CST401	ARTIFICIAL INTELLIGENCE	CATEGORY	L	T	P	CREDIT
		PCC	2	1	0	3

Preamble: The course aims to introduce the fundamental principles of intelligent systems to students. This involves ideas about the characteristics of intelligent systems, knowledge representation schemes, logic and inference mechanisms. The course helps the learner to understand the design of self learning systems along with some of their typical applications in the emerging scenario where the business world is being transformed by the progress made in machine learning.

Prerequisite : NIL

Course Outcomes: After the completion of the course the student will be able to

CO#	CO
CO1	Explain the fundamental concepts of intelligent systems and their architecture. **(Cognitive Knowledge Level: Understanding)**
CO2	Illustrate uninformed and informed search techniques for problem solving in intelligent systems. **(Cognitive Knowledge Level: Understanding)**
CO3	Solve Constraint Satisfaction Problems using search techniques. **(Cognitive Knowledge Level: Apply)**
CO4	Represent AI domain knowledge using logic systems and use inference techniques for reasoning in intelligent systems. **(Cognitive Knowledge Level: Apply)**
CO5	Illustrate different types of learning techniques used in intelligent systems **(Cognitive Knowledge Level: Understand)**

Mapping of course outcomes with program outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	⊘											
CO2	⊘	⊘										⊘
CO3	⊘	⊘	⊘	⊘								⊘
CO4	⊘	⊘	⊘	⊘								⊘
CO5	⊘	⊘			⊘							⊘

Abstract POs defined by National Board of Accreditation			
PO#	**Broad PO**	**PO#**	**Broad PO**
PO1	Engineering Knowledge	**PO7**	Environment and Sustainability
PO2	Problem Analysis	**PO8**	Ethics
PO3	Design/Development of solutions	**PO9**	Individual and team work
PO4	Conduct investigations of complex problems	**PO10**	Communication
PO5	Modern tool usage	**PO11**	Project Management and Finance
PO6	The Engineer and Society	**PO12**	Life long learning

Assessment Pattern

Bloom's Category	Continuous Assessment Tests		End Semester Examination Marks (%)
	Test 1 (%)	**Test 2 (%)**	
Remember	30	30	30
Understand	60	30	40
Apply	20	40	30
Analyze			
Evaluate			
Create			

Mark Distribution

Total Marks	CIE Marks	ESE Marks	ESE Duration
150	50	100	3

Continuous Internal Evaluation Pattern:

Attendance   **10 marks**

Continuous Assessment Tests(Average of SeriesTests1& 2)   **25 marks**

Continuous Assessment Assignment   **15 marks**

Internal Examination Pattern:

Each of the two internal examinations has to be conducted out of 50 marks. First series test shall be preferably conducted after completing the first half of the syllabus and the second series test shall be preferably conducted after completing remaining part of the syllabus. There will be two parts: Part A and Part B. Part A contains 5 questions (preferably, 2 questions each from the completed modules and 1 question from the partly completed module), having 3 marks for each question adding up to 15 marks for part A. Students should answer all questions from Part A. Part B contains 7 questions (preferably, 3 questions each from the completed modules and 1 question from the partly completed module), each with 7 marks. Out of the 7 questions, a student should answer any 5.

End Semester Examination Pattern:

There will be two parts; Part A and Part B. Part A contains 10 questions with 2 questions from each module, having 3 marks for each question. Students should answer all questions. Part B contains 2 full questions from each module of which student should answer any one. Each question can have maximum 2 sub-divisions and carries 14 marks.

Syllabus

Module – 1 (Introduction)
Introduction – What is Artificial Intelligence(AI) ? The Foundations of AI, History of AI, Applications of AI. Intelligent Agents – Agents and Environments, Good behavior: The concept of rationality, nature of Environments, Structure of Agents.

Module – 2 (Problem Solving)
Solving Problems by searching-Problem solving Agents, Example problems, Searching for solutions, Uninformed search strategies, Informed search strategies, Heuristic functions.

Module - 3 (Search in Complex environments)
Adversarial search - Games, Optimal decisions in games, The Minimax algorithm, Alpha-Beta pruning. Constraint Satisfaction Problems – Defining CSP, Constraint Propagation- inference in CSPs, Backtracking search for CSPs, Structure of CSP problems.

Module - 4 (Knowledge Representation and Reasoning)
Logical Agents – Knowledge based agents, Logic, Propositional Logic, Propositional Theorem proving, Agents based on Propositional Logic. First Order Predicate Logic – Syntax and Semantics of First Order Logic, Using First Order Logic, Knowledge representation in First Order Logic. Inference in First Order Logic – Propositional Vs First Order inference, Unification and Lifting, Forward chaining, Backward chaining, Resolution.

