19AI602

**Foundations of Artificial Intelligence**

Preamble

This course will deal with the fundamental principles of Artificial Intelligence including knowledge representation, reasoning, decision making and programming techniques. The course will also support developing an understanding of the theoretical relationships between these algorithms.

Course Objectives

* To understand basic principles of Artificial Intelligence
* To learn and design intelligent agents
* To understand the basic areas of artificial intelligence including problem solving, knowledge representation, reasoning, decision making, planning, perception and action

Course Outcomes

* Understand formal methods of knowledge representation
* Understand foundational principles, mathematical tools and program paradigms of AI
* Apply intelligent agents for Artificial Intelligence programming techniques
* Apply problem solving through search for AI applications
* Apply logic and reasoning techniques to AI applications

Syllabus

**Unit I**

Logic and Knowledge Representation -

Knowledge base -

Ontology -

Common-sense Knowledge -

Representation of Common-sense knowledge –

Graphical models –

Belief networks -

State space representation –

Vector representation -

Propositional logic and predicate logic -

Propositional and predicate logic -

Syntax -

Informal and formal semantics -

Validity,

satisfiability -

Semantic entailment -

Equivalence -

De Morgan’s laws -

Decidable problems -

Many-sorted logic -

first-order,

aspects of higher-order logic

**Unit II**

Automated Reasoning–

Formal program techniques:

specification by pre- and post-conditions,

derivation and verification of programs,

invariants.

Strategic Reasoning in AI -

Agents,

strategic behaviours of agents in multiagent systems (MAS) by using the language of alternating time temporal logic (ATL), an extension of the temporal logics CTL and LTL which allows to express game-theoretical notions such as the existence of a winning strategy for a group of agents -

Expert system-based reasoning -

Production system,

semantic network,

and frame -

Soft computing based reasoning – Fuzzy logic

**Unit III**

Decision Theory

Decision-Making: basics of utility theory, decision theory, sequential decision problems, decision networks, elementary game theory, sample applications;

Problem-solving through Search:

forward and backward,

state-space,

blind,

heuristic,

hill climbing,

best-first,

A,

A\*,

AO\*,

minimax,

constraint propagation,

intelligent search,

meta-heuristics,

problem-reduction,

neural and

stochastic;

Intelligent agents -

* reactive,
* deliberative,
* goal-driven,
* utility-driven, and
* learning agents

Artificial Intelligence programming techniques;

Planning:

* planning as search,
* partial order planning
* construction and use of planning graph

Text Book / References

1. Russell, Norvig, Artifificial Intelligence: A Modern Approach, Third edition, Prentice Hall,

2010

2. Tsang. Foundations of constraint satisfaction, Academic press, 1993

3. Gendreau, Michel, and Jean-Yves Potvin, Handbook of metaheuristics, Springer, 2010.