**Description of Course CSE 317**

**PART A: General Information**

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| **1** | **Course Title** | : Artificial Intelligence |
| **2** | **Type of Course** | : Sessional |
| **3** | **Offered to** | : Department of CSE |
| **4** | **Pre-requisite Course(s)** | : None |
| **5** | **Credit hours** | : 3.0 credit hours (3hrs/week) |

**PART B: Course Details**

1. **Course Content (As approved by the Academic Council)**

Introduction to AI, intelligent agents; Solving problems by searching: informed search strategies, greedy best-first search, A\* search, inadmissible heuristics and weighted A\*, heuristic functions; Local search and optimization problems: hill-climbing search, simulated annealing, local beam search, evolutionary algorithms; Adversarial search and games: alpha-beta tree search, Monte Carlo tree search; Constraint satisfaction problems (CSP): backtracking and local search for CSPs; Knowledge, reasoning, and planning: logical agents, inference in first-order logic, knowledge representation, automated planning; Learning from examples: forms of learning, supervised learning, learning decision trees, model selection and optimization, theory of learning; parametric models: linear regression and classification; Nonparametric models: nearest-neighbour models, support vector machines (SVM); Ensemble learning: bagging, random forests, stacking, boosting, gradient boosting, online learning; Markov decision process (MDP), partially observable MDP, learning from rewards, passive and active reinforcement learning, Q-learning, policy search; Robotics: robotic perception, planning and control, reinforcement learning in robotics; Ethics and future of AI.

1. **Course Objectives**

The main objectives of this course are as follows:

* + 1. To make students understand the fundamental knowledge of AI and machine learning
    2. To teach the students how the knowledge of AI and machine learning can be applied to solve real-world problems

1. **Knowledge required**

**Technical**

* Probability theory, linear algebra, multivariate calculus, good programming knowledge of C/C++/Java/Python

**Analytical**

* Problem solving and creating thinking

1. **Course Outcomes (COs)**

| **CO No.** | **CO Statement**  After undergoing this course, students should be able to: | **Corresponding PO(s)\*** | **Domains and Taxonomy level(s)\*\*** | **Delivery Method(s) and Activity(-ies)** | **Assessment Tool(s)** |
| --- | --- | --- | --- | --- | --- |
| CO1 | **Understand** the basic principles, techniques, and applications of AI | PO1 | C2 | Lecture and demonstration | Class tests and final exam |
| CO2 | **Apply** techniques of AI in knowledge representation, logic, inference, game theory, and in problems that require search algorithms including constraint satisfaction problems | PO1 | C3 | Lecture and demonstration | Class tests and final exam |
| CO3 | **Understand** and **apply** machine learning techniques for solving problems by supervised and unsupervised learning, reinforcement learning, Q-learning, and planning. | PO1 | C3 | Lecture and demonstration | Class tests and final exam |

**\*Program Outcomes (POs)**

PO1: Engineering knowledge; PO2: Problem analysis; PO3: Design/development of solutions; PO4: Investigation; PO5: Modern tool usage; PO6: The engineer and society; PO7: Environment and sustainability; PO8: Ethics; PO9: Individual work and teamwork; PO10: Communication; PO11: Project management and finance; PO12: Life-long learning.

**\*\*Domains**

**C-Cognitive**: C1: Knowledge; C2: Comprehension; C3: Application; C4: Analysis; C5: Synthesis; C6: Evaluation

**A-Affective**: A1: Receiving; A2: Responding; A3: Valuing; A4: Organizing; A5: Characterizing

**P-Psychomotor**: P1: Perception; P2: Set; P3: Guided Response; P4: Mechanism; P5: Complex Overt Response; P6: Adaptation; P7: Organization

1. **Mapping of Knowledge Profile, Complex Engineering Problem Solving and Complex Engineering Activities**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **COs** | **K1** | **K2** | **K3** | **K4** | **K5** | **K6** | **K7** | **K8** | **P1** | **P2** | **P3** | **P4** | **P5** | **P6** | **P7** | **A1** | **A2** | **A3** | **A4** | **A5** |
| CO1 |  |  |  | √ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| CO2 |  |  |  | √ | √ |  |  |  | √ |  | √ |  |  |  |  |  |  |  |  |  |
| CO3 |  |  |  | √ | √ |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**K-Knowledge Profile:**

