Lesson Plan

T.E. (AI & DS) (Semester V)

Subject: ***Artificial Intelligence***

Subject code: CSC 503

Teacher-in-charge: Prof. Saurabh Kulkarni

Academic Term: July – October 2022

Module		Detailed Content	Hours
1		Introduction to Artificial Intelligence	3
	1.1	Artificial Intelligence (AI), AI Perspectives: Acting and Thinking humanly, Acting and Thinking rationally	
	1.2	History of AI, Applications of AI, The present state of AI, Ethics in AI	
2		Intelligent Agents	4
	2.1	Introduction of agents, Structure of Intelligent Agent, Characteristics of Intelligent Agents	
	2.2	Types of Agents: Simple Reflex, Model Based, Goal Based, Utility Based Agents.	
	2.2	Environment Types: Deterministic, Stochastic, Static, Dynamic, Observable, Semi-observable, Single Agent, Multi Agent	
3		Solving Problems by Searching	12
	3.1	Definition, State space representation, Problem as a state space search, Problem formulation, Well-defined problems	
	3.2	Solving Problems by Searching, Performance evaluation of search strategies, Time Complexity, Space Complexity, Completeness, Optimality	
	3.3	Uninformed Search: Depth First Search, Breadth First Search, Depth Limited Search, Iterative Deepening Search, Uniform Cost Search, Bidirectional Search	
	3.4	Informed Search: Heuristic Function, Admissible Heuristic, Informed Search Technique, Greedy Best First Search, A* Search, Local Search: Hill Climbing Search, Simulated Annealing Search, Optimization: Genetic Algorithm	
	3.5	Game Playing, Adversarial Search Techniques, Mini-max Search, Alpha-Beta Pruning	
4		Knowledge and Reasoning	10

	4.1	Definition and importance of Knowledge, Issues in Knowledge Representation, Knowledge Representation Systems, Properties of Knowledge Representation Systems	
	4.2	Propositional Logic (PL): Syntax, Semantics, Formal logic-connectives, truth tables, tautology, validity, well-formed-formula, Introduction to logic programming (PROLOG)	
	4.3	Predicate Logic: FOPL, Syntax, Semantics, Quantification, Inference rules in FOPL,	
	4.4	Forward Chaining, Backward Chaining and Resolution in FOPL	
5		Reasoning Under Uncertainty	5
		Handling Uncertain Knowledge, Random Variables, Prior and Posterior Probability, Inference using Full Joint Distribution	
		Bayes' Rule and its use, Bayesian Belief Networks, Reasoning in Belief Networks	
6		Planning and Learning	5
	6.1	The planning problem, Partial order planning, total order planning.	
	6.2	Learning in AI, Learning Agent, Concepts of Supervised, Unsupervised, Semi -Supervised Learning, Reinforcement Learning, Ensemble Learning.	
	6.3	Expert Systems, Components of Expert System: Knowledge base, Inference engine, user interface, working memory, Development of Expert Systems	
		Total	39

Course Objectives:

1. To gain perspective of AI and its foundations.
2. To study different agent architectures and properties of the environment
3. To understand the basic principles of AI towards problem solving, inference, perception, knowledge representation, and learning.
4. To investigate probabilistic reasoning under uncertain and incomplete information.
5. To explore the current scope, potential, limitations, and implications of intelligent systems

Course Outcomes:

Upon completion of this course students will be able to:

CSC503.1:- Identify the characteristics of the environment and differentiate between various agent architectures.

CSC503.2:- Apply the most suitable search strategy to design problem solving agents

CSC503.3:- Represent a natural language description of statements in logic and apply the inference rules to design Knowledge Based agents

CSC503.4:- Apply a probabilistic model for reasoning under uncertainty

CSC503.5:- Comprehend various learning techniques.

