Yashwant Kantekar, BPB Publication

Reference Books:

1. Open Gl Programming Language: The Official Guide to Learning Open Gl, Version 1.2, 3/E , Pearson Education Publisher
2. Roger T. Stevens, Advanced Graphics Programming in C and C++, BPB Publication
3. Donald Hearn, M. Pauline Baker, Computer Graphics, C Version, Prentice Hall Publication

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	**% Distribution**
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	**Course Delivery Method**
CD1	Demonstration by use of smart boards/LCD projectors
CD2	Assignments
CD3	Viva-Voce/Quiz (s)
CD4	Software and Hardware
CD5	Laboratory experiments/Coding

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	3
CO2	2	1	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD3, CD5
CO3	CD3, CD5
CO4	CD2, CD3, CD4
CO5	CD1, CD3, CD5

Course Code: CS26527

Course Title: Cyber Security and Digital Forensics
Pre-requisite(s):
Co-requisite(s):
Credits: 3 **L:** 3 **T:** 0 **P:** 0
Class Schedule per Week: 3
Class: M. Tech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Develop a comprehensive understanding of cyber security principles, threats, and safeguards.
2.	Acquire knowledge of digital forensics techniques for detection, investigation, and prevention of cybercrimes.
3.	Gain proficiency in Intrusion Detection and Prevention Systems to secure digital infrastructures.
4.	Apply techniques for evidence collection, preservation, and analysis of digital devices and networks
5.	Understand the legal, ethical, and professional considerations in cyber security and forensics.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Explain key concepts of cyber security, cybercrime, and relevant laws and ethics.
CO2	Apply digital forensic tools and methodologies to investigate security incidents.
CO3	Evaluate e-discovery processes, guidelines, and evidence handling procedures.
CO4	Implement Intrusion Detection and Prevention Techniques in real-world scenarios.
CO5	Assess and secure web applications considering current threats and industry practices.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Introduction to Cyber Security and Cyber Crime Introduction to Cyber Security, Cyber Security Vulnerabilities and Cyber Security Safeguards – Overview, vulnerabilities in software, System administration, Complex Network Architectures, Open Access to Organizational Data, Weak Authentication, Unprotected Broadband communications, Cyber Security Safeguards – Overview, overview of cybercrime and its types.	8
Module 2: Securing Web Applications & Cryptography Classical Cryptography, Modern Cryptography, Symmetric Encryption, Asymmetric Encryption, Hash Functions, Digital Signatures, Public Key Infrastructure (PKI), Securing Web Application, Services and Servers Introduction, Basic security for HTTP Applications and Services, Basic Security for SOAP Services, Identity Management and Web Services, Authorization Patterns, Firewalls, Web Application Vulnerabilities.	8

Module 3: Intrusion Detection and Prevention Systems Intrusion Detection and Prevention, Physical Theft, Abuse of Privileges, Unauthorized Access by Outsider, Malware infection, Intrusion detection and Prevention Techniques, Anti-Malware software, Network based Intrusion detection Systems, Network based Intrusion Prevention Systems, Host based Intrusion prevention Systems, Security Information Management, Network Session Analysis, System Integrity Validation.	8
Module 4: Introduction to Digital Forensics Digital forensics fundamentals- Understanding digital forensics, its significance, and its role in cybersecurity; Types of Digital Forensics: Computer forensics, mobile device forensics, network forensics, multimedia forensics etc.; Steps involved in digital forensic investigations- Procedures for identifying and collecting digital evidence; Techniques for preserving the integrity of digital evidence; Maintaining and documenting the chain of custody.	8
Module 5: Digital Forensics Analysis and Tools Forensic Tools: Overview of commonly used tools in digital forensics (e.g., FTK, EnCase, Autopsy); Audio-video evidence collection, Preservation and Forensic Analysis. E-Mail investigations- investigating email crime and violations, understanding E-Mail servers, specialized E-Mail forensics tool.	8

Text Books:

1. Godbole, N. and Belapure, S., Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley India Pvt. Ltd., New Delhi, First Edition, 2014.
2. Johansen, G., Digital Forensics and Incident Response: Incident Response Techniques and Procedures to Respond to Modern Cyber Threats, Packt Publishing Ltd., Birmingham, UK, First Edition, 2017.
3. Stallings, W., Cryptography and Network Security: Principles and Practice, 8th Edition, Pearson Education, 2023. ISBN: 978-9356061316.

Reference Books:

1. Shema, M., Anti-Hacker Tool Kit, Indian Edition, McGraw-Hill Education, New Delhi.
2. Scarfone, K. and Mell, P., Guide to Intrusion Detection and Prevention Systems (IDPS), NIST Special Publication 800-94, National Institute of Standards and Technology, 2007.
3. Vacca, J. R., Computer Forensics: Computer Crime Scene Investigation, 2nd Edition, Charles River Media, Inc., 2015. ISBN: 978-1-58450-389-7.
4. Nelson, B., Phillips, A., Enfinger, F. and Steuart, C., Guide to Computer Forensics and Investigations, 6th Edition, Cengage Learning India Pvt. Ltd., 2019. ISBN: 9789353506261.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	20

Continuous Internal Assessment	% Distribution
Assignment(s)	10
Seminar before a committee	20
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	1	3
CO2	2	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD6
CO2	CD1, CD2, CD3, CD6
CO3	CD1, CD2, CD4, CD6

Course Outcomes	Course Delivery Method
CO4	CD1, CD3, CD4, CD7
CO5	CD1, CD2, CD4, CD6, CD7

Course Code: CS26528

Course Title: Cyber Security and Digital Forensics Lab
Pre-requisite(s):
Co-requisite(s):
Credits: 1.5 L:0 T: 0 P:3
Class Schedule per Week: 3
Class: M. Tech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Understand and implement cryptographic algorithms, hashing techniques, digital signatures, and key exchange protocols for secure communication.
2.	Apply information hiding techniques such as digital watermarking and steganography for data protection and authentication.
3.	Utilize cyber security tools and techniques for packet capture, network traffic analysis, port scanning, and intrusion detection.
4.	Develop practical skills in network security monitoring, vulnerability assessment, and cyber threat detection using industry-standard tools.
5.	Apply digital forensic investigation techniques for email analysis, evidence acquisition, and recovery of deleted, fragmented, or hidden digital data.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Implement and evaluate classical, symmetric, and asymmetric cryptographic algorithms along with digital signature and key exchange mechanisms.
CO2	Apply hashing, digital watermarking, and steganography techniques to ensure confidentiality, integrity, and authenticity of digital information.
CO3	Use cyber security tools such as Kali Linux, Wireshark, and Nmap to perform packet capture, traffic analysis, network monitoring, and vulnerability assessment.
CO4	Design and develop basic security solutions such as intrusion detection systems (IDS) for identifying and responding to suspicious network activities.
CO5	Perform digital forensic investigations including email forensics, evidence acquisition, and recovery of deleted or hidden files using forensic tools and methodologies.

