MANIPAL UNIVERSITY JAIPUR

School of Computer Science & Engineering

DEPARTMENT OF Computer Science and Engineering

Course Hand-out

Artificial Intelligence & Soft Computing | CS 3101| 3 1 0 4 | BTech V SEM (Core)

Session: Aug 24- Dec 24 | Faculty: Dr. Neha Choudhary, Dr. Divya Thakur, Dr. Neetu Gupta, Ms. Bali Devi, Dr. Juhi Singh, Ms. Anita Shrotriya

A. **Introduction:** This course introduces artificial intelligence techniques and soft computing techniques to the students. The course will teach them about Autonomous Agents, Problem solving, Search, Heuristic methods, State space Learning, Game Playing, Knowledge Representation, Uncertainty, Propositional Logic, Predicate Logic, Logic- based Agents, Basics of Natural Language Processing, Neural Networks, Evolutionary techniques and at end some Emerging Trends in AI.

B. **Course Outcomes:** At the end of the course, students will be able to:

[CS 3101.1] Define basics of Artificial intelligence and Intelligent agent. **[L1; Remember]**

[CS 3101.2] Explain AI problem and **apply** appropriate A.I. search technique to solve the problem**. [L1; Remember]**

[CS 3101.3] Illustrate knowledge representation using propositional, first order predicate logic and apply reasoning process to draw conclusions. **[L2; Understand]**

[CS 3101.4] Apply soft computing and Fuzzy techniques to solve problems and Improve entrepreneurship skills. **[L3; Apply]**

[CS 3101.5] Analyze evolutionary techniques for solving optimization problems and use Emerging Trends in AI**. [L4; Analyz]**

C. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES

[PO.1]. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems

[PO.2]. Problem analysis: Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences **[PO.3]. Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

[PO.4]. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

[PO.5]. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

[PO.6]. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

[PO.7]. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development. **[PO.8]. Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.

[PO.9]. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

[PO.10]. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

[PO.11]. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments

[PO.12]. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

[PSO.1]. Will be able to design, develop and implement efficient software for a given real life problem.

[PSO.2]. Will be able to apply knowledge of AI, Machine Learning and Data Mining in analysing big data for extracting useful information from it and for performing predictive analysis.

[PSO.3]. Will be able to design, manage and secure wired/ wireless computer networks for transfer and sharing of information.

D. Assessment Plan:

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	MTE	30
	CWS	30
	Class Test (Physical) IBM Certification Research paper review in Group of two, Presentation & statistical analysis via video presentation and repository submission Attendance	10 5 10 5
End Term Exam (Summative)	End Term Exam (Closed Book)	40
	Total	100
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Homework/ Home Assignment/ Activity Assignment (Formative)	Students is expected to participate and perform these assignments with full zeal since the activity/ flipped classroom participation by a student will be assessed and marks will be awarded.	

E. SYLLABUS

Pre-requisite(s): Programming in C, Data Structures, Engineering Mathematics - III

Introduction: Fundamental Concepts: Agents, environments, general model, Problem solving techniques, Introduction to intelligent agents. Automated Reasoning: Foundations of knowledge representation and reasoning, objects, relations, events, actions, time, and space; predicate logic Uncertain Knowledge Bayesian Networks-Basics of decision theory, sequential decision problems, elementary game theory; Problem solving through Search- forward and backward, state-space, blind, heuristic, problem-reduction, A, A*, AO*, minimax, constraint propagation, neural and stochastic. Soft computing: Neural networks: Perceptron, Back Propagation. Fuzzy set theory, Fuzzy sets, set-theoretic operations, membership functions, Union, intersection and complement, fuzzy rules, reasoning, and interference. Evolutionary techniques: genetic algorithms, Swarm Algorithm, ant colony optimization. Emerging Trends in AI: Explainable AI and interpretable models, Generative adversarial networks (GANs), Transfer learning and meta-learning, AI for sustainable development and social good.

A. REFERENCE BOOKS

1. S. Russell, and P. Norvig: Artificial Intelligence: A Modern Approach. Prentice Hall, 2011.
2. E. Rich, K. Knight, and S.B. Nair: Artificial Intelligence. 3rd Ed., Tata McGraw Hill, 2009.
3. G. F. Luger, Artificial Intelligence-Structures and Strategies for Complex Problem Solving, (6e), Addison-Wesley Pearson Education, 2012.

