MITS Kochi
Muthoot Institute of Technology and Science
(Autonomous)

M. TECH

ARTIFICIAL INTELLIGENCE & DATA SCIENCE

CURRICULUM & SYLLABUS

2025 REGULATION

M.Tech

in

ARTIFICIAL INTELLIGENCE AND DATA SCIENCE

2025 REGULATION

CURRICULUM & SYLLABUS

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SEMESTER II

CURRICULUM

SLOT	COURSE CATEGORY	COURSE CODE	COURSE NAME	L	T	J	P	SS	C
A	DC	M250902/CN200A	ADVANCED DATA STRUCTURES AND ALGORITHMS	3	0	0	0	2	3
B	PC	M250101/AD200B	DEEP LEARNING	3	0	0	0	2	3
C	PE	M250101/AD21*C	PROGRAM ELECTIVE 3	3	0	0	0	2	3
D	PE	M250101/AD22*D	PROGRAM ELECTIVE 4	3	0	0	0	2	3
E		M250101/AD23*E	INTERDISCIPLINARY/ INDUSTRY ELECTIVE/ MOOC	3	0	0	0	2	3
S	PS	M250902/CN200S	MINI PROJECT	0	0	4	0	2	2
T	PL	M250101/AD230T	DEEP LEARNING LAB	0	0	0	2	2	1
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work, C- Credit)									

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code		**Course Name**				**Course Category**	
M250902/CN200A		**ADVANCED DATA STRUCTURES AND ALGORITHMS**				**DC**	

COURSE OBJECTIVES	
1	Analyse the relevance of amortized analysis and applications.
2	Illustrate string matching algorithms.
3	Illustrate advanced data structures like Binomial heap, Fibonacci heap, Disjoint set and string matching algorithms.
4	Illustrate network flow algorithms and applications.
5	Make use of probabilistic algorithms and approximation algorithms in computing.
6	Design, develop and implement software using advanced data structures and algorithms.

COMPETENCY STATEMENT	
CC 1	Demonstrate the ability to apply advanced data structures, algorithmic analysis techniques, and specialized algorithms (such as amortized, probabilistic, and network flow algorithms) to solve computational problems efficiently.
CC 2	Design, develop, and implement efficient software solutions by integrating suitable advanced data structures and algorithms for real-world applications.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Analyse the relevance of amortized analysis and applications.	CC1	A
CO 2	Illustrate string matching algorithms.	CC1	A
CO 3	Illustrate advanced data structures like Binomial heap, Fibonacci heap, Disjoint set and string matching algorithms.	CC1	A
CO 4	Illustrate network flow algorithms and applications.	CC1	A
CO 5	Make use of probabilistic algorithms and approximation algorithms in computing.	CC1	A
CO 6	Design, develop and implement software using advanced data structures and algorithms.	CC2	C

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	3		3	2		2	
2	3		3	2		2	
3	3		3	2		2	
4	3		3	3		2	
5	3		3	3		2	
6	3	2	3	3	3	3	2

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME													
Teaching Scheme / Week				**Self-Learning (S) / Semester**	**Total Hours / Semester**	**Credits C**	**Examination Scheme**						
							Theory			**Practical**			**Total**
L	**T**	**J**	**P**				**CIA**	**ESE**	**Total**	**CIA**	**ESE**	**Total**	
3	0	0	0	30	67	3	40	60	100				100
***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*													

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Amortized analysis and String matching	Asymptotic Notations and Complexity Analysis, Amortized Analysis, String Matching Algorithms	8
2	Advanced data structures	Binary Heap Binomial Heap Fibonacci Heap Disjoint Set	9
3	Network flow	Residual Network & Augmenting Path,Max-Flow Min-Cut Theorem, Ford–Fulkerson Algorithm ,Edmonds–Karp Algorithm	6
4	Probabilistic algorithms	Types of Probabilistic Algorithms, Monte Carlo Algorithms , Number Theory Fundamentals, Las Vegas Algorithms	8
5	Approximation algorithm	Vertex Cover Problem,Travelling Salesman Problem , Set Covering Problem, Subset Sum Problem	6

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Micro project/Course based task	20
2	Fibonacci heap structure, Fibonacci heap operations, Maximum bipartite matching, Euler's Theorem ,Fermat's Theorem and vertex cover problem	6
3	Seminar	4

SUGGESTED LEARNING RESOURCES			
Text Book			
Sl. No.	Title of Book	Author	Publication
1	Introduction to Algorithms	T. H. Cormen, C. E. Leiserson, R. L. Rivest and C. Stein	MIT Press, 3rd edition, 2009
2	Fundamentals of algorithms	Gilles Brassard and Paul Bratley	Prentice-hall of India Private Limited, 2001
Reference			
Sl. No.	Title of Book	Author	Publication
1	Randomized Algorithms	Rajeev Motwani, Prabhakar Raghavan	Cambridge University Press, 2000
2	The Design and Analysis of Algorithms	Dexter C. Kozen	Springer
3	Algorithm Design	Jon Kleinberg and Eva Tardos	Pearson Education, 2006
Web Resources			

1.	Data Structures and Algorithms Design	Prof. Nitin Saxena	NPTEL| IIT Madras
2.	Data Structures and Algorithms	Prof. Naveen Garg	NPTEL| IIT Delhi

DETAILED SYLLABUS

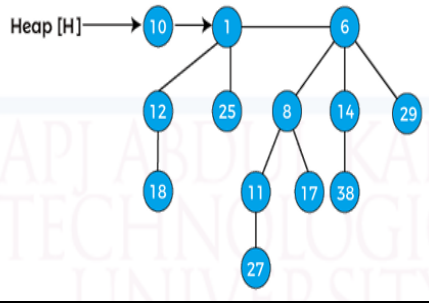
Module	Topic	Mode of Delivery	COs	Learning Domain Level C	Hours
1	Overview of asymptotic notations and complexity analysis	L	CO1	U	1
	Amortized analysis – aggregate analysis	L	CO1	A	1
	accounting method	L	CO1	A	1
	potential method	L	CO1	A	1
	String matching – introduction	L	CO1	U	1
	Rabin-Karp algorithm	L	CO2	A	1
	Knuth-Morris-Pratt algorithm (1)	L	CO2	A	1
	Knuth-Morris-Pratt algorithm (2)	L	CO2	A	1
2	Overview of binary heap operations	L	CO2	U	1
	Binomial tree and heap	L	CO2	U	1
	Binomial heap operations (1)	L	CO2	A	1
	Fibonacci heap structure	SS	CO2	U	1
	Fibonacci heap operations	SS	CO2	A	2
	Disjoint set – overview, linked list representation	L	CO2	U	1
	disjoint set forests	L	CO2	A	1
3	Network flow properties, examples	L	CO2	U	1
	residual network, augmenting path, cut of network	L	CO4	A	1
	maxflow-mincut theorem	L	CO4	A	1
	Ford-Fulkerson algorithm	L	CO4	A	1
	Edmonds-Karp algorithm	L	CO4	A	1
	Maximum bipartite matching	SS	CO4	A	1
4	Introduction, types of probabilistic algorithms	L	CO5	U	1
	Numerical algorithms – Numerical integration, Probabilistic counting	L	CO5	A	1
	Monte-Carlo algorithms – Verifying matrix multiplication	L	CO5	A	1
	Number theory fundamentals – modular arithmetic, modular exponentiation	L	CO5	U	1
	Euler's Theorem and Fermat's Theorem	SS	CO5	A	1
	Primality testing – Miller-Rabin test	L	CO5	A	2
	Las Vegas algorithms – Probabilistic selection and quick sort	L	CO5	A	1
5	Introduction	L	CO5	U	1
	Vertex-cover problem	SS	CO5,CO6	A	1
	Traveling-salesman problem	L	CO5,CO6	A	1
	Set-covering problem	L	CO5,CO6	A	1
	Subset-sum problem	L	CO5,CO6	A	2

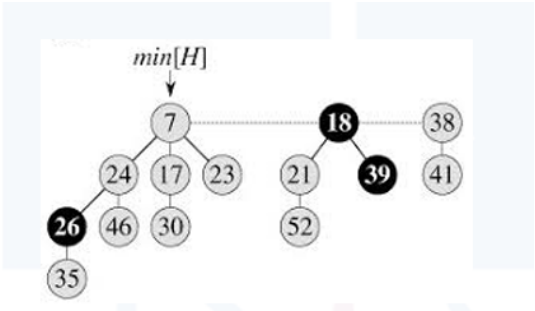
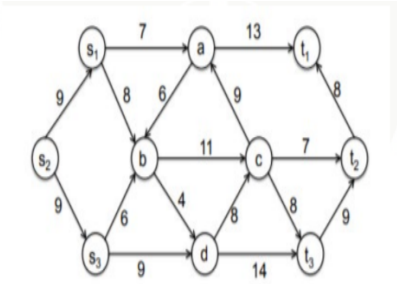
TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN									
Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Amortized analysis and String matching	8		✓	✓				12
2	Advanced data structures	9		✓	✓				12
3	Network flow	6		✓	✓				12
4	Probabilistic algorithms	8		✓	✓				12
5	Approximation algorithms	6		✓	✓				12
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.									

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/Course based task	10
Internal Examination	10
Mini Project/Course based Project	20
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250902/CN200A**		
Course Name:	**ADVANCED DATA STRUCTURES AND ALGORITHMS**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A			
(Answer all questions. Each question carries 5 marks)			
No.	***Question***	***CO***	***Marks***
1	A dynamic array doubles its size whenever it becomes full. Inserting an element usually takes constant time, but resizing takes longer.Use the accounting method to determine how to assign an amortized cost per insertion to keep the average operation cost constant.	CO1	(5)
2	Two departments maintain separate binomial heaps for tracking task priorities. During system integration, both heaps must be merged into one unified structure while preserving the heap order.Apply the union operation of binomial heaps to perform this merge and determine its time complexity.	CO2	(5)
3	Use the maximum flow approach to determine how a maximum matching in a bipartite graph G can be obtained through its corresponding flow network G′.Show how the flow network model helps in computing the maximum matching effectively.	CO3	(5)
4	Formulate a probabilistic algorithm to verify the correctness of a given matrix product. Illustrate how randomness helps reduce computational overhead while maintaining a high success probability.	CO4	(5)
5	Describe boosting. What is the relation between boosting and ensemble learning?	CO5	(5)
PART B			
(Answer any 5 questions. Each question carries 7 marks)			
No.	***Question***	***CO***	***Marks***
7	Apply the Knuth–Morris–Pratt (KMP) string matching algorithm on the given text and pattern: Text T = AABAACAADAABAABA Pattern P = AABA Construct the Longest Prefix Suffix (LPS) table for the pattern and trace the step-by-step execution of the KMP algorithm on the text using the constructed LPS table.		
	(a)A data structure performs a sequence of n operations such that the i-th operation costs i units if i is a multiple of 3, and 1 unit otherwise. Using the accounting method, determine the amortized cost per operation.	CO1	(3)
	(b)A binary counter with 8 bits starts at 0. Using the potential method, find the amortized cost of performing 10 increments. Show the potential change in at least two increments.	CO1	(4)
8	(a)If you are given a series of edges connecting vertices in an undirected graph, describe how you would use the union–find operations to group the vertices into connected components.	CO2	(3)
	(b)Show the binomial heap that results when a node with key 11 is deleted from the binomial heap shown in figure. 	CO2	(4)
9	(a) Describe the structural representation of a Fibonacci Heap and explain how potential function analysis relates to its structure.	CO3	(2)

	(b) Apply extract minimum operation on the Fibonacci heap shown in figure and show the result. 	CO3	(5)
10	A logistics company needs to transport goods from its main depot to the destination center through several intermediate hubs, as shown in the attached flow network.Each edge represents a route with a specified maximum capacity (in tonnes). Using the Ford–Fulkerson algorithm, 1. Find the maximum possible flow from main depot to destination center. 2. Identify the minimum cut and explain its significance in this scenario. 	CO4	(7)
11	(a) Apply Miller-Rabin algorithm to test whether the number 341 is prime or not.	CO5	(4)
	(b)Using the principles of Probabilistic Quick Sort, sort a list of elements and analyze how random pivot selection affects the overall performance. Provide an illustrative example.	CO5	(3)
12	(a) Describe polynomial-time approximation scheme and fully polynomial-time approximation scheme.	CO6	(3)
	(b) In real-world network optimization problems, the APPROX-VERTEX-COVER algorithm is often used for computational efficiency. Illustrate with an example where this approximation approach leads to a suboptimal solution and analyze its practical implications.	CO6	(3) (4)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code		**Course Name**				**Course Category**	
M250101/AD200B		**DEEP LEARNING**				**PC**	

COURSE OBJECTIVES	
1	To understand the theoretical foundations and architectures of deep neural networks
2	To learn regularization, optimization, and training techniques in deep learning
3	To explore convolutional, recurrent, and Graph neural network models
4	To expose students to recent research trends in Deep learning

COMPETENCY STATEMENT	
CC 1	Demonstrate sound knowledge in the principles of deep learning and architectures
CC 2	Apply deep learning solutions for solving real-world problems.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Identify core concepts and mathematics behind deep neural networks.	CC1	A
CO 2	Develop RNN models for sequential processing of data	CC1	A
CO 3	Build CNN models for Image processing applications	CC1	A
CO 4	Model GNNs to learn relationship between connected in graph-structure data	CC2	A
CO 5	Develop transformer networks for Vision and Text processing	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	2	-	2	2	3	2	-
2	2	-	2	2	3	2	-
3	2	-	2	2	3	2	-
4	2	-	2	2	3	2	-
5	2	-	2	2	3	2	-

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week				Self-Learning (S) / Semester	Total Hours / Semester	Credits C	Examination Scheme						
							Theory			Practical			Total
L	**T**	**J**	**P**				**CIA**	**ESE**	**Total**	**CIA**	**ESE**	**Total**	
4	0	0	0	30	60	3	40	60	100				100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Introduction to Deep Learning	**Fundamentals of Neural Networks, Backpropagation and Training**, Regularization Techniques, Optimization Algorithms	11
2	Recurrent Neural Networks	Sequence modelling, vanishing gradients, BPTT, Gating mechanisms, long-term dependencies, Applications of RNNs	10
3	Convolutional Neural Networks	Convolution, pooling, feature maps, visualization, classical architectures (AlexNet, VGG).	10
4	Graph Neural Networks	Graph Convolution Function, Gated Graph Neural Networks, Backpropagation in Graph Neural Networks , Applications of GNNs	11
5	Transformers	Attention Mechanism, Transformer architecture, Transformers for vision, Transformer-Based Pre-trained Language Models,GANs	11

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Micro project/Course based task	20
2	Case Studies/Seminar	10

SUGGESTED LEARNING RESOURCES			
Text Book			
Sl. No.	Title of Book	Author	Publication
1	Neural Networks and Deep Learning	Aggarwal, Charu C.	Springer International Publishing AG, part of Springer Nature 2023
2	Fundamentals of Deep Learning: Designing Next-Generation Machine Intelligence Algorithms	Nikhil Buduma and Nicholas Locascio	O'Reilly Media, Inc, 2017
Reference			
Sl. No.	Title of Book	Author	Publication
1	Deep Learning,	Ian Goodfellow, Yoshua Bengio and Aaron Courville.	Second edition, MITPress, 2016.
2	Deep Learning	M. Gopal	Pearson, 2022.
3	Dive into Deep Learning.	Aston Zhang, Zachary C. Lipton, Mu Li, and Alexander J. Smola.	available online at d2l.ai
Web Resource			
1	Deep Learning	Prof. Prabir Kumar Biswas	NPTEL| IIT Kharagpur
2	Deep Learning	Prof. Sudarshan Iyengar	NPTEL | IIT Ropar

DETAILED SYLLABUS					
Module	Topic	Mode of Delivery	COs	Learning Domain Level C	Hours
1	Introduction to Deep Learning, Biological Inspiration and Applications	L	CO1	U	1
	Deep Learning vs traditional machine learning.	L	CO1	U	1
	Perceptron, multilayer perceptron, feedforward propagation.	L	CO1	A	1
	Backpropagation and Training, Gradient descent	L	CO1	A	1
	chain rule, loss functions	L	CO1	U	1
	Regularization Techniques: Dropout, batch normalization	L	CO1	A	1
	Parameter Norm Penalties L2, L1 Regularization	L	CO1	A	1
	Dataset Augmentation, Noise Robustness, Early Stopping, Dropouts	L	CO1	A	1
	Optimization Algorithms: SGD, Momentum, RMSProp	L	CO1	A	1
	Adagrad, Adam Optimization	L	CO1	A	1
	Weight initialization strategies	L	CO1	A	1
2	Sequential data processing	L	CO2	A	1
	Architecture of RNN	L	CO2	A	1
	Language modelling examples	L	CO2	A	1
	Backpropagation through time	L	CO2	A	1
	Bidirectional Recurrent networks	L	CO2	A	1
	Multilayer RNNS	L	CO2	A	1
	Challenges in training RNN, Layer normalization	L	CO2	A	1
	LSTM, GRUs	L	CO2	A	1
	Applications of RNN : Sequence-to-Sequence Learning and Machine Translation	L	CO2	A	1
	RNN for Time series forecasting and prediction	L	CO2	A	1
3	Introduction to CNN	L	CO3	A	1
	Basic Structure of CNN	L	CO3	A	1
	Padding, strides, ReLU layer	L	CO3	A	1
	Pooling, Fully connected layer	L	CO3	A	1
	Training a CNN	L	CO3	A	1
	Back propagating Through Convolutions	L	CO3	A	1
	Backpropagation as Convolution with Inverted/Transposed Filter	L	CO3	A	1
	Convolution/Backpropagation as Matrix Multiplications	L	CO3	A	1
	Case Studies of Convolutional Architectures AlexNet, VGG,ResNet GoogLeNet	L	CO3	A	1
	Autoencoders- sparse autoencoders	L	CO3	A	1
	Denoising autoencoders	L	CO3	A	1
	Transfer learning and fine-tuning concepts	L	CO3	A	1
	Application of CNN in Object detection and localization	L	CO3	A	2
	Introduction to Graph Neural Networks	L	CO4	A	1
	The Neighbourhood Function	L	CO4	A	1
	Graph Convolution Function	L	CO4	A	1
	GraphSAGE	L	CO4	A	1
	Handling Edge Weights and new vertices	L	CO4	A	1