Syllabus

MODULE	NO. OF LECTURE HOURS
1. Implementation and Analysis of Classical Cryptographic Algorithms for secure message encryption and decryption.	6

2. Implementation and Performance Evaluation of Symmetric Key Cryptographic Techniques for secure data communication. 3. Implementation and Analysis of Asymmetric Key Cryptographic Techniques for public-key based security applications.	
1. Implementation of Digital Signature Algorithms for authentication, integrity verification, and non-repudiation. 2. Development of Programs for Hash Generation and Verification of files and messages using standard cryptographic hash functions. 3. Implementation and Analysis of Key Exchange Protocols for secure establishment of cryptographic keys between communicating entities.	6
1. Implementation of Digital Watermarking Techniques for ownership protection and authentication of digital media. 2. Implementation of Steganographic Techniques for secure information hiding within digital content. 3. Study and Familiarization of Cyber Security and Digital Forensics Tools, including Kali Linux, Autopsy, FTK Imager, and Wireshark.	9
1. Packet Capture and Traffic Monitoring using Wireshark for network communication analysis. 2. Network Traffic Analysis using Wireshark involving packet capture, protocol analysis, and identification of suspicious network activities. 3. Network Reconnaissance and Port Scanning using Nmap for service discovery and security assessment.	9
1. Email Forensic Investigation through Header Analysis, Sender Tracing, and Spoofing Detection using email forensic techniques and tools. 2. Design and Development of a Basic Intrusion Detection System (IDS) for monitoring and detecting suspicious network activities. 3. Recovery and Analysis of Deleted, Fragmented, and Hidden Files from Raw Disk Data using forensic recovery techniques independent of file system metadata.	9

Text Books:

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, 8th Edition, Pearson Education.
2. Nina Godbole and Sunit Belapure, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley India.
3. Bill Nelson, Amelia Phillips and Christopher Steuart, Guide to Computer Forensics and Investigations, Cengage Learning.
4. Eoghan Casey, Digital Evidence and Computer Crime, Academic Press.
5. Michael Sikorski and Andrew Honig, Practical Malware Analysis, No Starch Press.

Reference Books:

1. Jason Luttgens, Matthew Pepe, and Kevin Mandia, Incident Response and Computer Forensics, McGraw-Hill.
2. Chris Sanders and Jason Smith, Applied Network Security Monitoring, Syngress.
3. Ric Messier, Mastering Kali Linux for Advanced Penetration Testing, Packt Publishing.
4. David Cowen, Computer Forensics InfoSec Pro Guide, Apress.
5. Bruce Schneier, Applied Cryptography, Wiley.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	3	2	3
CO2	3	2	3
CO3	2	2	3

CO	PO1	PO2	PO3
CO4	3	2	3
CO5	3	3	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD3, CD6, CD7
CO2	CD1, CD3, CD6, CD7
CO3	CD1, CD2, CD3, CD4, CD6, CD7
CO4	CD1, CD2, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD6, CD7

Course Code: CS26529

Course Title: Internet of Things
Pre-requisite(s):
Co-requisite(s):
Credits: 3 L: 3 T:0 P:0
Class Schedule per Week: 3
Class: MTech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Understand the basic concept and the IoT Paradigm
2.	Know the state of art architecture for IoT applications
3.	Learn the available protocols used for IoT
4.	Design basic IoT Applications.
5.	Evaluate optimal IoT applications.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Identify the IoT Components and its capabilities
CO2	Explain the architectural view of IoT under real world constraints
CO3	Analyse the different Network and link layer protocols
CO4	Evaluate and choose among the transport layer protocols
CO5	Design an IoT application

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Introduction The **definition** of the Internet of Things, main assumptions and perspectives. Platform for IoT devices Device architectures. M2M Architectures, IoT reference Model - IoT Reference Architecture.	8
Module 2: Technology Fundamentals and Architecture of IOT Node structure: Sensing, Processing, Communication, Powering IoT networking: Topologies, Layer/Stack architecture. CoRE, REST Principles. Wireless communication technologies. Wireless sensor networks, IPv6, 6LowPAN, Physical layer, network layer protocols., Routing protocols; RPL.	8
Module 3: Communication Technologies Introduction to ZigBee, BLE, WiFi, LTE, IEEE 802.11ah, Service oriented protocols (COAP), Service discovery protocols. Communication protocols based on the exchange of messages (MQTT).	8

Module 4: Data processing for IoT Devices and gateways, Local and wide area networking, Data management, basics of Cloud computing. Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management	8
Module 5: Service Layer Protocols & Security Service Layer -oneM2M, ETSI M2M. Security in IoT Protocols –IPSec, DTLS. Application case studies: Smart Parking. Home Automation. Smart City	8

Text Books:

1. Raj Pethuru and Raman Anupama C., The Internet of Things: Enabling Technologies, Platforms, and Use Cases, CRC Press.
2. Holler Jan, TsiatsisVlasios, Mulligan Catherine, Avesand Stefan, Karnouskos Stamatis, Boyle David, From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence, 1st Edition, Academic Press, 2014.

Reference Books:

1. Madisetti Vijay and BahgaArshdeep, Internet of Things (A Hands-on-Approach), 1st Edition, VPT, 2014.
2. Vermesan Dr. Ovidiu, Friess Dr. Peter, Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems, River Publishers.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	1	3
CO2	2	1	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

Course Code: CS26531

Course Title: Quantum Computing

Pre-requisite(s): Probability and Statistics, Machine Learning
Co-requisite(s): Discrete Mathematics
Credits: 3 L: 3 T: 0 P: 0
Class Schedule per Week: 03
Class: MTech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Be familiar with the fundamental principles of quantum mechanics and mathematical foundations that form the basis of quantum computation.
2.	Understand the presentation and manipulation of quantum information through qubits, quantum gates, multi-qubit systems, and quantum circuits.
3.	Design quantum algorithms for solving complex problems.
4.	Develop practical skills in quantum programming, simulation, and implementation of quantum circuits.
5.	Explore emerging applications of quantum computing while understanding current challenges and future research directions.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Understand the fundamental principles of quantum mechanics relevant to quantum computing.
CO2	Explain the concepts of qubits, quantum gates, and quantum circuits.
CO3	Analyze and implement basic quantum algorithms.
CO4	Apply quantum computing frameworks such as Qiskit or Cirq for simple quantum programs.
CO5	Identify emerging applications of quantum computing in optimization, machine learning, and cryptography.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Fundamentals of Quantum Mechanics for Computing: Introduction to Quantum computing, Classical vs quantum computation, Mathematical foundations: vectors, matrices, complex numbers, Linear algebra concepts for quantum systems, Pauli matrices, Hilbert space, Postulates of quantum mechanics, Representation of quantum states, Dirac notation, Measurement postulate, Superposition principle	8
Module 2: Qubits and Quantum Gates: Qubit representation, Bloch sphere representation, Multi-qubit systems, Tensor product and composite systems, Quantum gates: Pauli gates (X, Y, Z), Hadamard	8

gate, Phase gate, T gate, Multi-qubit gates: Controlled-NOT (CNOT), SWAP gate, Universal quantum gates, Quantum circuit representation	
Module 3: Quantum Algorithms: Introduction to quantum algorithms, Quantum parallelism, Deutsch and Deutsch–Jozsa algorithms, Grover's search algorithm, Quantum Fourier Transform, Shor's factoring algorithm (overview), Quantum Phase Estimation, Variational Quantum Eigen solver (VQE), Quantum Approximate Optimization Algorithm (QAOA)	8
Module 4: Quantum Programming and Simulation: Introduction to quantum programming platforms, Quantum circuit design using Qiskit / Cirq, Quantum simulators, Execution on cloud quantum computers, Implementation of basic quantum algorithms, Noise in quantum systems, NISQ (Noisy Intermediate Scale Quantum) devices	8
Module 5: Quantum Computing and Security: Quantum cryptography and quantum key distribution, Quantum communication and teleportation, Quantum machine learning concept, Optimization problems using quantum computing, Emerging quantum technologies and future directions.	8

Text Books:

1. Michael A. Nielsen and Isaac L. Chuang, Quantum Computation and Quantum Information, Cambridge University Press.

2. Eleanor Rieffel and Wolfgang Polak, Quantum Computing: A Gentle Introduction, MIT Press.

Reference Books:

1. Phillip Kaye, Raymond Laflamme, and Michele Mosca, An Introduction to Quantum Computing, Oxford University Press.

2. Chris Bernhardt, Quantum Computing for Everyone, MIT Press.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓

Assessment Components	CO1	CO2	CO3	CO4	CO5
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Tutorials/Assignments
CD3	Seminars
CD4	Mini projects/Projects
CD5	Laboratory experiments/teaching aids
CD6	Industrial/guest lectures
CD7	Industrial visits/in-plant training

