INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal - 500 043, Hyderabad, Telangana

COURSE CONTENT

KNOWLEDGE REPRESENTATION AND REASONING								
Professional Elective: CSE (AI&ML)								
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
		L	**T**	**P**	**C**	**CIA**	**SEE**	**Total**
ACAD05	**Elective**	3	0	0	3	40	60	100
Contact Classes: 48	**Tutorial Classes: NIL**	**Practical Classes: Nil**				**Total Classes: 48**		
Prerequisite: Artificial Intelligence (Introduction Level), Discrete Mathematics, Data Structures and Algorithms								

I. COURSE OVERVIEW:

The course provides an introduction to the field. The main focus will be on decidable fragments of first order logic that are well suited for knowledge representation. We explore how such logics can be used to represent knowledge, identify relevant reasoning problems and show how these can be used to support the task of constructing suitable representations. We will also consider the computational properties of these logics, and study algorithms for solving the relevant reasoning problems. Finally, we will also discuss logics that depart from first order logic, such as non-monotonic logics.

II.COURSES OBJECTIVES:

The students will try to learn:

I. The key concepts of Knowledge Representation (KR) techniques and different notations.
II. The KR view as a knowledge engineering approach to model organizational knowledge
III. The study of ontologies as a KR paradigm and applications of ontologies.
IV. The various KR techniques and process, knowledge acquisition and sharing of ontology.

III. COURSE OUTCOMES:

At the end of the course, students should be able to:

CO1 Design knowledge-based systems intended for computer implementation.
CO2 Understand ontological categories and their philosophical foundations to describe physical entities and abstract concepts effectively.
CO3 Apply natural language semantics and multiple levels of representation to design intelligent systems capable of structured knowledge processing.
CO4 Analyze the classification and behavior of processes, events, and situations over time, including concurrent computation and constraint satisfaction.
CO5 Analyze the limitations of classical logic in handling vagueness, uncertainty, randomness, and ignorance using fuzzy and nonmonotonic logic frameworks.
CO6 Apply theories, models, and semiotic principles to acquire and share knowledge through ontologies, conceptual schemas, and diverse representation paradigms.

IV.COURSE CONTENT:

MODULE – I: THE KEY CONCEPTS (09)

Knowledge, Representation, Reasoning, Why knowledge representation and reasoning, Role of logic Logic: Historical background, Representing knowledge in logic, Varieties of logic, Name, Type, Measures, Unity Amidst diversity

MODULE – II: ONTOLOGY (09)

Ontological categories, Philosophical background, Top-level categories, Describing physical entities, Defining abstractions, Sets, Collections, Types and Categories, Space and Time

MODULE – III: KNOWLEDGE REPRESENTATIONS (09)

Knowledge Engineering, Representing structure in frames, Rules and data, Object-oriented systems, Natural language Semantics, Levels of representation

MODULE – IV: PROCESSES (09)

Times, Events and Situations, Classification of processes, Procedures, Processes and Histories, Concurrent processes, Computation, Constraint satisfaction, Change Contexts: Syntax of contexts, Semantics of contexts, First-order reasoning in contexts, Modal reasoning in contexts, Encapsulating objects in contexts.

MODULE – V: KNOWLEDGE SOUP (09)

Vagueness, Uncertainty, Randomness and Ignorance, Limitations of logic, Fuzzy logic, Nonmonotonic Logic, Theories, Models and the world, Semiotics Knowledge Acquisition and Sharing: Sharing Ontologies, Conceptual schema, Accommodating multiple paradigms, Relating different knowledge representations, Language patterns, Tools for knowledge acquisition.

V. TEXT BOOKS:

1. Knowledge Representation logical, Philosophical, and Computational Foundations by John F. Sowa, Thomson Learning.

VI. REFERENCE BOOKS:

1. Knowledge Representation and Reasoning by Ronald J. Brachman, Hector J. Levesque, Elsevier.

VII. ELECTRONICS RESOURCES

1. https://alison.com/course/advanced-knowledge-representation-and-reasoning
2. https://en.wikipedia.org/wiki/Knowledge_representation_and_reasoning
3. https://www.oxfordsemantic.tech/faqs/what-is-krr-knowledge-representation-and-reasoning

VIII. MATERIAL ONLINE:

1. Course template
2. Tutorial question bank
3. Tech talk topics
4. Open-ended experiments
5. Definitions and terminology
6. Assignments
7. Model question paper – I
8. Model question paper – II
9. Lecture notes
10. PowerPoint presentation
11. E-Learning Readiness Videos (ELRV)