4	Handling Relational Networks	L	CO4	A	1
	Gated Graph Neural Networks .	L	CO4	A	1
	Comparison with Image Convolutional Networks .	L	CO4	A	1
	Backpropagation in Graph Neural Networks	L	CO4	A	1
	Generating Graph-Level Models	L	CO4	A	1
	Applications of Graph Neural Networks- Social media analytics	L	CO4	A	1
5	Attention mechanism	L	CO5	A	1
	Recurrent Models of Visual Attention	L	CO5	A	1
	Attention Mechanisms for Image Captioning	L	CO5	A	1
	Transformer Networks- The Self-Attention Module	L	CO5	A	1
	The Sequence-to-Sequence Transformer	L	CO5	A	1
	Multi-head Attention	L	CO5	A	1
	Transformer-Based Pre-trained Language Models (GPT-n, BERT)	L	CO5	A	1
	Vision Transformer (ViT)	L	CO5	A	1
	Attention Mechanisms in Graphs	L	CO5	A	1
	Generative Adversarial Networks (GANs)	L	CO5	A	1
	Using GANs for Generating Image Data .	L	CO5	A	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Introduction to Deep Learning	11		✓	✓				12
2	Recurrent Neural Networks	10		✓	✓				12
3	Convolutional Neural Networks	10		✓	✓				12
4	Graph Neural Networks	11		✓	✓				12
5	Transformers	11		✓	✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN

Assessment	Marks
Continuous Internal Assessment	**40**
Learning Activity/Course based task	10
Internal Examination	10
Mini Project/Course based Project	20
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD200B**		
Course Name:	**DEEP LEARNING**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A			
(Answer all questions. Each question carries 5 marks)			
No.	***Question***	***CO***	***Marks***
1	There is a huge gap between training accuracy and testing accuracy while training a particular model. What might be the reason? Suggest possible methods of overcoming it.	CO1	(5)
2	The input to a CNN architecture is a color image of size 112x112x3. The first convolution layer comprises 64 kernels of size 5x5 applied with a stride of 2 and padding 0. What will be the number of parameters?	CO3	(5)
3	Show the computational graph of RNN along with the mathematical operation on the hidden layer.	CO2	(5)
4	Illustrate how information is propagated between nodes in a Graph Neural Network	CO4	(5)
5	In transformer models, demonstrate how self-attention help in understanding relationships between words, and why is positional encoding necessary?	CO5	(5)
PART B			
(Answer any 5 questions. Each question carries 7 marks)			
No.	***Question***	***CO***	***Marks***
6	You are training a deep neural network for handwriting recognition using a large and complex dataset. During training, you notice that the loss initially decreases but then begins to fluctuate and converge very slowly. Which optimization method would you choose to improve convergence speed and stability, and why?	CO1	(7)
7	You are developing a machine learning model to predict house prices using 50 different features such as size, location, year built, number of rooms, and amenities. After training, the model shows excellent performance on the training data but performs poorly on the test data, indicating overfitting. Which technique would you apply in this case to reduce overfitting, and how does your choice affect the model's feature selection and generalization ability?	CO1	(7)
8	In a satellite image classification project, an AI team finds that traditional CNNs struggle to capture multi-scale features due to using a single filter size per year. How does the Inception module in GoogleNet address this limitation, and why is it advantageous for complex scene understanding?	CO3	(7)
9	A financial analyst is developing a deep learning model to predict stock prices. Since market trends often depend on patterns spanning several days or weeks, the model needs to retain long-term dependencies in sequential data. In this scenario, why is an LSTM network more appropriate than a traditional RNN?	CO2	(7)
10	How are GNNs used in social network analysis for community detection or link prediction.	CO4	(7)
11	Explain the architecture and training mechanism of a Generative Adversarial Network (GAN). How do the generator and discriminator interact during the adversarial training process? Illustrate with a neat diagram.	CO5	(7)
12	Deep learning models, such as Transformers, have revolutionized sequence modelling tasks in NLP. Examine the role of self-attention in the Transformer architecture and explain how it improves model performance compared to traditional sequential models like RNNs or LSTMs.	CO5	(7)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
M250101/AD211C	**COMPUTER VISION**	**PE**

COURSE OBJECTIVES	
1	To implement the mathematical foundations of image processing (filtering, convolution) and evaluate the performance of classical feature detectors, such as SIFT and Harris corners.
2	To design, train, and optimize advanced Convolutional Neural Networks (ResNets, MobileNets) for image classification using techniques like finetuning and regularization.
3	To apply and compare modern deep learning architectures to solve complex tasks, specifically Object Detection (YOLO) and Image Segmentation (U-Net, Mask R-CNN).
4	To utilize the Vision Transformer (ViT) and the underlying Self-Attention mechanism for advanced image understanding and localization tasks.
5	To implement and critically analyze the latest generative models (Diffusion Models) and multimodal systems (CLIP) for high-fidelity synthesis and zero-shot learning.

COMPETENCY STATEMENT	
CC 1	Design and deploy advanced vision models (CNNs, ViT) for classification, detection (YOLO), and segmentation, mastering deep learning optimization.
CC 2	Implement and evaluate cutting-edge generative (Diffusion Models) and multimodal AI (CLIP, SSL) techniques for visual synthesis and cross-modal understanding.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Implement foundational image processing (filtering, convolution) and classical feature detection (SIFT, Harris corners).	CC1	A
CO 2	Design and optimize Convolutional Neural Networks (VGG, ResNets) for classification using advanced training techniques.	CC1	A
CO 3	Apply deep learning to solve complex tasks: Object Detection (YOLO) and Segmentation (U-Net), and utilize RNNs/LSTMs for video/sequential data.	CC1	A
CO 4	Explain the Self-Attention mechanism and successfully implement Vision Transformers (ViT) for modern recognition and localization tasks.	CC1	A
CO 5	Implement and evaluate deep generative models, including GANs, VAEs, and state-of-the-art Diffusion Models.	CC2	A
CO 6	Utilize Self-Supervised Learning (SSL) and Vision-Language Models (CLIP) for zero-shot learning and multimodal research.	CC2	C

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	2	2	1	1	3	-	-
2	3	3	3	2	3	-	-
3	3	3	3	2	3	-	-

4	3	3	3	3	3	1	-
5	3	3	3	3	3	1	-
6	3	3	3	3	3	2	3
Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"							

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week				Self-Learning (S) / Semester	Total Hours / Semester	Credits C	Examination Scheme						
							Theory			Practical			Total
L	T	J	P				CIA	ESE	Total	CIA	ESE	Total	
4	0	0	0	30	70	3	40	60	100				100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)

Module	Title	Major Topics	Contact Hours
1	Image Analysis Foundations and Classical Vision	Introduction and Filtering, Classical Features	8
2	Deep Learning Fundamentals and Core CNN Architectures	Deep Learning Basics, Core CNNs for Classification, Advanced CNNs and Analysis	9
3	Advanced Vision Tasks and Sequence Modeling	Detection and Segmentation, Recurrent Models in Vision	8
4	The Attention and Generative Revolution	Attention Mechanisms, Vision Transformers (ViT), Generative Models: GANs & VAEs	7
5	Generative Models Diffusion, Vision-Language and SSL	Introduction to Diffusion Models (DDPMs), Self-Supervised Learning (SSL)	8

SELF-LEARNING / TEAM WORK

Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Micro project/Course based project:Team development and implementation of a complex vision system (e.g., fine-tuning a Vision Transformer for a custom classification task, or developing a generative model for image inpainting).	20
2	Regularization Techniques (e.g., Mixup, adversarial training methods), Graphical Models in vision, and Gaussian Mixture Models (GMMs) for clustering/segmentation.	6
3	Seminar:Presentation on a cutting-edge research paper (e.g., a recent work on Diffusion Models or the latest Vision-Language Model architecture like BLIP-2) from a top-tier conference (CVPR, ICCV, NeurIPS).	4

SUGGESTED LEARNING RESOURCES

Text Book

Sl. No.	Title of Book	Author	Publication
1	Computer Vision: Algorithms and Applications, 2010.	Richard Szeliski	Springer-Verlag
2	Computer Vision: Models, Learning, and Inference, 2012.	Simon Prince	Cambridge University Press
3	Computer Vision: A Modern Approach, 2002.	David Forsyth, Jean Ponce	Prentice Hall Professional Technical Reference.

4	Deep Learning, 2016	Ian Goodfellow, Yoshua Bengio, Aaron Courville,	Addison-Wesley Professional
5	Neural Networks and Deep Learning, 2016	Michael Nielsen,	Published by MIT Press.
6	Learning Deep Architectures for AI, 2009.	Yoshua Bengio,	Now Publishers
Reference			
Sl. No.	Title of Book	Author	Publication
1	Neural Networks for Pattern Recognition. New York, NY: Oxford University Press, 1995. ISBN: 9780198538646.	Bishop, Christopher.	Oxford University Press and Clarendon Press.
2	Pattern Recognition and Machine Learning. Springer, 2006. ISBN 978-0-387-31073-2	Bishop, Christopher M.	Springer.
3	Machine Learning. New York, NY: McGraw-Hill, 1997. ISBN: 9780070428072.	Mitchell, Tom	McGraw-Hill.
4	Multiple View Geometry in Computer Vision, 2004	Richard Hartley, Andrew Zisserman	Cambridge University Press.
5	Vision	David Marr	Wiley-Interscience
6	Pattern Classification. 2nd ed. New York, NY: Wiley-Interscience, 2000. ISBN: 9780471056690.	Duda, Richard, Peter Hart, and David Stork	Wiley-Interscience
Web Resource			
1	https://arxiv.org/abs/1706.03762	Ashish Vaswani, Noam Shazeer, Niki Parmar, Jakob Uszkoreit, Llion Jones, Aidan N. Gomez, Lukasz Kaiser, Illia Polosukhin	arXiv:1706.03762
2	Deep Learning for Computer Vision	Prof. Vineeth N Balasubramanian	IIT Hyderabad

DETAILED SYLLABUS

Module	Topic	Mode of Delivery	COs	Learning Domain Level	Hours
				C	
1	Representation (Color Spaces, Sampling, Quantization)	L	CO1	U	1
	Linear Filtering	L	CO1	U	1
	Convolution (mathematics and implementation),	L	CO1	A	1
	Correlation, History, and Image Formation.	L	CO1	A	1
	Edge Detection (Canny)	L	CO1	A	1
	Corner Detection (Harris)	L	CO1	U	1
	Blob Detection, Scale Space, Image Pyramids	L	CO2	A	1

	SIFT and Variants, Human Visual System	L	CO2	A	1
2	Neural Network Review, Feedforward NNs,	SS	CO2	U	1
	Regularization (Dropout, Improving Training (Batch Norm, Initialization).	L	CO2	U	1
	Backpropagation (Chain Rule)	L	CO2	A	1
	Gradient Descent and Variants (Adam)	L	CO2	A	1
	Convolutional Layer (Parameter Sharing, Sparse Connectivity), Pooling, Backpropagation in CNNs,	L	CO2	A	1
	Standard CNN Architectures, Loss Functions (Cross-Entropy).	L	CO2	A	1
	Evolution of Architectures: VGG, Inception, ResNets (Residual Connections),	L	CO2	A	1
	Efficient Architectures (MobileNet, EfficientNet),	L	CO2	U	1
	Finetuning/Transfer Learning, Visualizing CNNs (Grad-CAM, Saliency Maps).	L	CO2	A	1
3	Object Detection (Two-stage: Faster R-CNN; Single-stage: YOLO, SSD).	L	CO3	U	1
	Metrics (IoU, mAP)	L	CO3	A	1
	Semantic Segmentation (FCN, U-Net), Instance Segmentation (Mask R-CNN)	L	CO3	A	1
	Recurrent Neural Networks (RNNs),.	L	CO3	A	1
	Backpropagation Through Time (BPTT)	SS	CO3	U	1
	Gated Units (LSTMs, GRUs),	SS	CO3	A	1
	Video Understanding using CNN-RNN structures,	L	CO3	A	1
	Introduction to Image Captioning	L	CO3	A	1
4	Attention in Vision (Soft/Hard),	L	CO4	U	1
	Self-Attention (Query-Key-Value), Multi-Head Attention,	L	CO4	A	1
	The core Transformer Encoder/Decoder block, Positional Encoding.	L	CO4	A	1
	From Transformers to ViT (Patch Embedding, Class Token)	L	CO4	A	1
	Transformers for Object Detection (DETR)	SS	CO4	A	1
	Transformers for Segmentation (MaskFormer).	SS	CO4	A	1
	Generative Adversarial Networks (GANs, Min-Max Game	SS	CO4	A	1
	Conditional GANs, WGAN)	SS	CO5	A	1
	Variational Autoencoders (VAEs, Reparameterization Trick, Disentanglement	SS	CO5	A	1
5	Forward and Reverse Processes	L	CO5,CO6	A	1
	Classifier and Classifier-Free Guidance	L	CO5,CO6	A	1
	Text-conditioned Diffusion (LDMs),	L	CO5,CO6	A	1
	Sampling, Noise Schedules.	L	CO5,CO6	U	1
	SimCLR, Contrastive Learning,	L	CO5,CO6	U	1
	Joint Vision-Language Models,	L	CO5,CO6	U	1
	CLIP (Zero-Shot Classification), BLIP	L	CO5,CO6	U	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN									
Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Image Analysis Foundations and Classical Vision	8		✓	✓				12
2	Deep Learning Fundamentals and Core CNN Architectures	9		✓	✓				12
3	Advanced Vision Tasks and Sequence Modeling	8		✓	✓				12
4	The Attention and Generative Revolution	10		✓	✓				12
5	Generative Models Diffusion,Vision-Language and SSL	7		✓	✓				12
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.									

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/ Course based task	15
Internal Examination	10
Course Project/ Review article	15
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD211C**		
Course Name:	**Computer Vision**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A			
(Answer all questions. Each question carries 5 marks)			
No.	***Question***	***CO***	***Marks***
1	Analyze the theoretical limitation of the local image gradient magnitude when computing the rotation invariance property of the SIFT descriptor. How does the descriptor overcome this limitation?	CO1	(5)
2	Evaluate why the non-linear activation function ReLU is generally preferred over the Sigmoid activation function in the hidden layers of deep CNNs, particularly concerning the gradient flow during training.	CO2	(5)
3	Differentiate between the primary outputs (and their intended function) of the Region Proposal Network (RPN) in Faster R-CNN and the grid cell output in a YOLO architecture.	CO3	(5)
4	Analyze the role of Positional Encodings in a Vision Transformer (ViT). If these encodings were simply dropped, what would be the most immediate functional deficiency of the network?	CO4	(5)
5	Propose a minimal set of modifications to the standard GAN objective function to improve the quality of generated images by reducing mode collapse. Justify your choice of modification (e.g., specific loss term).	CO5	(5)
PART B			
(Answer any 5 questions. Each question carries 7 marks)			
No.	***Question***	***CO***	***Marks***
6	Analyze the robustness of the Canny edge detector versus the Harris corner detector under conditions of non-Gaussian noise and significant scale variation. Which detector's output would degrade more severely and why? Justify your answer using the underlying mathematical principles (e.g., gradient magnitude vs. autocorrelation matrix).	CO1	(7)
7	Evaluate the trade-offs between Batch Normalization and Layer Normalization when training a very deep CNN (like ResNet-101) for classification on two different image modalities: a) static, large image batches, and b) video sequences with small batch sizes. Determine which normalization technique is theoretically superior for the video scenario and explain why.	CO1	(7)
8	You are tasked to create a real-time object detection and tracking system for highly occluded objects. Propose a modification to the standard YOLO architecture. Specifically, detailed changes to the loss function and the Non-Max Suppression (NMS) mechanism to improve performance under severe occlusion.	CO2	(7)
9	Analyze the computational and memory complexity differences between a standard multi-layer CNN and a multi-layer Vision Transformer (ViT) for a large input image H*W and a given number of parameters (P). Under what conditions (i.e., image size vs. patch size) does the ViT's complexity exceed that of the CNN and why?	CO3	(7)
10	Evaluate the stability and sample quality performance of Diffusion Models (DDPMs) against Wasserstein GANs (WGANs) for high-resolution image synthesis. Conclude which model offers superior controllability and diversity in the generated output, justifying your answer by discussing the role of the loss function and the generation process in each architecture.	CO4	(7)
11	Design a novel Self-Supervised Learning (SSL) pre-training strategy that can be used to improve the performance of a Vision-Language Model like CLIP for downstream medical image diagnosis (e.g., X-ray classification). Formulate the contrastive loss function and describe the data augmentation strategy required to make the SSL task effective in the medical domain.	CO5	(7)
12	Evaluate the critical differences in design philosophy, complexity, and performance between Two-Stage Object Detectors (e.g., Faster R-CNN) and Single-Stage Object Detectors (e.g., YOLOv7). For an application requiring both high accuracy on small objects and real-time processing (like drone-based surveillance), justify which detection framework is the most suitable starting	CO6	(7)

	point for development and the specific architectural changes you would implement to meet these dual requirements.		

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code	**Course Name**						**Course Category**
M250101/AD212C	**BLOCKCHAIN TECHNOLOGIES**						**PE**
Pre-requisite							
Data Structures and Operating Systems.							

COURSE OBJECTIVES	
1	To create awareness and understanding among students on the foundation of blockchain technology.
2	The course introduces the cryptographic principles behind blockchain and helps the students understand concepts like consensus, crypto-currency, smart contracts, use cases etc.
3	Students will be able to develop simple decentralized applications using blockchain networks such as Ethereum

COMPETENCY STATEMENT (CC)	
CC 1	Design, develop and deploy secure, transparent and scalable blockchain solutions using decentralized ledger architecture, consensus mechanisms, cryptography and smart contracts.
CC 2	Design and deploy secure, gas-efficient smart contracts on the Ethereum platform using Solidity best practices.