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	1	3
CO2	2	1	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

Course Code: CS26533

Course Title: Modern Optimisation Techniques
Pre-requisite(s):
Co-requisite(s):
Credits: 3 L: 3 T:0 P:0
Class Schedule per Week:3
Class: M.Tech.
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Model a problem of real world into a mathematical system.
2.	Recognize common issues that occur while modelling a real-life problem using optimization techniques.
3.	Understand the core concept of various Classical and Modern Optimization approaches
4.	Select most suitable technique among the multiple option to solve complex problem.
5.	Develop the capacity of suggesting changes to an existing system for optimality issues.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Develop an understanding of optimization principles and their use in real-world problems using Linear Programming Problem modeling
CO2	Use Integer Programming techniques to real-world problems
CO3	Develop an understanding of the approach of Evolutionary Computing for solving Complex optimization Problems
CO4	Use Genetic Algorithms to solve in real-world problems
CO5	Use Swam Intelligence approaches like PSO to Model and solve optimization problems

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Linear Programming Introduction to Linear Programming, Solving Linear Programming Problems, The Simplex Method, Duality Theory and Sensitivity Analysis, Other Algorithms for Linear Programming.	8
Module 2: Integer Programming Some Formulation Examples, The Branch-and-Bound Technique for BIP and Mixed Integer Programming, The Branch-and-Cut Approach, The Incorporation of Constraint Programming.	8

Module 3: Introduction to Evolutionary Computation Generic Evolutionary Algorithm, Representation, Initial Population, Fitness Function, Selection, Reproduction Operators, Stopping Conditions, Evolutionary Computation versus Classical Optimization	8
Module 4: Genetic Algorithms Canonical Genetic Algorithm, Crossover, Mutation, Control Parameters, Genetic Algorithm Variants, Niching Genetic Algorithms, Constraint Handling, Multi-Objective Optimization, Dynamic Environments.	8
Module 5: Computational Swam Intelligence Basic Particle Swarm Optimization, Social Network Structures, Basic Variations, Basic PSO Parameters, Single-Solution Particle Swarm Optimization, Constraint Handling Approaches, Multi-Objective Optimization	8

Text Books:

1. Frederick S. Hillier and Gerald J. Lieberman, "Introduction to Operation Research", 10th Edition, McGraw-Hill Education, 2015.
2. A. P. Engelbrecht, Computational Intelligence, Wiley, USA, 2007.

Reference Books:

1. Taha, Hamdy A., "Operations Research an Introduction". 9th Edition, Pearson Prentice Hall, 2014.
2. S.N.Sivanandam & S.N.Deepa, Introduction to Genetic Algorithms, Springer Berlin Heidelberg New York, 2008.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	3
CO2	3	2	3
CO3	2	1	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

Course Code: CS26535

Course Title: GPU Computing
Pre-requisite(s): Parallel Computing
Co-requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class Schedule per Week: 3
Class: M.Tech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Understand the basics of GPU architectures
2.	Identify CPU GPU Program Partitioning
3.	Write programs for massively parallel processors
4.	Identify the issues in mapping algorithms for GPUs
5.	Introduce different GPU programming models

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Understand about GPU architectures
CO2	Partition CPU GPU Program
CO3	Write Massively Parallel Program (MPP) to solve Complex problems
CO4	Identify the part of the algorithm that can be MPP
CO5	Write CUDA and OpenCL code

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module I: GPU ARCHITECTURE– Flynn's Taxonomy, Basic five stage RISC Pipeline, Cache Memory. Concept on Threads, Blocks and Grids, Warps, Concept on Shared and Distributed Memory. Parallelism over Flynns's Architectures.	8
Module II: GPU Architecture and CUDA PROGRAMMING – Introduction to GPU architecture and Parallelism with GPU, CUDA Hardware Overview, Memory Handling with CUDA. Introduction to GPU programming, Comparison between CPU and GPU, Parallel programming using CUDA and Multi-GPU, Division of work between CUDA Kernels and CPU, Optimizing CUDA Applications: Problem Decomposition, Memory Considerations, Transfers, Thread Usage, Resource Contentions.	10

Module III: PROGRAMMING ISSUES- CUDA Errors Handling, Parallel Programming Issues: Synchronization and Barriers (local versus global), Algorithmic Issues, Finding and Avoiding Errors.	6
Module IV: OPENCL BASICS- OpenCL Standard– Kernels– Host Device Interaction– Execution Environment– Memory Model– Basic OpenCL Examples.	8
Module V: ALGORITHMS ON GPU - Parallel Patterns: Convolution, Prefix Sum, Sparse Matrix– Matrix Multiplication– Programming Heterogeneous Cluster**.**	8

Text Book

1. Shane Cook, CUDA Programming (2012): A Developer's Guide to Parallel Computing with GPUs (Applications of GPU Computing), First Edition, Morgan Kaufmann, 2012.

Reference Books

1. Programming Massively Parallel Processors: A Hands-on Approach; David Kirk, Wen-mei Hwu; Morgan Kaufman; 2022 (ISBN: 978-0323912310)
2. CUDA Programming: A Developer's Guide to Parallel Computing with GPUs; Shane Cook; Morgan Kaufman; 2012 (ISBN: 978-0124159334)

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
Semester End Examination	50

Continuous Internal Assessment	**% Distribution**
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	3
CO2	3	2	3
CO3	2	1	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

Course Code: CS26537

Course Title: Video Processing
Pre-requisite(s): Linear Algebra
Co-requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class Schedule per Week: 3
Class: MTech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Understand the fundamentals of digital video representation and processing.
2.	Apply video enhancement and segmentation techniques.
3.	Design algorithms for motion analysis.
4.	Develop intelligent video analytics solutions using deep learning.
5.	Explore applications of video processing.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Explain the fundamental concepts of digital video processing, including video representation, acquisition, color models, sampling techniques, video standards, and quality assessment metrics.
CO2	Analyze motion in video sequences using motion estimation, optical flow, and motion compensation techniques for dynamic scene understanding.
CO3	Analyze motion in video sequences using motion estimation, optical flow, and motion compensation techniques for dynamic scene understanding.
CO4	Evaluate deep learning architectures, including CNNs, 3D CNNs, RNNs, LSTMs, and Transformers, for video analytics and video understanding applications.
CO5	Design and develop intelligent video processing solutions using advanced techniques such as video super-resolution, vision-language models, Generative AI, and intelligent video analytics for real-world applications in healthcare, robotics, surveillance, and autonomous systems.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module:1 (Fundamentals of Video Processing) Introduction to video processing, Digital video representation, Human visual system and perception, Video acquisition, sensors, and frame representation, Different Color Models, Temporal and spatial sampling, Video formats and standards, Frame rate, resolution, aspect ratio, interlaced and progressive scanning, Video quality assessment metrics	8

Module: 2 (Video Enhancement and Segmentation) Introduction to video enhancement, Types of video degradation, Spatial and temporal characteristics of video, Objective and subjective quality assessment, Spatial Domain Enhancement, Frequency and Transform Domain Enhancement, Scene segmentation, Object detection and localization, Region-based and graph-based segmentation.	8
Module: 3 (Motion Analysis) Fundamentals of motion in video sequences, Motion models and assumptions, Applications of motion analysis, Motion Estimation Techniques, Optical Flow, Motion Compensation	8
Module 4: (Deep learning for Video Processing) Introduction to video analytics, CNN-based video processing, 3D Convolutional Neural Networks, Recurrent Neural Networks (RNN), Long Short-Term Memory (LSTM), Transformers for video understanding, Video classification	8
Module 5: (Advanced Topics and Applications) Video Super-Resolution, Video Understanding, Intelligent Video Analytics, Vision-Language Models, Generative AI for Video Synthesis, Medical video analysis, Robotics and UAV vision	8

Text Books:

1. Murat Tekalp, *Digital Video Processing*, 2nd Edition, Prentice Hall.
2. Yao Wang, Joern Ostermann, and Ya-Qin Zhang, *Video Processing and Communications*, Prentice Hall.