**K1:** A systematic, theory-based understanding of the natural sciences applicable to the discipline; **K2:** Conceptually based mathematics, numerical analysis, statistics and the formal aspects of computer and information science to support analysis and modeling applicable to the discipline; **K3:** A systematic, theory-based formulation of engineering fundamentals required in the engineering discipline; **K4:** Engineering specialist knowledge that provides theoretical frameworks and bodies of knowledge for the accepted practice areas in the engineering discipline; much is at the forefront of the discipline; **K5:** Knowledge that supports engineering design in a practice area; **K6:** Knowledge of engineering practice (technology) in the practice areas in the engineering discipline; **K7:**Comprehension of the role of engineering in society and identified issues in engineering practice in the discipline: ethics and the engineer’s professional responsibility to public safety; the impacts of engineering activity; economic, social, cultural, environmental and sustainability; **K8:** Engagement with selected knowledge in the research literature of the discipline

**P-Range of Complex Engineering Problem Solving:**

**P1:** Cannot be resolved without in-depth engineering knowledge at the level of one or more of K3, K4, K5, K6 or K8 which allows a fundamentals-based, first principles analytical approach; **P2:** Involve wide-ranging or conflicting technical, engineering and other issues; **P3:** Have no obvious solution and require abstract thinking, originality in analysis to formulate suitable models; **P4:** Involve infrequently encountered issues; **P5:** Are outside problems encompassed by standards and codes of practice for professional engineering; **P6:** Involve diverse groups of stakeholders with widely varying needs; **P7:** Are high level problems including many component parts or sub-problems

**A-Range of Complex Engineering Activities:**

**A1:** Involve the use of diverse resources (and for this purpose resources include people, money, equipment, materials, information and technologies); **A2:** Require resolution of significant problems arising from interactions between wide-ranging or conflicting technical, engineering or other issues; **A3:** Involve creative use of engineering principles and research-based knowledge in novel ways; **A4:** Have significant consequences in a range of contexts, characterized by difficulty of prediction and mitigation; **A5:** Can extend beyond previous experiences by applying principles-based approaches

1. **Lecture/Activity Plan**

| **Week** | **Lecture Topics** | **Corresponding CO(s)** |
| --- | --- | --- |
| Week 1 | Introduction to AI, intelligent agents; Solving problems by searching: informed search strategies, greedy best-first search, A\* search, inadmissible heuristics and weighted A\*, heuristic functions | CO1-CO2 |
| Week 2 | Local search and optimization problems: hill-climbing search, simulated annealing, local beam search, evolutionary algorithms | CO1-CO2 |
| Week 3 | Adversarial search and games: alpha-beta tree search, Monte Carlo tree search | CO1-CO2 |
| Week 4 | Constraint satisfaction problems (CSP): backtracking and local search for CSPs | CO1-CO2 |
| Week 5 | Knowledge, reasoning, and planning: logical agents, inference in first-order logic | CO1-CO2 |
| Week 6 | Knowledge representation, automated planning | CO1-CO2 |
| Week 7 | Learning from examples: forms of learning, supervised learning, learning decision trees, model selection and optimization, theory of learning | CO3 |
| Week 8 | Parametric models: linear regression and classification | CO3 |
| Week 9 | Nonparametric models: nearest-neighbor models, support vector machines (SVM) | CO3 |
| Week 10 | Ensemble learning: bagging, random forests, stacking, boosting, gradient boosting, online learning | CO3 |
| Week 11 | Markov decision process (MDP), partially observable MDP, learning from rewards | CO3 |
| Week 12 | Passive and active reinforcement learning, Q-learning, policy search | CO3 |
| Week 13 | Robotics: robotic perception, planning and control, reinforcement learning in robotics | CO3 |
| Week 14 | Ethics and future of AI | CO1 |

1. **Assessment Strategy**
   * Class Attendance: Class attendance will be recorded in every class.
   * Class Tests/Assignments/Projects: There will be a minimum of 4 (four) Class Tests/Assignments/Projects, out of which the best 3 (three) will be considered in final evaluation.
   * Final exam: A comprehensive Final exam will be held at the end of the semester as per the institutional ordinance.
2. **Distribution of Marks**

Attendance: 10%

Class tests: 20%

Final quiz: 70%

Total: 100%

1. **Textbook/ Reference**
   * + 1. “Artificial Intelligence: A Modern Approach” by Stuart Russel and Peter Norvig
       2. “Machine Learning” by Tom M. Mitchell

**Course Teacher(s):**

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| **Prepared by:** |
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| Date of Preparation: October 23, 2022 |
| Date of Approval by BUGS: |