Courses offered for Minor in Computer Science & Engineering (AI & ML)
(Offered for ChE / CE / ECE / EEE / ME branch students)

S. No.	Course Code	Course Title	Hours Per Week	Scheme of Examination			Category Code
			L – T – P	INT	EXT	Credits	
1	CM MR1	Introduction to Artificial Intelligence	4 – 0 – 0	30	70	4	PC
2	CM MR2	Machine Learning	4 – 0 – 0	30	70	4	PC
3	CM MR3	Data Analytics	4 – 0 – 0	30	70	4	PC
4	CM MR4	Soft Computing	4 – 0 – 0	30	70	4	PC
5	CM MR5	MOOCS – I	0 – 0 – 0	-	-	2	PC
6	CM MR6	MOOCS – II	0 – 0 – 0	-	-	2	PC

Note: Two courses to be done through MOOCs (8/12 weeks duration) with the acceptance of CSE (AI & ML) BoS

List of MOOCS
A. Natural Language Processing
B. Deep Learning
C. Data Science for Engineers
D. Robotics
E. Cloud Computing
F. Introduction to Internet of Things

CMMR1	Introduction to Artificial Intelligence	L	T	P	C
		4	-	-	4

Course Objectives:

The main objectives of this course are
1. Introduce fundamental concepts of problem solving methodologies in artificial intelligence
2. Demonstrate various search and game playing strategies
3. Instruct logical representation of natural language sentences
4. Discuss knowledge representation strategies and planning algorithms

Course Outcomes:

After successful completion of the course, the students will be able to:
CO1. Use the fundamental concepts of artificial intelligence in problem solving
CO2. Apply search, game playing strategies for solving AI problems
CO3. Construct the given natural language sentences into appropriate predicate/proposition logic
CO4. Choose knowledge representation strategy for the real world problems and suitable algorithms for classical planning

Course Content:

UNIT – I **[CO1]** **12 Hours**

Introduction to AI: What Is AI?, The Foundations of AI, The History of AI, The State of the Art. **Intelligent Agents:** Agents and Environments, Good Behavior: The Concept of Rationality, The Nature of Environments, The Structure of Agents.
Problem Solving by Search: Problem-Solving Agents, Example Problems, searching for Solutions, Uninformed Search Strategies, Informed (Heuristic) Search Strategies, Heuristic Functions.

UNIT – II **[CO2]** **12 Hours**

Beyond Classical Search: Local Search Algorithms and Optimization Problems, Searching with Non-Deterministic Actions.
Adversarial Search: Games, Optimal Decisions in Games, Alpha–Beta Pruning,
Constraint Satisfaction Problems: Defining Constraint Satisfaction Problems, Constraint Propagation, Backtracking Search for CSPs, Local Search for CSPs, The Structure of Problems.

UNIT – III **[CO3]** **12 Hours**

Logical Agents: Knowledge-Based Agents, The Wumpus World, Logic, Propositional Logic, Propositional Theorem Proving, Effective Propositional Model Checking, Agents Based on Propositional Logic.
First-Order Logic: Representation Revisited, Syntax and Semantics of First-Order Logic, Using First Order Logic, Knowledge Engineering in First-Order Logic.

UNIT – IV **[CO4]** **12 Hours**

Inference in First-Order Logic: Propositional vs. First-Order Inference, Unification and Lifting, Forward Chaining, Backward Chaining, Resolution.
Knowledge Representation: Ontological Engineering, Categories and Objects, Events. Mental Events and Mental Objects, Reasoning Systems for Categories, Reasoning with Default Information.
Automated Planning: Definition of Classical Planning, Algorithms for Classical Planning.

