Minor in Artificial Intelligence and Machine Learning (For the students of other than CSE, AIML, DS, Cyber Security)

Sr	Sem	Course Code	Course Title	Hrs/ Week			Credits	Maximum Marks			ESE Duration
				L	T	P		CA	ESE	Total	Hrs
1.	III	CATM301	Programming and Data structure with Python	3	0	0	3	40	60	100	3
2.	IV	CATM401	Artificial Intelligence	3	0	0	3	40	60	100	3
3.	V	CATM501	Machine Learning	4	0	0	4	40	60	100	3
4.	VI	CATM601	Deep Learning and its Applications	4	0	0	4	40	60	100	3
5.	VII	CAPM701	Project	0	0	8	4	50	50	100	-

Syllabus for Semester III (Minor), B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CATM301**	**Course:**	**Programming and Data structure with Python**
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits:**	**03**

Course Objectives

- Learn basic concepts of programming and write code using different data structure of python
- To implement different searching and sorting techniques and perform complexity analysis
- To perform data manipulation using Pandas
- To Learn Dynamic Programming to improve efficiency of python programming

Syllabus:

Unit1`: Data Structures Introduction

Introduction to programming using Python, Data Types, Data structures, Flow Control: Conditional blocks: if, else, elif, Loops in python For Loops in Python: Loops with range, Strings : Indexing and Slicing with Strings

Unit 2: Data structures in Python:

List : Operations , slicing, Tuples: indexing and slicing , Dictionary and it's use in Hash table , Set Operations, Hash Maps , Chain Map, Map Reordering, Heap

Unit 3 : Programming in Python using Numpy

Arrays: Creation, Indexing, slicing, Different approaches to sorting and searching algorithms, Complexity analysis , 2 D Array , Backtracking: N Queens Problem solving using Python

Unit 4: Programming in Python using Pandas

Data Frame: Creation, Indexing, extracting, Merging, Joining, and Concatenating, Series, Text processing,

Unit 5: Advance Programming

File handling , Function Writing , Exception Handling, Regex, Validation in Python Collections

Unit 6: Dynamic Programming

Dynamic Programming: Improving the efficiency of Python Programs Using Memorization down Approach with Memorization, Bottom Up Approach with Tabulation, Number Factor, House Robber, Convert String, Zero One Knapsack Problem problem solving,

Course Outcomes:

On successful completion of the course, students will be able to

- Implement python data structures
- Implement different programming concepts
- Implement dynamic programming styles for improving efficiency of code.

Text Books:

1. Python Programming Using Problem Solving Approach: Reema Thareja, Oxford University Press; First edition

Reference Books:

1. Data Structures and Algorithms Using Python Rance D. Necaise
2. Data Structures and Algorithms in Python by Michael T. Goodrich, Roberto Tamassia

Syllabus for Semester IV (Minor), B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CATM401**	**Course:**	**Artificial Intelligence**
L: 3 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits:**	**03**

Course Objectives:

1. To understand challenges involved in designing intelligent systems.
2. To represent given problem using state space representation and solve it by using different search techniques.
3. To understand knowledge representation methods using logic programming.
4. To understand uncertainty theory in designing AI systems.

Syllabus

UNIT I:

Introduction: Basics of problem solving, problem representation (toy problems and real world problems); Structure of agent, rational agent, Specifying task environment, Properties of task environment; measuring problem-solving performance

UNIT II:

Uninformed search techniques: Depth, Breadth, Uniform Cost, Depth Limited, Iterative deepening DFS, Bidirectional Search

UNIT III:

Informed search techniques: Heuristic Based Search, Greedy Best First Search, A* Search; Local Search algorithms: Hill-climbing, Simulated Annealing, Genetic Algorithms.

UNIT IV:

Adversarial Search: Two player Games, The min-max algorithm, Alpha-Beta pruning. Constraint Satisfaction Problems: Constraint propagation, backtracking search

UNIT V:

Propositional Logic: Inference, Equivalence, Validity and satisfiability, Resolution, Forward and Backward Chaining, First Order Logic: Syntax and Semantics of FOL, Inference in FOL, Unification, Forward Chaining, Backward Chaining, and Resolution.

UNIT VI:

Uncertainty Knowledge and Reasoning: Probability and Baye's Theorem, Statistical reasoning: Bayesian networks, Naïve bayes algorithm, Fuzzy Logic, Introduction to expert system

Course Outcomes:

On successful completion of the course, students will be able to:

1. Represent given problem using state space representation and apply uninformed and informed search techniques on it.
2. Solve the fully informed two player games using different AI techniques.
3. Solve the AI problems by using logic programming
4. Apply uncertainty theory based on techniques like probability theory and fuzzy logic.

Text Book:

1. Stuart Russel and Peter Norvig; Artificial Intelligence: A Modern Approach; Third Edition; Pearson Education, 2009.

Reference Books:

1. E.Rich, K. Knight, S. B. Nair; Artificial Intelligence; 3rd Edition; Tata McGraw Hill, 2014.
2. Denis Rothman; Artificial Intelligence By Example: Develop machine intelligence from scratch using real artificial intelligence use cases; Kindle Edition, Packt Publishing Ltd, 2018

Syllabus for Semester V (Minor), B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CATM501**	**Course:**	**Machine Learning**
L: 4 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits:**	**04**

Course Pre-requisite

- Artificial Intelligence

Course Objectives

- To introduce the basic concepts and techniques of machine learning.
- To understand major machine learning algorithms.
- To identify machine learning techniques suitable for a given problem.