Module - 5 (Machine Learning)
Learning from Examples – Forms of Learning, Supervised Learning, Learning Decision Trees, Evaluating and choosing the best hypothesis, Regression and classification with Linear models.

Text Book
 1. Stuart Russell and Peter Norvig. Artificial Intelligence: A Modern Approach, 3rd Edition. Prentice Hall.

References
1. Nilsson N.J., Artificial Intelligence - A New Synthesis, Harcourt Asia Pvt. Ltd.

Course Level Assessment Questions

Course Outcome 1 (CO1):

 1. Explain about the basic types of agent programs in intelligent systems.

 2. For the following activities, give a PEAS description of the task environment and characterize it in terms of the task environment properties.

 a) Playing soccer.

 b) Bidding on an item at an auction.

Course Outcome 2 (CO2):

 1. Differentiate between uninformed and informed search strategies in intelligent systems.

 2. Illustrate the working of Minimax search procedure.

Course Outcome 3 (CO3):

 1. Solve the following crypt arithmetic problem by hand, using the strategy of backtracking with forward checking and the MRV & least-constraining-value heuristics.

$$\begin{array}{r} T\ W\ O \\ +\ T\ W\ O \\ \hline F\ O\ U\ R \end{array}$$

Course Outcome 4 (CO4):
1. Prove, or find a counter example to, the following assertion:
 If $\alpha \models \gamma$ or $\beta \models \gamma$ (or both) then $(\alpha \wedge \beta) \models \gamma$
2. For each pair of atomic sentences, find the most general unifier if it exists:
 a) P (A, B, B), P (x, y, z).
 b) Q(y, G(A, B)), Q(G(x, x), y).

Course Outcome 5 (CO5):
1. Consider the following data set comprised of three binary input attributes (A1 , A2 , and

A3) and one binary output.

Example	A_1	A_2	A_3	Output y
x_1	1	0	0	0
x_2	1	0	1	0
x_3	0	1	0	0
x_4	1	1	1	1
x_5	1	1	0	1

Use the DECISION-TREE-LEARNING algorithm to learn a decision tree for these data. Show the computations made to determine the attribute to split at each node.

2. What is multivariate linear regression? Explain.

Model Question Paper

QP CODE:

Reg No: _____

Name: _____   **PAGES : 4**

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION, MONTH & YEAR

Course Code: CST401

Course Name: Artificial Intelligence

Max. Marks : 100   **Duration: 3 Hours**

PART A

Answer All Questions. Each Question Carries 3 Marks

1   What is a rational agent? Explain.

2   Describe any two ways to represent states and the transitions between them in agent programs.

3   Differentiate between informed search and uninformed search.

4   Define heuristic function? Give two examples.

5   What are the components of a Constraint Satisfaction Problem? Illustrate with an example.

6   Formulate the following problem as a CSP. Class scheduling: There is a fixed number of professors and classrooms, a list of classes to be offered, and a list of possible time slots for classes. Each professor has a set of classes that he or she can teach.

7   What is a knowledge based agent? How does it work?

8.   Represent the following assertion in propositional logic:

"A person who is radical (R) is electable (E) if he/she is conservative (C), but otherwise is not electable."

9   Describe the various forms of learning?

10 State and explain Ockham's razor principle   **(10x3=30**)

Part B

(Answer any one question from each module. Each question carries 14 Marks)

11 (a) Explain the structure Goal-based agents and Utility-based agents with the   **(8)**
.   help of diagrams.

    (b) For the following activities, give a PEAS description of the task environment   **(6)**
         and characterize it in terms of the task environment properties.
         a) Playing soccer
         b) Bidding on an item at an auction.

                                              OR

12 (a) Explain the structure Simple reflex agents and Model-based reflex agents   **(8)**
.   with the help of diagrams.

    (b) Discuss about any five applications of AI.   **(6)**

13 (a) Explain Best First Search algorithm. How does it implement heuristic search?   **(6)**
.