Learning Resources:

Text Book:

1. Artificial Intelligence - A Modern Approach, Stuart Russell and Peter Norvig, Fourth Edition, Pearson Education.

Reference Books:

1. Artificial Intelligence, E. Rich and K. Knight,3rd Edn.,(TMH)
2. Artificial Intelligence, 3rd Edn., Patrick Henny Winston, 3rd Edn., Pearson Education.
3. A First Course in Artificial Intelligence, Deepak Khemani, Tata Mc-Grah Hill.
4. Artificial Intelligence and Expert systems – Patterson, Pearson Education.
5. Artificial Intelligence, SarojKaushik, CENGAGE Learning

CMMR2	Machine Learning	L	T	P	C
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Course Objectives:

The main objectives of this course are
1. Introduce basic concepts and applications of machine learning.
2. Discuss supervised learning and its applications
3. Discuss unsupervised learning and its applications
4. Provide multilayer perceptrons and kernel tricks

Course Outcomes:

After successful completion of the course, the students will be able to:
1. apply the machine learning concepts in real life problems
2. design solutions for classification problems
3. implement clustering algorithms
4. use multilayer perceptrons and kernel tricks for classification

Course Content:

UNIT – I **[CO1]** **12 Hours**

Introduction to Machine Learning- What is Machine Learning, Examples of Machine Learning Applications.
Supervised Learning- Learning a Class from Examples, Vapnik-Chervonenkis Dimension, Probably Approximately Correct Learning, Noise, Learning Multiple Classes, Regression, Model Selection and Generalization, Dimensions of a Supervised Machine Learning Algorithm.

UNIT – II **[CO2]** **12 Hours**

Bayesian Decision Theory- Introduction, Classification, Losses and Risks, Discriminant Functions, Association Rules.
Parametric Methods- Introduction, Maximum Likelihood Estimation, Evaluating an Estimator: Bias and Variance, The Bayes' Estimator, Parametric Classification, Regression, Tuning Model Complexity: Bias/Variance Dilemma, Model Selection Procedures.

UNIT – III **[CO3]** **12 Hours**

Clustering- Introduction, Mixture Densities, k-Means Clustering, Expectation-Maximization Algorithm, Mixtures of Latent Variable Models, Supervised Learning after Clustering, Spectral Clustering, Hierarchical Clustering, Choosing the Number of Clusters.
Decision Trees- Decision Trees, Univariate Trees, Pruning, Rule Extraction from Trees, Learning Rules from Data, Multivariate Trees.

UNIT – IV **[CO4]** **12 Hours**

Multilayer Perceptrons- Introduction, The Perceptron, Training a Perceptron, Learning Boolean Functions, Multilayer Perceptrons, MLP as a Universal Approximator, Backpropagation Algorithm, Training Procedures, Tuning the Network Size, Bayesian View of Learning, Dimensionality Reduction, Learning Time, Deep Learning.
Kernel Machines- Introduction, Optimal Separating Hyperplane, The Nonseparable Case: Soft Margin Hyperplane, v-SVM, Kernel Trick, Vectorial Kernels, Defining Kernels.

Learning Resources:

Text Book:

1. Ethem Alpaydin, Introduction to Machine Learning, MIT Press, Prentice Hall of India, Third Edition 2014

Reference Books:

1. Tom Mitchell, Machine Learning, McGraw Hill,1997.
2. Kevin P. Murphy, Machine Learning: A Probabilistic Perspective, The MIT Press, 2012.
3. Christopher M. Bishop, Pattern Recognition and Machine Learning, Springer, 2006.

CMMR3	Data Analytics	L	T	P	C
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Course Objectives:

The main objectives of this course are
5. Introduce basic concepts and applications of machine learning.
6. Discuss supervised learning and its applications
7. Discuss unsupervised learning and its applications
8. Provide multilayer perceptrons and kernel tricks

Course Outcomes:

After successful completion of the course, the students will be able to:
5. apply the machine learning concepts in real life problems
6. design solutions for classification problems
7. implement clustering algorithms
8. use multilayer perceptrons and kernel tricks for classification

Course Content:

UNIT – I **[CO1]** **12 Hours**

Introduction to Data: The basic data types – nominal, ordinal, interval, ratio scaled.
Data Pre-processing: Why pre-process the data? Descriptive data summarization-measuring the central tendency, measuring the dispersion of data-range, quartiles, outliers, and box plots, variance and standard deviation, graphic displays of basic descriptive data summaries, data cleaning - missing values, noisy data-outlier detection, correction and removal, data cleaning as a process, data imputation techniques, data integration and transformation - data integration, data transformation, data reduction -attribute subset selection, numerosity reduction.

UNIT – II **[CO2]** **12 Hours**

Visualizing Data: Mapping data onto aesthetics, aesthetics and types of data, scales map data values onto aesthetics.
Visualizing amounts: bar plots, grouped and stacked bars, dot plots and heat maps, exploration of visualization tools.