CO-PO-PSO Mapping:

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO 11**	**PO 12**	**PSO1**
CSC503.1	3	3		1									3
CSC503.2	3	3	3	2									3
CSC503.3	3	3											3
CSC503.4	3	3											3
CSC503.5	3	3		1									3

Provide justification of CO to PO mapping

CSC503.1	**PO-1**	Students have to use knowledge of Computer Engineering concepts for different agent architectures.
	PO-2	Students need to identify the correct agent architecture to solve the given problem Students need to identify the correct environment characteristics for given problem Students need to differentiate between different agent architectures and environment types
	PO-4	Students can select appropriate agent architecture and environment types for given problem/case study
CSC503.2	**PO-1**	Students have to use knowledge of Computer Engineering concepts like data structures and algorithms for solving the problems.
	PO-2	Students need to identify the algorithms and parameters to solve a problem. Students need to identify mathematical algorithmic knowledge applicable to given problem Students need to identify existing solution to solve the problem, including forming justified approximations and assumptions Students need to compare and contrast alternative solution to select the best methods Students can identify the limitations of the solution and sources Students can arrive at conclusions with respect to objectives
	PO-3	Students need to define a precise problem statement with objectives and scope Students need to explore design alternatives Students need to evaluate different design alternatives
	PO-4	Students need to define problem for purposes of investigation, its scope and importance Students need to choose appropriate algorithm
	PO-1	Students need to use concepts learnt in discrete mathematics and logic

CSC503.3	**PO-2**	Students need to identify algorithms to solve inference problems Students need to identify mathematical algorithmic knowledge applicable to given problem. Students apply discrete mathematics to implement the solution
CSC503.4	**PO-1**	Students need to apply concepts of probability in modeling inference-based systems Students need to apply concepts in computer science to solve the problems
	PO-2	Students need to apply computer engineering principles to formulate modules of system Students need to apply engineering mathematics to implement solution
CSC503.5	**PO-1**	Students need to apply theory and principles of computer science and engineering to solve problem.
	PO-2	Students need to identify modules of a computer-based system to solve problem Students need to identify functionalities and computing resources Students need to compare and contrast alternative solution to select the best methods
	PO-4	Students need to choose appropriate procedure/algorithm/technique as per their comprehension and level of knowledge.

Mapping of CO with PSO with Justification:-

CSC503.1	**PSO-1**	Students will have strong foundation to use AI tools and techniques to develop solutions
CSC503.2	**PSO-1**	Students will have strong foundation to use AI tools and techniques to develop solutions
CSC503.3	**PSO-1**	Students will have strong foundation to use AI tools and techniques to develop solutions
CSC503.4	**PSO-1**	Students will have strong foundation to use AI tools and techniques to develop solutions
CSC503.5	**PSO-1**	Students will have strong foundation to use AI tools and techniques to develop solutions

CO Assessment Tools:

Course Outcomes (CO)	Assessment Methods					
	Direct Methods (80 %)					Indirect Method (20 %)
	Unit Tests	Assignments*	Quiz	Oral	End Semester Exam (ESE)	Course Exit Survey (CES)
CSC503.1	40 %	---	30 %	10%	20 %	100 %
CSC503.2	40 %	30%	---	10%	20 %	100 %
CSC503.3	40 %	---	30 %	10%	20 %	100 %
CSC503.4	40 %	---	30 %	10%	20 %	100 %
CSC503.5	40 %	30 %	---	10%	20 %	100 %

CO calculation= (0.8 *Direct method + 0.2*Indirect method)

Rubrics for assessing Course Outcome with Assignment:

Indicator				
Timeline (3)	More than two sessions late (0)	More than one session late (1)	One session late (2)	On time (3)
Depth of Understanding (4)	Unsatisfactory (1)	Superficial (2)	Satisfactory (3)	Adequate (4)
Completeness (3)	Not submitted (0)	Major topics are omitted or addressed minimally (1)	Most major and some minor points are covered and are accurate (2)	All major and minor points are covered and are accurate (3)

Curriculum Gap identified: (with action plan)

Etical AI. Students are given presentation topics related to the same.