Syllabus:

Unit-1

Foundations for ML: ML Techniques overview, Validation Techniques (Cross-Validations), Over-fitting and under-fitting, Data Normalization, Hypothesis Evaluation, Feature Reduction/Dimensionality reduction, Linear and Logistic regression

Unit-2

Discriminative Methods: K-nearest neighbor, Linear Discriminant Functions, Decision Tree, Random Forest algorithm, Bagging and Boosting

Unit -3

Artificial Neural Network: Linear threshold units, Perceptron, Multilayer networks, Feature extraction, Feature selection techniques: Filter Method, Wrapper Method, Dimensionality Reduction techniques: Introduction to PCA, LDA.

Unit-4

Parameter Estimation: Maximum Likelihood and Bayesian Parameter Estimation

Kernel Machines: SVMs (primal and dual forms), Kernel Tricks, Radial Basis function

Unit-5

Bayes Decision Theory: Bayes decision rule, Minimum error rate classification, Normal density and discriminant functions, Naïve Bayes Classifiers, probably approximately correct (PAC) learning

Unit-6

Unsupervised Learning: Clustering (K means, Fuzzy-c means), Hidden Markov Models, Gaussian Mixture Modeling, EM-algorithms

Course Outcomes

On successful completion of the course, students will be able to:

1. Apply various preprocessing techniques before solving the problems
2. Use supervised machine learning techniques to solve different problems.
3. Apply probability based models to solve different problems.
4. Apply un-supervised machine learning techniques to solve different problems.

Text Books

1. Shalev-Shwartz,S., Ben-David,S., (2014), Understanding Machine Learning: From Theory to Algorithms, Cambridge University Press
2. Christopher Bishop, Pattern Recognition and machine learning; Springer Verlag, 2006.

Reference Books

1. Tom Mitchell; Machine Learning- an Artificial Intelligence Approach, Volume-II; Morgan Kaufmann, 1986.
2. A. K. Jain and R. C. Dubes; Algorithms for Clustering Data; Prentice Hall PTR, 1988.
3. Ethem Alpaydin, Introduction to Machine Learning, PHI.

Syllabus for Semester VI (Minor), B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CATM601**	**Course:**	**Deep Learning and Its Applications**
L: 4 Hrs, T: 0 Hr, P: 0 Hr, Per Week		**Total Credits:**	**04**

Course Pre-requisite

- Artificial Intelligence, Machine Learning

Course Objectives

- To introduce the basic concepts and techniques of machine learning.
- To understand major machine learning algorithms.
- To identify machine learning techniques suitable for a given problem.

Syllabus:

Unit-1

Introduction to Neural Networks: FeedForward Neural Networks, Backpropagation , Gradient Descent (GD), Momentum Based GD, Nesterov Accelerated GD, Stochastic GD, AdaGrad, RMSProp, Adam.

Unit -2

Autoencoders: Autoencoders and relation to PCA, Regularization in autoencoders, Denoising autoencoders, Sparse autoencoders, Contractive autoencoders

Unit-3

Regularization: Bias Variance Tradeoff, L2 regularization, Early stopping, Dataset augmentation, Parameter sharing and tying, Injecting noise at input, Ensemble methods, Dropout.

Unit-4

Convolutional Neural Networks: The Convolution Operation, Motivation, Pooling, LeNet, AlexNet, ZF-Net, VGGNet, GoogLeNet, ResNet, Visualizing Convolutional Neural Networks, Guided Backpropagation.

Unit-5

Recurrent Neural Networks: Recurrent Neural Networks, Backpropagation through time (BPTT), Vanishing and Exploding Gradients, Truncated BPTT, LSTMs, GRU

Unit-6

Applications of Deep learning in Image Processing and Natural Language Processing

Course Outcomes

On successful completion of the course, students will be able to:

1. Solve various deep learning problems
2. Apply autoencoders for unsupervised learning problems
3. Implement Convolutional Neural Networks to image classification problems
4. Apply recurrent neural network to sequence Learning Problem.

5. Apply DL techniques in various applications

Text Books

1. Neural Networks and Deep Learning A Textbook, Charu C. Aggarwal, Springer
2. Deep Learning from Scratch ,Building with Python from First Principles, Seth Weidman, O'Reilly

Reference Books.

1. Deep Learning by Ian Goodfellow, Yoshua Bengio and Aaron Courville MIT press.

Syllabus for Semester VII (Minor), B. Tech. Computer Science & Engineering
(Artificial Intelligence and Machine Learning)

Course Code:	**CAPM701**	**Course:**	**Project**
L: 0 Hrs, T: 0 Hr, P: 8 Hr, Per Week		**Total Credits:**	**04**

Outcomes

These learning outcomes are intended to assist students in acquiring a comprehensive understanding of AI and ML concepts and their practical applications. On successful completion of the project, students will be able to:

1. Identify, understand, formulate, and solve engineering problems
2. Apply knowledge of Math, Science, and Engineering
3. Participate in a hands-on project involving AI and ML techniques, and the applications of these skills in different domains and settings.
4. Identify and employ appropriate system development tools and techniques
5. Test and deploy the system to solve the society's and industry's real life problems
6. Function in multi-disciplinary teams
7. Engage in Life-long learning.
8. Employ techniques, skills, and modern engineering tools for presentation, report / paper drafting, and product manual development.

The project will focus on the creation of artificial intelligence and machine learning-based products, utilizing the expertise acquired in previous semesters. This topic primarily centers on the product development cycle and its sequential execution. The acquisition of skills necessary for producing high-quality research papers, project reports, product manuals, patent documents, and presentations is facilitated by engaging in a range of educational activities like as attending technical sessions and seminars, accessing online resources like YouTube lectures, participating in courses offered by platforms like NPTEL, EDX, and Coursera, and completing associated assessments.