Reference Books:

1. Richard Szeliski, *Computer Vision: Algorithms and Applications*, 2nd Edition, Springer.
2. D. Forsyth and J. Ponce, *Computer Vision: A Modern Approach*.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	**% Distribution**
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	3
CO2	3	2	3
CO3	2	1	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

Course Code: AI26513

Course Title: Deep Learning
Pre-requisite(s):
Co-requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class Schedule per Week:3
Class: M.Tech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Develop a strong foundation in deep learning principles, architectures, and training methodologies for solving complex learning problems.
2.	Analyze the influence of optimization strategies, regularization techniques, and performance evaluation methods on the accuracy, convergence, and generalization of deep learning models.
3.	Design deep learning solutions for processing visual and sequential data using appropriate neural network architectures.
4.	Explore modern deep learning paradigms, including attention-based models and generative learning techniques, for addressing advanced artificial intelligence applications.
5.	Apply deep learning methodologies to develop scalable, efficient, and intelligent solutions for real-world engineering and research problems.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Design efficient deep neural network models by selecting suitable network architectures, training strategies, and regularization techniques for diverse learning tasks.
CO2	Analyze the convergence, generalization, and computational performance of deep learning models using appropriate optimization and evaluation methodologies.
CO3	Develop deep learning solutions for visual perception problems by selecting suitable architectures and transfer learning strategies.
CO4	Design deep learning models capable of learning contextual and sequential representations for complex temporal and language-based applications.
CO5	Evaluate and adapt state-of-the-art generative and representation learning techniques to address advanced artificial intelligence problems.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Deep Neural Networks and Optimization- Deep Feedforward Networks Weight Initialization Strategies, Hyperparameter Tuning, Regularization Techniques Dropout, Batch Normalization.	9

Module 2: Optimization perspectives- Optimization Algorithms: SGD, Momentum, Nesterov Momentum, RMSProp, Adam, Model Evaluation and Performance Metrics, Bias-Variance Trade-off, Vanishing and Exploding Gradient Problems	8
Module 3: Convolutional Neural Networks and Computer Vision- Digital Image Representation, Convolution Operations, Pooling Techniques, CNN Architecture, VGGNet, GoogLeNet, ResNet, Transfer Learning, Fine-Tuning Techniques, Image Segmentation.	6
Module 4: Sequence Models and Transformer Architectures- Sequential Data Processing, Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), Gated Recurrent Unit (GRU), Encoder–Decoder Models, Positional Encoding, Attention Mechanisms, Self-Attention, Transformer Architecture.	8
Module 5: Generative AI, Large Language Models, and Advanced Deep Learning Applications- Autoencoders and Variational Autoencoders (VAE), Generative Adversarial Networks (GANs), Diffusion Models (Introduction), Self-Supervised Learning.	9

Text Books:

1. Francois Chollet, *Deep Learning with Python*, 3rd Edition, Manning Publications, 2025.
2. Charu C. Aggarwal, *Neural Networks and Deep Learning*, Springer, 2018.

Reference Books:

1. Aston Zhang, Zachary Lipton, Mu Li, Alexander Smola, *Dive into Deep Learning*, Cambridge University Press, 2023.
2. Nikhil Buduma and Nicholas Locascio, *Fundamentals of Deep Learning*, O'Reilly Media.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Interactive Classroom Lectures
CD2	NPTEL Video-Based Learning
CD3	Flipped Classroom Sessions
CD4	Hands-on Laboratory Experiments using TensorFlow and PyTorch
CD5	Case Study and Research Paper Analysis
CD6	Project-Based Learning and Mini Projects
CD7	Seminars, Technical Presentations, and LLM Demonstrations

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	0	3
CO2	3	1	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2
CO2	CD1, CD2, CD3
CO3	CD3, CD4
CO4	CD5, CD6
CO5	CD5, CD6, CD7

Course Code: CS26539

Course Title: Natural Language Processing
Pre-requisite(s): Machine Learning
Co-requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class Schedule per Week: 03
Class: MTech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Provide students with foundational knowledge of Natural Language Processing (NLP), including text processing techniques and linguistic challenges involved in analyzing natural language data.
2.	Develop an understanding of statistical and classical approaches for language modeling, text representation, sequence labeling, and syntactic analysis.
3.	Enable students to explore semantic analysis techniques and lexical resources for representing and interpreting meaning in text.
4.	Introduce machine learning and deep learning approaches for solving Natural Language Processing tasks and building intelligent language systems.
5.	Familiarize students with transformer-based architectures, transfer learning, and modern NLP applications while understanding ethical considerations in language technologies.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Apply text preprocessing and linguistic analysis techniques to prepare and process natural language data.
CO2	Analyze and implement statistical and classical NLP methods for language modeling, syntactic analysis, and information extraction.
CO3	Employ semantic analysis techniques, lexical resources, and word representations for understanding and modeling textual information.
CO4	Develop NLP solutions using machine learning and deep learning models for language processing tasks.
CO5	Evaluate and apply transformer-based models and modern NLP approaches for real-world applications while considering ethical implications.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Foundations of NLP and Text Processing Introduction to NLP and applications, Phases of NLP, Text preprocessing: Tokenization and normalization, Stemming and Lemmatization, Regular Expressions, Spelling Correction, Ambiguities in NLP	6
Module 2: Statistical and Classical NLP Methods N-gram Language Models, Smoothing Techniques, Perplexity, Text Representation: Bag of Words and TF-IDF, Part-of-Speech Tagging: Hidden Markov Model, Viterbi Algorithm, Named Entity Recognition **Syntactic Parsing:** Context-Free Grammars (CFGs), CYK Parser	10
Module 3: Semantics and Lexical Resources Lexical Semantics, WordNet and lexical database, Semantic similarity, Cosine similarity, Word embeddings: Word2Vec, GloVe, FastText , Word Sense Disambiguation (WSD)	8
Module 4: Learning models for NLP **Machine Learning for NLP**: Feature Engineering for Text, Text Classification, Logistic Regression, Support Vector Machines, Sequence Labeling **Deep Learning for NLP**: Recurrent Neural Networks, LSTM and GRU, Attention Mechanism, Sequence-to-Sequence Models	9
Module 5: Transformer Models	9

Transformer Architecture, Contextual Embeddings, Transfer Learning in NLP, Large Language Models Applications (Machine Translation, Question Answering, Sentiment Analysis, Text Summarization), Ethical Issues and Bias in NLP	

Text Books:

1. Speech and Language Processing – Daniel Jurafsky & James H. Martin, Pearson Education, 3rd Edition
2. Foundations of Statistical Natural Language Processing – Christopher D. Manning & Hinrich Schütze, MIT Press, 1st edition.