COURSE OUTCOMES (CO)

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Illustrate and implement the cryptographic building blocks of blockchain technology. (Cognitive Knowledge Level: Apply)	CC1	Apply
CO 2	Make use of the concepts of blockchain technology. (Cognitive Knowledge Level: Apply)	CC1	Apply
CO 3	Summarize the classification of consensus algorithms. (Cognitive Knowledge Level: Understand)	CC1	Understand
CO 4	Illustrate the concepts of first decentralized cryptocurrency bitcoin. (Cognitive Knowledge Level: Apply)	CC1	Apply
CO 5	Implement smart contracts and its use cases. (Cognitive Knowledge Level: Apply)	CC2	Apply
CO 6	Develop simple applications using Solidity language on Ethereum platform. (Cognitive Knowledge Level: Apply)	CC2	Apply

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes & Program Specific Outcomes						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	2	-	2	2	2	2	-
2	2	-	2	2	2	2	-
3	2	-	2	2	2	2	-
4	2	-	2	2	2	2	-
5	2	-	2	2	2	2	-
6	2	2	2	2	2	2	2
Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"							

TEACHING AND ASSESSMENT SCHEME												
Teaching Scheme / Week				**Self-Learning (S) / Semester**	**Total Hours / Semester**	**Credits C**	**Examination Scheme**					
							Theory			**Practical**			**Total**
L	**T**	**J**	**P**				**CIA**	**ESE**	**Total**	**CIA**	**ESE**	**Total**	
3	0	0	0	30		3							

					40		40	60	100				100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Fundamentals of Cryptography	RSA, Elliptic curve cryptography	7
2	Fundamentals of Blockchain Technology	Elements of blockchain	6
3	Consensus Algorithms and Bitcoin	CFT,BFT,PBFT,PoW, Mining	7
4	Smart Contracts and Use cases	Smart Contracts	6
5	Ethereum and Solidity	Components of the Ethereum ecosystem& Solidity language	9

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Course based task	30

SUGGESTED LEARNING RESOURCES

Sl. No.	Title of Book	Author	Publication
Text Book			
1	Mastering Blockchain: A deep dive into distributed ledgers, consensus protocols, smart contracts, DApps, cryptocurrencies, Ethereum, and more,	Imran Bashir	Packt Publishing, Third edition, 2020.
Reference			
1	Solidity Programming Essentials: A beginner's guide to build smart contracts for Ethereum and blockchain,	Ritesh Modi	Packt Publishing, First edition, 2018
2	Blockchain Technology: Concepts and Applications	Kumar Saurabh, Ashutosh Saxena	M, First Edition, Wiley Publications, First edition, 2020.IT Press, 2016.
Web Resource			
1	Blockchain and its Applications	Prof. Sandip Chakraborty, Prof. Shamik Sural	NPTEL| IIT Kharagpur
2	Certified Ethereum Network Administrator		KBA

DETAILED SYLLABUS *(Self-learning if any to be marked)*					
Module	Topic	Mode of Delivery	COs	Learning Domain Level C	Hours
1.1	Introduction to cryptography	L	CO1	U	1
1.2	Symmetric cryptography, AES	L	CO1	A	1
1.3	Asymmetric cryptography, RSA	L	CO1	A	1
1.4	Elliptic curve cryptography	L	CO1	A	1
1.5	Digital signatures – RSA digital signature algorithm	L	CO1	A	1
1.6	Secure Hash Algorithms – SHA-256	L	CO1	A	1
1.7	Applications of cryptographic hash functions – Merkle trees, Distributed hash tables	L	CO2	A	1
2.1	Blockchain – definition and architecture	L	CO2	A	1
2.2	Elements of blockchain	L	CO2	A	1

2.3	Blockchain – benefits and limitations, types.	L	CO2	A	1
2.4	Consensus – definition, types, consensus in blockchain	L	CO3	A	1
2.5	Decentralization using blockchain, Methods of decentralization	L	CO3	A	1
2.6	Routes to decentralization, Blockchain and full ecosystem decentralization	L	CO3	A	1
3.1	Consensus Algorithms – Crash fault-tolerance (CFT) algorithms – Paxos, Raft (working is expected).	L	CO3	U	1
3.2	Byzantine fault-tolerance (BFT) algorithms – Practical Byzantine Fault Tolerance (PBFT) (working is expected).	L	CO3	U	1
3.3	Proof of work (PoW), Proof of stake (PoS), Types of PoS	L	CO3	U	1
3.4	Bitcoin – Definition, Cryptographic keys – Private keys, public keys, addresses	L	CO4	A	1
3.5	Transactions – Lifecycle, coinbase transactions, transaction validation	SS	CO4	A	1
3.6	Blockchain – The genesis block. Mining – Tasks of miners.	SS	CO4	A	1
3.7	Mining – mining algorithm, hash rate. Wallets – Types of wallets.	L	CO4	A	1
4.1	Smart Contracts – Definition, Smart contract templates	L	CO5	A	1
4.2	Oracles, Types of oracles, Deploying smart contracts.	L	CO5	A	1
4.3	Decentralization terminology –Decentralized applications, Decentralized Autonomous Organizations	L	CO5	A	1
4.4	Use cases of Block	L	CO5	U	1
5.1	Ethereum - The Ethereum network, Components of the Ethereum ecosystem – Keys and addresses, Accounts	L	CO6	A	1
5.2	Components of the Ethereum ecosystem – Transactions and messages.	L	CO6	A	1
5.3	The Ethereum Virtual Machine	L	CO6	A	1
5.4	Ethereum Blocks and blockchain	L	CO6	A	1
5.5	The Solidity language – The layout of a Solidity source code, Structure of a smart contract, variables, data types	L	CO6	A	1
5.6	The Solidity language – control structures, events,inheritance, libraries	L	CO6	A	1
5.7	The Solidity language – functions, error handling.	L	CO6	A	1
5.8	Smart contracts Case study: Voting.	SS	CO5	U	1
5.9	Smart contracts Case study: Auction	SS	CO5	U	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Fundamentals of Cryptography	8		✓	✓				12
2	Fundamentals of Blockchain Technology	9		✓	✓				12
3	Consensus Algorithms and Bitcoin	8		✓	✓				12
4	Smart Contracts and Use cases	7		✓	✓				12
5	Ethereum and Solidity	8		✓	✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/ Course based task	15
Internal Examination	10
Course Project/ Review article	15
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD212C**		
Course Name:	**BLOCKCHAIN TECHNOLOGIES**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A			
(Answer all questions. Each question carries 5 marks)			
No.	***Question***	***CO***	***Marks***
1	Illustrate how would you use hash functions to construct a Merkle tree in a blockchain to ensure data integrity and efficient verification.	CO1	(5)
2	List various benefits, features and limitations of blockchain.	CO2	(5)
3	Discuss the steps involved in the mining algorithm used in Bitcoin with the help of a flowchart.	CO3	(5)
4	Illustrate the design process of decentralized applications with diagrams.	CO4	(5)
5	Define block difficulty. Discuss how block difficulty is adjusted in Ethereum blockchain network..	CO5	(5)
PART B			
(Answer any 5 questions. Each question carries 7 marks)			
No.	***Question***	***CO***	***Marks***
6	Suppose you are developing a blockchain application that requires secure data hashing. How would you apply the design principles of SHA-256 and its compression function, using a diagram, to ensure data integrity within your system?	CO1	(7)
7	Illustrate how blockchain technology can be implemented in finance sector.	CO2	(7)
8	Demonstrate how Practical Byzantine Fault Tolerance can achieve consensus in the presence of Byzantine faults.	CO3	(7)
9	Demonstrate the complete process of creating, validating, and securing a Bitcoin transaction in a real-world scenario.	CO4	(7)
10	Build a smart contract for Finance sector.	CO5	(7)
11	Apply the concept of Gas to calculate the transaction cost in an Ethereum blockchain network.	CO6	(7)
12	Using Solidity language, create a simple bank contract that allows a user to deposit, withdraw and view balance.	CO6	(7)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code		**Course Name**				**Course Category**	
M250101/AD213C		**IMAGE AND VIDEO ANALYTICS**				**PE**	

COURSE OBJECTIVES	
1	**Introduce** the fundamental concepts and mathematical principles underlying digital image and video processing.
2	**Equip** students with knowledge of image enhancement, filtering, segmentation, and feature extraction techniques, and enable them to apply pattern recognition and classification methods effectively.
3	**Explain** the principles of video formation, representation, and enhancement techniques for improving video quality.
4	**Explore** analytical techniques for object detection, recognition, and motion estimation in images and videos
5	**Enable** students to design and implement real-life applications using open-source libraries and frameworks for image and video analytics.

COMPETENCY STATEMENT	
CC 1	**Apply** image enhancement, filtering, segmentation, and feature extraction techniques to process and analyze visual data effectively.
CC 2	**Utilize** pattern recognition and classification methods, along with suitable tools and libraries, to develop and evaluate intelligent solutions for image and video analytics applications.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Interpret the mathematical principles in digital image enhancement and apply them in spatial domain and frequency domain.	CC1	A
CO 2	Apply various methods for image filtering and segmentation	CC1	A
CO 3	Make use of various video enhancement and noise reduction techniques.	CC1	A
CO 4	Apply various feature extraction and pattern classification techniques on images.	CC2	A
CO 5	Analyze various object detection and recognition techniques on image and video.	CC2	An
CO 6	Design, develop, implement and present solutions to simple real-life problems with popular open-source library using image and video analytical techniques.	CC2	C

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	3	-	2	2	-	2	-
2	2	-	2	2	-	2	-
3	3	-	3	2	-	2	-
4	3	-	3	2	3	2	-
5	3	-	3	2	3	2	-
6	3	3	3	3	3	3	3

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME													
Teaching Scheme / Week				**Self-Learning (S) / Semester**	**Total Hours / Semester**	**Credits C**	**Examination Scheme**						
							Theory			**Practical**			**Total**
L	**T**	**J**	**P**				**CIA**	**ESE**	**Total**	**CIA**	**ESE**	**Total**	
4	0	0	0	30	70	3	40	60	100				100
***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*													

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Fundamentals of Image Processing & Enhancement	Image representation, sampling, quantization; Image operations and colour models; Spatial domain enhancement and image transforms	8
2	Histogram Processing, Filtering & Segmentation	Histogram equalization and spatial/frequency filtering; Image segmentation and edge detection techniques	8
3	Video Processing	Video formation and color perception; Video capture, display, and digital video formats	8
4	Image Analytics	Feature extraction (PCA, SIFT, SURF); Pattern recognition and classification (k-NN, SVM); Image understanding and content-based retrieval.	7
5	Video Analytics & Applications	Object detection, recognition, and tracking; Motion estimation and video classification; Implementation using TensorFlow/Keras with case studies	9

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Micro project/Course based project	20
2	Color space conversions (HSV, LAB) in image analysis, High frame rate and slow-motion video analysis, Applications of video analytics in surveillance and smart cities	6
3	Seminar	4

SUGGESTED LEARNING RESOURCES			
Text Book			
Sl. No.	Title of Book	Author	Publication
1	Digital Image Processing Machine Learning: A Probabilistic Perspective	Rafael C. Gonzalez and Richard E. Woods	Third Edition, Pearson Education, 2009. .
2	Fundamentals of Digital Image Processing	Anil K.Jain	Pearson Education, 2003
3	Image Processing, Analysis and Machine Vision	Milan Sonka, Vaclav Hlavac and Roger Boyle	Third Edition, Cengage Learning, 2007

Reference			
Sl. No.	Title of Book	Author	Publication
1	Video Processing and Communications	Yao Wang, Jorn Ostermann, Ya-Qin Zhang	Prentice Hall, 2001
2	Computer Vision: Models, Learning, and Inference	Simon J. D. Prince	Cambridge University Press
3	Practical Machine Learning and Image Processing	Himanshu Singh	APress, 2019
Web Resource			
1	Data Analytics with Python	Prof. A Ramesh	NPTEL|IITRoorkee https://nptel.ac.in/courses/106107220
2	The Analytics Edge, MIT OpenCourseWare	Prof. Dimitris Bertsimas	https://ocw.mit.edu/courses/15-071-the-analytics-edge-spring-2017/pages/an-introduction-to-analytics/

DETAILED SYLLABUS					
Module	Topic	Mode of Delivery	COs	Learning Domain Level	Hours
1	Steps in Image Processing Systems, Digital image representation	L	CO1	U	1
	Image Operations – Arithmetic, Geometric, Morphological operations	L	CO1	A	1
	Colour Models	L	CO1	A	1
	Image Enhancement in Spatial Domain	L	CO1	A	1
	Transformations – Negative, Logarithmic	L	CO1	A	1
	Gamma, Contrast Stretching, Grey level & Bit Plane Slicing	L	CO1	A	1
	Image Transforms - DFT	L	CO1	U	1
	DCT, Hadamard Transforms	L	CO1	A	1
2	Histogram Processing - Histogram Equalisation.	L	CO2	A	1
	Spatial correlation and convolution,	L	CO2	U	1
	Spatial filtering- Smoothing, Sharpening spatial filters	L	CO2	A	1
	Basics of filtering in frequency domain, Smoothing in frequency domain	L	CO2	U	1
	Sharpening in frequency domain	L	CO2	A	1
	Image Segmentation- Fundamentals, Thresholding	L	CO2	U	1
	Edge Detection - Point, Line and Edge Detection	L	CO2	A	1
	Edge Detection operators.	L	CO2	A	1
	Video Formation, Perception and Representation: Color Perception and Specification-Human Perception of Color, The Trichromatic Theory of Color Mixture	L	CO3	A	1
	Color Specification by Tristimulus Values, Color Specification by Luminance and Chrominance Attributes	L	CO3	U	1

3	Video Capture and Display-Principles of Color Video Imaging, Video Cameras, Video Display	L	CO3	U	1
	Composite versus Component Video, Gamma Correction,	L	CO3	A	1
	Analog Video Raster-Progressive and Interlaced Scan, Characterization of a Video Raster.	L	CO3	A	1
	Analog Color Television Systems- Spatial and Temporal Resolution, Color Coordinate, Signal Bandwidth, Multiplexing of Luminance, Chrominance, and Audio	SS	CO3	U	1
	Analog Video Recording.	SS	CO3	A	1
	Digital video- ITU-R BT.601 Digital Video, Other Digital Video Formats and Applications.	L	CO3	A	1
4	Feature Extraction , Binary object feature	L	CO4	U	1
	Histogram based (Statistical) Features, PCA				
	SIFT, SURF	L	CO4	A	1
	Visual Pattern Recognition, Patterns and Pattern Classes	L	CO4	A	1
	Statistical Pattern Classification Techniques- k-Nearest Neighbours Classifier	L	CO4	U	1
	Support Vector Machines	L	CO4	U	1
	Image Understanding, Content Based Image Retrieval	SS	CO4	U	1
5	Object detection and recognition in video, Texture models	L	CO5	U	1
	Video classification models, Object tracking in Video, Applications	L	CO5,CO6	U	1
	Two Dimensional Motion Estimation	L	CO5	A	1
	Object detection and recognition in video, Texture models	L	CO5	A	1
	Video classification models, Object tracking in Video , Applications	L	CO5,CO6	A	1
	Pixel Based Motion Estimation	L	CO5,CO6	A	1
	Block Matching Algorithm	L	CO5,CO6	A	1
	Implementation examples of simple Image and Video processing problems using TensorFlow and Keras.	L	CO5,CO6	A	1
	Case Study : Face Detection and Recognition, Automatic Traffic Monitoring	L	CO5,CO6	C	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Fundamentals of Image Processing & Enhancement	8		✓	✓				12
2	Histogram Processing, Filtering & Segmentation	8		✓	✓				12
3	Video Processing	8		✓	✓				12
4	Image Analytics	7		✓	✓	✓			12

5	Video Analytics & Applications	9		✓	✓	✓			12
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.									

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/ Course based task	15
Internal Examination	10
Course Project/ Review article	15
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD213C**		
Course Name:	**IMAGE AND VIDEO ANALYTICS**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A			
(Answer all questions. Each question carries 5 marks)			
No.	***Question***	***CO***	***Marks***
1	A grayscale medical X-ray image contains noise due to low exposure. a) Apply suitable spatial filters to reduce noise without losing key structural information. b) Compare results of mean and median filters and justify which is better for medical imaging.	CO1	(5)
2	Compute the 4-point DFT of the discrete sequence $x(n) = \{1,2,3,4\}$and show the magnitude and phase spectrum.	CO2	(5)
3	A company needs to digitize old analog video recordings for archiving. a) Explain how sampling, quantization, and color encoding will impact the digitized output. b) Suggest a method to correct color fading using gamma correction or color balance adjustments.	CO3	(5)
4	A machine learning engineer trains an SVM classifier to recognize handwritten digits (0–9) from the MNIST dataset. The input images have 784 features (28×28 pixels). a) How can PCA preprocessing improve the speed and performance of the classifier without significantly reducing accuracy? b) Explain with an example of how many components might be retained and why.	CO4	(5)
5	A video streaming platform wants to compress high-resolution videos efficiently without noticeable quality loss. You are tasked with designing a motion compensation module for frame prediction. a) Explain how block-based motion estimation (e.g., using the block matching algorithm) contributes to compression efficiency in codecs like MPEG or H.264. b) Discuss one advantage and one drawback compared to pixel-based optical flow in this context.	CO5	(5)
PART B			
(Answer any 5 questions. Each question carries 7 marks)			
No.	***Question***	***CO***	***Marks***
6	a) Find the 4 order Hadamard Transform for the following image segment (4) 1 1 2 2 2 1 1 3 3 2 1 2 1 2 2 3 b) Demonstrate the steps of generating digital images from the sensed data. Find out the number of bits needed to represent 512 Gray levels. (3)	CO1	(7)
7	A tiny 1×2 image row has intensity values [100, 150]. a) Compute the 2-point DFT (show derivation). b) Discuss how these frequency values would change if you subtract the mean from the row before transforming, and why mean removal is useful in some image processing tasks.	CO1	(7)
8	a) For the image given below, apply histogram equalization to achieve image enhancement	CO2	(7)

	f(x,y)= 4 4 4 3 4 3 4 5 4 3 3 5 5 5 3 3 4 5 3 3 4 4 4 4 4 b) What are the various smoothing non-linear filters in the spatial domain? Which is the best among them and why?		
9	a) For the image given below, apply Prewitt filter both in X and Y direction and find the resultant image. Also, find the magnitude and angle of gradient at the two underlined pixel positions f(x,y)= 2 0 1 3 2 1 **4** 7 0 3 5 4 **3** 5 7 1 2 0 4 4 b) Illustrate how sharpening can be done in the frequency domain using Butterworth high-pass filters	CO3	(7)
10	A sports analytics firm wants to measure player movement speed from a soccer match video. a) Propose a frame differencing or optical flow method to estimate movement. b) Explain how frame rate and spatial resolution influence the accuracy of results.	CO4	(7)
11	A startup wants to classify animal species from camera trap images using machine learning. a) Identify features you would extract (e.g., SIFT, HOG, PCA). b) Implement a k-NN or SVM classifier and discuss its expected performance.	CO5	(7)
12	A city surveillance system aims to detect and track vehicles in real-time from traffic camera feeds. a) Design a video analytics pipeline involving object detection, tracking, and motion estimation. b) Discuss how block matching or optical flow can assist in identifying vehicle motion patterns.	CO6	(7)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							

Course Code	Course Name	Course Category
M250101/AD214C	**INTERNET OF THINGS**	**PE**

COURSE OBJECTIVES	
1	To introduce the fundamental concepts, architecture, and enabling technologies of the Internet of Things (IoT), emphasizing how IoT integrates with physical devices, networks, and cloud infrastructure to create smart systems.
2	To familiarize students with various IoT architectures, communication protocols, and frameworks, including Fog computing, TinyOS, and nesC, for effective system design and implementation.
3	To develop an understanding of data management, analytics, and processing techniques in IoT environments for efficient handling of sensor-generated data and decision-making.
4	To explore the challenges of security, privacy, and ethical considerations in IoT systems, and to understand methods for ensuring data integrity, confidentiality, and operational control.
5	To familiarize students to design and implement IoT-based real world applications.