UNIT – III **[CO3]** **12 Hours**

Visualizing Distributions: Histograms and density plots - visualizing a single distribution, visualizing multiple distributions at the same time.
Empirical cumulative distribution functions and q-q plots: empirical cumulative distribution functions, highly skewed distributions, quantile-quantile plots.

UNIT – IV **[CO4]** **12 Hours**

Visualizing Multiple Distributions: Visualizing distributions along the vertical axis, visualizing distributions along the horizontal axis.
Visualizing associations among two or more quantitative variables: scatterplots, scatterplot matrix, ggplots, correlograms, dimension reduction, paired data

Learning Resources:

Text Book:

1. Claus O. Wilke, Fundamentals of Data Visualization, Oreilly publication, 1stEdition.
2. Charu C Aggarwal, Data Mining, Springer International Publishing Switzerland, 2015.
3. Jiawei Han and MichelineKamber, Data Mining- Concepts and Techniques, Morgan Kaufmann Publishers, Elsevier, 2nd Edition, 2006.

Reference Books:

4. Arun K Pujari, Data Mining Techniques, 3rdEdition, Universities Press.
5. Kieran Healy, Data Visualization: A Practical Introduction 1stEdition, Princeton university press.

CMMR4	Soft Computing	L	T	P	C
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Course Objectives:

The main objectives of this course are

1. Explain the principles and core components of these techniques.
2. Equip students with practical skills to apply soft computing techniques to real-world problems.
3. Independently analyze, model, and solve complex problems using soft computing methods.
4. Assess when and where soft computing approaches are most suitable and articulate their reasoning.

Course Outcomes:

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

CO1. Understand the principles and concepts of soft computing, neural networks.
CO2. Proficiency in supervised and unsupervised learning.
CO3. Understand fuzzy logic and Fuzzy relations.
CO4. Understand genetic algorithms to optimization and search problems.

Course Content:

UNIT – I	[CO1]	12 Hours
Introduction: Neural Networks, Application Scope of Neural Networks, Fuzzy Logic, Genetic Algorithm, Hybrid Systems, Soft Computing. **Artificial Neural Network:** An Introduction, Fundamental Concept, Evolution of Neural Networks, Basic Models of Artificial Neural Network, Important Terminologies of A.NNs, McCulloch-Pitts Neuron, Linear Separability, Hebb Network.		
UNIT – II	**[CO2]**	**12 Hours**
Supervised Learning Network: Introduction, perceptron Networks, Adaptive Linear Neuron, Multiple Adaptive Linear Neurons, Back propagation Network. **Un-Supervised Learning algorithms-** Introduction, Fixed Weight Competitive Nets, Kohonen Self-Organizing Feature Maps, Counter Propagation Networks		
UNIT – III	**[CO3]**	**12 Hours**
Introduction to Fuzzy Logic, Classical Sets and Fuzzy Sets: Introduction to Fuzzy Logic, Classical Sets, Fuzzy Sets. **Classical Relations and Fuzzy Relations:** Introduction, Cartesian Product of Relation, Classical Relation, fuzzy Relations, Tolerance and Equivalence Relations, Non interactive Fuzzy Sets.		
UNIT – IV	**[CO4]**	**12 Hours**
Genetic Algorithms: Introduction, Biological Background, Traditional Optimization and Search Techniques, Genetic Algorithm and Search Space, Generic Algorithm vs. Traditional Algorithms, Basic Terminologies in Genetic Algorithm, Simple GA, General Genetic Algorithm. **Operators in Generic Algorithm:** Encoding, Selection, Crossover, Mutation.		

Learning Resources:

Text Book:

1. Principles of Soft Computing by S. N. Sivanandan and S. N. Deepa, 2nd edition, Wiley India 2007.

Reference Books:

1. NEURAL NETWORKS, FUZZY LOGIC, AND GENETIC ALGORITHMS: SYNTHESIS ANDAPPLICATIONS (WITH CD-ROMby S. Rajasekaran and G. A. Vijayalakshmi Pai, PHI, 2013.
2. Soft computing and Intelligent Systems: Theory and Applications, by Naresh K. Sinha, Madan N. Gupta, Academic Press 2000.