Reference Books:

1. *Neural Network Methods in Natural Language Processing*, Goldberg, Y., Morgan & Claypool Publishers, 1st Edition.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures

Code	Course Delivery Method
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	1	3
CO2	2	2	3
CO3	2	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

Course Code: AI26514

Course Title: Deep Learning Lab
Pre-requisite(s): Python, Basic ML, Algebra,
Co-requisite(s): Probability and Statistics, Advanced ML, Research Methodology
Credits: 1.5 L: 0 T:0 P: 1.5
Class Schedule per Week:3
Class: M.Tech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Understand and implement deep neural network architectures, learning algorithms, and optimization techniques using modern deep learning frameworks such as TensorFlow and PyTorch.
2.	Develop practical skills in designing, training, validating, and fine-tuning deep learning models for classification, prediction, and representation learning tasks.
3.	Experiment with and analyze the impact of various hyperparameters, regularization methods, optimization algorithms, and evaluation metrics on model performance.
4.	Apply advanced deep learning architectures, including CNNs, RNNs, LSTMs, Attention Mechanisms, and Transformers, to solve computer vision and natural language processing problems.
5.	Design and deploy intelligent AI solutions using Generative AI, Large Language Models (LLMs), Prompt Engineering, and Explainable AI techniques while considering ethical and responsible AI practices.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Implement and train feedforward neural networks using TensorFlow/PyTorch for solving classification and regression problems through appropriate data preprocessing, model design, and performance evaluation.
CO2	Analyze the impact of hyperparameter tuning, optimization algorithms, regularization methods, and performance metrics on the effectiveness of deep learning models.
CO3	Develop and evaluate Convolutional Neural Network (CNN) models for image classification and computer vision applications using transfer learning and fine-tuning techniques.
CO4	Assess the suitability and performance of sequence models, including RNNs, LSTMs, GRUs, Attention mechanisms, and Transformer architectures, for natural language processing and sequential data analysis tasks.
CO5	Design and develop intelligent AI solutions using Generative AI, Large Language Models (LLMs), Prompt Engineering, Retrieval-Augmented Generation (RAG), and Explainable AI techniques for real-world applications while considering ethical AI principles.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Assignment 1: Neural Network Development and Optimization Mapped COs-CO1, CO2, Bloom's Levels-Apply (L3), Analyze (L4) Problem Statement:Develop a Feedforward Neural Network (FNN) using TensorFlow/PyTorch for a multiclass classification problem. Tasks: Select a dataset (Iris, Wine Quality, MNIST, etc.). 1. Perform data preprocessing and feature scaling.	6

2. Implement MLP with varying: o Number of hidden layers o Activation functions o Learning rates 3. Compare SGD, RMSProp, and Adam optimizers. 4. Plot: o Training Loss o Validation Loss o Accuracy Curves 5. Analyze overfitting and underfitting scenarios. Deliverables • Source Code • Experimental Report • Performance Comparison Table Practical Outcome- Students understand how neural networks learn and how optimization affects perfo**rmance.**	
Assignment 2: Hyperparameter Tuning and Model Evaluation Framework Mapped COs-CO2 Bloom's Levels- Analyze (L4), Evaluate (L5) Problem Statement: Build a model evaluation framework for deep learning systems. Tasks: 1. Use a benchmark dataset. 2. Perform: o Grid Search o Random Search 3. Experiment with: o Batch Size o Learning Rate o Dropout o Number of Epochs 4. Evaluate using: o Accuracy o Precision o Recall	6

○ F1 Score ○ ROC Curve Deliverables • Automated Hyperparameter Tuning Script • Comparative Analysis Report Practical Outcome- Students learn systematic model optimization used in industrial AI projects.	
Assignment 3: Computer Vision System using CNN and Transfer Learning Mapped COs- CO3 Bloom's Levels- Apply (L3), Analyze (L4), Evaluate (L5) Problem Statement- Develop an image classification system using CNN and Transfer Learning. Tasks 1. Select a real-world dataset: ○ Medical Images ○ Plant Disease Dataset ○ Waste Classification ○ Face Mask Detection 2. Design a CNN from scratch. 3. Implement Transfer Learning using: ○ VGG16 ○ ResNet50 ○ EfficientNet 4. Compare model performances. 5. Generate confusion matrix and explain misclassifications. Deliverables • Trained Model • Experimental Report • Deployment Demo Practical Outcome- Students gain experience in developing industrial-grade computer vision solutions.	6
Assignment 4: NLP System using Transformers Mapped COs- CO4 Bloom's Levels- Analyze (L4), Evaluate (L5) Problem Statement- Build a Transformer-based NLP application. Tasks Choose any one: • Sentiment Analysis	6

• News Classification • Fake News Detection • Question Answering Implement: 1. RNN/LSTM baseline. 2. BERT-based model. 3. Compare: o Accuracy o Training Time o Inference Time 4. Visualize attention weights. Deliverables • Source Code • Comparative Study • Presentation Practical Outcome- Students learn why Transformer architectures dominate modern AI systems.	
Assignment 5: Prompt Engineering and LLM Evaluation Mapped COs- CO4, CO5 Bloom's Levels- Evaluate (L5), Create (L6) Problem Statement- Design and evaluate prompts for a Large Language Model. Tasks 1. Use ChatGPT, Gemini, Claude, or Llama. 2. Create prompts for: o Summarization o Code Generation o Information Extraction o Report Writing 3. Evaluate: o Accuracy o Hallucination Rate o Prompt Robustness 4. Document prompt engineering strategies. Deliverables • Prompt Repository	6

• Evaluation Report Practical Outcome- Students learn how to effectively utilize LLMs in practical applications.	
Assignment 6: Retrieval-Augmented Generation (RAG) System Mapped COs- CO5 Bloom's Levels- Create (L6) Problem Statement- Develop a domain-specific AI assistant using RAG. Tasks 1. Select a domain: o Healthcare o Education o Legal o Cybersecurity 2. Create a knowledge base. 3. Use: o LangChain/LlamaIndex o Vector Database (FAISS/Chroma) 4. Integrate with an LLM. 5. Evaluate response quality. Deliverables • Functional RAG System • Architecture Diagram • Demonstration Practical Outcome- Students develop enterprise-grade AI assistants. Assignment 7: Explainable AI for Deep Learning Models Mapped COs- CO5 Bloom's Levels- Analyze (L4), Evaluate (L5) Problem Statement- Explain predictions made by a deep learning model. Tasks 1. Train CNN or Transformer model. 2. Apply: o SHAP o LIME o Grad-CAM 3. Compare explanations. 4. Analyze model biases. Deliverables	6

• Visualization Report • Bias Analysis Report Practical Outcome- Students learn trustworthy and responsible AI development.	
Assignment 8 (Capstone Mini Project): End-to-End Intelligent AI System Mapped COs- CO1–CO5 Bloom's Levels- Create (L6) Problem Statement- Design and implement a complete AI system addressing a real-world problem. Suggested Projects 1. AI Research Assistant using RAG 2. Medical Image Diagnosis System 3. Smart Attendance System 4. AI-powered Resume Screening Tool 5. Cyber Threat Detection System 6. AI Academic Advisor 7. Legal Document Summarization Assistant 8. Agricultural Disease Detection System Deliverables • Working Prototype • Research Paper Style Report • Source Code Repository • Technical Presentation Practical Outcome- Students integrate Deep Learning, Transformers, LLMs, RAG, XAI, and Responsible AI concepts into a deployable AI solution.	3

Text Books:

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, MIT Press, 2016
2. Charu C. Aggarwal, *Neural Networks and Deep Learning*, Springer, 2018.