COMPETENCY STATEMENT	
CC 1	Ability to apply IoT concepts, architectures, and programming frameworks to design and develop innovative IoT-based systems and applications that solve real-world challenges effectively.
CC 2	Ability to analyze emerging IoT paradigms such as Fog computing, data management, and security mechanisms, and evaluate their effectiveness in building secure, scalable, and efficient IoT environments.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Make use of the concepts and features of the IOT paradigm.	CC1	U
CO 2	Analyse Fog computing, TinyOS -nesC and programming frameworks for IOT.	CC1	An
CO 3	Analyse the data management techniques applied to the IOT environment.	CC1	An
CO 4	Analyse security, and privacy in IOT environments.	CC1	A
CO 5	Analyse key enablers and solutions to enable practical IoT systems.	CC2	A
CO 6	Design of microprojects for Smart Gas Leakage Detector/Night Patrol at home.	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	2	-	2	-	-	2	-
2	2	-	2	2	2	2	-
3	3	-	3	-	-	2	-
4	3	3	-	2	-	2	-
5	3	-	3	-	3	2	3
6	3	-	3	-	-	2	-

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME												
Teaching Scheme / Week				Self-Learning (S) / Semester	Total Hours / Semester	Credits C	Examination Scheme					
							Theory			Practical		Total
L	T	J	P				CIA	ESE	Total	CIA	ESE	Total
3	0	0	0	30	75	3	40	60	100			100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Introduction-Internet of things	Overview of Internet of Things: Open-source semantic web infrastructure for managing IOT Resources in the Cloud-Device/Cloud Collaboration framework for intelligence applications	9
2	Programming frameworks	Introduction to Fog Computing: principles, architectures, and applications. TinyOS– NesC, Programming frameworks for Internet of Things	11
3	Data management techniques	Stream processing in IoT: foundations, state-of-the-art, and future directions-A framework for Distributed data analysis for IoT.	8
4	Security and privacy	Security and privacy in the Internet of Things-Internet of Things-robustness and reliability. TinyTO: two-way authentication for constrained devices in the Internet of Things-Obfuscation and Diversification for securing the Internet of Things	9
5	IoT Implementation	Creating a simple IoT project-Preparing Raspberry Pi–Interfacing the hardware-Internal representation of sensor values-Persisting data- Creating the Actuator project- Creating a controller.	8

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Micro project/Course based project	20
2	Backend processing to CLOUD or not to cloud Creating a simple sensor project-Preparing RaspberryPi–Clayster libraries.	4
3	Seminar	6

SUGGESTED LEARNING RESOURCES			
Text Book			
Sl. No.	Title of Book	Author	Publication
1	Internet of Things A to Z	Qusay F. Hassan	IEEE Press, Wiley, 2018
2	Architecting the Internet of Things	Dieter Uckelmann, Mark Harrison, Michahelles and Florian	Springer,2011.
Reference			
Sl. No.	Title of Book	Author	Publication

1	Learning Internet of Things	Peter Waher	Packt Publishing, 2015
2	Internet of Things	Rajkumar Buyya, Amir Vahid Dastjerdi	Morgan Kaufmann, 2016
3	Fundamentals of Sensor Network Programming: Applications and Technology	S. SitharamaIyengar, Nandan Parameswaran, Vir V. Phoha; N. Balakrishnan, Chuka Okoye	Wiley,December14, 2010
Web Resource			
1	https://www.coursera.org/specializations/internet-of-things	Course era	Course era
2	http://web.mit.edu/professional/digital-programs/courses/IoT	MIT	MIT

DETAILED SYLLABUS

Module	Topic	Mode of Delivery	COs	Learning Domain Level C	Hours
1	Internet of things-definition, evolution. Applications-Smart home applications, Healthcare, Eldercare, Traffic surveillance.	L	CO1	U	1
	SOA-Based Architecture, API oriented Architecture, Resource Management. Computational Offloading,	L	CO1	U	1
	Identification and Resource/Service Discovery, IOT Data Management and Analytics, IOT and the CLOUD	L	CO1	U	1
	Open IOT architecture for IOT/Cloud convergence, Sensor middleware, Cloud computing infrastructure, Directory service.	L	CO1	U	1
	Global Scheduler Local Scheduler component, Service delivery and utility manager Work flow of open IOT platform	L	CO1	U	1
	Scheduling process and IOT Services, lifecycle, State diagram of the Open IOT Services life cycle within the scheduler module. Scheduling and resource management	L	CO1	U	1
	Resource optimization schemes, Caching technique Service Creation flowchart, Comparison of cost-with cache server and public cloud data-score.	L	CO1	U	1
	Runtime adaptation engine, Device/cloud collaboration framework Applications of device	L	CO2	U	1
	Cloud collaboration, Semantic QA cache	L	CO2	U	1
2	Introduction to Fog Computing: principles, architectures, and Applications Motivating scenario for Fog Computing,	SS	CO2	An	1
	Advantages of Fog Computing, Reference architecture of Fog Computing Software-Defined Resource management layer,	L	CO2	An	1
	Services of Software Defined Resource management layer, Applications of Fog Computing	L	CO2	An	1
	History of TinyOS, Implementation, Requirements motivating the design of TinyOS, Component Model, Interfaces. TinyOS	L	CO2	An	1

	computational concepts, Overview of TinyOS Execution Model				
	Concurrency, TinyOS Theory of Execution: Events & Tasks, TinyOS Architecture. TinyOS-Programming Model	L	CO2	An	1
	nesC design, Component Implementation, Design Decisions for nesC, Module Components, Configuration Components Whole- Program Analysis	L	CO2	An	1
	Detecting Race Conditions, Dealing with Race Conditions, Issues for nesC. Overview of Embedded Programming Languages- nesC, Keil, C, DynamicC, B#	L	CO2	An	1
	Message Passing in Devices- Remote Procedure Call (RPC), Light weight RPC (LRPC) Representational state transfer (REST),	L	CO2	An	1
	Computational REST (CREST), Constrained Application Protocol (CoAP), Comparison of HTTP and CoAP	L	CO2	An	1
	Advantages of CoAP Coordination Languages-Orchestration, Choreography, Linda and eLinda	L	CO2	An	1
	Orc, Features of Orc, Java, Orchestration Language Interpreter Engine (Jolie), Polyglot Programming	L	CO2	An	1
3	Stream, Stream Processing, Data Stream Management System (DSMS)	L	CO3	An	1
	Differences between two use cases of Stream Processing: DSMS and CEP,	L	CO3	An	1
	The characteristics of stream data in IOT	L	CO3	An	1
	General architecture of a stream-processing system in IOT,	L	CO3	An	1
	Continuous logic processing system, challenges in stream Processing systems,	L	CO3	An	1
	Anomaly detection, problem statement and definitions.	L	CO3	An	1
	Hyper ellipsoidal anomaly detection.	L	CO3	An	1
	Distributed anomaly detection.	L	CO3	An	1
4	IOT security threats, IOT security requirements, security frameworks for IOT, IOT security overview, IOT gateways and security	L	CO4	A	1
	IOT routing attacks. Security frameworks for IOT-Light weight cryptography, asymmetric LWC algorithms, privacy in IOT networks	L	CO4	A	1
	IOT characteristics and reliability issues, reliability challenges	L	CO4	A	1
	Addressing reliability, security aspects and solutions	L	CO4	A	1
	TinyTO: Two-way authentication for constrained devices in the Internet of Things.	L	CO4	A	1
	TinyTO protocol. BCK with pre-shared keys for TinyTO, Handshake implementation	L	CO4	A	1
	IOT network stack and access protocols, Obfuscation and diversification technique	L	CO4	A	1
	Enhancing these curity in IOT using f1 obfuscation and Diversification techniques,	L	CO4	A	1

	motivations and limitations, different use-case scenarios on software diversification and obfuscation	L	CO4	A	1
5	Three key components to an IOT architecture, Sensor to gateway communication	L	CO5,CO6	A	1
	Wired gateway interfaces, wireless gateway interfaces. Sensors- Sensors required to build the environmental	L	CO5,CO6	A	1
	Sensing IOT gateway device for weather monitoring. Gateway, Gateway hardware, Gateway software	L	CO5,CO6	A	1
	Data transmission-advanced message queuing protocol, backend processing, to CLOUD or not to cloud	SS	CO5,CO6	A	1
	Creating a simple sensor project-Preparing Raspberry Pi– Clayster libraries. Hardware, Interfacing the hardware	SS	CO5,CO6	A	1
	Creating a simple sensor project-Preparing Raspberry Pi– Clayster libraries. Hardware, Interfacing the hardware	SS	CO5,CO6	A	1
	Creating a simple sensor project-Preparing Raspberry Pi– Clayster libraries. Hardware, Interfacing the hardware	SS	CO5,CO6	A	1
	Internal representation of sensor values-Persisting data. External Representation of sensor values, Exporting sensor data.	L	CO5,CO6	A	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Introduction	9		✓					12
2	Programming frameworks	11				✓			12
3	Data management techniques	8				✓			12
4	Security and privacy	9			✓				12
5	IoT Implementation	8			✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/ Course based task	15
Internal Examination	10
Course Project/ Review article	15
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD214C**		
Course Name:	**INTERNET OF THINGS**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programme			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A			
(Answer all questions. Each question carries 5 marks)			
No.	***Question***	***CO***	***Marks***
1	A user monitors their home security cameras and smart lights through a mobile app connected to a cloud server. Explain how IoT enables communication and collaboration between the mobile device, smart home devices, and the cloud in this scenario.	CO1	(5)
2	Analyze the major challenges faced in the Fog paradigm and examine how they impact the performance and scalability of IoT systems.	CO2	(5)
3	In a smart manufacturing plant, temperature sensors in multiple machines start showing irregular spikes in readings during night shifts. Analyze how anomaly detection techniques can be used to identify the source of these irregular spikes and categorize the type of anomaly occurring in this scenario.	CO3	(5)
4	A company develops a smart home automation app that connects door locks, cameras, and lighting systems. Hackers attempt to reverse-engineer the mobile app to exploit vulnerabilities. Apply the concepts of obfuscation and diversification to explain how the company can protect its IoT software and user data from reverse-engineering and unauthorized access.	CO4	(5)
5	A smart home controller needs to communicate with multiple I²C devices such as an EEPROM, a real-time clock, and a humidity sensor. Demonstrate how you would configure the TWI module to enable successful communication with these devices on a shared I²C bus	CO5	(5)
PART B			
(Answer any 5 questions. Each question carries 7 marks)			
No.	***Question***	***CO***	***Marks***
6	A farmer uses an Open IoT platform to monitor soil moisture, temperature, and irrigation schedules through cloud-based services. Explain the state diagram of the Open IoT services lifecycle represents the different stages in this smart agriculture scenario.	CO1	(7)
7	a) A smart building system requires real-time monitoring of temperature, lighting, and occupancy using TinyOS-powered devices. Break down the four major design requirements that motivated TinyOS and analyze how each contributes to efficient resource management and system responsiveness in this context. b) Analyze how the design decisions of nesC contribute to addressing the challenges of concurrency, modularity, and resource constraints in embedded IoT systems.	CO2	(4+3)
8	Analyze how the design objectives of DSMS and CEP influence their suitability for different IoT applications such as sensor data monitoring and event-driven automation.	CO2	(7)
9	A hospital uses wearable IoT devices to monitor patients' heart rate, oxygen levels, and temperature in real time. Some devices start sending irregular readings that do not match patients' actual conditions. Analyze how distributed anomaly detection techniques can identify faulty sensor readings across multiple devices and improve the reliability of patient health monitoring.	CO3	(7)
10	In a smart manufacturing facility, multiple IoT sensors collect real-time production data. Apply an IoT security framework incorporating lightweight cryptography to protect sensitive factory data while ensuring real-time communication.	CO4	(7)
11	A rural area without stable internet connectivity requires a weather monitoring solution that stores sensor data locally and uploads it once connectivity is restored. Apply appropriate IoT gateway hardware and software configurations to ensure reliable data collection, local storage, and synchronization once the network connection resumes.	CO5	(7)

12	You have been asked to create a sensor-based system to detect available parking slots and display them on a mobile app. Apply the structured steps of developing a sensor project to describe how you would design, integrate, and test the system components for reliable operation.	CO6	(7)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code		**Course Name**				**Course Category**	
M250101/AD215C		**INTELLIGENT SYSTEMS**				**PE**	

COURSE OBJECTIVES	
1	To understand the Principles Artificial Intelligence and Intelligent Systems
2	To identify the Application of AI Techniques in Problem Solving and Decision Making
3	To understand the concepts of learning methods and expert systems

COMPETENCY STATEMENT	
CC 1	Demonstrate understanding of the fundamental principles, structures, and methodologies of Artificial Intelligence, including intelligent agents, search strategies, and reasoning mechanisms.
CC 2	Apply machine learning and expert system techniques to design, develop, and evaluate intelligent systems capable of learning and reasoning from data and knowledge bases.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Apply the fundamental concepts a of artificial intelligence, including the roles and structures of intelligent agents.	CC1	A
CO 2	Apply uninformed and informed search strategies to solve complex problems and game scenarios.	CC1	A
CO 3	Identify different knowledge representation schemes and reasoning methods for AI systems.	CC1	A
CO 4	Implement learning techniques for developing intelligent systems.	CC2	A
CO 5	Develop expert systems, considering their structure, knowledge acquisition and inferencing methods	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	2	3	4	5	6	7
1	3	2	3				
2	3	2	3	3	3	2	-
3	3	2	3	2	2		-
4	3	-	3	3	3	2	-
5	3	-	3	3	3	2	-

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week				Self-Learning (S) / Semester	Total Hours / Semester	Credits C	Examination Scheme						
							Theory			Practical			Total
L	T	J	P				CIA	ESE	Total	CIA	ESE	Total	
3	0	0	0	30	60	3	40	60	100				100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Foundations of AI and Intelligent Agents	Introduction to AI and its History, Intelligent Agents- Concepts of agents and environments, Structures of agents-Problem-Solving Agents-Problem formulation and agent-based problem Solving-Examples of problem-solving scenarios	11
2	Search Strategies and Game Playing	Uninformed search strategies: Breadth-first search (BFS), Depth-first search (DFS), Heuristic search: Hill climbing, A* algorithm, Problem reduction techniques Game Playing and Adversarial Search- Mini-max algorithm for optimal decision-making, Alpha-Beta pruning for efficient game tree exploration, Constraint Satisfaction Problems	11
3	Knowledge representation and reasoning	Logical agents, First order logic, First Order Inference, Unification, Forward chaining, Backward chaining, Resolution Strategies, Reasoning under uncertainty	11
4	Planning Agents	Planning Problem, Planning with State Space Search, Partial-Order planning, Planning Graphs, Conditional Planning, Continuous Planning, Multiagent Planning	10
5	Learning Methods and Expert Systems	Learning from Observations: Inductive learning and decision trees, Explanation-based learning, Statistical learning methods and reinforcement learning Expert Systems: Introduction and basic concepts of expert systems, Structure and functioning of expert systems, Knowledge engineering and acquisition methods, Handling uncertainty in expert systems	11

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Micro project/Course based task	20
2	Seminar	10

SUGGESTED LEARNING RESOURCES			
Text Book			
Sl. No.	Title of Book	Author	Publication
1	Artificial Intelligence: A Modern Approach	Stuart Russell, Peter Norvig	Pearson
2	Artificial Intelligence: Foundations of Computational Agents	David L. Poole, Alan K. Mackworth	Cambridge University Press
3	Artificial Intelligence	Elaine Rich, Kevin Knight, Sivasankar B nair	Tata McGraw Hill 3/e.2010
Reference			
Sl. No.	Title of Book	Author	Publication
1	Artificial Intelligence: Structures and		

	Strategies for Complex Problem Solving	George F. Luger	Addison Wesley
2	Expert Systems: Principles and Programming	Joseph C. Giarratano and Gary D. Riley	Cengage Learning 2/e, 2017
Web Resource			
1	https://nptel.ac.in/courses/108104049	NPTEL	NPTEL
2	https://www.coursera.org/learn/introduction-to-ai	Course era	Course era

DETAILED SYLLABUS

Module	Topic	Mode of Delivery	COs	Learning Domain Level	Hours
				C	
1	Introduction to AI and its History	L	CO1	U	2
	Intelligent Agents -characteristics	L	CO1	U	1
	Agents and environments	L	CO1	U	1
	Concept of Rationality	L	CO1	A	1
	Nature of environments	L	CO1	A	1
	Structure of agents programs	L	CO1	A	2
	Learning Agents	L	CO1	A	1
	Problem solving agents	L	CO1	A	2
2	Uninformed search strategies	L	CO2	A	1
	Breadth-first search (BFS)	L	CO2	A	1
	Depth-first search (DFS)	L	CO2	A	1
	Heuristic search strategies and Heuristic functions	L	CO2	A	1
	Hill climbing search , Local Beam Search	L	CO2	A	1
	A* search	L	CO2	A	1
	Problem reduction techniques	L	CO2	U	1
	Game Playing and Adversarial Search	L	CO2	A	1
	Mini-max algorithm for optimal decision making	L	CO2	A	1
	Alpha-Beta pruning for efficient game tree exploration,	L	CO2	A	1
	Constraint Satisfaction Problems	L	CO2	A	1
3	Logical agents	L	CO3	U	1
	First order logic	L	CO3	A	1
	First Order Inference,	L	CO3	A	1
	Unification,	L	CO3	A	1
	Forward chaining	L	CO3	A	1
	Backward chaining	L	CO3	A	2
	Resolution Strategies	L	CO3	A	2
	Reasoning under uncertainty	L	CO3	A	2
4	Planning Problem	L	CO4	U	1
	Planning with State Space Search	L	CO4	A	2
	Partial-Order planning	L	CO4	A	1
	Planning Graphs	L	CO4	A	1
	Conditional Planning	L	CO4	A	1
	Continuous Planning	L	CO4	A	2
	Multi agent Planning	L	CO4	A	2
	Inductive learning	L	CO5	A	1
	Learning from Decision trees,	L	CO5	A	2
	Explanation-based learning	L	CO5	A	1

