GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Subject Code: BE04043011

Subject Name: Artificial Intelligence

w.e.f. Academic Year:	A.Y.2024-25
Semester:	4
Category of the Course:	PCC

Prerequisite:	Data Structures, Basic mathematics, Programming skills
Rationale:	AI and its techniques are being used in many areas which directly affect human life. Various techniques for encoding knowledge in computer systems such as Predicate Logic, Production rules, Semantic networks find application in real world problems. The fields of AI such as Game Playing, Natural Language Processing, and Connectionist Models are also important. Student should know some programming language for AI.

Course Outcome:

After Completion of the Course, Student will be able to:

No	Course Outcomes	RBT Level
1	Understand the search technique procedures applied to real world problems	R, U
2	Understand and use various types of logic and knowledge representation schemes.	R, A
3	Understand various Game Playing techniques and apply them in programs.	U, A
4	Gain knowledge in AI Applications and advances in Artificial Intelligence	U, A
5	Use Prolog Programming language using predicate logic	R, U, A

**Revised Bloom's Taxonomy(RBT)*

Teaching and Examination Scheme:

Teaching - Learning Scheme (in Hours per Semester)					Total Credits = TH/30	Assessment Pattern and Marks					Total Marks
						Theory		Tutorial / Practical			
L	T	P	PBL*	TH		ESE (E)	PA (M)	PA (I)	PBL (I)	ESE (V)	
45	0	30	15	90	03	70	30	20	30	50	200

* Problem Based Learning (PBL) aims to accommodate learning beyond syllabus as per clause 9.4 of NBA manual.

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Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	**Introduction**: The AI Problems, The Underlying Assumption, AI techniques, The Level of The Model, Criteria For Success	**2**	**5**
2.	**Problems, State Space Search & Heuristic Search Techniques**: Defining The Problems As A State Space Search, Production Systems, Production Characteristics, Production System Characteristics and Issues in the Design of Search Programs, Generate-And-Test, Hill Climbing, Best-First Search, Problem Reduction, Constraint Satisfaction, Means-Ends Analysis	6	15
3.	**Knowledge Representation**: Representations And Mappings, Approaches To Knowledge Representation, Representation Simple Facts In Logic, Representing Instance and Isa Relationships, Computable Functions and Predicates, Resolution, Procedural versus Declarative Knowledge, Logic Programming, Forward versus Backward Reasoning.	6	**15**
4.	**Symbolic Reasoning Under Uncertainty**: Introduction to Nonmonotonic Reasoning, Logics for Non-monotonic Reasoning	6	15
5.	**Probabilistic Reasoning**: Probability And Bays' Theorem, Certainty Factors and Rule Base Systems, Bayesian Networks, Dempster-Shafer Theory, Fuzzy Logic	3	10
6.	**Game Playing**: Overview, MinMax Search Procedure, Alpha-Beta Cut-offs, Refinements, Iterative deepening.	2	5
7.	**Planning:** The Blocks World, Components Of a Planning System, Goal Stack Planning, Nonlinear Planning Using Constraint Posting, Hierarchical Planning, Reactive Systems	3	5
8.	**Natural Language Processing**: Introduction, Syntactic Processing, Semantic Analysis, Discourse And Pragmatic Processing, Spell Checking	3	5
9.	**Connectionist Models**: Introduction: Hopfield Network, Learning In Neural Network, Application Of Neural Networks, Recurrent Networks, Distributed Representations, Connectionist AI And Symbolic AI.	4	5
10.	**Expert Systems**: Representing and Using Domain Knowledge, Expert System Shells, Explanation, Knowledge Acquisition.	2	5
11.	**Genetic Algorithms**: A Peek into the Biological World, Genetic Algorithms (GAs), Significance of the Genetic Operators, Termination Parameters.	4	5
12	**Introduction to Prolog**: Introduction, Converting English to Prolog Facts and Rules, Goals, Prolog Terminology, Variables, Control Structures, Arithmetic Operators, Matching in Prolog, Backtracking, Cuts, Recursion, Lists	4	10

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in%)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
25	**20**	**25**	**10**	**10**	**10**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

Books:

1. "Artificial Intelligence" -By Elaine Rich And Kevin Knight (2nd Edition) Tata Mcgraw-Hill
2. "Artificial Intelligence: A Modern Approach" -By Stuart Russel, Peter Norvig, PHI
3. "Introduction to Prolog Programming" -By Carl Townsend.
4. "PROLOG Programming For Artificial Intelligence" -By Ivan Bratko(Addison-Wesley)
5. "Programming with PROLOG" –By Klocksin and Mellish.