Reference Books:

1. Francois Chollet, *Deep Learning with Python*, 3rd Edition, Manning Publications, 2025.
2. Aston Zhang, Zachary Lipton, Mu Li, Alexander Smola, *Dive into Deep Learning*, Cambridge University Press, 2023.
3. Nikhil Buduma and Nicholas Locascio, *Fundamentals of Deep Learning*, O'Reilly Media.
4. Jay Alammar and Maarten Grootendorst, *Hands-On Large Language Models*, O'Reilly Media, 2024.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	60

Assessment Tool	% Contribution during CO Assessment
End Semester Examination	40

Continuous Internal Assessment	% Distribution
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Guided Hands-on Laboratory Sessions using Python, TensorFlow, and PyTorch
CD2	Experiment-Based Learning through Implementation of Deep Learning Algorithms
CD3	Dataset-Centric Learning involving Data Preprocessing, Feature Engineering, and Model Training
CD4	Project-Based Learning (PBL) through Development of Real-World AI Applications
CD5	Case Study Analysis of State-of-the-Art Deep Learning and Generative AI Systems
CD6	Research Paper Review and Reproducibility Experiments on Recent Deep Learning Models
CD7	Collaborative Learning through Team-Based AI System Development and Peer Evaluation
CD8	Model Evaluation and Performance Analysis using Visualization and Explainability Tools
CD9	Industry-Oriented Development using Transfer Learning, LLMs, RAG Frameworks, and AI Deployment Tools
CD10	Seminar, Technical Demonstration, and Project Presentation on Emerging AI Technologies

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	3	2	3

CO	PO1	PO2	PO3
CO2	3	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3
CO2	CD2, CD3, CD8
CO3	CD1, CD4, CD8, CD9
CO4	CD4, CD5, CD6, CD9
CO5	CD4, CD6, CD7, CD9, CD10

Course Code: CS26540

Course Title: Natural Language Processing Lab
Pre-requisite(s): Python, Machine Learning
Co-requisite(s):
Credits: 1.5 L: 0 T: 0 P: 3
Class Schedule per Week: 3
Class: MTech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Provide a practical understanding of the Natural Language Processing (NLP) pipeline and text preprocessing techniques for handling textual data.
2.	Develop skills in implementing statistical and classical NLP methods for language modeling, sequence labeling, and information extraction.
3.	Enable students to represent textual information using traditional and distributed word representation techniques.
4.	Provide hands-on experience in applying machine learning and neural approaches for text classification tasks.
5.	Expose students to deep learning-based NLP applications and develop simple end-to-end language processing systems.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Implement text preprocessing and normalization techniques to prepare textual datasets for Natural Language Processing tasks.
CO2	Apply statistical and classical NLP methods for language modeling, tagging, and information extraction.
CO3	Generate and analyze text representations using feature-based and embedding-based approaches.
CO4	Develop and evaluate machine learning-based text classification models using suitable feature representations.
CO5	Design and implement deep learning-based NLP applications for solving real-world language processing problems.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: NLP Pipeline and Text Preprocessing Text preprocessing: Tokenization and normalization, Stemming and Lemmatization, Regular Expressions for Information Retrieval, Spelling Correction using sample corpora	6

Module 2: Statistical and Classical NLP Methods Build N-gram LM, Apply smoothing, Evaluate using perplexity, Implement POS tagging, Implement Named Entity Recognizer	6
Module 3: Text Representation and Document Classification TF-IDF, Bag-of-words, PMI, Word2Vec, GloVe, FastText, Cosine Similarity	9
Module 4: Text Classification **Text Classification using Machine Learning**: Naïve Bayes, Logistic Regression, Support Vector Machines **Neural Embeddings in Text Classification:** Word Embeddings and Document Embeddings	9
Module 5: Deep Learning Models in NLP and Chatbot CNN and LSTM for NLP, A Simple FAQ Bot Mini Project: Develop an end-to-end NLP Application (Teamwork)	9

Text Books:

1. Practical Natural Language Processing: A Comprehensive Guide to Building Real-World NLP Systems- S Vajjala, B Majumder, A Gupta & H Surana, O'Reilly, 1st Edition

Reference Books:

1. Speech and Language Processing – Daniel Jurafsky & James H. Martin, Pearson Education, 3rd Edition
2. Foundations of Statistical Natural Language Processing – Christopher D. Manning & Hinrich Schütze, MIT Press, 1st edition.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	**% Contribution during CO Assessment**
Continuous Internal Assessment	60
End Semester Examination	40

Continuous Internal Assessment	**% Distribution**
Day-to-day progressive evaluation	30
Lab Quiz 1	10
Lab Viva	20
End Semester Examination	**% Distribution**
End Sem Performance	30
Lab Quiz 2	10

Assessment Components	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars
CD3	Laboratory experiments/teaching aids
CD4	Industrial/guest lectures
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	1	2	3
CO2	3	2	3
CO3	2	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD6
CO2	CD1, CD6, CD7
CO3	CD1, CD2, CD3, CD6, CD7
CO4	CD1, CD3, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD7

Course Code: AI26501

Course Title: Modern Artificial Intelligence
Pre-requisite(s): Basic Artificial Intelligence, Machine Learning
Co-requisite(s):
Credits: 3 L: 3 T: 0 P: 0
Class Schedule per Week: 3 class/ week
Class: M. Tech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Provide a comprehensive understanding of the fundamental concepts, principles, and applications of Artificial Intelligence and Generative AI.
2.	Introduce intelligent search techniques, heuristic methods, and adversarial search algorithms used in AI-based problem solving.
3.	Develop knowledge of Natural Language Processing (NLP), language models, and deep learning techniques for text understanding and generation.
4.	Explain modern deep learning architectures, generative models, robotics, and automation for designing intelligent systems.
5.	Familiarize students with contemporary computer vision techniques, multimodal AI, and vision-language models for solving real-world AI applications and Promote awareness of responsible AI practices, ethical issues, and emerging trends in modern Artificial Intelligence.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Understand the fundamental concepts of Artificial Intelligence, Generative AI, ethical AI, and intelligent search techniques, and apply search algorithms to solve AI problems.
CO2	Apply Natural Language Processing techniques, language models, word embeddings, and recurrent neural networks to analyze and solve text processing and language understanding problems.
CO3	Understand and analyze the principles of AI-enabled robotics, including robot perception, motion planning, navigation, and automation in intelligent systems.
CO4	Analyze and evaluate deep learning architectures, including ANN, CNN, RNN, LSTM, and generative models such as Autoencoders, Variational Autoencoders (VAE), GANs, and Diffusion Models for AI applications.
CO5	Apply computer vision techniques, including image classification, object detection, image segmentation, Vision Transformers (ViT), vision-language models, and multimodal AI to design and develop intelligent vision-based applications.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: INTRODUCTION TO ARTIFICIAL INTELLIGENCE, GENERATIVE AI, AGENTS AND SEARCH TECHNIQUES **Introduction to Artificial Intelligence:** What is Artificial Intelligence? Evolution and History of AI (Brief), Foundations of AI, Characteristics, Benefits and Risks of AI, Types of AI: Narrow AI, General AI, Generative AI, AI Applications across domains, Responsible and Ethical AI, Introduction to Generative AI: What is Generative AI? Discriminative vs Generative AI , Foundation Models, Large	9

Language Models (LLMs), Transformers (basic idea), Text, Image, Audio and Video Generation, Prompt Engineering, AI Hallucination and Limitations, Popular Generative AI Tools (ChatGPT, Gemini, Claude, GitHub Copilot), Search Techniques: Problem Solving using Search, State Space Representation, Blind Search: BFS, DFS , Heuristic Search-Hill Climbing, Simulated Annealing, Greedy Best-First Search, A* Search, Introduction to Adversarial Search- Mini-Max Algorith, Alpha-Beta Pruning.	
Module 2: NATURAL LANGUAGE PROCESSING AND IMPLEMENTATION Natural Language Processing: Introduction to NLP, Language Models, Grammar and Parsing, Morphological Analysis, Syntactic Processing, Semantic Analysis, Discourse and Pragmatic Processing, Ambiguity in NLP, NLP Applications: Text Representation, TF-IDF, Word Embeddings, Word2Vec, NLP Implementation: Recurrent Neural Networks, LSTM.	8
Module 3: ROBOTICS AND AUTOMATION Introduction to Robotics, Robot Hardware and Software, Robot Architectures, Robotic Perception, Motion Planning, Navigation and Control, Robotics in Certain and Uncertain Environments, AI-enabled Robotics Applications.	6
Module 4: DEEP LEARNING AND GENERATIVE MODELS Deep Learning: Artificial Neural Networks, Multilayer Perceptron, CNN Architecture, CNN Models – AlexNet, VGG16 vs VGG19, ResNet18 vs ResNet50, UNet, Mask RCNN, RNN, LSTM, Time-Series Prediction, Introduction to Generative Deep Learning: Autoencoders (Basic), Variational Autoencoders (Overview), Generative Adversarial Networks (GANs), Diffusion Models (Introduction).	9
Module 5: COMPUTER VISION Fundamentals of Computer Vision: Introduction to Computer Vision, Image Formation and Representation, Image Features and Feature Extraction, Digital Image Representation, Fundamentals of Image Classification. Deep Learning for Computer Vision: Convolutional Neural Networks (CNNs) for Vision, Transfer Learning, Image Classification, Object Detection, Semantic and Instance Segmentation. Advanced Computer Vision: Video Analytics, 3D Vision, Vision Transformers (ViT) (Introduction), Vision-Language Models (Introduction), Multimodal AI: Integrating Vision and Language. Comparative Study: Image Processing vs. Computer Vision vs. Computer Graphics.	8