5	Neural Networks based learning	L	CO5	A	2
	Reinforcement learning	L	CO5	U	2
	Introduction and basic concepts of expert systems.	L	CO5	U	1
	Expert Systems: and functioning of expert systems	L	CO5	A	1
	Handling uncertainty in expert systems	L	CO5	A	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Foundations of AI and Intelligent Agents	9		✓					12
2	Search Strategies and Game Playing	11		✓	✓				12
3	Knowledge representation and reasoning	8		✓	✓				12
4	Planning Agents	9		✓	✓				12
5	Learning Methods and Expert Systems	9		✓	✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN

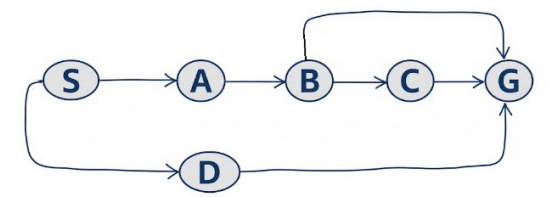
Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/ Course based task	15
Internal Examination	10
Course Project/ Review article	15
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD215C**		
Course Name:	**INTELLIGENT SYSTEMS**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

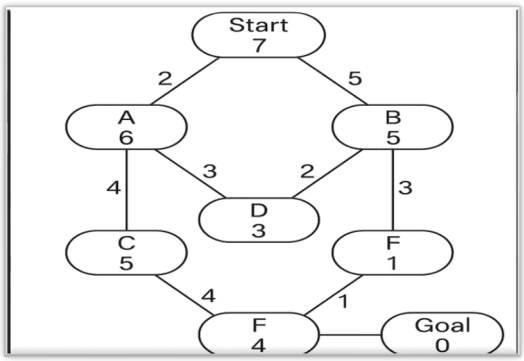
PART A

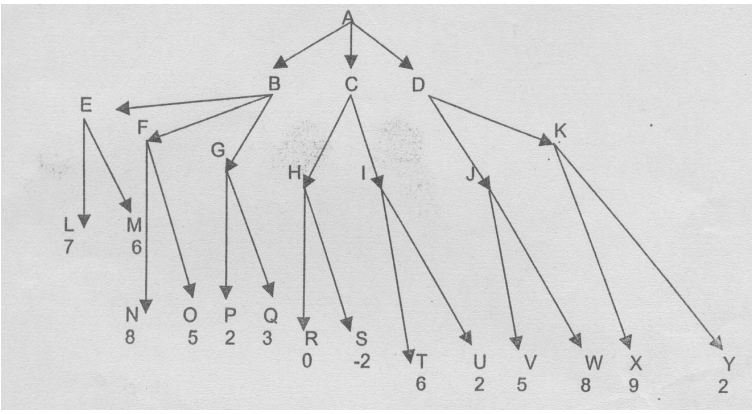
(Answer all questions. Each question carries 5 marks)

No.	***Question***	***CO***	***Marks***
1	For each of the following agents , develop a PEAS(Performance, Environment, Actuators, Sensors) description of the task environment. (a) Autonomous Car Driver (b) Intelligent book-shopping agent	CO1	(5)
2	Find the path from node **S** to node **G** in the following graph using (1) DFS (2) BFS 	CO2	(5)
3	Generate First Order Predicate Logic representations for the statements i) Every man respects his parent ii) Not all students like both Mathematics and Science iii) Only one student failed in Mathematics	CO3	(5)
4	A warehouse robot needs to move packages from Zone A to Zone D. The robot can move between adjacent zones (A→B, B→C, C→D) and can lift only one package at a time. The initial state is that a package is at Zone A, and the goal is to have it at Zone D. Using state-space search, outline the sequence of actions the robot should take to move the package from Zone A to Zone D. Represent your solution as a forward search plan**.**	CO 4	(5)
5	What are the major components of an expert system? Specify the role of each.	CO5	(5)

PART B

(Answer any 5 questions. Each question carries 7 marks)

No.	***Question***	***CO***	***Marks***
6	What are problem-solving agents? Explain how a problem-solving agent formulate the **8-Puzzle** problem and solve it.	CO1	(7)
7	A delivery robot must travel from the **Start (S)** node to the **Goal (G)** node in the following search space. The numbers in the nodes represent heuristic values (h), and the numbers on the edges represent the path cost (g). Using A* algorithm find the best path from **S** to **G** 	CO2	(7)
8	Consider the following piece of knowledge	CO3	(7)

	i. John likes all kinds of food ii. Apples are food iii. Anything anyone eats and is not killed by is food iv. Bill eats peanuts and is still alive v. Sue eats everything bill eats Represent the sentences in first order logic and prove that "John likes peanuts" using backward chaining.		
9	Illustrate the procedure for converting a first-order logic statement to CNF	CO3	(7)
10	A smart home AI assistant is tasked with preparing breakfast. The tasks involved are: 1. Boil water 2. Make tea 3. Toast bread 4. Spread butter on toast Constraints: • Tea cannot be made before the water is boiled. • Butter cannot be spread before the bread is toasted. • Some tasks, like boiling water and toasting bread, can be done concurrently. a) Draw a partial-order plan (POP) showing the ordering constraints and possible concurrent actions. Clearly indicate which tasks can occur simultaneously and which must follow a specific order.	CO4	(7)
11	Consider the following game tree, find the best move from the root node using Min-Max algorithm. Explain how pruning can improve the search time without compromising on the path that gives information about the best move. 	CO2	(7)
12	What do you mean by uncertain knowledge? Explain how probabilistic reasoning can be used for handling uncertain knowledge.	CO5	(7)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code		**Course Name**				**Course Category**	
M250101/AD221D		**SOFT COMPUTING**				**PE**	

COURSE OBJECTIVES	
1	To understand the fundamental concepts and techniques of soft computing — including neural networks, fuzzy systems, and genetic algorithms.
2	To apply the appropriate soft computing methods for modelling and solving real-life problems .
3	To evaluate and compare the effectiveness of different soft-computing approaches .

COMPETENCY STATEMENT	
CC 1	Implements AI models, fuzzy logic, and computational intelligence techniques for data-driven decision-making.
CC 2	Understand and apply the principles of evolutionary computation, especially genetic algorithms and use them for optimisation problems

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Analyse soft computing techniques and their applications	CC1	An
CO 2	Apply various neural-network models to solve real-life problems.	CC1	A
CO 3	To analyse various fuzzy-system concepts by deconstructing their structures, comparing their functions, and relating them to suitable applications.	CC1	An
CO 4	Illustrate use of fuzzy models in various applications	CC1	A
CO 5	Analyse genetic algorithms and their applications	CC2	An
CO 6	Design, develop, implement and present solutions to simple real-life problems with popular open source library using soft computing techniques	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1		-	2	2	-	2	-
2	2	-	2	2	2	2	-
3	-	-	3	2	-	2	-
4	3	-	3	2	-	2	-
5	3	-	3	2	3	2	-
6	3	3	3	2	3	2	3

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week				Self-Learning (S) / Semester	Total Hours / Semester	Credits C	Examination Scheme						
							Theory			Practical			Total
L	**T**	**J**	**P**				**CIA**	**ESE**	**Total**	**CIA**	**ESE**	**Total**	
3	0	0	0	30	70	3	40	60	100				100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Introduction to Soft Computing and Neural Networks	Computational Intelligence, Biological Neurons,Perception Networks	8
2	Neural Networks	Supervised learning, Reinforcement Learning,Unsupervised Learning Neural Networks, Applications of ANNs to solve real life problems	8
3	Fuzzy Sets & Logic	Fuzzy sets, Membership function, Fuzzy relations, Fuzzy Logic	8
4	Fuzzy Reasoning	Fuzzy Expert Systems, Fuzzification and Defuzzification methods, Applications	8
5	Genetic Algorithm	Genetic algorithms, Classification, GA features, Applications, GA based systems	8

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Micro project/Course based project	20
2	Supervised Learning Neural Networks Application of ANN to solve real life problems	6
3	Seminar	4

SUGGESTED LEARNING RESOURCES			
Text Book			
Sl. No.	Title of Book	Author	Publication
1	Principles of Soft Computing	S.N. Sivanandam, S.N. Deepa	Wiley India Pvt. Ltd ,2018
2	Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence	Jyh-Shing Roger Jang, Chuen-Tsai Sun & Eiji Mizutani	Pearson India, 2015
Reference			
Sl. No.	Title of Book	Author	Publication
1	Fuzzy Logic with Engineering Applications	Timothy J. Ross	Wiley India Pvt. Ltd , 2021
2	Soft Computing: Fundamentals, Techniq ues and Applications	Saroj Kaushik & Sunita Tiwari	McGraw Hill Education ,2018
3	Soft Computing and Machine Learning: A Fuzzy and Neutrosophic View of Reality	Mohd Anas Wajid, Aasim Zafar, Mohammad Saif Wajid, Akib Mohi Ud Din Khanday, Pronaya Bhattacharya	CRC Press, 2025
Web Resource			
1	Introduction to Soft Computing	Prof. Debasis Samanta	NPTEL| IIT Kharagpur
2	Soft Computing Techniques	Prof. Santimoy Kundu	NPTEL | IIT Dhanbad

DETAILED SYLLABUS					
Module	Topic	Mode of Delivery	COs	Learning Domain Level	Hours
				C	
1	Soft Computing Constituents, Computational Intelligence and Soft Computing vs Artificial Intelligence and Hard Computing	L	CO1	U	1
	Introduction to artificial neural networks, biological neurons	L	CO1	U	1
	Mc Culloch and Pitts models of neurons, Perception networks	L	CO1	A	1
	Multilayer Perceptron, Types of activation function	L	CO1	A	1
	Network architectures, Learning process	L	CO1	A	1
	Learning XOR and other logical Gate functions	L	CO1	U	1
	Sigmoid Neurons, Gradient Descent Algorithm	L	CO2	A	1
	Back propagation Neural Network.	L	CO2	A	1
2	Adaptive Networks, Feed Forward Networks	L	CO2	U	1
	Supervised Learning Neural Networks	SS	CO2	U	1
	Radial Basis Function Networks, Reinforcement Learning	L	CO2	A	1
	Unsupervised Learning Neural Networks, Adaptive Resonance Architectures	L	CO2	A	1
	BAM, Maxnet, Kohonen Self Organizing Maps,	L	CO2	A	1
	K-means clustering algorithm, Introduction to Convolutional Neural Networks	L	CO2	A	1
	Applications of ANNs to solve real life problems ,Familiarisation of Neural Networks tools	SS	CO3	An	1
	Feed-Forward Neural Network	L	CO2	U	1
	Back propagation algorithm	L	CO2	A	1
3	Fuzzy versus Crisp, Fuzzy sets	L	CO4	U	1
	Membership function, linguistic variable	L	CO4	A	1
	Basic operators, properties	L	CO4	A	1
	Fuzzy relations	L	CO4	A	1
	Cartesian product		CO4	U	1
	Operations on Fuzzy sets	SS	CO4	A	1
	Operations on fuzzy relations	L	CO4	A	1
	Fuzzy Logic	L	CO4	A	1
4	Fuzzy If-Then Rules	L	CO4	U	1
	Fuzzy Inference Systems	L	CO4	A	1
	Fuzzy Expert Systems	L	CO4	A	1
	Fuzzification and Defuzzification methods	L	CO4	U	1
	Fuzzy Decision Making	SS	CO4	U	1
	Mamdani Fuzzy Models	SS	CO4	U	1
	Sugeno Fuzzy Models	L	CO4	A	1
	Applications of Fuzzy logic, Neuro Fuzzy Systems.	SS	CO4	An	
	Introduction to genetic algorithm and hybrid systems	L	CO5	A	1
	Genetic algorithms , Natural evolution , Properties	L	CO5	A	1
	Classification, GA features	L	CO5	A	1
	Coding, Selection, Selection methods	L	CO5	U	1

5	Reproduction - Cross over and Mutation operators	L	CO5	U	1
	Basic GA and structure, Solving Travelling Salesman Problem using GA	L	CO5,CO6	A	1
	Applications using GA	L	CO5,CO6	An	1
	Hybrid Systems - GA based BPNN	L	CO5,CO6	A	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Introduction to Soft Computing and Neural Networks	8		✓	✓				12
2	Neural Networks	8		✓	✓				12
3	Fuzzy Sets & Logic	8		✓	✓				12
4	Fuzzy Reasoning	8		✓	✓				12
5	Genetic Algorithm	8		✓	✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN

Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/ Course based task	15
Internal Examination	10
Course Project/ Review article	15
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD221D**		
Course Name:	**SOFT COMPUTING**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

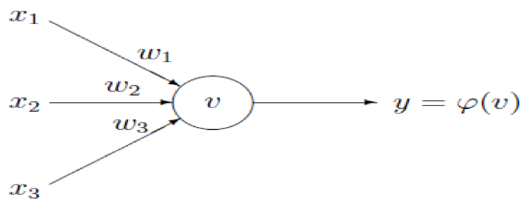
PART A

(Answer all questions. Each question carries 5 marks)

No.	*Question*	*CO*	*Marks*
1	Show that a single-layer perceptron cannot simulate the XOR (exclusive-OR) function. Use the perceptron model (weighted sum plus threshold activation) for inputs (0,0), (0,1), (1,0), (1,1) and explain the reason in terms of linear separability of the data.	CO1	(5)
2	Illustrate with an example how the Supervised Learning technique can be used to solve a multilabel classification problem	CO2	(5)
3	Differentiate the Generalised Bell membership function and the Left-Right Membership Function.	CO3	(5)
4	Discuss Fuzzy Expert System with an example	CO4	(5)
5	A logistics company needs to schedule 6 trucks over 6 daily delivery tasks, minimising total distance and time. Apply a genetic algorithm for route optimisation.	CO5	(5)

PART B

(Answer any 5 questions. Each question carries 7 marks)

No.	*Question*	*CO*	*Marks*
6	A large e-commerce retailer collects three daily customer metrics: "Number of ItemsViewed", "TimeSpentOnSite" (in minutes), and "DayOfWeek" (1 = Monday … 7 = Sunday). The retailer wants to build a system to predict whether the customer will purchase the same session (output: 0 = no, 1 = yes). (a) Design a suitable feed-forward neural network for this classification task: specify the number of input neurons, hidden layer size(s), output neuron, and propose activation functions for the hidden layer(s) and output layer.	CO1	(7)
7	Design a suitable neural network for human face recognition.	CO2	(7)
8	Consider the unit shown in the figure  Suppose that the weights corresponding to the three inputs have the following values: w1= 1, w2= - 3, w3= 2 and the activation of the unit is given by the step-function: $\varphi(v) = \begin{cases} 1 & \text{if } v \geq 0 \\ 0 & \text{otherwise} \end{cases}$ Calculate what will be the output value y of the unit for each of the following input patterns: Pattern | P_1 | P_2 | P_3 | P_4 x_1 | 1 | 0 | 1 | 1 x_2 | 0 | 1 | 0 | 1 x_3 | 0 | 1 | 1 | 1	CO2	(7)
9	Consider a two input – one output problem that includes following three rules. Rule: 1 - IF x is A3 OR y is B1 THEN z is C1 Rule: 2 - IF x is A2 AND y is B2 THEN z is C2	CO3	(7)

	Rule: 3 - IF x is A1 THEN z is C3 Assume A3=0.2, B1=0.4, A2=0.7,B2=0.9,A1=0.3 and the selected values of z in C1=(0,11,21), C2=(,40,50,60, 70) & C3=(60, 70,80,90). Using a Mamdani fuzzy inference system: (a) Determine the firing strength of each rule. (b) Compute the output fuzzy set(s) for each rule by applying the rule strength to the corresponding output membership function. (c) Aggregate the output fuzzy sets and then defuzzify to find a crisp value of z.		
10	Design a fuzzy controller to determine the wash time of a washing machine. Assume the input is dirt and grease. Use three descriptors for input variable and five descriptors for output variable. Derive the set of rules for controller action and defuzzification. Show that if the dirt are more , the wash time will be more and vice versa.	CO4	(7)
11	Illustrate Roulette Wheel Selection technique with an example.	CO5	(7)
12	Consider a population of 5 individuals with the following fitness values: Individuals: P1, P2, P3, P4,P5, P6 Fitnes: P1=12 ,P2= 8, P3=15 , P4=9, P5=11 Apply tournament selection in genetic algorithm with tournament size k=3 (select 3 randomly-chosen individuals for each tournament) and select 3 parents for the next generation. (a) Perform one tournament: randomly pick 3 individuals, show their fitnesses, identify the winner selected as a parent. (b) Repeat until you have selected 3 parents (you may reuse individuals). (c) Explain how increasing tournament size to k=5k = 5k=5 (so all individuals compete) would affect the selection pressure, diversity of the population and chances of weaker individuals being selected.	CO6	(7)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code		**Course Name**				**Course Category**	
M250101/AD222D		**ADVANCED NATURAL LANGUAGE PROCESSING**				**PE**	

COURSE OBJECTIVES	
1	To get a comprehensive understanding of the various stages of Natural Language Processing
2	To get a deep insight about how neural network models have revolutionised Natural language processing.

