Artificial Intelligence

Course Title: Artificial Intelligence
Course No: CSC261
Nature of the Course: Theory + Lab
Semester: IV

Full Marks: 60 + 20 + 20
Pass Marks: 24 + 8 + 8
Credit Hrs: 3

Course Description: The course introduces the ideas and techniques underlying the principles and design of artificial intelligent systems. The course covers the basics and applications of AI, including: design of intelligent agents, problem solving, searching, knowledge representation systems, probabilistic reasoning, neural networks, machine learning and natural language processing.

Course Objectives: The main objective of the course is to introduce fundamental concepts of Artificial Intelligence. The general objectives are to learn about computer systems that exhibit intelligent behavior, design intelligent agents, identify AI problems and solve the problems, design knowledge representation and expert systems, design neural networks for solving problems, identify different machine learning paradigms and identify their practical applications.

Course Contents:

Unit I: Introduction (3 Hrs.)

1.1. Artificial Intelligence (AI), AI Perspectives: acting and thinking humanly, acting and thinking rationally
1.2. History of AI
1.3. Foundations of AI
1.4. Applications of AI

Unit II: Intelligent Agents (4 Hrs.)

2.1. Introduction of agents, Structure of Intelligent agent, Properties of Intelligent Agents
2.2. Configuration of Agents, PEAS description of Agents
2.3. Types of Agents: Simple Reflexive, Model Based, Goal Based, Utility Based.
2.4. Environment Types: Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent

Unit III: Problem Solving by Searching (9 Hrs.)

3.1. Definition, Problem as a state space search, Problem formulation, Well-defined problems,
3.2. Solving Problems by Searching, Search Strategies, Performance evaluation of search techniques
3.3. Uninformed Search: Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Search, Bidirectional Search
3.4. Informed Search: Greedy Best first search, A* search, Hill Climbing, Simulated Annealing
3.5. Game playing, Adversarial search techniques, Mini-max Search, Alpha-Beta Pruning.
3.6. Constraint Satisfaction Problems

Unit IV: Knowledge Representation (14 Hrs.)

4.1. Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems.
4.2. Types of Knowledge Representation Systems: Semantic Nets, Frames, Conceptual Dependencies, Scripts, Rule Based Systems, Propositional Logic, Predicate Logic
4.3. Propositional Logic(PL): Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula, Inference using Resolution, Backward Chaining and Forward Chaining
4.4. Predicate Logic: FOPL, Syntax, Semantics, Quantification, Inference with FOPL: By converting into PL (Existential and universal instantiation), Unification and lifting, Inference using resolution
4.5. Handling Uncertain Knowledge, Radom Variables, Prior and Posterior Probability, Inference using Full Joint Distribution, Bayes' Rule and its use, Bayesian Networks, Reasoning in Belief Networks
4.6. Fuzzy Logic

Unit V: Machine Learning (9 Hrs.)

5.1. Introduction to Machine Learning, Concepts of Learning, Supervised, Unsupervised and Reinforcement Learning
5.2. Statistical-based Learning: Naive Bayes Model
5.3. Learning by Genetic Algorithm
5.4. Learning with Neural Networks: Introduction, Biological Neural Networks Vs. Artificial Neural Networks (ANN), Mathematical Model of ANN, Types of ANN: Feed-forward, Recurrent, Single Layered, Multi-Layered, Application of Artificial Neural Networks, Learning by Training ANN, Supervised vs. Unsupervised Learning, Hebbian Learning, Perceptron Learning, Back-propagation Learning

Unit VI: Applications of AI (6 Hrs.)

6.1. Expert Systems, Development of Expert Systems
6.2. Natural Language Processing: Natural Language Understanding and Natural Language Generation, Steps of Natural Language Processing
6.3. Machine Vision Concepts
6.4. Robotics

Laboratory Works:

The laboratory work consists of design and implementation of intelligent agents and expert systems, searching techniques, knowledge representation systems and machine learning techniques. Students are also advised to implement Neural Networks, Genetic Algorithms for solving practical problems of AI. Students are advised to use LISP, PROLOG, or any other high level language.

Text Books:

1. Stuart Russel and Peter Norvig, *Artificial Intelligence A Modern Approach*, Pearson

Reference Books:

1. E. Rich, K. Knight, Shivashankar B. Nair, *Artificial Intelligence*, Tata McGraw Hill.
2. George F. Luger, *Artificial Intelligence: Structures and Strategies for Complex Problem Solving*, Benjamin/Cummings Publication
3. D. W. Patterson, *Artificial Intelligence and Expert Systems*, Prentice Hall.
4. P. H. Winston, *Artificial Intelligence*, Addison Wesley.