Text Books:

1. Artificial Intelligence: A Modern Approach, Authors: Stuart Russell & Peter Norvig, Publisher: Pearson

Reference Books:

1. Deep Learning, Authors: Ian Goodfellow, Yoshua Bengio, Aaron Courville, Publisher: MIT Press.
2. Computer Vision: Algorithms and Applications, Author: Richard Szeliski, Publisher: Springer.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Interactive Classroom Lectures/ Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars/ Case Studies/ Project-Based Learning
CD3	Laboratory experiments/ Hands-on Laboratory Sessions/ Generative AI Tool Demonstrations
CD4	Industry Applications based lecture/guest lecture/ Expert Talks
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Continuous Assessment and Practical Evaluation/ Theoretical understanding /Practical implementation/ Collaborative learning/ Real-world exposure.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	3
CO2	2	2	3
CO3	3	2	3
CO4	3	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD6, CD7
CO2	CD1, CD2, CD3, CD4, CD6, CD7
CO3	CD1, CD2, CD3, CD4, CD5, CD6, CD7

Course Outcomes	Course Delivery Method
CO4	CD1, CD2, CD3, CD4, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD6, CD7

Course Code: AI26525

Course Title: Large Language Models
Pre-requisite(s): Machine Learning
Co-requisite(s):
Credits: 3 L: 3 T:0 P:0
Class Schedule per Week: 3
Class: MTech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Understand the fundamental concepts of Natural Language Processing, Transformer architectures, and Large Language Models.
2.	Analyze the design principles, training methodologies, and optimization techniques employed in modern LLMs.
3.	Apply Transformer-based models to solve Natural Language Understanding and Generation tasks.
4.	Develop and deploy intelligent applications using prompt engineering, fine-tuning, Retrieval-Augmented Generation (RAG), and agentic AI frameworks.
5.	Evaluate the performance, reliability, ethical implications, and societal impact of Large Language Models for real-world applications.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Explain the architecture and working principles of Transformer-based language models.
CO2	Implement Transformer models for various Natural Language Understanding tasks.
CO3	Develop Transformer-based solutions for text generation and conversational AI applications.
CO4	Fine-tune and optimize large language models using modern frameworks and tools.
CO5	Design, evaluate, and deploy responsible LLM-based systems for real-world applications.

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Foundations of LLMs: Sequential Neural Networks for Language Modeling (Recurrent Neural Networks (RNNs), Long Short-Term Memory (LSTM), Gated Recurrent Units (GRU), Introduction to Natural Language Processing, Evolution of NLP, Word Embeddings, Transformer Architecture, Self-Attention Mechanism, Encoder and Decoder Architectures.	8
Module 2: Transformer Models for Natural Language: Understanding Text Classification using Transformers, Transformer Variants (BERT, GPT, T5), Named Entity Recognition (NER), Token Classification, Sequence Classification, Fine-Tuning Pre-trained Models, Performance Evaluation and Benchmarking.	8
Module 3: Transformer Models for Natural Language Generation: Text Generation Techniques, Autoregressive Models, Beam Search, Sampling Strategies, Summarization, Translation, Tokenizers and Subword Techniques	8
Module 4: Building and Training Transformer Models Conversational AI, Practical Applications using GPT and T5 Models., Training Transformers from Scratch, Fine-Tuning Large Language Models, Parameter-Efficient Fine-Tuning (PEFT), Transfer Learning.	8

Module 5: Advanced LLMs, Deployment and Responsible AI: Retrieval-Augmented Generation (RAG), Embeddings and Semantic Search, Vector Databases, LLM Agents and Tool Usage, Model Compression and Quantization, Recent Advances in Foundation Models and Multimodal LLMs.	8

Text Books:

1. Jay Alammar and Maarten Grootendorst, *Hands-On Large Language Models*, O'Reilly Media, 2024.
2. Lewis Tunstall, Leandro von Werra, and Thomas Wolf, *Natural Language Processing with Transformers: Building Language Applications with Hugging Face*, O'Reilly Media, 2022.
3. Chris Fregly and Antje Barth, *Generative AI on AWS: Building Context-Aware Multimodal Reasoning Applications*, O'Reilly Media, 2024.

Reference Books:

1. Daniel Jurafsky and James H. Martin, *Speech and Language Processing*, 3rd Edition (Draft), Pearson Education.
2. Sebastian Raschka, *Build a Large Language Model (From Scratch)*, Manning Publications, 2024.
3. Ian Goodfellow, Yoshua Bengio, and Aaron Courville, *Deep Learning*, MIT Press, 2016.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Interactive Classroom Lectures/ Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments/Seminars/ Case Studies/ Project-Based Learning
CD3	Laboratory experiments/ Hands-on Laboratory Sessions/ Generative AI Tool Demonstrations
CD4	Industry Applications based lecture/guest lecture/ Expert Talks
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Continuous Assessment and Practical Evaluation/ Theoretical understanding /Practical implementation/ Collaborative learning/ Real-world exposure.

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD4, CD6, CD7
CO2	CD1, CD2, CD3, CD4, CD6, CD7
CO3	CD1, CD2, CD3, CD4, CD5, CD6, CD7
CO4	CD1, CD2, CD3, CD4, CD6, CD7
CO5	CD1, CD2, CD3, CD4, CD5, CD6, CD7

Course Code: AI26527

Course Title: Agentic AI Systems
Pre-requisite(s): Machine Learning / Modern Artificial Intelligence
Co-requisite(s):
Credits: 3 L: 3 T:0 P:0
Class Schedule per Week: 3
Class: M. Tech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Understand the concept of Agentic AI and gain an understanding of the type of tasks that can be done in an Agentic AI System.
2.	Understand the idea of Generative AI from as it is used in the context of Agentic AI.
3.	Gain an understanding of the core components of Agentic AI including orchestration and planning.
4.	Understand the important of knowledge bases and how they can be used as part of an Agentic AI system to provide enhanced performance.
5.	Gain fundamental understanding of how to build an Agentic AI System.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Determine the type of problems that can utilize Agentic AI systems
CO2	Choose/Build the most appropriate LLM from an available collection to act as the main agent in Agentic AI
CO3	Build planning mechanisms for efficient orchestration in the Agentic AI system, build prompts that can aid in effectively solving a given problem
CO4	Build tools that can be used as peripheral components to provide additional functionality to the Agentic AI system
CO5	Build an Agentic AI framework with appropriate components for a given problem

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: **Introduction :** What is Agentic AI ? What is an AI Agent ? Agentic AI vs AI Agents, examples of Agentic AI (such as use in logistic management). **Introduction to Components:** The main LLM, Planner, Context Management, Guardrails, Tools, RAG, Prompts, example of component usage	8
Module 2: **Introduction to Generative AI :** What is Generative AI ? examples of Generative AI, transformers (architectures, single headed and multiheaded attention, self-attention, cross-attention, masked attention), language models, LLMs (with examples such as GPT), decoder only models, supervised fine tuning, introduction to reinforcement learning from human feedback (RLHF) for training LLMs, Multimodal LLMs, introduction to diffusion models, non-determinism in LLMs	8
Module 3: **Knowledge Base:** Introduction to Retrieval Augmented Generation (RAG), knowledge representation (including vectorization), data chunking, chunk scoring, similarity based retrieval (BM25, KNN, Approximate Nearest Neighbor), re-ranking	8