COMPETENCY STATEMENT	
CC 1	Understand the various stages of NLP and the complexities involved
CC 2	Demonstrate a thorough understanding of various deep learning models used in NLP tasks

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Understand the fundamentals of NLP and apply them in text processing	CC1	A
CO 2	Apply various parsing techniques on English text, and evaluate their performance	CC1	A
CO 3	Application of word vectors like TF-IDF, PMI and word embeddings effectively in NLP tasks	CC2	A
CO 4	Apply advanced architectures such as RNNs, LSTMs, and encoder-decoder models with attention for sequence modelling.	CC2	A
CO 5	Implementation of NLP techniques such as machine translation, question answering, and information retrieval.	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	2	-	2	2	2	2	-
2	2	-	2	2	2	2	-
3	3	-	3	3	3	2	-
4	3	-	3	3	3	2	-
5	3	-	3	3	3	2	-

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week				Self-Learning (S) / Semester	Total Hours / Semester	Credits C	Examination Scheme						
L	T	J	P				Theory			Practical			Total
							CIA	ESE	Total	CIA	ESE	Total	
3	0	0	0	30	70	3	40	60	100				100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Introduction to NLP	Introduction to Natural Language Processing - Various stages of traditional NLP – Challenges - Basic Text Processing techniques - Common NLP Tasks. N-gram Language Models - Naive Bayes for Text Classification, and Sentiment Analysis - Introduction to Neural Networks.	8
2	Linguistic structures	Linguistic Structures - Constituency Trees, Context-Free Grammars, Ambiguity, CKY Parsing, PCFG-Statistical Parsing-Dependency Grammar	7
3	Word representations	Word representations - Lexical Semantics, Vector Semantics, TF-IDF, Pointwise Mutual Information (PMI), Neural Word embeddings - Word2vec, GloVe. Contextual Word Embeddings. Evaluating Vector Models - Feedforward neural networks for text Classification	8
4	Deep learning Models for NLP	Sequence Modelling - Recurrent Neural Networks, RNNs as Language Models, RNNs for NLP tasks, Stacked and Bidirectional RNN architectures, Recursive Neural Networks, LSTM & GRU, Common RNN NLP Architectures, Encoder-Decoder Model with RNNs, Attention models-Transfer learning and pre-trained language Models, CNN for NLP	14
5	NLP Applications	NLP Applications - Machine Translation, Question Answering and summarization, Dialogue and conversational agents, Information Retrieval, Research perspectives in NLP, Introduction to Large Language Models	13

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Micro project/Course based project	20
2	Python implementation of various NLP tasks	10

SUGGESTED LEARNING RESOURCES			
Text Book			
Sl. No.	Title of Book	Author	Publication
1	Speech and Language Processing	Dan Jurafsky and James H. Martin	3rd Edition. https://web.stanford.edu/~jurafsky/slp3/
2	A Primer on Neural Network Models for Natural Language Processing	Yoav Goldberg	Morgan & Claypool Publishers, 1ed, 2017
Reference			
Sl. No.	Title of Book	Author	Publication
1	Deep Learning	Goodfellow, I., Bengio,Y., and Courville, A.,	MIT Press, 2016.
3	Practical Natural Language Processing	Sowmya Vajjala, Bodhisattwa	O'Reilly , 2020

		Majumder, Anju Gupta, Harishit Surana	
Web Resource			
1	Deep learning for NLP	Prof. Pawan Goyal	NPTEL | IIT Kharagpur

Module	Topic	Mode of Delivery	COs	Learning Domain Level	Hours
				C	
1	Building Blocks of NLP	L	CO1	U	1
	Challenges & Basic NLP Tasks	L	CO1	U	1
	English Morphology and Finite state Morphological Parsing	L	CO1	A	1
	Words and Sentence Tokenization- subword tokenization, Byte pair encoding	L	CO1	A	1
	Text classification- Naïve Bayes, Logistic regression	L	CO1	A	1
	POS Tagging methods- HMM	L	CO1	A	1
	N-grams for Language Modelling	L	CO1	A	1
	Implementation of Language models	L	CO1	A	1
2	Context Free Grammar	L	CO2	U	1
	Some Grammar Rules for English	L	CO2	U	1
	Parsing With CFG	L	CO2	A	1
	Dynamic programming parsing-CKY Parsing	L	CO2	A	1
	Probabilistic CFG	L	CO2	A	1
	Probabilistic CKY parsing	L	CO2	A	1
	Dependency Grammar	L	CO2	A	1
3	Lexical Semantics	L	CO3	U	1
	Vector Semantics	L	CO3	A	1
	TF-IDF	L	CO3	A	1
	Pointwise Mutual Information	L	CO3	A	1
	Word2Vec- CBOW, Skipgram,	L	CO3	A	1
	GloVe, Contextual Word Embedding , BERT	L	CO3	A	1
	Visualization of Embeddings	L	CO3	U	1
	Evaluating Vector Models	L	CO3	A	1
4	Sequence modelling - examples	L	CO4	A	1
	Recurrent Neural Networks	L	CO4	A	1
	RNN as language models	L	CO4	A	1
	RNNS for other NLP tasks	L	CO4	A	1
	Stacked and Bidirectional RNNs	L	CO4	A	1
	The LSTMs and BiLSTMs	L	CO4	A	1
	Self-attention networks, Transformers	L	CO4	A	1
	Transformers as Language Models	L	CO4	A	1
	Machine translation and encoder-decoder models	L	CO4	A	1
	Encoder-Decoder with Transformers	L	CO4	A	1
	Transfer Learning with Contextual Embeddings	L	CO4	A	1
	CNN for NLP	L	CO4	A	1
	Pre-trained Language Model	L	CO4	A	1
	LSTM for text Classification	L	CO4	A	1

5	Learning with No or Less Data and Adapting to New Domains	L	CO5	A	1
	Information Extraction Pipeline	L	CO5	A	1
	Named Entity Extraction	L	CO5	A	1
	Dialogue systems- Deep dive in to components	L	CO5	A	1
	Recommender System for Textual data	L	CO5	A	1
	Machine Translation Systems	L	CO5	A	1
	Text summarization	L	CO5	A	1
	NLP application in Finance	L	CO5	A	1
	NLP application in Health Care	L	CO5	A	1
	Introduction to Large Language Models	L	CO5	A	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Introduction to NLP			✓	✓				12
2	Linguistic structures			✓	✓				12
3	Word Representations			✓	✓				12
4	Deep learning for NLP			✓	✓				12
5	NLP Applications			✓	✓				12
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.									

ASSESSMENT PATTERN

Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/ Course based task	15
Internal Examination	10
Course Project/ Review article	15
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD222D**		
Course Name:	**ADVANCED NATURAL LANGUAGE PROCESSING**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A			
(Answer all questions. Each question carries 5 marks)			
No.	***Question***	***CO***	***Marks***
1	(a) Why is sub word tokenization preferred over word-level tokenization?. (b) With an example explain Byte Pair Encoding	CO1	(5)
2	Demonstrate how the CKY algorithm can be extended to handle probabilistic grammars with an example.	CO2	(5)
3	Given a small text corpus of food-related sentences: 1. *I like to eat apple pie.* 2. *She baked a fresh apple pie.* 3. *He likes banana milkshake.* *Calculate PMI and find the probability of the words apple and pie occurring together.*	CO3	(5)
4	Draw the structure of a LSTM cell. What are the formulas used for computation of output at each gate	CO4	(5)
5	Discuss transfer learning as a solution for low-resource NLP	CO5	(5)
PART B			
(Answer any 5 questions. Each question carries 7 marks)			
No.	***Question***	***CO***	***Marks***
6	Apply the HMM-based POS tagging approach on a given sentence and show how the most probable tag sequence is obtained.	CO1	(7)
7	Explain how BERT generates contextual word representations and how they differ from traditional word embedding TF-IDF	CO3	(7)
8	Explain the difference between content-based filtering and collaborative filtering approaches with suitable examples in the context of Recommender Systems	CO5	(7)
9	Draw parse trees for the following sentences a. The book is illustrating the programming examples b. I prefer a morning flight c. All the evening buses from Delhi to Simla leave at midnight d. I saw the girl with binoculars	CO2	(7)
10	Discuss the structure and functioning of a Transformer-based Encoder–Decoder model used for machine translation	CO4	(7)
11	Explain how a Convolutional Neural Network can be applied to Natural Language Processing tasks such as text classification or sentiment analysis.	CO4	(7)
12	Explain in detail the architecture and working of an LLM (e.g., GPT or BERT)	CO5	(7)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code		**Course Name**				**Course Category**	
M250101/AD223D		**CRYPTOGRAPHY AND NETWORK SECURITY**				**PE**	

COURSE OBJECTIVES	
1	Summarize basic cryptographic algorithms and security issues
2	Compare and analyze various symmetric and asymmetric key cryptographic algorithms.
3	Demonstrate cryptographic hash functions and digital signature schemes.
4	Summarize key management and distribution schemes for symmetric and asymmetric encryption.
5	Apply the concepts to design an efficient cryptographic algorithm, hash function and digital signature scheme.

COMPETENCY STATEMENT	
CC 1	Demonstrate a comprehensive understanding of fundamental cryptographic principles by analysing and comparing symmetric and asymmetric key algorithms, hash functions, and digital signature schemes to evaluate their security, efficiency, and applicability in different contexts.
CC 2	Design and implement effective cryptographic solutions through proper key management and distribution strategies, integrating encryption, hashing, and digital signing techniques to develop secure and efficient data protection mechanisms.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Summarize basic cryptographic algorithms and security issues.	CC1	A
CO 2	Compare and analyze various symmetric and asymmetric key cryptographic algorithms.	CC1	A
CO 3	Demonstrate cryptographic hash functions and digital signature schemes.	CC1	A
CO 4	Summarize key management and distribution schemes for symmetric and asymmetric encryption.	CC2	A
CO 5	Apply the concepts to design an efficient cryptographic algorithm, hash function and digital signature scheme.	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	2	-	2	2	2	2	-
2	3	-	2	2	2	2	-
3	3	-	3	2	3	2	-
4	2	-	2	2	3	2	-
5	2	-	3	2	3	2	-
6	2	-	3	2	-	2	-

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME				
Teaching Scheme / Week	**Self-Learning (S) / Semester**		**Credits C**	**Examination Scheme**

L	T	J	P		Total Hours / Semester		Theory			Practical			Total
3	0	0	0	30	70	3	CIA	ESE	Total	CIA	ESE	Total	100
							40	60	100				

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)

Module	Title	Major Topics	Contact Hours
1	Security Concepts, Cryptography Concepts and Techniques	Security Concepts - Introduction, The need for security, Security approaches, Principles of security, Types of Security attacks. Services and Mechanism, A model for Network Security. Cryptography Concepts and Techniques - Introduction, plain text and cipher text, substitution techniques, transposition techniques, encryption and decryption, symmetric and asymmetric key cryptography, steganography, key range and key size, possible types of attacks.	9
2	Symmetric and Asymmetric Key Cryptography	Symmetric Key Cryptography - Block Cipher principles, DES, AES, Blowfish, RC5, IDEA, Block cipher operation, Stream ciphers, RC4. Asymmetric Key Cryptography - Principles of public key cryptosystems, RSA algorithm, Elgamal Cryptography, Diffie- Hellman Key Exchange, Knapsack Algorithm.	11
3	Cryptographic Hash Functions	Message Authentication, Secure Hash Algorithm (SHA 512), Message authentication codes: Authentication requirements, HMAC, CMAC, Digital signatures, Elgamal Digital Signature Scheme.	7
4	Key Management and Distribution	Symmetric Key Distribution Using Symmetric& Asymmetric Encryption, Distribution of Public Keys, Kerberos, X.509 Authentication Service, Public – Key Infrastructure.	6
5	Case Studies of Cryptography	Denial of service attacks, IP spoofing attacks, Secure inter branch payment transactions, Conventional Encryption and Message Confidentiality, Conventional Encryption Principles, Conventional Encryption Algorithms, Location of Encryption Devices, Key Distribution	7

SELF-LEARNING / TEAM WORK

Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Review article based on peer reviewed original publications	10
2	Micro-project	20

SUGGESTED LEARNING RESOURCES

Text Book

Sl. No.	Title of Book	Author	Publication
1	Cryptography and Network Security.	William Stallings	6th Edition, Pearson Education, 2013.
2	Cryptography and Network Security.	Behrouz A. Forouzan, Debdeep Mukhopadhyay.	Special Indian Edition, Mc Graw Hill Education, 2007.
Reference			
Sl. No.	Title of Book	Author	Publication
1	Cryptography and Network Security.	Atul Kahate	Mc Graw Hill, 2nd Edition, 2008.
2	Cryptography and Network Security	C K Shyamala, N Harini, Dr T R Padmanabhan.	Wiley India, 1st Edition, 2011.
3	Information Security, Principles, and Practice.	Mark Stamp	Wiley India, 2011.
4	Principles of Computer Security.	WM. Arthur Conklin, Greg White.	TMH, 2018.
5	Introduction to Network Security.	Neal Krawetz	Cengage Learning, 2007.
6	Network Security and Cryptography	Bernard Menezes	Cengage Learning, 2010.
Web Resource			
1	Cryptography and Network Security	Prof. Sourav Mukhopadhyay	IIT Kharagpur
2	Network Security.	Prof. Gaurav S. Kasbekar	IIT Bombay

DETAILED SYLLABUS

Module	Topic	Mode of Delivery	Cos	Learning Domain Level	Hours
				C	
1	Security Concepts - Introduction, The need for security, Security approaches	L	CO1	U	1
	Principles of security, Types of Security attacks.	L	CO1	U	1
	Services and Mechanism	L	CO1	U	1
	A model for Network Security.	L	CO1	A	1
	Cryptography Concepts and Techniques - Introduction, plain text and cipher text, substitution techniques	L	CO1	A	1
	Transposition techniques	L	CO1	A	1
	Encryption and decryption	L	CO1	A	1
	Symmetric and asymmetric key cryptography, steganography	L	CO1	A	1
	Key range and key size, possible types of attacks.	L	CO1	A	1
2	Symmetric Key Cryptography - Block Cipher principles, DES	L	CO2	A	1
	AES	L	CO2	A	1
	Blowfish	L	CO2	A	1
	RC5	L	CO2	A	1
	IDEA	L	CO2	A	1
	Block cipher operation	L	CO2	A	1
	Stream ciphers, RC4	L	CO2	A	1
	Asymmetric Key Cryptography - Principles of public key cryptosystems, RSA algorithm	L	CO2	A	1
	Elgamal Cryptography	L	CO2	A	1
	Diffie-Hellman Key Exchange	L	CO2	A	1

	Knapsack Algorithm.	L	CO2	A	1
3	Cryptographic Hash Functions - Message Authentication	L	CO3	A	1
	Secure Hash Algorithm (SHA-512)	L	CO3	A	1
	Message authentication codes: Authentication requirements	L	CO3	A	1
	HMAC	L	CO3	A	1
	CMAC	L	CO3	A	1
	Digital signatures	L	CO3	A	1
	Elgamal Digital Signature Scheme.	L	CO3	A	1
4	Symmetric Key Distribution Using Symmetric & Asymmetric Encryption	L	CO4	A	1
	Symmetric Key Distribution Using Symmetric &Asymmetric Encryption	L	CO4	A	1
	Distribution of Public Keys	L	CO4	A	1
	Kerberos	L	CO4	A	1
	X.509 Authentication Service	L	CO4	A	1
	Public – Key Infrastructure.	L	CO4	A	1
5	Denial of service attacks, IP spoofing attacks	L	CO5	A	1
	Secure inter branch payment transactions	L	CO5	A	1
	Conventional Encryption and Message Confidentiality.	L	CO5	A	1
	Conventional Encryption Principles	L	CO5	A	1
	Conventional Encryption Algorithms	L	CO5	A	2
	Location of Encryption Devices, Key Distribution	L	CO5	A	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Security Concepts, Cryptography Concepts and Techniques	9		✓	✓				12
2	Symmetric and Asymmetric Key Cryptography	11			✓				12
3	Cryptographic Hash Functions	7			✓				12
4	Key Management and Distribution	6			✓				12
5	Case Studies of Cryptography	7			✓				12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/ Course based task	15
Internal Examination	10
Course Project/ Review article	15
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD223D**		
Course Name:	**CRYPTOGRAPHY AND NETWORK SECURITY**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A			
(Answer all questions. Each question carries 5 marks)			
No.	***Question***	***CO***	***Marks***
1	Encrypt the message "the movie is set to release this Friday" using Vigenere cipher with key "awards". Ignore the space between words. Decrypt the message to get the plain text.	CO1	(5)
2	Alice and Bob agreed to use RSA algorithm for the secret communication. Alice securely choose two primes, p=5 and q=11 and a secret key d=7. Find the corresponding public key. Bob uses this public key and sends a cipher text 18 to Alice. Find the plain text.	CO2	(5)
3	Compare digital signatures with authentication protocols.	CO3	(5)
4	Explain why message authentication alone is insufficient as proof of message origin in general, and to settle disputes about whether messages have been sent.	CO4	(5)
5	Quoting suitable examples, differentiate between IP spoofing attacks and denial of service attacks.	CO5	(5)
PART B			
(Answer any 5 questions. Each question carries 7 marks)			
No.	***Question***	***CO***	***Marks***
6	The encryption key in a transposition cipher is (3,1,4,5,2). Perform encryption and decryption for the message "meet me after the toga party". Add a bogus character at the end to make the last group the same size as the others.	CO1	(7)
7	Elaborate on the algorithm for generating keys in RSA algorithm. Perform encryption and decryption using RSA for the following. P=7; q=11; e=13; M=8.	CO2	(7)
8	Illustrate man in the middle attack on Diffie Hellman key exchange algorithm.	CO2	(7)
9	Alice wants to send a message M with a digital signature Sig(M) to Bob. Alice and Bob have an authentic copy of each other's public keys, and have agreed on using a specific hash function h. Outline the steps that Alice must follow when signing M, and the steps that recipient Bob must follow for validating the signature Sig(M).	CO3	(7)
10	Alice wants to send a message to Bob. Alice wants Bob to be able to ensure that the message did not change in transit. Briefly outline the cryptographic steps that Alice and Bob must follow to ensure the integrity of the message by creating and verifying a MAC.	CO3	(7)
11	Explain Kerberos authentication mechanism with suitable diagram.	CO4	(7)
12	With the help of an example, illustrate IP spoofing attacks.	CO5	(7)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code		**Course Name**				**Course Category**	
M250101/AD224D		**BIG DATA ANALYTICS ON GENOMIC DATA**				**PE**	

COURSE OBJECTIVES	
1	To provide practical/research solutions to problems in the domain of Bioinformatics.
2	To understand. concepts of Bioinformatics, Application of AI in Bioinformtics, Big Data Bioinformatics and Data Analytics with NGS data.
3	To develop practical solutions to problems in bioinformatics.