    (b) Describe any four uninformed search strategies.   **(8)**

OR

14. (a) Write and explain A* search algorithm. **(6)**

    (b) Explain the components of a well defined AI problem? Write the standard formulation of 8-puzzle problem. **(8)**

15. (a) (a) Solve the following crypt arithmetic problem by hand, using the strategy of backtracking with forward checking and the MRV and least-constraining-value heuristics. **(8)**

$$
\begin{array}{r}
T\ W\ O \\
+\ T\ W\ O \\
\hline
F\ O\ U\ R
\end{array}
$$

    (b) What is local consistency in CSP constraint propagation? Explain different types local consistencies. **(6)**

OR

16. (a) Illustrate the use of alpha-beta pruning in games. **(6)**

    (b) Consider the following game tree in which static evaluation score are all from the players point of view: static evaluation score range is (+10 to -10) **(8)**
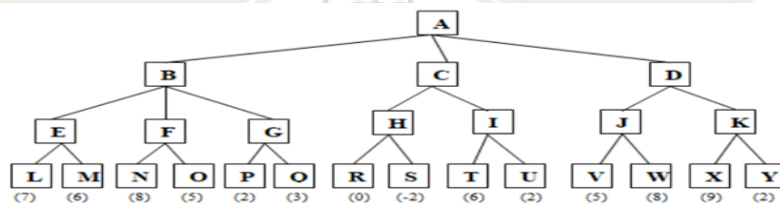
    Suppose the first player is the maximizing player. What move should be chosen? Justify your answer.

17. (a) Convert the following sentences into first order logic: **(6)**

    Everyone who loves all animals is loved by someone.

    Anyone who kills an animal is loved by no one.

    Jack loves all animals.

    Either Jack or Curiosity killed the cat, who is named Tuna.

Did Curiosity kill the cat?

(b) Give a resolution proof to answer the question "Did Curiosity kill the cat? " **(8)**

OR

18. (a) Prove or find a counter example to the following assertion in propositional **(6)**
logic:
If α |= (β ∧ γ) then α |= β and α |= γ.

(b) For each pair of atomic sentences, give the most general unifier if it exists: **(8)**
Older (Father (y), y), Older (Father (x), John).

19. (a) How is best hypothesis selected from alternatives? **(8)**

(b) Explain Univariate Linear Regression. **(6)**

OR

20. (a) Consider the following data set comprised of two binary input attributes (A1 **(8)**
and A2) and one binary output.

Example	A₁	A₂	Output y
X₁	1	1	1
X₂	1	1	1
X₃	1	0	0
X₄	0	0	1
X₅	0	1	0
X₆	0	1	0

Use the DECISION-TREE-LEARNING algorithm to learn a decision tree for
these data.   Show the computations made to determine the attribute to split at
each node.

(b) Explain Linear classification with logistic regression **(6)**

Teaching Plan

No	Contents	No of Lecture Hrs (36)
Module – 1 (Introduction) (7 hrs)		
1.1	Introduction, What is Artificial Intelligence(AI)?	1
1.2	The foundations of AI, The history of AI	1
1.3	Applications of AI	1
1.4	Intelligent Agents – Agents and Environments	1
1.5	Good behavior: The concept of rationality	1
1.6	The nature of Environments	1
1.7	The structure of Agents	1
Module - 2 (Problem Solving by searching) (7 hrs)		
2.1	Solving Problems by searching-Problem solving Agents	1
2.2	Illustration of the problem solving process by agents	1
2.3	Searching for solutions	1
2.4	Uninformed search strategies:BFS, Uniform-cost search, DFS, Depth-limited search, Iterative deepening depth-first search	1
2.5	Informed search strategies: Best First search	1
2.6	Informed search strategies: A* Search	1
2.7	Heuristic functions	1
Module - 3 (Problem Solving in complex environments) (7 hrs)		
3.1	Adversarial search - Games	1
3.2	Optimal decisions in games, The Minimax algorithm	1
3.3	Alpha-Beta pruning	1
3.4	Constraint Satisfaction Problems – Defining CSP	1
3.5	Constraint Propagation- inference in CSPs	1
3.6	Backtracking search for CSPs	1
3.7	The structure of problems	1

	Module - 4 (Knowledge Representation and Reasoning) (9 hrs)	
4.1	Logical Agents – Knowledge based agents and logic	1
4.2	Propositional Logic	1
4.3	Propositional Theorem proving	1
4.4	Agents based on Propositional Logic	1
4.5	First Order Predicate Logic – Syntax and Semantics of First Order Logic	1
4.6	Using First Order Logic, Knowledge representation in First Order Logic	1
4.7	Inference in First Order Logic – Propositional Vs First Order inference, Unification and Lifting	1
4.8	Forward chaining, Backward chaining	1
4.9	Resolution	1
	Module - 5 (Machine Learning)(6 hrs)	
5.1	Learning from Examples – Forms of Learning	1
5.2	Supervised Learning	1
5.3	Learning Decision Trees	1
5.4	Generaliztion and overfitting	1
5.5	Evaluating and choosing the best hypothesis	1
5.6	Regression and classification with Linear models.	1