Module 4: **Planning:** ReAct (Reason + Act), chain of thought, tree of thought, hierarchical planning, self-reflection, re-planning **Context Management:** Why is context management needed? working memory (including active instructions), short-term memory, long-term memory **Tool Orchestration: Why** are tools needed? How are tools accessed? Model Context Protocol (MCP), examples of tools (such as google/ Microsoft suite, project management tools such as Asana, team management tools such as Slack) **Introduction to prompts:** System instructions, user instructions, embedding examples in a prompt. Example prompts for popular LLMs (claude, GPT)	8
Module 5: **Multi-Agent Systems:** Why multi-agent systems? Communication between agents in an Agentic AI system (orchestrator-worker, peer-to-peer) Agent-to-Agent protocol (A2A), agent as a tool available to main agent, example of a multi-agent setup in Agentic AI (such as travel planning) **Large scale Agentic AI frameworks:** Introduction to LangGraph, Microsoft AutoGen, Amazon Quick Suite, smolagents	8

Text Books:

1. "The Agentic AI Handbook: Concepts, Design Patterns, and Future Directions" by Kaushik Brar.

Reference Books:

1. "LLM Engineer's Handbook: Master the art of engineering large language models from concept to production" by Paul Iusztin and Maxime Labonne.
2. "A practical guide to building agents" by OpenAI
3. "Build a Large Language Model (From Scratch" by Sebastian Raschka
4. Chapter 11 of "Speech and Language Processing" by Daniel Jurafsky and James Martin
5. https://platform.claude.com/docs/en/build-with-claude/prompt-engineering/overview
6. https://developers.openai.com/api/docs/guides/prompt-engineering
7. "An Introduction to MultiAgent Systems, 2nd Edition" by Michael Wooldridge
8. https://a2a-protocol.org/latest/announcing-1.0/

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	20
Assignment(s)	10
Seminar before a committee	20

Continuous Internal Assessment	% Distribution
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lecture by use of boards/LCD projectors/OHP projectors
CD2	Assignments
CD3	Laboratory experiments/Teaching Aids/Seminars
CD4	Mini projects
CD5	Industrial visits/in-plant training
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Simulation

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	2	1	3
CO2	2	2	3
CO3	3	2	3
CO4	2	2	3
CO5	3	2	3

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD2, CD3, CD6
CO2	CD1, CD2, CD3, CD4, CD6
CO3	CD1, CD2, CD3, CD4, CD6
CO4	CD1, CD2, CD3, CD4, CD6
CO5	CD1, CD2, CD3, CD4, CD6, CD7

Course Code: CS26541

Course Title: NoSQL
Pre-requisite(s): Database Management System, Data Structures
Co-requisite(s): NoSQL Lab
Credits: 3 L: 3 T: 0 P: 0

Class Schedule per Week: 3
Class: MTech
Semester / Level: Second/Fifth
Branch: CSE

Course Objectives

This course enables the students to:

1.	Introduce the fundamental concepts, architectures, and data models of NoSQL databases.
2.	Understand distributed storage systems, replication, and consistency mechanisms in NoSQL databases.
3.	Learn Map-Reduce programming and key-value based data processing techniques.
4.	Familiarize with document databased and column-family databases along with their applications.
5.	Understand graph databases and schema evolution in NoSQL systems.

Course Outcomes (COs)

After the completion of this course, students will be able to:

CO1	Explain the concepts, data models and design principles of NoSQL databases for scalable data management. (BL2)
CO2	Analyze distributed NoSQL architectures, replication strategies and consistency models for reliable data storage. (BL4)
CO3	Apply Map-Reduce programming and key-value database concepts to process and manage large-scale data efficiently. (BL3)
CO4	Evaluate document-oriented and column-family databases for suitable application domains and use cases. (BL5)
CO5	Assess graph databases and schema evolution techniques to support complex relationships and changing data requirements. (BL5)

SYLLABUS

MODULE	NO. OF LECTURE HOURS
Module 1: Introduction to NoSQL, Impedance Mismatch, Aggregate Data Models, Aggregates, Key-Value and Document Data Models, Column-Family Stores, Relationships, Graph Databases, Schemaless Databases, Materialized View, Modelling for Data Access.	10
Module 2: Distribution models, Single Server, Sharding, Master-Slave Replication, Peer-to-Peer Replication, Combining Sharding and Replication, Update Consistency, Read Consistency, Relaxing Consistency, Relaxing Durability, Quorums.	10
Module 3: Map-Reduce, Partitioning and Combining, Composing Map-Reduce Calculations, Key-Value Databases, Key-Value Store, Store Features, Suitable Use Cases.	6

Module 4: Document Databases, Features, Suitable Use Cases, Colum-Family Stores, Features, Suitable Use Cases,	6
Module 5: Graph Databases, Features, Suitable Use Cases, Schema Migration, Schema Changes**,** Schema Changes in RDBMS, Schema Changes in NoSQL Data Store	8

Text Books:

1. Pramod J. Sadalage, Martin Fowler, NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence, 1st Edition, 2012, Addison-Wesley Professional, ISBN: 978-0321826626.

Reference Books:

1. Brian Pau, NoSQL Databases: Comprehensive Introduction to Non-Relational Data Management, 1st Edition, 2024, Khin Soe.
2. Michael Kaufmann, Andreas Meier, SQL and NoSQL Databases: Modeling, Languages, Security and Architectures for Big Data Management, 2nd Edition, 2023, Springer Nature.

COURSE OUTCOME (CO) ATTAINMENT ASSESSMENT TOOLS & EVALUATION PROCEDURE

Direct Assessment

Assessment Tool	% Contribution during CO Assessment
Continuous Internal Assessment	50
End Semester Examination	50

Continuous Internal Assessment	% Distribution
3 Quizzes (Best two Quizzes)	30
Assignment(s)	10
Seminar before a committee	10
Total	50

Assessment Components	CO1	CO2	CO3	CO4	CO5
Continuous Internal Assessment	✓	✓	✓	✓	✓
Semester End Examination	✓	✓	✓	✓	✓

Indirect Assessment

- Student Feedback on Course Outcome

Course Delivery Methods

Code	Course Delivery Method
CD1	Lectures by use of boards/LCD projectors/OHP projectors
CD2	Concept based Assignments
CD3	Laboratory experiments/Teaching aids/Seminars
CD4	Mini projects

Code	Course Delivery Method
CD5	Interactive Lectures, Flipped Classroom Activities
CD6	Self- learning such as use of NPTEL materials and internets
CD7	Case Studies via Research Papers

Mapping of Course Outcomes onto Program Outcomes and Program Specific Outcomes

Grading: 0- No Correlation **(0)**, 0-44.99- Low Correlation **(1)**, 45-64.99 Medium Correlation **(2)**, 65-100 High Correlation **(3)**

CO	PO1	PO2	PO3
CO1	3	1	1
CO2	3	1	1
CO3	3	2	2
CO4	3	2	2
CO5	3	2	2

Mapping Between Course Outcomes and Course Delivery Method

Course Outcomes	Course Delivery Method
CO1	CD1, CD5, CD6, CD7
CO2	CD1, CD2, CD5, CD6, CD7
CO3	CD1, CD2, CD3, CD4, CD5, CD6, CD7
CO4	CD1, CD2, CD3, CD4, CD5, CD6
CO5	CD1, CD2, CD3, CD4, CD5, CD6