COMPETENCY STATEMENT	
CC 1	Demonstrate the ability to apply computational, analytical, and machine learning techniques to process, analyze, and interpret complex biological datasets for solving real-world bioinformatics problems.
CC 2	Design and implement data-driven pipelines and models integrating biological knowledge, big data frameworks, and AI tools to support research and innovation in genomics and molecular biology.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Analyse basic concepts of Biomolecules, Biological databases, Sequence characteristics	CC1	A
CO 2	Apply ML/DL Model for RNA /Protein structure Analysis	CC1	A
CO 3	Apply Big data techniques in Bioinformatics	CC2	A
CO 4	Comprehend the Data Analytics pipelines for NGS data	CC2	A
CO 5	Design and Develop RNASeq /Chip/ Metagenomics seq Pipelines	CC2	A
CO 6	Develop/suggest a solution for any research problems in the field of Bioinformatics	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	2	1	2	2	1	-	-
2	3	1	3	3	1	-	-
3	3	1	2	3	3	1	-
4	3	1	2	3	3	1	-
5	3	1	3	3	3	2	1
6	3	2	3	3	3	3	2

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week				Self-Learning (S) / Semester	Total Hours / Semester	Credits C	Examination Scheme						
							Theory			Practical			Total
L	**T**	**J**	**P**				**CIA**	**ESE**	**Total**	**CIA**	**ESE**	**Total**	
3	0	0	0	30	70	3	40	60	100				100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Introduction to Bioinformatics	Biological databases, Sequence Similarity, Identity, and Homology, Scoring Matrices	10
2	AI in Bioinformatics	AI Applications in Genomics and Computational Biology, ML/DL Algorithms Relevant to Bioinformatics, Protein Structure Prediction, RNA Structure Prediction	8
3	Big Data Bioinformatics	Data Storage and Analysis, Big Data Analytics Architecture and Types. Big Data Frameworks – MapReduce, Hadoop, Spark	7
4	Data Analytics with NGS data	NGS Data Sources and Retrieval, Read Mapping and Alignment, Denovo assemblies, Visualization tools	7
5	Advanced Data Analytics with NGS data	RNA-Seq Analysis, ChIP-Seq Analysis, Motif Finding and Theoretical Basis, Metagenomics Data Analysis	7

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Micro project/Course based project	20
2	Learning about Explainable AI (XAI) in biological data interpretation.	6
3	Seminar	4

SUGGESTED LEARNING RESOURCES			
Text Book			
Sl. No.	Title of Book	Author	Publication
1	Discovering Genomics, Proteomics and Bioinformatics.	Campbell, A.M. & Heyer, L.J	Benjamin/Cummings 2002.
2	Next-Generation DNA Sequencing Informatics	Stuart M. Brown.	Second Edition ,New York University School of Medicine
Reference			
Sl. No.	Title of Book	Author	Publication
1	Next Generation Sequencing Data Analysis	Xinkun Wang.	CRC Press.
2	Machine learning for dummies	Mueller J. P. & Massaron L.	John Wiley & Sons. 2016.
3	Artificial Intelligence A Modern Approach	Russell S. J. & Norvig P.	Pearson Education 2003
Web Resource			
1	Computational Genomics	Prof. Vineet Kumar Sharma	NPTEL| IISER Bhopal
2	Biological data analysis and visualization with R	Prof. Riddhiman Dhar	NPTEL | IIT Kharagpur

DETAILED SYLLABUS					
Module	Topic	Mode of Delivery	COs	Learning Domain Level C	Hours
1	Informational view of life science; Definition; DNA-RNA and Protein as information, Primary and secondary structure of DNA	SS	CO1,CO6	U	1
	Chargaff's Rules, Different forms of DNA, RNA, Introduction to Biomolecules through games-Foldit (Protein overlapping), Eterna Game (RNA Structure)	L	CO1,CO6	U	1
	History of Bioinformatics, Definition of Bioinformatics, Bioinformatics versus Computational Biology, Goals of Bioinformatics analysis	SS	CO1,CO6	U	1
	Biological data bases :- File format, conversion of file format, Data retrieval system, Genome browsers. Biological data file formats	L	CO1,CO6	A	1
	Basic concepts of sequence similarity, identity and homology, Scoring matrices-PAM and BLOSUM matrices	L	CO1,CO6	A	1
	Data retrieval system, Sequence databases-EMBL, GenBank, DDBJ	L	CO1,CO6	U	1
	Protein databases- UniProt, Protein Data Bank	L	CO1,CO6	U	1
	Concept of sequence alignment- pairwise and multiple Pairwise- Local and global	L	CO1,CO6	U	1
	Dot plot, BLAST, Multiple sequence alignment (MSA) – CLUSTAL Omega	L	CO1,CO6	A	1
	Phylogeny: Basic concepts of phylogeny, Phylogenetic tree construction using MEGA.	L	CO1,CO6	A	1
2	AI applications in the field of genomics, the role of deep learning and data mining in computational biology and bioinformatics.	SS	CO2,CO6	U	1
	ML/DL algorithms: ANN, CNN, LSTM	L	CO2,CO6	A	1
	ML/DL algorithms: BERT, GAN	L	CO2,CO6	A	1
	ML model for protein expression /Sequence classification	L	CO2,CO6	A	1
	Protein structure prediction (deep neural networks), RNA structure prediction (deep learning models)	L	CO2,CO6	A	1
	RNA-protein binding sites prediction with CNN, Deep neural net to predict target gene expression	L	CO2,CO6	A	1
	Transcription Factor Binding via MLP, LSTM, CNN	L	CO2,CO6	A	1
	Protein Contextual Embeddings via BERT	L	CO2,CO6	A	1
	Overview of Big data – Definition, Characteristics, Sources, Types-Structured, Unstructured & Semi-structured	SS	CO3,CO6	U	1

3	Data Storage and Analysis -NAS, DAS, NoSQL databases; Processing SCV principle, Batch Vs Stream processing	SS	CO3,CO6	U	1
	Big data Analytics- Typical Analytical Architecture – Requirement for new analytical architecture -Types (Descriptive, Inquisitive, Predictive, Perspective); Visualisation and Applications	L	CO3,CO6	U	1
	Computational facilities for analysing Big data – Cluster computing vs. Cloud computing, – Challenges in Big Data Analytics –Need of big data frameworks	L	CO3,CO6	U	1
	Big data Frameworks - MapReduce, Hadoop and Spark, Spark SQL and dataframes	L	CO3,CO6	A	1
	Spark for Bioinformatics, Big data analytics using Python- PySpark	L	CO3,CO6	A	1
	Big data processing for DNA sequence analysis – PASTASpark	L	CO3,CO6	A	1
4	Introduction to next generation sequencing: NGS Platforms	SS	CO4,CO6	U	1
	NGS technologies (WGS, ChIP-seq & RNA-seq), advantages, limitations and applications	L	CO4,CO6	U	1
	NGS Data sources: NCBI SRA, EBI-ENA, DDBJ-SRA	L	CO4,CO6	A	1
	SRA toolkit; NGS Data analysis: FASTQ files, Quality check, Pre processing,	SS	CO4,CO6	A	1
	Mapping - Principles, tools - BWA, Bowtie, SAM tools -output file formats -BAM, SAM	L	CO4,CO6	A	1
	Denovo assemblies - Principles, tools	L	CO4,CO6	A	1
	SOAPdenovo, Velvet; Visualization tools - IGV	L	CO4,CO6	A	1
	Whole Genome/Exome pipeline for Variant calling - VCF files	L	CO4,CO6	A	1
5	RNAseq - Gene expression analysis	L	CO5,CO6	A	1
	Differential expression analysis. Alternative splicing	L	CO5,CO6	A	1
	TopHat and Cufflinks for RNAseq	L	CO5,CO6	A	1
	ChIPseq - Introduction and biological theories on ChIPseq analysis.	L	CO5,CO6	U	1
	DNA fragment evaluation. Peak identification. Two condition comparison. Saturation analysis	L	CO5,CO6	A	1
	Motif finding and related theories	SS	CO5,CO6	U	1
	Metagenomics analysis using QIIME and Picrust	L	CO5,CO6	A	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Introduction to Bioinformatics	10		✓	✓				19
2	AI in Bioinformatics	8			✓				19
3	Big Data Bioinformatics	7			✓				15
4	Data Analytics with NGS data	7			✓				12

5	Advanced Data Analytics with NGS data	7			✓				9
This ToS shall be treated as a general guideline for students and teachers for distribution of marks.									

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/ Course based task	15
Internal Examination	10
Course Project/ Review article	15
End Semester Examination	**60**
Total	**100**

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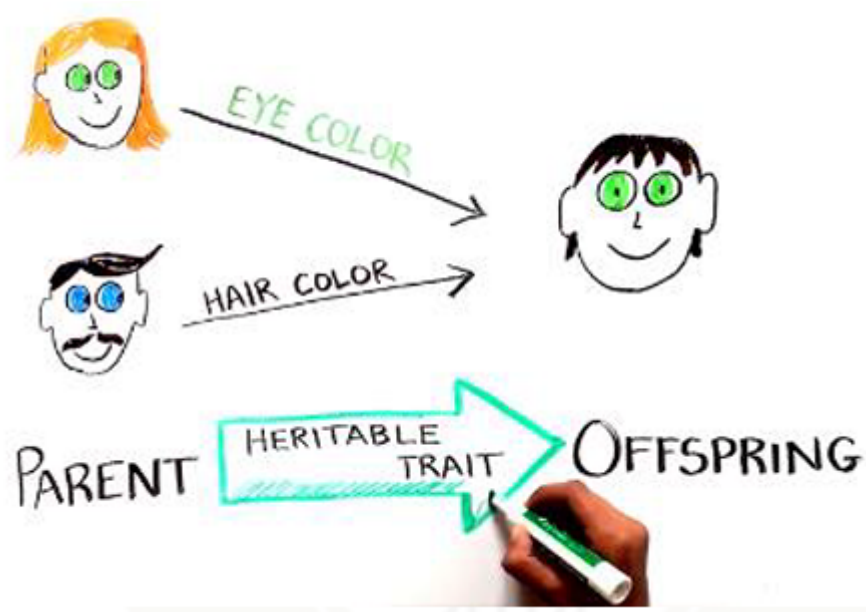
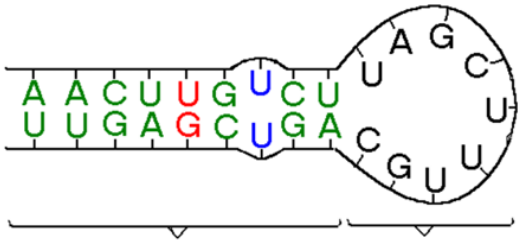
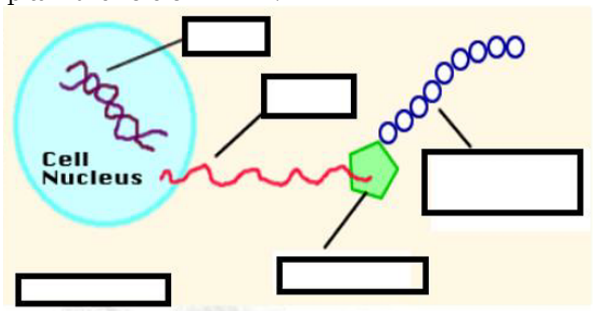
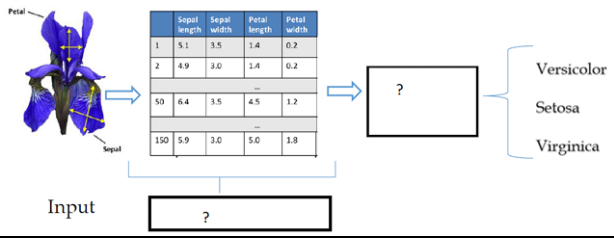
SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD224D**		
Course Name:	**BIG DATA ANALYTICS ON GENOMIC DATA**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A			
(Answer all questions. Each question carries 5 marks)			
No.	***Question***	***CO***	***Marks***
1	i) A couple has a child with green eyes and black hair. The mother has green eyes and brown hair, and the father has blue eyes and black hair. Using the principles of heredity shown in the cartoon, explain which parent's traits are dominant and which are recessive for eye and hair color.  ii) A new partial DNA sequence is found: 5'ACTCGATGCTAG3' 3'TGAGCTACGATC5' Using the principles of DNA transcription, which of these two strands would be the template strand for synthesizing an mRNA molecule, and what would the resulting mRNA sequence be?	CO1	(5)
2	Use computational methods to manage and analyse the rapidly growing volume of molecular biology data.	CO2	(5)
3	Demonstrate how biological databases can perform sequence analysis by explaining why they are needed and how they are applied.	CO3	(5)
4	Write a Python program using PySpark to implement a solution that: • Creates a dataframe for student data containing student ID, name, and marks. • Filters the dataframe to identify students who scored less than 50% using a Spark SQL query. • Calculates the average, variance, maximum, and minimum marks for the students.	CO4	(5)
5	Use a metagenomics data-analysis pipeline to explain and execute the necessary steps involved in processing and interpreting microbial community sequence data.	CO5	(5)

PART B			
(Answer any 5 questions. Each question carries 7 marks)			
No.	***Question***	***CO***	***Marks***
6 a)	Given an RNA sequence, construct a potential stem-loop structure and predict how a mutation in the stem region could affect the function of the RNA molecule. 	CO2	(3)
6 b)	The protein synthesising process the shown below. Identify the different stages and explain the role of mRNA? 	CO2	(4)
7 a)	Demonstrate the process of submitting biological data to a public database and identify the appropriate submission tools available in NCBI for this purpose.	CO1	(3)
7 b)	From NCBI, while downloading a gene sequence, you can download the sequence in two formats- GenBank & FASTA. To know more information about the sequence, which format will be useful? Justify your answer. 	CO1	(4)
8 a)	Using an appropriate scoring matrix and gap penalty, perform a global alignment of the sequences AGCTCAG and AGGTCA	CO1	(5)
8 b)	Differentiate between Pairwise and Multiple sequence alignment.	CO1	(2)
9 a)	Write a simple python program demonstrating the map reduce model used in Hadoop?	CO3	(4)
9 b)	Demonstrate how the PageRank algorithm can be implemented using the MapReduce programming model, and apply it to a sample web-graph with step-by-step mapping and reducing phases	CO3	(3)
10 a)	Study the pictorial representation given below. Comment on the unknown block and its relevance in machine learning 	CO2	(3)

10 b)	Given a neural network architecture comprising two convolutional layers, apply your understanding of a convolutional neural network's (CNN) architecture to estimate the number of trainable parameters in this model.	CO2	(4)
11 a)	Using your knowledge of big data in the life sciences, apply it to identify and briefly explain the major challenges faced in the field of bioinformatics.	CO3	(3)
11 b)	Compare and contrast Bowtie and BWA by outlining their major differences in algorithmic strategy, performance trade-offs, and ideal use-cases.	CO4	(4)
12 a)	Using your knowledge of genome assembly, apply it to define a contig and a scaffold, describe the process of de novo assembly, and then identify a software tool that can perform de novo assembly.	CO4	(3)
12 b)	Using your understanding of bioinformatics and next-generation sequencing (NGS), apply it to describe key public sequence databases that support NGS data and explain the main data formats they handle.	CO5	(4)

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**3-0-0-0-2**	**Version**	**25/0**	**Credits**	**3**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code		**Course Name**				**Course Category**	
M250101/AD225D		**PATTERN RECOGNITION**				**PE**	

COURSE OBJECTIVES	
1	Apply principles of probability, numerical, and statistical methods for feature selection, parameter estimation, and statistical pattern recognition.
2	Apply classification methods such as decision trees and other statistical decision models for recognizing patterns in data.
3	Design pattern recognition systems using artificial neural networks and deep learning techniques to address real-world problems creatively.

COMPETENCY STATEMENT	
CC 1	Apply probability theory, numerical and statistical methods, feature selection techniques, and decision algorithms to model, estimate, and classify patterns using classical approaches.
CC 2	Design neural and deep learning-based models to develop and present innovative solutions for real-world pattern recognition problems.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Apply probability and numerical methods in statistical pattern recognition.	CC1	A
CO 2	Apply statistical methods in feature selection.	CC1	A
CO 3	Apply linear algebra and statistical methods in parameter and non-parameter estimation.	CC1	A
CO 4	Apply the technique of decision trees in pattern recognition.	CC1	A
CO 5	Analyse the use of deep learning networks and artificial neural networks in pattern recognition.	CC2	An
CO 6	Design, Develop, Implement and Present innovative ideas in problem solving with various pattern recognition techniques.	CC1, CC2	C

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

CO	Program Outcomes (PO) Correlation Matrix						
	PO						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	2	-	2	2	2	2	-
2	3	-	2	2	2	2	-
3	3	-	3	2	3	2	-
4	2	-	2	2	3	2	-
5	2	-	3	2	3	2	-
6	2	1	3	2	-	2	1

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week				Self-Learning (S) / Semester	Total Hours / Semester	Credits C	Examination Scheme						
							Theory			Practical			Total
L	**T**	**J**	**P**				**CIA**	**ESE**	**Total**	**CIA**	**ESE**	**Total**	
3	0	0	0	30	70	3	40	60	100				100

***L**: Lecture (One unit is of one-hour duration), **T**: Tutorial (One unit is of one-hour duration), **P**: Practical (One unit is of one-hour duration), **J**: Project (One unit is of one-hour duration), **S**: Self-Learning & Team Work (One unit is of one-hour duration), **CIA**: Continuous Internal Assessment, **ESE**: End Semester Examination*

SYLLABUS (Major Topics)			
Module	Title	Major Topics	Contact Hours
1	Introduction to Pattern Recognition	Basics of pattern recognition systems, various applications, Machine Perception, classification of pattern recognition systems. Design of Pattern recognition system, Pattern recognition Life Cycle. Statistical Pattern Recognition: Review of probability theory, Gaussian distribution. Normal density and discriminant functions.	7
2	Feature Selection	Feature selection – Outlier removal – Data normalization – Missing data, The Peaking phenomenon, Feature selection using statistical hypothesis testing- Hypothesis testing basics – Application of t-Test in feature selection. Class separability measures-Divergence-Chernoff bound and Bhattacharya distance-Scatter matrices, Feature subset selection –Scalar feature selection, Feature vector selection.	10
3	Clustering Algorithms	Unsupervised learning and clustering - Criterion functions for clustering. Cluster validation. Fuzzy clustering algorithms- Point representatives-quadratic surfaces and representatives – hyper plane representatives. Binary morphology clustering algorithms (BMCAs) – Discretization – Morphological operations - Determination of clusters in a discrete binary set-Assignment of feature vectors to clusters – The algorithmic scheme, Boundary detection algorithms.	9
4	Dimensionality reduction	Dimensionality reduction: Principal component analysis - its relationship to Eigen analysis. Fisher discriminant analysis - Generalised Eigen analysis. Eigen vectors/Singular vectors as dictionaries. Factor Analysis, Total variability space - a dictionary learning method. Non negative matrix factorisation - a dictionary learning method. Linear discriminant functions: Gradient descent procedures, Perceptron.	8
5	Artificial neural networks and Pattern Classification	Artificial neural networks: Review of Artificial neural network concepts, convolutional neural networks, recurrent neural networks. Non-metric methods for pattern classification: Non-numeric data or nominal data. Decision trees: Classification and Regression Trees (CART).	6