List of Open Source Software/learning website:

- https://nptel.ac.in/courses/106/105/106105077/
- http://www.journals.elsevier.com/artificial-intelligence

Suggested Course Practical List:(List can be change according to Latest Development)

1. Write a program to implement Tic-Tac-Toe game problem.
2. Write a program to implement BFS (for 8 puzzle problem or Water Jug problem or any AI search problem) .
3. Write a program to implement DFS (for 8 puzzle problem or Water Jug problem or any AI search problem)
4. Write a program to implement Single Player Game (Using any Heuristic Function)
5. Write a program to Implement A* Algorithm.
6. Write a program to implement mini-max algorithm for any game development.
7. Assume given a set of facts of the form father(name1,name2) (name1 is the father of name2).
8. Define a predicate brother(X,Y) which holds iff X and Y are brothers.

Define a predicate cousin(X,Y) which holds iff X and Y are cousins.
Define a predicate grandson(X,Y) which holds iff X is a grandson of Y.
Define a predicate descendent(X,Y) which holds iff X is a descendent of Y.
Consider the following genealogical tree:

```
father(a,b).
father(a,c).
father(b,d).
father(b,e).
father(c,f).
```

Say which answers, and in which order, are generated by your definitions for the following queries in Prolog:

```
?- brother(X,Y).
?- cousin(X,Y).
```

?- grandson(X,Y).
?- descendent(X,Y).

9. Write a program to solve Tower of Hanoi problem using Prolog.
10. Write a program to solve N-Queens problem using Prolog.
11. Write a program to solve 8 puzzle problem using Prolog.
12. Write a program to solve travelling salesman problem using Prolog.

- **List of suggested activities for Problem Based Learning:**

Sl. No.	Name of the activity	No. of hours	Evaluation Criteria
1	Assignment writing. Numerical based assignment is preferable.	5 assignments of 3h each. Total = 15h	Based on the assignment submitted.
2	Problem solving/Coding using C, C++, Python, SCILAB, MATLAB, MS-EXCEL or any other relevant software	5 small coding-based problems of 3h each. Total = 15h	Based on the coding solution submitted.
3	Technical Video based learning related to the subject	Duration of video = 5h Report preparation & Presentation = 10h Total = 15h	Report /presentation based on the video learning outcomes.
4	Discussion on research paper based on relevant subject	3 research paper = 15h	Summarize research paper and evaluation critical parameters
5	Poster/chart/power point preparation on technical topics	Duration = 10 h	Based on poster/chart preparation and presentation skills
6	Application/Software development	Duration = 15 h	Depending on the complexity of the Application/Software
7	Group Discussion on emerging/trending technical topics based on subject	Duration = 1 h each	Based on performance in group discussion, technical depth, knowledge etc.
8	Seminar / Presentation	Duration for study and preparation=5h Report writing=3h Presentation=2h Total=10h	Topic can be selected technical content beyond syllabus
9	Real world case studies-based learning	Duration of data collection/study = 5h Report preparation = 10h Total = 15h	Based on in-depth study, technical depth, data collected, fact finding, etc.
10	Working/non-working model on technical topics	Working = 12 h Non- working = 8 h	Based on inter department/external evaluation

11	Self-learning on-line course	Minimum duration of the course should be 15h.	Examination based assessment at the end of course. Based on the certificate produced.
12	Complex problem solving	Maximum 3 problem. Study of the problem and solution finding, Total = 15h	Based on the depth of the solution submitted.
13	Industry/Research laboratory visit	Visit = 5h, Report preparation = 5h Total = 10h	Based on report submitted. Report should contain observations and calculations based on industry/ lab data.
14	Videos on Industrial safety aspects based on subject	Duration of video = 5h Report preparation = 5h Total = 10h	Based on quiz/report submitted
15	Industrial exposure for 2-3 days to observe and provide tentative solutions on society/environment /health/any other issue	Duration = 15 h for industrial exposure Problem identification and tentative solution = 10 h Total = 20 h	Based on evaluation of critical problems and solutions

Note:

- All the suggested activity should be related to the subject.
- Min 3 activities must be carried out as per the availability of faculties and students.
- The number of hours is suggestive. Faculty can sub-divide the number of hours based on the activity. However, total number of hours is fixed.
- Rubrics for the evaluation can be prepared by the faculty.

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