Content beyond syllabus:

Ethcial AI presentations

Modes of content delivery

Modes of Delivery	Brief description of content delivered
Class room lecture	1. Introduction to AI 2. Intelligent agents 3. Solving problems by searching 4. Knowledge and reasoning 5. Reasoning under uncertainty 6. Planning and learning
Flipped classroom	1. Introduction to AI 2. Solving problems by searching
Online lecture	1. Knowledge and reasoning (CNF) 2. Reasoning under uncertainty (Bayesian Belief Network)

Textbooks:	
1	Stuart J. Russell and Peter Norvig, ficial Intelligence A Modern Approach —Second "Arti Edition" Pearson Education.
2	Elaine Rich and Kevin Knight al Intelligence‖ Third Edition, Tata McGraw-Hill —ArtificiEducation Pvt. Ltd., 2008.
3	George F Luger "Artificial Intelligence" Low Price Edition, Pearson Education., Fourth edition.
References:	
1	Ivan Bratko "PROLOG Programming fo r Artificial Intelligence", Pearson Education, Third Edition.
2	D. W. Patterson, Artificial Intelligence and Expert Systems, Prentice Hall.
3	Saroj Kaushik "Artificial Intelligence", Cengage Learning.
4	Davis E. Goldberg, "Genetic Algorithms: Search, Optimization and Machine Learning", Addison Wesley, N.Y., 1989.
5	Patrick Henry Winston, "Artificial Intelligence", Addison-Wesley, Third Edition.
6	N. P. Padhy, "Artificial Intelligence and Intelligent Systems", Oxford University Press.

Research Papers:

1. L. Migle , "The intelligent machine: a new metaphor through which to understand both corporations and AI," AI and Society, July. 2020, doi: 10.1007/s00146-020-01018-7.

2. H. Xiaoxia, Y. Dong, L.Yue, Q.Xu, G.Xie, X. Xu, “State-transition simulated annealing algorithm for constrained and unconstrained multi-objective optimization problems,” Applied Intelligence, August 2020, doi: 10.1007/s10489-020-01836-8

Class & Division	T.E. (AI & DS) – Semester V		
Academic Term	July 2022 – October 2022		
Subject	**Artificial Intelligence (AI) –CSC503**		
Periods (Hours) per week	**Lectures**	**03**	
	Practicals	**02**	
	Tutorials	**--**	
Evaluation System		**Hours**	**Marks**
	Theory examination	03	80
	Internal Assessment	--	20
	Oral & Practical Examination	--	25
	Term work	--	25
	Total	--	150
Time Table	**Days**	**Time**	
	Monday	12:00 – 13:00	
	Tuesday	09.45 – 10.45	
	Thursday	13.30 – 14.30	

No.	Portion to be covered	Planned date	Actual date	Content Delivery - Reference /Assessment Method
1	Introduction to AI, Course outline, Discussion on Course Outcomes and evaluation methods	18/07/2022	18/07/2022	PPT, Blackboard
2	AI Perspectives, Acting and thinking humanly, Acting and thinking rationally	19/07/2022	19/07/2022	PPT, Discussion
3	History of AI, Applications of AI, The present state of AI, Ethics in AI	21/07/2022	21/07/2022, 25/07/2022	PPT, Flipped classroom/Discussion forum
4	Introduction to agents, Structure of intelligent agent, characteristics of intelligent agents	25/07/2022	25/07/2022	PPT, Blackboard

