

**Year: M. Tech. I (Semester – I)**

**Subject Name:** Artificial and Computational Intelligence

**Subject Code:** MTCO23102

**Type of course:** Professional Core Course

**Prerequisite (if any):** —

**List of Courses where this course will be prerequisite:**

**Rationale:** Learners can gain a thorough understanding of the fundamentals of Artificial Intelligence, the recent applications and the various components of Artificial Intelligence. This course provides insights into the different search methods including heuristic and adversarial search, various bio inspired learning methods, reasoning, Logic programming and natural language processing along with the applications.

**Teaching and Examination Scheme:**

| Teaching Scheme |   |   |   | Theory Marks |     |     | Practical Marks |     | Total |
|-----------------|---|---|---|--------------|-----|-----|-----------------|-----|-------|
| L               | T | P | C | TEE          | CA1 | CA2 | TEP             | CA3 |       |
| 4               | 0 | 2 | 5 | 60           | 25  | 15  | 30              | 20  | 150   |

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

**Content:**

| Sr. No. | Content   | Total Hrs |
|---------|---|-----------|
| 1       | Introduction of AI : Introduction to Artificial Intelligence (AI), Scope and view of Artificial Intelligence, typical AI problems, Intelligent behavior, Turing test, Popular AI applications, AI agent, Goal directed agent.   | 3         |
| 2       | State space and search strategies : State space search problem and its representation, Search tree - 8 puzzle, Water jug problem, N Queen problem.<br>Uninformed search and analysis - Breadth First Search, Depth First Search, Iterative Deepening Depth First Search, Bi-directional search; Informed search and analysis - Heuristic function, Hill Climbing, Simulated | 14        |

|   |  |    |
|---|--|----|
|   | Annealing, Greedy Best-First Search, A*, AO* algorithm; Constraint Satisfaction Problem.   |    |
| 3 | Game Playing : Overview, Zero Sum Games, Adversarial Search, MiniMax, Alpha-Beta Cut-off, Refinements.   | 4  |
| 4 | Knowledge presentation and Probabilistic Reasoning : Knowledge representation - Issues and Approaches; Proposition, Inference and Deduction, First Order Logic, Unification, Resolution by refutation, Rule based systems, Non-monotonic reasoning, Expert system. Probability and Bayes' Theorem, Certainty Factors and Rule-Base Systems, Bayesian Networks. | 10 |
| 5 | Introduction to Soft Computing and Fuzzy Logic: Soft Computing definition, soft computing Vs hard computing, Applications of soft computing Techniques, Fuzzy set. Operation on Fuzzy set, fuzzy membership function, Fuzzification, Defuzzification, fuzzy proposition, Fuzzy relations. Fuzzy Inference System   | 6  |
| 6 | Evolutionary Algorithm : Basic Concepts of "Genetics" and "Evolution", Genetic Algorithms (GA), GA based optimization, Working Principle, Encoding methods, Fitness function, GA Operators - Reproduction, Crossover, Mutation; Convergence of GA, Multi objective Optimization problem using GA, Applications and Problem solving using GA                    | 10 |
| 7 | Swarm Intelligence : Ant Colony Optimization: Ant system, MM-AS, Ant Miner, Snake-Ant Algorithm; Particle Swarm Optimization: Particle, Velocity, Velocity clamp, Solving a real time problem using PSO  | 6  |
| 8 | Introduction to Artificial Neural Networks (ANN) : Perceptron, Linearly separable problems, Complex problems, Perceptron Learning, Concept of activation functions, Applications of ANN.   | 7  |

**Reference Books:**

| Sr No | Title of book /article                    | Author(s)                    | Publisher and details like ISBN | Year of publication / Publication Edition |
|-------|---|------------------------------|---------------------------------|---|
| 1     | Artificial Intelligence:A Modern Approach | Stuart Russel, Peter Norvig  | Prentice Hall, 0136042597       | Latest Edition                            |
| 2     | Artificial Intelligence                   | Elaine Rich And Kevin Knight | Tata Mcgraw-Hill, 9780070087705 |   |

|   |  |                                       |                               |  |
|---|--|---------------------------------------|-------------------------------|--|
| 3 | Principles of Soft Computing   | S.N.Sivanandam and S.N.Deepa          | Wiley                         |  |
| 4 | Genetic algorithm in search, optimization and machine learning                 | Goldberg, D. E                        | Addison- Wesley, Reading Mass |  |
| 5 | Fuzzy Logic with Engineering Applications                                      | Timothy J.Ross                        | McGraw-Hill                   |  |
| 6 | Fundamentals of Computational Swarm Intelligence                               | Engelbrecht A. P                      | John Wiley & Sons,            |  |
| 7 | Neural Networks, Fuzzy Logic, and Genetic Algorithms synthesis and application | S. Rajasekaran & GA Vijayalakshmi Pai | PHI                           |  |

**Course Outcomes:**

| Sr. No. | CO statement   | Marks % weightage |
|---------|--|-------------------|
| CO-1    | Assess different uninformed and heuristic search techniques  | 35                |
| CO-2    | Examine knowledge representation issues, reasoning, formulate predicates-rules for real life problem solving | 15                |
| CO-3    | Analyse evolutionary algorithms to combinatorial optimization problems                                       | 20                |
| CO-4    | Examine solutions by swarm intelligence approaches for real life problems                                    | 10                |
| CO-5    | Construct ANN and Fuzzy models for problem solving   | 20                |

**List of Open learning website:**

- NPTEL online course: An Introduction to Artificial Intelligence, IIT Delhi by Prof. Mausam  
(<https://nptel.ac.in/courses/106102220>)
- NPTEL online course: Artificial Intelligence: Search Methods for Problem Solving, IIT Madras by Prof. Deepak Khemani  
(<https://nptel.ac.in/courses/106106126>)
- NPTEL online course: Introduction To Soft Computing, By Prof. Debasis Samanta, IIT Kharagpur  
(<https://archive.nptel.ac.in/courses/106/105/106105173/>)

**List of Open Source Software:**

- Python and its libraries

**FOR LAB SESSIONS:**

**List of Experiments:**

| Sr. No | Practical  |
|--------|--|
| 1      | Write a program to implement BFS / DFS (for 8 puzzle problem or Water Jug problem or any AI search problem) .          |
| 2      | Write a program to Implement A* Algorithm  |
| 3      | Implement the game of Tic – Tac – Toe, where one player is a human and the other is the Computer using Min-Max method. |
| 4      | Write a program to solve travelling salesman problem using any heuristic search.                                       |
| 5      | Solve quadratic equation using Genetic algorithm.  |
| 6      | Write a program to create and train a ANN model for i) AND gate ii) X-OR gate  |
| 7      | Write Prolog Program to Explore basic Prolog syntax and structure.   |
| 8      | Write a Prolog Program for a family tree and demonstrate inference.  |
| 9      | Implement Genetic algorithm for Travelling Salesman Problem.   |
| 10     | Implement Swarm Intelligence based algorithm for any minimization/ maximization/ optimization problem.                 |



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|    |   |
|----|---|
| 11 | <p>Consider fuzzy set A of tall men and fuzzy set B of short men.<br/>Given <math>A = \{0/175, 0/150, 0/140, 0.5/185, 1/190\}</math><br/>Given <math>B = \{1/155, 1/150, 0/190, 0.5/170, 0.8/160\}</math><br/>Apply the appropriate fuzzy set operations to derive fuzzy set containing</p> <ul style="list-style-type: none"><li>• Not very tall men and not very short men</li><li>• Not very very tall and not very very short men</li></ul> |
| 12 | <p>Design fuzzy inference system for the following case studies</p> <ul style="list-style-type: none"><li>• Calculating the washing time of washing machine based on the weight and type of clothes</li><li>• Inferring the immunity of person based on the age, lifestyle (fitness routine, diet)</li><li>• Inference of student academic record based on the marks of the student, co-curricular activities (sports, cultural etc)</li></ul>  |