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs/Semester
1	Review article based on peer reviewed original publications	10
2	Course based task / Seminar/ Data collection and interpretation	20

SUGGESTED LEARNING RESOURCES
Text Book

Sl. No.	Title of Book	Author	Publication
1	Pattern Recognition and Machine Learning	C.M.Bishop	Springer, 2006
2	Introduction to Statistical Pattern Recognition	Keinosuke Fukunaga	Second Edition, Academic Press
Reference			
Sl. No.	Title of Book	Author	Publication
1	Pattern Recognition	S.Theodoridis and K.Koutroumbas	4th Ed., Academic Press, 2009
2	Pattern Classification,	R.O.Duda, P.E.Hart and D.G.Stork,	John Wiley, 2001.
3	The Elements of Statistical Learning	Hastie, T., Tibshirani, R. and Friedman, J.	Springer. 2001.
Web Resource			
1	https://nptel.ac.in/courses/117105101 Pattern Recognition and Application	Prof. Prabir Kumar Biswas	IIT Kharagpur
2	https://www.fau.tv/series/pattern-recognition-pr-w20		

DETAILED SYLLABUS

Module	Topic	Mode of Delivery	Cos	Learning Domain Level C	Hours
1	Basics of pattern recognition systems, applications	L	CO1	U	1
	Machine Perception, Classification of pattern recognition systems	L	CO1	U	1
	Design of Pattern recognition system	L	CO1	U	1
	Pattern recognition Life Cycle	L	CO1	A	1
	Statistical Pattern Recognition	L	CO1	A	1
	Review of probability theory	L	CO1	A	1
	Normal density and discriminant functions	L	CO1	A	1
2	Feature selection – Outlier removal	L	CO2	A	1
	Data normalization – Missing data	L	CO2	A	1
	The peaking phenomenon	L	CO2	A	1
	Feature selection using statistical hypothesis testing	L	CO2	A	1
	Hypothesis testing basics – Application of tTest in feature selection	L	CO2	A	1
	Class separability measures-Divergence	L	CO2	A	1
	Chernoff bound and Bhattacharya distance	L	CO2	A	1
	Scatter matrices	L	CO2	A	1
	Feature subset selection –Scalar feature selection	L	CO2	A	1
	Feature vector selection	L	CO2	A	1
3	Unsupervised learning and clustering				
	Criterion functions for clustering. Cluster validation.	L	CO3	A	1
	Fuzzy clustering algorithms- Point representatives	L	CO3	A	1
	Quadratic surfaces and representatives – hyper plane representatives.	L	CO3	A	1
	Binary morphology clustering algorithms (BMCAs)	L	CO3	A	1
	Discretization	L	CO3	A	1

	Morphological operations - Determination of clusters in a discrete binary set	L	CO3	A	1
	Assignment of feature vectors to clusters	L	CO3	A	1
	The algorithmic scheme, Boundary detection algorithms.	L	CO3	A	1
4	Principal component analysis - its relationship to Eigen analysis	L	CO3	A	1
	Fisher discriminant analysis	L	CO3	A	1
	Generalised Eigen analysis	L	CO3	A	1
	Eigen vectors/Singular vectors as dictionaries	L	CO3	A	1
	Total variability space - a dictionary learning method	L	CO3	A	1
	Non negative matrix factorisation - a dictionary learning method	L	CO3	A	1
	Linear discriminant functions: Gradient descent procedures	L	CO3	A	1
	Perceptron	L	CO3	A	1
5	Review of Artificial neural networks, Introduction to deep neural networks	L	CO5	An	1
	Convolutional neural networks	L	CO5	An	1
	Recurrent neural networks	L	CO5	An	1
	Non-metric methods for pattern classification: Non-numeric data or nominal data	L	CO5	A	1
	Decision trees: Classification and Regression Trees (CART) lecture 1	L	CO4	A	1
	Decision trees: Classification and Regression Trees (CART) lecture 2	L	CO4	A	1

TABLE OF SPECIFICATIONS (ToS) FOR QUESTION PAPER DESIGN

Module	Module Title	Teaching Hours	Distribution of Marks (Revised Bloom's Level)						Total Marks
			R	U	A	An	E	C	
1	Introduction to Pattern Recognition	7			✓				12
2	Feature Selection	10			✓				12
3	Clustering Algorithms	9			✓				12
4	Dimensionality reduction	8			✓				12
5	Artificial neural networks and Pattern Classification	6			✓	✓			12

This ToS shall be treated as a general guideline for students and teachers for distribution of marks.

ASSESSMENT PATTERN

Assessment	**Marks**
Continuous Internal Assessment	**40**
Learning Activity/ Course based task	15
Internal Examination	10
Course Project/ Review article	15
End Semester Examination	**60**
Total	**100**

(AN AUTONOMOUS COLLEGE AFFILIATED TO APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANATHAPURAM)

SECOND SEMESTER M. TECH DEGREE (REGULAR) EXAMINATION, APRIL 2026 (2025 SCHEME)			
Course Code:	**M250101/AD225D**		
Course Name:	**Pattern Recognition**		
Max. Marks	**60**	**Duration**:	2 hours 30 minutes
Specify if the question paper is common to different programmes			
Use of Data Book / IS codes, etc to be specified by the question paper setter			

PART A

(Answer all questions. Each question carries 5 marks)

No.	***Question***	***CO***	***Marks***
1	In a town it was estimated that 3% of people have a particular disease. Adiagnosis test was conducted for all the people, which yielded 8% false positiveand 92% true positive results. A person is found as positive after the test. What isthe probability that this person is truly having the disease?	CO1	(5)
2	How does morphological operations play a role in pattern recognition?	CO2	(5)
3	How can visual imagery be analysed using convolutional neural networks?	CO3	(5)
4	How does a decision tree handle continuous attributes?	CO4	(5)
5	Define the terms: weights, bias, activations with respect to neural networks	CO5	(5)

PART B

(Answer any 5 questions. Each question carries 7 marks)

No.	***Question***	***CO***	***Marks***
6	Illustrate the design principles of pattern recognition system with an example.	CO1	(7)
7	Derive the fuzzy C spherical shells (FCSS) algorithm for the case that spherical clusters are to be identified.	CO2	(7)
8	Show that in the case of Gaussian distributions the Chernoff bound becomes $$\epsilon CB = \exp(-b(s))$$ $$b(s) = \frac{s(1-s)}{2}(\mu_i - \mu_j)^T[s\Sigma + (1-s)\Sigma]^{-1}(\mu_i - \mu_j) + \frac{1}{2}\ln\frac{|s\Sigma + (1-s)\Sigma|}{|\Sigma|^s|\Sigma|^{1-s}}$$ Then take the derivative with respect to s and show that for equal covariance matrices the optimum is achieved for s = 1/2 Thus, in this case b(s) equals the Bhattacharyya distance	CO2	(7)
9	Let N_1, N_2 be the available values of a feature in two classes, respectively. The feature is assumed to follow a Gaussian distribution with the same variance in each class. Define the test statistic $$q = \frac{(\bar{x} - \bar{y}) - (\mu_1 - \mu_2)}{s_z\sqrt{\frac{1}{N_1} + \frac{1}{N_2}}}$$ Where $$s_z^2 = \frac{1}{N_1 + N_2 - 2}\left(\sum_{i=1}^{N_1}(x_i - \bar{x})^2 + \sum_{i=1}^{N_2}(y_i - \bar{y})^2\right)$$ and μ_1 μ_2 are the respective true mean values. Show that q follows the t-distribution -with $N_1 + N_2 - 2$ degrees of freedom.	CO3	(7)
10	Discuss the significance of pre-processing in feature selection. Illustrate any two methods used for pre-processing.	CO3	(7)
11	How can artificial neural networks be applied in Pattern recognition? Also illustrate the features of recurrent neural networks.	CO4	(7)
12	Construct a decision tree using the following data.	CO5	(7)

Outlook	Temp	Humidity	Windy	Play Golf
Rainy	Hot	High	FALSE	No
Rainy	Hot	High	TRUE	No
Cloudy	Hot	High	FALSE	Yes
Sunny	Mild	High	FALSE	Yes
Sunny	Cool	Normal	FALSE	Yes
Sunny	Cool	Normal	TRUE	No
Cloudy	Cool	Normal	TRUE	Yes
Rainy	Mild	High	FALSE	No
Rainy	Mild	Normal	FALSE	Yes

		Sunny	Mild	Normal	FALSE	Yes			
		Rainy	Cool	Normal	TRUE	Yes			
		Cloudy	Mild	High	TRUE	Yes			
		Cloudy	Mild	Normal	FALSE	Yes			
		Sunny	Hot	High	TRUE	No			

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COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**0-0-0-4-0**	**Version**	**25/0**	**Credits**	2
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code	**Course Name**						**Course Category**
M250902/CN200S	**MINI PROJECT**						**PS**

COURSE OBJECTIVES	
1	To strengthen students' understanding of fundamental concepts through practical application of theoretical knowledge.
2	To develop analytical, problem-solving, and design skills through hands-on project work.
3	To foster creativity, innovation, and independent research capabilities for future dissertation or research projects.
4	To enhance project management and professional documentation skills

COMPETENCY STATEMENT		
Competency Statements	CC1	Ability to integrate theoretical concepts with practical implementation to solve real-world engineering problems.
	CC 2	Capability to conduct independent project work, document results professionally, and present outcomes effectively.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Identify and define a relevant engineering or research problem through systematic investigation.	CC1	An
CO 2	Apply theoretical concepts and analytical methods to design and implement an effective solution.	CC1	A
CO 3	Demonstrate creativity, innovation, and technical competence in developing project outcomes.	CC2	C
CO 4	Communicate project findings effectively through professional documentation and presentations.	CC2	E

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes (PO) Correlation Matrix						
CO	**PO**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	3	2	2	3	2	1	1
2	2	1	3	3	3	2	2
3	3	2	3	3	3	2	2
4	2	3	2	1	1	1	2

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME

Teaching Scheme / Week					Credit	Hours / Semester	Examination Scheme		
							Practical		
L	**T**	**J**	**P**	**S**	**C**		**CIA**	**ESE**	**Total**
0	**0**	**0**	4	0	2	60	**100**	**0**	**100**

L: Lecture (One unit is of one-hour duration), T: Tutorial (One unit is of one-hour duration), P: Practical (One unit is of one-hour duration), J: Project (One unit is of one-hour duration), S: Self-Learning & Team Work (One unit is of one-hour duration), CIA: Continuous Internal Assessment, ESE: End Semester Examination

ASSESSMENT PATTERN		
Assessment	**Marks**	**Assessment Criteria**
Continuous Internal Assessment	**100**	
Interim evaluation 1	20	
Interim evaluation 2	20	
Final evaluation by a committee	35	The committee will be evaluating the level of completion and demonstration of functionality/ specifications, clarity of presentation, oral examination, work knowledge and involvement
Report	15	The committee will be evaluating the technical content, adequacy of references, templates followed and permitted plagiarism level (not more than 25%)
Supervisor/Guide	10	
Total	**100**	

Evaluation Committee - Programme Coordinator, One Senior Professor and Guide.

COURSE DESCRIPTION							
Regulation	**2025**	**L-T-J-P-S**	**0-0-0-2-2**	**Version**	**25/0**	**Credits**	**1**
(L- Lecture, T-Tutorial, J-Project, P-Practical, S-Self-learning & Team Work)							
Course Code	**Course Name**						**Course Category**
M250101/AD230T	**DEEP LEARNING LAB**						**PL**

COURSE OBJECTIVES	
1	To enables the learners to gain practical proficiency in using a modern deep learning framework for model building, training, and evaluation.
2	To design and implement advanced deep learning models to solve complex problems in computer vision.
3	To design and implement recurrent and sequence-to-sequence deep learning models for applications in time series forecasting and natural language processing (NLP) tasks.
4	To enable the learners to improve model robustness and generalization through the application of key optimization strategies

COMPETENCY STATEMENT		
Competency Statements	CC1	Apply deep learning fundamentals, standard architectures (CNN, RNN, LSTM, Seq2Seq, GAN/VAE), and chosen frameworks (e.g., TensorFlow/PyTorch) to successfully implement models for predictive and generative tasks across various data modalities
	CC 2	Design, develop, train, and critically evaluate the performance of deep learning systems, utilizing techniques like regularization and hyperparameter tuning to deliver robust and efficient solutions for real-world application problems.

COURSE OUTCOMES

Course Outcomes (CO): At the end of this course, learners will be able to:

CO	CO Statement	Competency Mapping	Cognitive (C)
CO 1	Implement deep learning techniques to solve problems in computer vision (Cognitive Knowledge Level: Apply)	CC1	A
CO 2	Implement deep learning techniques to solve problems involving time series data (Cognitive Knowledge Level: Apply)	CC1	A
CO 3	Implement deep learning techniques to solve problems in text processing (Cognitive Knowledge Level: Apply)	CC2	A
CO 4	Implement deep learning techniques to develop generative modeling (Cognitive Knowledge Level: Apply)	CC2	A

Cognitive (Revised blooms Level): *- **R**: Remember; **U**: Understand; **A**: Apply; **An**: Analyse; **E**: Evaluate; **C**: Create*

	Program Outcomes (PO) Correlation Matrix						
CO	**PO**						
	1	**2**	**3**	**4**	**5**	**6**	**7**
1	2	-	-	1	-	1	-
2	2	1	-	1	1	1	-
3	3	2	2	2	2	2	-
4	3	2	2	2	2	2	1

Correlation levels: 1 - Low; 2 - Medium; 3 - High; No Correlation - "-"

TEACHING AND ASSESSMENT SCHEME									
Teaching Scheme / Week					**Credit**	**Hours / Semester**	**Examination Scheme**		
							Practical		
L	**T**	**J**	**P**	**S**	**C**		**CIA**	**ESE**	**Total**

0	**0**	**0**	**2**	**2**	**1**	**30**	**100**	**0**	**100**

L: Lecture (One unit is of one-hour duration), T: Tutorial (One unit is of one-hour duration), P: Practical (One unit is of one-hour duration), J: Project (One unit is of one-hour duration), S: Self-Learning & Team Work (One unit is of one-hour duration), CIA: Continuous Internal Assessment, ESE: End Semester Examination

PRACTICAL SYLLABUS

Sl. No.	Topic	Objective	COs	Learning Domain Level	Hrs
				C	
1	Basic Image Processing Operations (Histogram equalization, thresholding, edge detection, data augmentation, morphological operations)	To understand and implement fundamental image preprocessing techniques that enhance data quality and prepare images for deep learning models.	CO1	U	2
2	Image Classification on CIFAR-10 Dataset (Using KNN, SVM/Softmax, and 3-layer Neural Network)	To develop and compare different classifiers (traditional and neural network-based) for image classification tasks on benchmark datasets.	CO1	A	2
3	Effect of Batch Normalization and Dropout	To analyze how batch normalization and dropout improve training stability, convergence, and generalization of deep neural networks.	CO1,CO4	A	4
4	Familiarization with Image Labelling Tools	To explore and use annotation tools (LabelImg, CVAT, LabelMe, Roboflow) for preparing datasets required for object detection and segmentation tasks.	CO1	A	2
5	Image Segmentation using Mask R-CNN, U-Net, and SegNet	To implement and compare advanced segmentation models for identifying and classifying pixels in images.	CO1	A	4
6	Time Series Forecasting using Deep Learning *(using LSTM / GRU / Temporal CNN)*	To enable students to understand the structure and functionality of recurrent and temporal convolutional models.	CO1	A	4
7	Object Detection using YOLO, SSD, and Faster R-CNN	To understand single-stage and two-stage object detection architectures and evaluate their accuracy and computational performance.	CO1	A	2
8	Image Captioning with RNNs and LSTMs	To integrate computer vision and natural language processing techniques to automatically generate descriptive captions for images.	CO1,CO3, CO4	A	4
9	Chatbot using Bi-directional LSTMs	To design and implement a sequence-based conversational chatbot capable of	CO3	A	2

		understanding and generating natural language responses.			
10	Performance Analysis and Optimization of Deep Convolutional Neural Networks Using CPU and GPU Acceleration	To analyze and optimize the training performance of deep convolutional neural networks by comparing CPU-based, GPU-based, and optimized GPU training strategies on large-scale image datasets.	CO1	A	4

SELF-LEARNING / TEAM WORK		
Sl. No	Self-learning / Team Work Description	Hrs
1	Machine Learning using Python	30

SUGGESTED LEARNING RESOURCES			
Text Book			
Sl. No.	Title of Book	Author	Publication
1	Hands-On Computer Vision with TensorFlow 2: Leverage deep learning to create powerful image processing apps with TensorFlow	Benjamin Planche,Eliot Andres	Packt Publishers, 2019
2	Deep Learning with Python, by François Chollet, Manning, 2021	Goodfellow, I., Bengio,Y., and Courville, A.,	MIT Press, 2016.
3	Principles and labs for deep learning.	Huang, Shih-Chia, and Trung-Hieu Le.	Academic Press, 2021.
Reference			
Sl. No.	**Title of Book**	**Author**	**Publication**
1	Deep Learning	Ian Goodfellow, Yoshua Bengio, Aaron Courville	MIT Press,2016.
2	Deep learning: A practitioner's approach"	Josh Patterson and Adam Gibson,	O'Reilly Media, First Edition, 2017.
Web Resource			
1	Deep Learning,Prof. Prabir Kumar Biswas, IIT Kharagpur		
2	Deep Learning Part 1 , Prof. Sudarshan Iyengar & Prof.Mitesh M. Khapra | IIT Madras		

ASSESSMENT PATTERN	
Assessment	**Marks**
Continuous Internal Assessment	**100**
Continuous Lab Evaluation	60
Internal Examination	40
Total	**100**