5	Types of agents: Simple reflex, Model-based	26/07/2022	26/07/2022	PPT, Blackboard
6	Types of agents: Goal-based, utility-based	28/07/2022	28/07/2022	PPT, Blackboard
7	Environment types: deterministic, stochastic, static, dynamic, observable, semi-observable, single agent, multi agent	01/08/2022	01/08/2022	PPT, Blackboard
8	Definition of search and state space representation	02/08/2022	02/08/2022	PPT, Blackboard
9	Problem as state space search, problem formulation	05/08/2022	05/08/2022	PPT, Blackboard
10	Well-defined problems	08/08/2022	08/08/2022	PPT, Blackboard
11	Solving problems by searching	09/08/2022 (holiday)	21/08/2022	Flipped classroom
12	Performance evaluation of search strategies, time complexity, space complexity, completeness, optimality	12/08/2022	12/08/2022	PPT, Blackboard
13	Uninformed search: DFS, BFS, uniform cost search	19/08/2022 (Declared holiday in Mumbai)	11/09/2022	Flipped classroom
14	Iterative deepening and bi-directional search and comparison of all the uninformed search techniques	22/08/2022	22/08/2022	PPT, Blackboard
15	Informed search: Heuristic function, Admissible heuristic	23/08/2022	23/08/2022	Flipped classroom
16	Informed search technique	26/08/2022	26/08/2022	PPT, Blackboard
17	Greedy best first search	29/08/2022	29/08/2022	PPT, Blackboard
18	A* search	02/09/2022 (Declared Holiday by University)	11/09/2022	Flipped classroom
19	Adversarial search	09/09/2022 (Declared holiday due to Anant Chaturdashi)	18/09/2022	Flipped classroom
20	Local search: Hill climbing	12/09/2022	12/09/2022	PPT, Blackboard

21	Simulated annealing, genetic algorithm	13/09/2022	13/09/2022	PPT, Blackboard
22	Mini-max algorithm and alpha-beta pruning	16/09/2022	16/09/2022	PPT, Blackboard
23	Definition and importance of knowledge, issues in knowledge representation, knowledge representation systems, properties of knowledge representation systems	19/09/2022	19/09/2022	PPT, Blackboard
24	Propositional logic- syntax, semantics, formal connectives, truth tables	20/09/2022	20/09/2022	PPT, Blackboard
25	Tautology, validity, well-formed formula, Prolog introduction	23/09/2022	23/09/2022	PPT, Blackboard, demo for prolog
26	Predicate logic- FOPL, syntax, semantics, quantification	26/09/2022	26/09/2022	PPT, Blackboard
27	Inference rules in FOPL	27/09/2022	27/09/2022	PPT, Blackboard
28	Forward chaining, backward chaining	30/09/2022	30/09/2022	PPT, Blackboard
29	CNF (Pre-requisite to understand Resolution)	01/10/2022	01/10/2022	Online in google meet Lecture recording link
30	Resolution in FOPL	03/10/2022	03/10/2022	PPT, Blackboard
31	Handling uncertain knowledge, random variables	04/10/2022	04/10/2022	PPT, Blackboard
32	Prior and posterior probability	07/10/2022	07/10/2022	PPT, Blackboard
33	Full joint distribution	10/10/2022	10/10/2022	PPT, Blackboard
34	Bayes rule and its use	11/10/2022	11/10/2022	PPT, Blackboard
35	Bayesian belief network and inference	14/10/2022	14/10/2022	Online in google meet Lecture recording link
36	The planning problem, partial order planning, total order planning	20/10/2022	20/10/2022	PPT, Blackboard

37	Learning in AI, learning agent, concepts of supervised learning	21/10/2022	21/10/2022	PPT, Blackboard
38	Concepts of unsupervised, semi supervised, reinforcement learning, ensemble learning	25/10/2022	25/10/2022	PPT, Blackboard
39	Expert system- concepts and components	28/10/2022	28/10/2022	PPT, Blackboard

Examination Scheme

Module		Lecture Hours	Marks distribution in Test (For internal assessment/TW)		Approximate Marks distribution in Sem. End Examination
			Test 1	Test 2	
1	Introduction to Artificial Intelligence	03	05	--	
2	Intelligent agents	04	05	--	
3	Solving problems by searching	12	10	--	
4	Knowledge and reasoning	10	--	10	
5	Reasoning under uncertainty	05	--	05	
6	Planning and learning	05	--	05	