B. Lecture Plan:

Lec. No	Topic(s)	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1	Course Handout	Discussion on Course handout and CWS	Lecture	**CS3101.1**	NA
2-3	Fundamental Concepts	Introduction about AI, Agents, environments, general model, ,	Lecture	**CS3101.1**	CWS MTE End Term

		Introduction to intelligent agents.			

3– 6	Problem Solving, Production System	Defining a Problem Characteristics of a Problem A brief introduction to problem solving techniques. Production system design	Lecture	**CS3101. 2**	CWS MTE End Term
7-10	Intelligent Agents	Agent v/s Software Program Rational Agent and PEAS Description Classification of Agents, Working of an Agent Single and Multi-Agent System Performance Evaluation of Agents, Architecture of Agent	Lecture	**CS3101. 1**	CWS MTE End Term
10-16	Heuristic Search Techniques	forward and backward, state-space, blind, heuristic Heuristic search technique: Generate and Test, Hill Climbing, Best-first search, A* Algo, Problem reduction, Constraint satisfaction, Means-ends analysis	Lecture	**CS3101. 2**	CWS MTE End Term
16-20	Game Playing	problem-reduction, A, A*, AO*, minimax, constraint propagation, neural and stochastic, Min-Max Search Procedure Alpha-Beta Pruning	Lecture Tutorial	**CS3101.2**	CWS MTE End Term
Class Test- CWS (1)					
20-22	Automated Reasoning	Introduction and Foundations of knowledge representation and reasoning,	Lecture	**CS3101.3**	CWS MTE End Term
22-24	Knowledge Representation	Knowledge Representation Issues, objects, relations, events, actions, time, and space	Lecture	**CS3101.3**	CWS End term
25-28	Propositional and	Propositional and Logic operators, Simplification laws, Predicate Calculus: Limitations of Propositional Logic, Quantifiers: Existential and Universal Domain Constraints Nested Quantifiers	Lecture	**CS3101.3**	CWS End term
28-30	Predicate Logic	predicate logic, Semantics for predicate calculus, Inference rules, Resolution principle Uncertain Knowledge Bayesian Networks	Lecture	**CS3101.3**	CWS End term
31- 32	Decision Theory	Basics of decision theory, sequential decision problems, elementary game theory	Lecture	**CS3101.3**	CWS End term
MID TERM Examination (21st Oct 2024)					
33-35	Soft computing	Neural networks: Introduction, Neuron Model, Perceptron, Perceptron, Back propagation	Lecture	**CS3101.4**	CWS End term

36-37	Fuzzy	Fuzzy sets, set-theoretic operations, membership functions, Union, intersection and complement, fuzzy rules, reasoning, and interference	Lecture	**CS3101.4**	CWS End term
Group Presentation & Video Assignment **CWS (3)**					
38-42	Evolutionary Techniques	Optimization Algorithms	Lecture	**CS3101.5**	CWS End term
43-45	Emerging Trends in AI	Explainable AI and interpretable models, Generative adversarial networks (GANs),	Lecture	**CS3101.5**	CWS End term
46-48	Emerging Trends in AI	Transfer learning and meta-learning, AI for sustainable development and social good	Lecture	**CS3101.5**	CWS End term
Collection of IBM Certification- CWS (4)					

49	Course Revision	Revision	Lecture	**NA**	NA
50	Conclusion and Course Summarization	NA	Lecture	**NA**	NA
END TERM Examination (9th Dec 2024)					

C. Course Articulation Matrix: (Mapping of COs with POs & PSOs)

CO	STATEMENT	Correlation with Program Outcomes **(POs)**												ATTAINMENT OF PROGRAM SPECIFIC OUTCOMES		
		PO1	PO 2	PO 3	PO 4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
[CS3101.1]	**Define** basics of Artificial intelligence and Intelligent agent								1	1	1		1		2	
[CS3101.2]	**Explain** AI problem and **apply** appropriate A.I. search technique to solve the problem.		3	2					1	1	1		1	2	3	
[CS3101.3]	**Illustrate** knowledge representation using propositional, first order predicate logic and apply reasoning process to draw conclusions.		1	2					1	1	1				3	
[CS3101.4]	**Apply** soft computing and Fuzzy techniques to solve problems and Improve entrepreneurship skills.				2	3			1	1	1		1		3	
[CS3101.5]	**Analyze** evolutionary technique for solving optimization problems and use Emerging Trends in AI.		1	2	2				1	1	1		1		3	

1-Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation