JEPPIAAR ENGINEERING COLLEGE

DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

CS6659
ARTIFICIAL INTELLIGENCE

Question Bank

III YEAR A & B / BATCH : 2016 -20

Vision of Institution

To build Jeppiaar Engineering College as an Institution of Academic Excellence in Technical education and Management education and to become a World Class University.

Mission of Institution

M1	To excel in teaching and **learning, research and innovation** by promoting the principles of scientific analysis and creative thinking
M2	To participate in the production, **development and dissemination of knowledge** and interact with **national and international communities**
M3	To equip students with **values, ethics and life skills** needed to enrich their lives and enable them to meaningfully contribute to the **progress of society**
M4	To prepare students **for higher studies and lifelong learning**, enrich them with the **practical and entrepreneurial skills** necessary to excel as future professionals and contribute to **Nation's economy**

Program Outcomes (POs)

PO1	**Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO2	**Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO3	**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
PO4	**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.
PO5	**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.
PO6	**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.

PO7	**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.
PO8	**Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO9	**Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO10	**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.
PO11	**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.
PO12	**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.

Vision of Department

To emerge as a globally prominent department, developing ethical computer professionals, innovators and entrepreneurs with academic excellence through quality education and research.

Mission of Department

M1	To create **computer professionals** with an ability to identify and **formulate the engineering problems** and also to provide **innovative solutions** through **effective teaching learning process.**
M2	To **strengthen the core-competence** in computer science and engineering and to create an ability to **interact** effectively with industries.
M3	To produce engineers with good professional skills, **ethical values** and life skills for the **betterment of the society.**
M4	To encourage students towards **continuous and higher level learning** on technological advancements and provide a platform for **employment and self-employment.**

Program Educational Objectives (PEOs)

PEO1	**To address the real time complex engineering problems using innovative approach with strong core computing skills.**
PEO2	**To apply core-analytical knowledge and appropriate techniques and provide solutions to real time challenges of national and global society**
PEO3	**Apply ethical knowledge for professional excellence and leadership for the betterment of the society.**
PEO4	**Develop life-long learning skills needed for better employment and entrepreneurship**

Programme Specific Outcome (PSOs)

PSO1 – An ability to understand the core concepts of computer science and engineering and to enrich problem solving skills to analyze, design and implement software and hardware based systems of varying complexity.

PSO2 - To interpret real-time problems with analytical skills and to arrive at cost effective and optimal solution using advanced tools and techniques.

PSO3 - An understanding of social awareness and professional ethics with practical proficiency in the broad area of programming concepts by lifelong learning to inculcate employment and entrepreneurship skills.

BLOOM TAXANOMY LEVELS

BTL1: Remembering., BTL2: Evaluating., BTL3: Analyzing., BTL4: Applying., BTL5: Understanding., BTL6: Creating

SYLLABUS

UNIT I INTRODUCTION TO Al AND PRODUCTION SYSTEMS 9

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms, Measure of performance and analysis of search algorithms.

UNIT II REPRESENTATION OF KNOWLEDGE 9

Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

UNIT III KNOWLEDGE INFERENCE 9

Knowledge representation -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster - Shafer theory.

UNIT IV PLANNING AND MACHINE LEARNING 9

Basic plan generation systems - Strips -Advanced plan generation systems – K strips -Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

UNIT V EXPERT SYSTEMS 9

Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Kevin Night and Elaine Rich, Nair B., "Artificial Intelligence (SIE)", Mc Graw Hill- 2008. (Units-I,II,IV & V)
2. Dan W. Patterson, "Introduction to AI and ES", Pearson Education, 2007. (Unit-III).

REFERENCES:

1. Peter Jackson, "Introduction to Expert Systems", 3rd Edition, Pearson Education, 2007.
2. Stuart Russel and Peter Norvig "AI – A Modern Approach", 2nd Edition, Pearson Education 2007.
3. Deepak Khemani "Artificial Intelligence", Tata Mc Graw Hill Education 2013.
4. http://nptel.ac.in

Course Outcomes (COs)

C313.1	**Identify** problems that are amenable to solution by AI methods
C313.2	**Describe** the way of representation of knowledge
C313.3	**Formalise** a given problem in the language/framework of different AI methods.
C313.4	**Design** and summarize Different type of Activity Planning.
C313.5	**Outline** the concepts of Expert Systems and **illustrate** its applications

INDEX PAGE

UNIT	REFERENCE BOOK	PAGE NUMBER
I	Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill- 2008.	
II	Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill	
III	Dan W. Patterson, “Introduction to AI and ES”, Pearson Education, 2007	
IV	Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill	
V	Kevin Night and Elaine Rich, Nair B., “Artificial Intelligence (SIE)”, Mc Graw Hill	

UNIT I

INTRODUCTION TO Al AND PRODUCTION SYSTEMS

Introduction to AI-Problem formulation, Problem Definition -Production systems, Control strategies, Search strategies. Problem characteristics, Production system characteristics -Specialized production system- Problem solving methods - Problem graphs, Matching, Indexing and Heuristic functions -Hill Climbing-Depth first and Breath first, Constraints satisfaction - Related algorithms, Measure of performance and analysis of search algorithms.

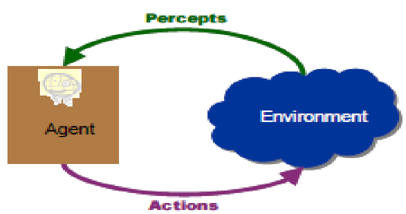
PART A

S. No.	Question	Course Outcome	Blooms Taxanomy Level
1	**What is Artificial Intelligence?** Artificial Intelligence is the study of how to make computers do things which at the moment people do better.	**C313.1**	BTL6
2	**What are the different types of agents?** A human agent has eyes, ears, and other organs for sensors and hands, legs, mouth, and other body parts for actuators. A robotic agent might have cameras and infrared range finders for sensors and various motors for actuators. A software agent receives keystrokes, file contents, and network packets as sensory inputs and acts on the environment by displaying on the screen, writing files, and sending network packets. Generic agent – A general structure of an agent who interacts with the environment.	**C313.1**	BTL6
3	**Define rational agent?** For each possible percept sequence, a rational agent should select an action that is expected to maximize its performance measure, given the evidence provided by the percept sequence and whatever built-in knowledge the agent has. A rational agent should be autonomous	**C313.1**	BTL6
4	**List down the characteristics of intelligent agent. [APRIL/MAY 2017]** **Internal characteristics are** – Learning/reasoning: an agent has the ability to learn from previous experience and to successively adapt its own behavior to the environment. – reactivity: an agent must be capable of reacting appropriately to influences or information from its environment. – autonomy: an agent must have both control over its actions and internal states. The degree of the agent's autonomy can be specified. There may need intervention from the user only for important decisions. – Goal-oriented: an agent has well-defined goals and gradually influence its environment and so achieve its own goals. **External characteristics are**	**C313.1**	BTL6

	– communication: an agent often requires an interaction with its environment to fulfill its tasks, such as human, other agents, and arbitrary information sources. – cooperation: cooperation of several agents permits faster and better solutions for complex tasks that exceed the capabilities of a single agent. – mobility: an agent may navigate within electronic communication networks. – Character: like human, an agent may demonstrate an external behavior with many human characters as possible.		
5	**What is PEAS?** PEAS (Performance, Environment, Actuators, Sensors)	**C313.1**	BTL6
6	**What are the tasks of Artificial Intelligence?** ➢ Mundane Task ➢ Formal Task ➢ Expert Task	**C313.1**	BTL6
7	**What things we should do to built a system?** • Define the problem precisely • Analyze the problem • Isolate and represent the task knowledge that is necessary to solve the problem • Choose the best problem solving technique	**C313.1**	BTL6
8	**What production system consists of?** • A set of rules, each consists of a left side that determines the applicability of the rule and a right side that describes the operation to be performed if the rule is applied. • One or more knowledge database that contains whatever information is appropriate for particular task. • A control strategy that specifies the order in which the rules will be compared to the database and a way of resolving the conflict that arises when several rules match at once.	**C313.1**	BTL6
9	**What are the advantages of Breadth First Search? [NOV/DEC 2017, APR/MAY 2018]** • BFS will not get trapped exploring a blind alley. This contrast to the DFS which may follow a single unfruitful path for a very long time, perhaps forever before the path actually terminates in a state that has no successors. • If there is a solution, then BFS is guaranteed to find it. Furthermore, if there are multiple solutions then a minimal solution will be found.	**C313.1**	BTL6
10	**What are the advantages of Depth First Search?** • DFS requires less memory since only the nodes on the current path are stored. In contrast to BFS where all the tree that has so fab been generated must be stored. • By chance, DFS may find a solution without examining much of the state space at all, where in BFS the entire tree must be examined to level n before any nodes on level n+1 can be examined.	**C313.1**	BTL6

11	**What is Heuristic Search?** A heuristic search is a technique that improves the efficiency of a search process, possibly by sacrificing claims of completeness.	**C313.1**	BTL6
12	**What is Heuristic Function?** A function that maps from problem state description to measures of desirability, usually represented as numbers.	**C313.1**	BTL6
13	**Write Generate and Test algorithm. <u>[MAY / JUNE 2016</u>]** • Generate a possible solution. For some problems this means generating a particular point in the problem space. For others, it means generating a path from a start state. • Test to see if this is actually a solution by comparing the chosen point or the end point of the chosen path to the set of acceptable goal states. • If a solution has been found, quit otherwise return step1	**C313.1**	BTL6
14	**What is the difference between Simple Hill Generate and Test algorithm Climbing <u>[MAY / JUNE 2016]</u>** The key difference between Simple Hill Climbing and Generate and Test algorithm is the use of an evaluation function as a way to inject task-specific knowledge into the control process.	**C313.1**	BTL6
15	**What is Local Maxima?** local maxima is a state that is better than all its neighbor but is not better than some other states father away. At local maxima all the moves appear to make things worse. Local maxima are particularly frustrating because they often occur almost within sight of a solution. In this case they are called foothills.	**C313.1**	BTL6
16	**What is a plateau?** It is a flat area of the search space in which a whole set of neighboring states have the same value. On a plateau it is not possible to determine the best direction in which to move by making local comparisons.	**C313.1**	BTL6
17	**What is a Ridge? <u>[MAY/ JUNE 2016</u>]** A ridge is a special kind of local maximum. It is an area of the search space that is higher than surrounding area and that itself has a slope.	**C313.1**	BTL6
18	**What is Simulated Annealing?** It is a variation of hill climbing in which, at the beginning of the process some downhill moves may be made. The idea is to do enough exploration of the whole space early on so that the final solution is relatively insensitive to the starting state. We use the term objective function in place of the term heuristic function.	**C313.1**	BTL6
19	**What do you mean by Graceful Decay of Admissibility?** If h' rarely overestimates h by more than (delta), then the A* algorithm will rarely find a solution whose cost is more than (delta) greater than the cost of the optimal solution.	**C313.1**	BTL6
20	**What do you mean by Constraint Satisfaction?** It is a search procedure that operates in the space of constraint sets. The initial state contains the constraints that are originally given in the problem description and the goal state is constrained "enough" where "enough" must be defined in the problem.	**C313.1**	BTL6

21	**What is meant by Means-Ends Analysis?** A collection of search strategies that can either reason a forward or backward, but for a given problem, one direction or the other must be chosen. However, a mixture of two directions is appropriate. Such a mixed strategy would make it possible to solve the major parts of the problem first and then go back and solve the small problems. This is known as means-ends analysis.	**C313.1**	BTL6
22	**Define Operator subgoaling**. The thing of backward chaining in which operators are selected and then the sub goals are set up to establish the preconditions of the operators is called operator subgoaling.	**C313.1**	BTL6
23	**Differentiate simple hill Climbing and Steepest Hill climbing.** A useful variation on simple hill climbing considers all the moves from the current state and selects the best one as the next state.	**C313.1**	BTL2
24	**Differentiate Simple hill climbing and Simulated annealing.** • Annealing schedule must be maintained. • Moves to worst case may be accepted. • It is a good Idea to maintain in addition to the current state the best state found so far.	**C313.1**	BTL2
25	**Differentiate uniformed and informed search? [APRIL/MAY 2017]** • Uninformed or blind search strategies uses only the information available in the problem definition • Informed or heuristic search strategies uses additional information	**C313.1**	BTL2
26	**What are the ways to formulate the problem? [APR/MAY 2018]** 1. A set of states S 2. An initial state si ∈ S 3. A set of actions A s Actions(s) = the set of actions that can be executed in s,∀— that are applicable in s. sr→Actions(s) Result(s, a) ∈ a∀ s∀ 4. Transition Model: —sr is called a successor of s —{si Successors(si∪})* = state space 5. Goal test Goal(s) — Can be implicit, e.g. checkmate(x) — s is a goal state if Goal(s) is true 6. Path cost (additive) —e.g. sum of distances, number of actions executed, … —c(x,a,y) is the step cost, assumed ≥ 0 – (where action a goes from state x to state y)	**C313.1**	BTL6
27	**What is frame problem? <u>[MAY/ JUNE 2016</u>]** The *frame problem* in AI is concerned with the question of what piece of knowledge is relevant to the situation.	**C313.1**	BTL6
28	**What is Poblem graph ? [APR/MAY 2018]** The AND-OR GRAPH (or tree) is useful for representing the solution of problems that can solved by decomposing them into a set of smaller problems, all of which must then be solved. This decomposition, or reduction, generates arcs that we call AND arcs.	**C313.1**	BTL6

	One AND arc may point to any number of successor nodes, all of which must be solved in order for the arc to point to a solution. Just as in an OR graph, several arcs may emerge from a single node, indicating a variety of ways in which the original problem might be solved. This is why the structure is called not simply an AND-graph but rather an AND-OR graph (which also happens to be an AND-OR tree)		
29	**How much knowledge would be required by a perfect program for the problem of playing chess? Assume the unlimited computing power is available. [MAY/ JUNE 2016]** The rules for determining legal moves and some simple control mechanism that implements an appropriate search procedure. Additional knowledge about such things as good strategy and tactics could of course help considerably to constrain the search and speed up the execution of the program.	**C313.1**	BTL6
30	**Give the structure of an agent in an environment.(MAY/JUNE 2014)** Agent interacts with environment through sensors and actuators. A general structure of an agent interacts with the environment.  	**C313.1**	BTL6
31	**List the criteria to measure the performance of search strategies. (MAY/JUNE 2014)** • Completeness • Time complexity • Space complexity • Optimality	**C313.1**	BTL6
32	**List some of the uninformed search techniques. [APRIL/MAY 2017]** Uninformed Search Techniques: –Depth-first Search –Breadth-first Search –Iterative Deepening	**C313.1**	BTL6

<table>
<tr><td>33</td><td>Differentiate forward and backward reasoning. (Forward and backward chaining) [NOV/DEC 2017]
<table>
<tr><th>Forward-chaining</th><th>Backward-chaining</th></tr>
<tr><td>Starts with the initial facts.</td><td>Starts with some hypothesis or goal.</td></tr>
<tr><td>Asks many questions.</td><td>Asks few questions.</td></tr>
<tr><td>Tests all the rules.</td><td>Tests some rules.</td></tr>
<tr><td>Slow, because it tests all the rules.</td><td>Fast, because it tests fewer rules.</td></tr>
<tr><td>Provides a huge amount of information from just a small amount of data.</td><td>Provides a small amount of information from just a small amount of data.</td></tr>
<tr><td>Attempts to infer everything possible from the available information.</td><td>Searches only that part of the knowledge base that is relevant to the current problem.</td></tr>
<tr><td>Primarily data-driven</td><td>Goal-driven</td></tr>
<tr><td>Uses input; searches rules for answer</td><td>Begins with a hypothesis; seeks information until the hypothesis is accepted or rejected.</td></tr>
<tr><td>Top-down reasoning</td><td>Bottom-up reasoning</td></tr>
<tr><td>Works forward to find conclusions from facts</td><td>Works backward to find facts that support the hypothesis</td></tr>
<tr><td>Tends to be breadth-first</td><td>Tends to be depth-first</td></tr>
<tr><td>Suitable for problems that start from data collection, e.g. planning, monitoring, control</td><td>Suitable for problems that start from a hypothesis, e.g. diagnosis</td></tr>
<tr><td>Non-focused because it infers all conclusions, may answer unrelated questions</td><td>Focused; questions all focused to prove the goal and search as only the part of KB that is related to the problem</td></tr>
<tr><td>Explanation not facilitated</td><td>Explanation facilitated</td></tr>
<tr><td>All data is available</td><td>Data must be acquired interactively (i.e. on demand)</td></tr>
<tr><td>A small number of initial states but a high number of conclusions</td><td>A small number of initial goals and a large number of rules match the facts</td></tr>
<tr><td>Forming a goal is difficult</td><td>Easy to form a goal</td></tr>
</table></td><td>C313.1</td><td>BTL2</td></tr>
<tr><td>34</td><td>What are the capabilities, computer should posses to pass Turing test?
Natural Language Processing• Knowledge representation• Automated reasoning• Machine Learning•</td><td>C313.1</td><td>BTL6</td></tr>
<tr><td>35</td><td>What is autonomy?
A rational agent should be autonomous. It should learn what it can do to compensate for partial (or) in correct prior knowledge.</td><td>C313.1</td><td>BTL6</td></tr>
<tr><td>36</td><td>What is important for task environment?
PEAS → P- Performance measure E - Environment A- Actuators S – Sensors</td><td>C313.1</td><td>BTL6</td></tr>
<tr><td>37</td><td>Define problem solving agent.
Problem solving agent is one kind of goal based agent, where the agent Should select one action from sequence of actions which lead to desirable states.</td><td>C313.1</td><td>BTL6</td></tr>
<tr><td>38</td><td>List the steps involved in simple problem solving technique.
i. Goal formulation ii. Problem formulation iii. Search iv. Solution v. Execution phase</td><td>C313.1</td><td>BTL6</td></tr>
<tr><td>39</td><td>What are the components of a problem?
There are four components. They are i. initial state ii. Successor function iii. Goal test iv. Path cost v. Operator vi. state space vii. path</td><td>C313.1</td><td>BTL6</td></tr>
<tr><td>40</td><td>Give example for real world end toy problems.
Real world problem examples: i. Airline travel problem. ii. Touring problem. iii. Traveling salesman problem. iv. VLSI</td><td>C313.1</td><td>BTL6</td></tr>
</table>

	Layout problem v. Robot navigation vi. Automatic Assembly vii. Internet searching Toy problem Examples: Vacuum world problem. 8 – Queen problem 8 – Puzzle problem		
41	**Define fringe.** The collection of nodes that have been generated but not yet expanded, this collection is called fringe or frontier	**C313.1**	BTL6
42	**Define Path Cost.** A function that assigns a numeric cost to each path, which is the sum of the cost of the each action along the path.	**C313.1**	BTL6
43	**Define Path.** A path in the state space is a sequence of state connected by sequence of actions.	**C313.1**	BTL6
44	**What is environment program?** It defines the relationship between agents and environments.	**C313.1**	BTL6
45	**List the properties of environments.** o Fully Observable Vs Partially Observable o Deterministic Vs Stochastic o Episodic Vs Sequential o Static Vs Dynamic o Discrete Vs Continuous o Single Agent Vs Multi agent a. Competitive Multi agent b.Co – operative Multi agent	**C313.1**	BTL6
46	**Define Omniscience.** An Omniscience agent knows the actual outcome of its actions and can act accordingly	**C313.1**	BTL6
47	**How agent should act?** Agent should act as a rational agent. Rational agent is one that does the right thing, (i.e.) right actions will cause the agent to be most successful in the environment.	**C313.1**	BTL6
48	**How to measure the performance of an agent?** Performance measure of an agent is got by analyzing two tasks. They are How and When actions.	**C313.1**	BTL6
49	**Define Percept Sequence**. An agent's choice of action at any given instant can depend on the entire percept sequence observed to elate.	**C313.1**	BTL6
50	**What are the factors that a rational agent should depend on at any given time?** 1. The performance measure that defines degree of success. 2. Ever thing that the agent has perceived so far. We will call this complete perceptual history the percept sequence. 3. When the agent knows about the environment. 4. The action that the agent can perform.	**C313.1**	BTL6

PART – B			
1	Explain briefly the various problem characteristics? **[APR/MAY 2018]** Refer Page 36 in Kevin Night	**C313.1**	BTL5
2	What are the problems encountered during hill climbing and what are the ways available to deal with these problems? **[MAY 2016]** Refer Page 52 in Kevin Night	**C313.1**	BTL6
3	Write A* algorithm and discuss briefly the various observations about algorithm [**NOV/ DEC 2018**] Refer Page 59 in Kevin Night	**C313.1**	BTL6
4	Write in detail about the constraint satisfaction procedure with map coloring example? [**NOV/ DEC 2018**] Refer Page 68 in Kevin Night	**C313.1**	BTL6
5	Explain how the steepest accent hill climbing works and Heuristic Functions? **[MAY 2016][NOV/DEC 2017]** Refer Page 53 in Kevin Night	**C313.1**	BTL5
6	Write in detail about Generate and Test and Simple Hill Climbing. **[MAY 2016] [NOV/DEC 2017]** Refer Page 52 in Kevin Night	**C313.1**	BTL6
7	Discuss the memory bounded heuristic search. [**NOV/ DEC 2018**] Refer Page 32 in Kevin Night	**C313.1**	BTL6
8	Solve the Water Jug problem: you are given 2 jugs, a 4-gallon one and 3-gallon one. Neither has any measuring maker on it. There is a pump that can be used to fill the jugs with water. How can you get exactly 2 gallons of water into 4-gallon jug? Explicit assumptions: A jug can be filled from the pump, water can be poured out of a jug onto the ground, water can be poured from one jug to another and that there are no other measuring devices available. **[MAY 2016]** Refer Page 27 in Kevin Night	**C313.1**	BTL3
9	Explain the various problem solving and problem reduction methods with algorithm and example? Refer Page 64 in Kevin Night	**C313.1**	BTL5
10	Discuss in detail the uninformed search strategies and compare the analysis of various searches. **[NOV/DEC 2018]** Refer Page 101 in Stuart Russell	**C313.1**	BTL6
11	Explain informed search strategies with an example **[APRIL/MAY 2017]** Refer Page 122 in Stuart Russell	**C313.1**	BTL5
12	Explain the process of simulated annealing with example. **[APRIL/MAY 2017] [NOV/DEC 2017]** Refer Page 55 in Kevin Night	**C313.1**	BTL5
13	Discuss constraint satisfaction problem with an algorithm for solving a Cryptarithmetic problem**. [NOV/DEC 2017, APR/MAY 2018]** Refer Page 68, 70 in Kevin Night	**C313.1**	BTL6
14	Discuss AO* algorithm in detail? [**NOV/ DEC 2018**]	**C313.1**	BTL6
15	Explain problem reduction methods with algorithm and example? Refer Page 64 in Kevin Night	**C313.1**	BTL5

UNIT II

REPRESENTATION OF KNOWLEDGE

Game playing - Knowledge representation, Knowledge representation using Predicate logic, Introduction to predicate calculus, Resolution, Use of predicate calculus, Knowledge representation using other logic-Structured representation of knowledge.

PART A

S. No.	Question	Course Outcome	Blooms Taxanomy Level
1	**What is game playing?** The term Game means a sort of conflict in which *n* individuals or groups (known as players) participate. Game theory denotes games of strategy. Game theory allows decision-makers (players) to cope with other decision-makers (players) who have different purposes in mind. In other words, players determine their own strategies in terms of the strategies and goals of their opponent.	**C313.2**	BTL6
2	**What is Mini –Max Strategy?** • generate the whole game tree , calculate the value of each terminal state • based on the utility function - calculate the utilities of the higher-level nodes • starting from the leaf nodes up to the root - MAX selects the value with the highest node - MAX assumes that MIN in its move will select the node that minimizes the value from MAX's perspective • MAX tries to move to a state with the maximum value, MIN to one with the minimum assumes that both players play optimally • selects the best successor from a given state , invokes MINIMAX-VALUE for each successor state	**C313.2**	BTL6
3	**Define pruning? [MAY/ JUNE 2016]** **Alpha–beta pruning** is a search algorithm that seeks to decrease the number of nodes that are evaluated by the minimax algorithm in its search tree. It is an adversarial search algorithm used commonly for machine playing of two-player games (Tic-tac-toe, Chess, Go, etc.). It stops completely evaluating a move when at least one possibility has been found that proves the move to be worse than a previously examined move.	**C313.2**	BTL6
4	**How Knowledge is represented? [MAY/ JUNE 2016]** A variety of ways of knowledge (facts) have been exploited in AI programs. Facts: truths in some relevant world. These are things we want to represent.	**C313.2**	BTL6
5	**What is propositional logic?** It is a way of representing knowledge. In logic and mathematics, a propositional calculus or logic is a formal system in which formulae representing *propositions* can be formed by Combining atomic propositions using *logical connectives*. Sentences considered in	**C313.2**	BTL6

	propositional logic are not arbitrary sentences but are the ones that are either true or false, but not both. This kind of sentences are called propositions. **Example** Some facts in propositional logic: It is raning. - RAINING It is sunny - SUNNY It is windy - WINDY If it is raining ,then it is not sunny - RAINING -> ¬ SUNNY		
6	**What are the elements of propositional logic?** Simple sentences which are true or false are basic propositions. Larger and more complex sentences are constructed from basic propositions by combining them with **connectives**. Thus **propositions** and **connectives** are the basic elements of propositional logic. Though there are many connectives, we are going to use the following **five basic connectives**here:NOT, AND, OR, IF_THEN(orIMPLY), IF_AND_ONLY_IF. They are also denoted by the symbols: $\neg$, $\wedge$, $\vee$, $\rightarrow$, $\leftrightarrow$, respectively.	**C313.2**	BTL6
7	**Define Generalized Modus ponens. [NOV/DEC 2018]** In *Boolean logic*, with the rule ``IF *X* is *A* THEN *Y* is *B*", the proposition *X* is *A* has to be observed to consider the proposition *Y* is *B*. In *fuzzy logic*, a proposition ``*X* is A' ", close to the premise ``*X* is *A*" can be observed to provide a conclusion ``*Y* is B' " close to the conclusion ``*Y* is *B* ". A simple fuzzy inference can be represented as: Rule : IF *X* is *A* THEN *Y* is *B* Fact : *X* is A' Conclusion : *Y* is B'	**C313.2**	BTL6
8	**Define Logic** Logic is one which consist of i. A formal system for describing states of affairs, consisting of a) Syntax b)Semantics. ii. Proof Theory – a set of rules for deducing the entailment of a set sentences.	**C313.2**	BTL6
9	**What is entailment?** Propositions tell about the notion of truth and it can be applied to logical reasoning. We can have logical entailment between sentences. This is known as entailment where a sentence follows logically from another sentence. In mathematical notation we write : $\alpha \models \beta$	**C313.2**	BTL6
10	**Define First order Logic?** First-order logic (like natural language) assumes the world contains Objects: people, houses, numbers, colors, baseball games, wars, … Relations: red, round, prime, brother of, bigger than, part of, comes between, … Functions: father of, best friend, one more than, plus, …	**C313.2**	BTL6

11	**Specify the syntax of First-order logic in BNF form** *Sentence* → *AtomicSentence* | (*Sentence Connective Sentence*) | *Quantifier Variable,. . . Sentence* | ¬ *Sentence* *AtomicSentence* → *Predicate*(*Term*, . . .) | *Term* = *Term* *Term* → *Function*(*Term*, . . .) | *Constant* | *Variable* *Connective* → ⇒ | ∧ | ∨ | ⇔ *Quantifier* → ∀ | ∃ *Constant* → *A* | X_1 | *John* | . . . *Variable* → *a* | *x* | *s* | . . . *Predicate* → *Before* | *HasColor* | *Raining* | . . . *Function* → *Mother* | *LeftLeg* | . . .	**C313.2**	BTL6
12	**What are quantifiers?** There is need to express properties of entire collections of objects,instead of enumerating the objects by name. Quantifiers let us do this. FOL contains two standard quantifiers called a) Universal (∀) and b) Existential (∃)	**C313.2**	BTL6
13	**Explain the connection between ∀ and ∃** "Everyone likes icecream" is equivalent", "there is no one who does not like ice cream" This can be expressed as : ∀x Likes(x,IceCream) is equivalent to ¬ ∃¬Likes(x,IceCream)	**C313.2**	BTL5
14	**What is universal instantiation?** ❖ Every instantiation of a universally quantified sentence is entailed by it: $\frac{\forall v\ \alpha}{\mathrm{Subst}(\{v/g\},\ \alpha)}$ for any variable *v* and ground term *g* ❖ E.g., ∀x *King*(*x*) ∧ *Greedy*(*x*) ⇒ *Evil*(*x*) yields:	**C313.2**	BTL6
15	**What are the levels in Structuring of knowledge?** (i) The knowledge level at which facts are described (ii)The symbol level at which representation of objects at knowledge level are defined in terms of symbols.	**C313.2**	BTL6
16	**What are the four properties for knowledge representation ?** . Representational adequacy . Inferential adequacy . Inferential efficiency . Acquisitional efficiency	**C313.2**	BTL6
17	**What is resolution ?** Resolution produces proof by refutation. It attempts to show that the	**C313.2**	BTL6

	negation of the statements produces contradiction with the known statements.		
18	**What is predicate calculus?** Predicate Calculus is a generalization of propositional calculus.Hence besides terms, predicates, and quantifiers, predicate calculus contains propositional variables, constants and connectives as part of the language.	**C313.2**	BTL6
19	**What is frame problem? [MAY/JUNE 2016]** The whole problem of representing the facts, the change as well as those that do not is known as frame problem	**C313.2**	BTL6
20	**What are semantic nets?** A semantic net are informations represented as a set of nodes connected to each other by a set of labeled arcs, which represent relationship among the nodes.	**C313.2**	BTL6
21	**Define Declarative and procedural knowledge. [NOV/DEC 2018]** Declarative knowledge involves knowing THAT something is the case - that J is the tenth letter of the alphabet, that Paris is the capital of France. Declarative knowledge is conscious; it can often be verbalized. Metalinguistic knowledge, or knowledge about a linguistic form, is declarative knowledge. Procedural knowledge involves knowing HOW to do something - ride a bike, for example. We may not be able to explain how we do it. Procedural knowledge involves implicit learning, which a learner may not be aware of, and may involve being able to use a particular form to understand or produce language without necessarily being able to explain it.	**C313.2**	BTL6
22	**What are frames?** A frame is a collection of attributes and associated values that describe some entity in the world.	**C313.2**	BTL6
23	**What is structured knowledge representation? [APR/MAY 2018, NOV/DEC 2018]** Structure knowledge representations were explored as a general representation for symbolic representation of declarative knowledge. One of the results was a theory for schema systems.	**C313.2**	BTL6
24	**Difference between Logic programming and PROLOG.** • In logic, variables are explicitly quantified. In PROLOG, quantification is provided implicitly by the way the variables are interpreted • In logic, there are explicit symbols for and, or. In PROLOG, there is an explicit symbol for and, but there is none for or • In logic, implications of the form “p implies q” are written as p. q . In PROLOG, the same implication is written “backward” as q:-p .	**C313.2**	BTL2
25	**What is property inheritance?** Property inheritance, in which, elements of specific classes inherit attributes and values from more general classes in which they are included.	**C313.2**	BTL6

<table>
<tr><td>26</td><td>Difference between predicate and propositional logic.
[APRIL/MARY 2017, APR/MAY 2018, NOV/DEC 2018]
<table>
<tr><th>PROPOSITIONAL LOGIC</th><th>PREDICATE / FIRST ORDER LOGIC</th></tr>
<tr><td>Symbols are logical constants True / False</td><td>Symbols are constants, predicates and function symbols</td></tr>
<tr><td>Sentences are formed from 5 logical connectives (and , or, implies, equivalent, not)</td><td>Sentences are formed from predicate symbol followed by parenthesized list of terms and logical connectives</td></tr>
</table></td><td>C313.2</td><td>BTL2</td></tr>
<tr><td>27</td><td>Define Interpretation
Interpretation specifies exactly which objects, relations and functions are referred to by the constant predicate, and function symbols.</td><td>C313.2</td><td>BTL6</td></tr>
<tr><td>28</td><td>What do you mean by local maxima with respect to search techniques?
A local maxima is a peak that is higher than each of its neighboring state but lower than the global maximum</td><td>C313.2</td><td>BTL6</td></tr>
<tr><td>29</td><td>Define an inference procedure
An inference procedure reports whether or not a sentence is entiled by knowledge base provided a knowledge base and a sentence. An inference procedure ‘i’ can be described by the sentences that it can derive. If i can derive from knowledge base, we can write. Alpha is derived from KB or i derives alpha from KB</td><td>C313.2</td><td>BTL6</td></tr>
<tr><td>30</td><td>For the given sentence “All Pompians were Romans” write a well formed formula in predicate logic. <u>[MAY / JUNE 2016]</u>
∀x Pompian(x) => Roman(x)</td><td>C313.2</td><td>BTL4</td></tr>
<tr><td>31</td><td>Define FOL.
FOL is a first order logic. It is a representational language of knowledge which is powerful than propositional logic (i.e.) Boolean Logic. It is an expressive, declarative, compositional language</td><td>C313.2</td><td>BTL6</td></tr>
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An inference procedure reports whether or not a sentence is entiled by knowledge base provided a knowledge base and a sentence .An inference procedure ‘i’ can be described by the sentences that it can derive. If i can derive from knowledge base, we can write. KB --Alpha is derived from KB or i derives alpha from KB.</td><td>C313.2</td><td>BTL6</td></tr>
<tr><td>33</td><td>What are the three levels in describing knowledge based agent? Logical level• Implementation level• Knowledge level or epistemological level•</td><td>C313.2</td><td>BTL6</td></tr>
<tr><td>34</td><td>Define Quantifier and it’s types.
Quantifiers are used to express properties of entire collection of objects rather than representing the objects by name. Types: i. Universal Quantifier ii. Existential Quantifier iii. Nested Quantifier.</td><td>C313.2</td><td>BTL6</td></tr>
<tr><td>35</td><td>Define kinship domain.
The domain of family relationship is called kinship domain which consists of objects unary predicate, binary predicate, function, relation.</td><td>C313.2</td><td>BTL6</td></tr>
</table>

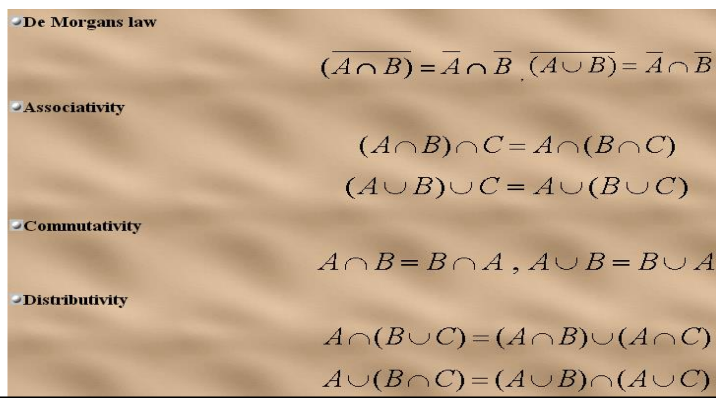
36	**Define Unification**. Lifted Inference rule require finding substitutions that make different logical expressions look identical (same). This is called Unification.	**C313.2**	BTL6
37	**Explain the function of Rete Algorithm?** This algorithm preprocess the set of rules in KB to constant a sort of data flow network in which each node is a literals from rule a premise.	**C313.2**	BTL6
38	**Define backward chaining.** This algorithm works backward from the goal, chaining through rules to find known facts that support the proof.	**C313.2**	BTL6
39	**Define Prolog program.** It is a set of definite clauses written in a notation somewhat different from standard FOL	**C313.2**	BTL6
40	**What is important for agent?** Time (i.e.) intervals is important for agent to take an action. There are 2 kinds; i. Moments ii. Extended Intervals	**C313.2**	BTL6
41	**What are the basic Components of propositional logic?** i. Logical Constants (True, False)	**C313.2**	BTL6
42	**What are the basic Components of propositional logic?** i. Logical Constants (True, False)	**C313.2**	BTL6
43	**Define AND –Elimination rule in propositional logic** AND elimination rule states that from a given conjunction it is possible to inference any of the conjuncts.	**C313.2**	BTL6
44	**Define a Proof** A sequence of application of inference rules is called a proof. Finding proof is exactly finding solution to search problems. If the successor function is defined to generate all possible applications of inference rules then the search algorithms can be applied to find proofs.	**C313.2**	BTL6
45	**What are the two we use to query and answer in knowledge base?** ASK and TELL.	**C313.2**	BTL6
46	**What are the 3 types of symbol which is used to indicate objects, relations and functions?** i) Constant symbols for objects ii) Predicate symbols for relations iii) Function symbols for functions	**C313.2**	BTL6
47	**Define Logic** Logic is one which consist of i. A formal system for describing states of affairs, consisting of a) Syntax b)Semantics. ii. Proof Theory – a set of rules for deducing the entailment of a set sentences.	**C313.2**	BTL6
48	**Define a knowledge Base:** Knowledge base is the central component of knowledge base agent and it is described as a set of representations of facts about the world.	**C313.2**	BTL6
49	**With an example, show objects, properties functions and relations. Example "EVIL KING JOHN BROTHER OF RICHARD RULED ENGLAND IN 1200"** Objects : John, Richard, England, 1200 Relation : Ruled Properties : Evil, King Functions : BROTHER OF	**C313.2**	BTL6
50	**Define a Sentence?** Each individual representation of facts is called a sentence. The sentences are expressed in a language called as knowledge representation language.	**C313.2**	BTL6

PART – B			
1	List the Issues in knowledge representation Refer Page 86 in Kevin Night	**C313.2**	BTL6
2	State Representation of facts in predicate logic with an example. Refer Page 99 in Kevin Night	**C313.2**	BTL6
3	How will you represent facts in propositional logic with an example? **[NOV/DEC 2018, APR/MAY 2018]** Refer Page 113 in Kevin Night	**C313.2**	BTL6
4	Explain Resolution in brief with an example. **[MAY/ JUNE 2016]** Refer Page 108 in Kevin Night	**C313.2**	BTL5
5	Write algorithm for propositional resolution and Unification algorithm. **[MAY/JUNE 2016]** Refer Page 113 in Kevin Night	**C313.2**	BTL6
6	Convert the following well formed formula into clause from with sequence of steps: **[MAY/JUNE 2016]** $\forall$x: [Roman(x) ^ Know (x, Marcus)] $\rightarrow$[hate(x, Caesar) v ($\forall$y: $\exists$z: hate(y,z) $\rightarrow$thinkcrazy(x,y))] Refer Page 100 in Kevin Night	**C313.2**	BTL4
7	Explain the Minimax algorithm in detail. **[APRIL/MAY 2017, APR/MAY 2018]** Refer Page 165 in Stuart Russell	**C313.2**	BTL5
8	Explain Alpha-Beta Pruning **[APRIL/MAY 2017]** Refer Page 167 in Stuart Russell	**C313.2**	BTL5
9	Consider the following sentences: [**NOV/DEC 2017**, **NOV/DEC 2018**] ▪ John likes all kinds of food * Applies are food * Chicken is food * Anything anyone eats and isn't killed by is food ▪ Bill eats peanuts and is still alive ▪ Sue eats everything Bill eats (i). Translate these sentences into formulas in predicate logic (ii). Convert the formulas of part a into clause form Refer Notes	**C313.2**	BTL4
10	Trace the operation of the unification algorithm on each of the following pairs of literals: ▪ f(Marcus) and f(Caesar) ii. f(x) and f(g(y)) ▪ f(Marcus,g(x,y)) and f(x,g(Caesar,Marcus)) Refer Page 100 in Kevin Night	**C313.2**	BTL4
11	Explain Alpha-Beta algorithm **[APRIL/MAY 2017]** Refer Page 167 in Stuart Russell	**C313.2**	BTL5
12	Write algorithm for Unification algorithm. **[MAY/JUNE 2016]** Refer Page 113 in Kevin Night	**C313.2**	BTL6
13	State Representation of facts in propositional logic with an example. Refer Page 99 in Kevin Night	**C313.2**	BTL6
14	Perform Resolution for "India Wins the match" example. **[MAY/ JUNE 2016]** Refer Page 108 in Kevin Night	**C313.2**	BTL5
15	Consider a two player game in which the minimax search procedure is used to compute the best moves for the first player. Assume a static evaluation function that returns values ranging from -10 to 10, with 10 indicating a win for the first player and -10 a win for the second player. Assume the following game tree in which the static scores are from the first player's point of view. Suppose the first player is the maximizing player and needs to take the next move. What move should be chosen at this point? Can the search be optimized? **[APR/ MAY 2018]**	**C313.2**	BTL5

UNIT III			
KNOWLEDGE INFERENCE			
Knowledge representation -Production based system, Frame based system. Inference - Backward chaining, Forward chaining, Rule value approach, Fuzzy reasoning - Certainty factors, Bayesian Theory-Bayesian Network-Dempster - Shafer theory.			
PART A			
S. No.	**Question**	**Course Outcome**	**Blooms Taxanomy Level**
1	**What is a Production System?** Knowledge representation formalism consists of collections of condition-action rules (Production Rules or Operators), a database which is modified in accordance with the rules, and a Production System Interpreter which controls the operation of the rules i.eThe 'control mechanism' of a Production System, determining the order in which Production Rules are fired.A system that uses this form of knowledge representation is called a productionsystem.A production system consists of rules and factors.	**C313.3**	BTL6
2	**List out the advantages of production systems** • Production systems provide an excellent tool for structuring AI programs. • Production Systems are highly modular because the individual rules can be added, removed or modified independently. • The production rules are expressed in a natural form, so the statements contained in the knowledge base should the recording of an expert thinking out loud.	**C313.3**	BTL6
3	**What is Frame based System? [MAY/JUNE 2016]** A frame is an artificial intelligence data structure used to divide knowledge into substructures by representing "stereotyped situations." Frames are the primary data structure used in artificial intelligence Frame languages. Frames are also an extensive part of knowledge representation and reasoning schemes. Frames were originally derived from semantic networks and are therefore part of structure based knowledge representations.	**C313.3**	BTL6
4	**What type of information frame contains?** Facts or Data , Values (called facets) Procedures (also called procedural attachments) a. IF-NEEDED : deferred evaluation b. IF-ADDED : updates linked information Default Values c. For Data d. For Procedures Other Frames or Sub frames	**C313.3**	BTL6
5	**What is forward chaining? [APRIL/MAY 2017, APR/MAY 2018]** Using a deduction to reach a conclusion from a set of antecedents is called forward chaining. In other words, the system starts from a set of facts,and a	**C313.3**	BTL6

	set of rules,and tries to find the way of using these rules and facts to deduce a conclusion or come up with a suitable course of action. This is known as data driven reasoning.		
6	**What is backward chaining? ? [APRIL/MAY 2017, APR/MAY 2018]** In **backward chaining**,we start from a **conclusion**,which is the hypothesis we wish to prove,and we aim to show how that conclusion can be reached from the rules and facts in the data base.The conclusion we are aiming to prove is called a goal and the reasoning in this way is known as **goal-driven**.	**C313. 3**	BTL6
7	**Define Prior probability?** p(a) for the Unconditional or Prior Probability Is That the Proposition A is True. It is important to remember that p(a) can only be used when there is no other information	**C313. 3**	BTL6
8	**Give the Baye's rule equation? [APRIL/MAY 2017, APR /MAY 2018]** W.K.T P(A^B) = P(A/B) P(B) -------------------------- 1 P(A^B) = P(B/A) P(A) -------------------------- 2 DIVIDINGBYP(A);WEGET P(B/A) = P(A/B) P(B) -------------------- P(A)	**C313. 3**	BTL6
9	**What is the basic task of a probabilistic inference?** The basic task is to reason in terms of prior probabilities of conjunctions, but for the most part, we will use conditional probabilities as a vehicle for probabilistic inference.	**C313. 3**	BTL6
10	**Define certainty factor?** A certainty factor (*cf*), a number to measure the expert's belief. The maximum value of the certainty factor is, say, +1.0 (definitely true) and the minimum –1.0 (definitely false).For example, if the expert states that some evidence is almost certainly true, a *cf* value of 0.8 would be assigned to this evidence.	**C313. 3**	BTL6
11	**What is fuzzy logic?** • The term fuzzy logic is used in two senses: – Narrow sense: Fuzzy logic is a branch of fuzzy set theory, which deals (as logical systems do) with the representation and inference from knowledge. Fuzzy logic, unlike other logical systems, deals with imprecise or uncertain knowledge. In this narrow and perhaps correct sense, fuzzy logic is just one of the branches of fuzzy set theory. – Broad Sense: fuzzy logic synonymously with fuzzy set theory	**C313. 3**	BTL6
12	**Write the semantics of Bayesian network?** Semantics of Bayesian Networks 1. Representing the full joint distribution 2. Conditional independence relations in Bayesian networks	**C313. 3**	BTL6
13	**Define Dempster-Shafter Theory?** It considers sets of propositions and assigns to each of them an interval *[Belief, Plausibility*] in which the degree of belief must lie. Belief *(Bel*) measures the strength of the evidence in favor of set of propositions. It ranges from 0 (indicating no evidence) to 1 (denoting certainty)	**C313. 3**	BTL6
14	**What is meant by belief network?** A belief network is a graph in which the following holds A set¬ of random variables	**C313. 3**	BTL6

	A set of directive links or arrows connects pairs of¬ nodes. The conditional probability table for each node¬ The graph has¬ no directed cycles.		
15	**What is a Bayesian network? [MAY/JUNE 2016]** Bayesian network is an approach in which we preserves the formulations & rely instead on the modulating of the world we are trying to model.	**C313. 3**	BTL6
16	**What is goal directed node?** In goal directed node the search is done in the backward direction from the goal state to an achievable initial node	**C313. 3**	BTL6
17	**Why does uncertainty arise?** Agents almost never¬ have access to the whole truth about their environment. Agents cannot find¬ a categorical answer. Uncertainty can also arise because of incompleteness,¬ incorrectness in agents understanding of properties of environment.	**C313. 3**	BTL3
18	**What is the need for utility theory in uncertainty?** Utility theory says that every state has a degree of usefulness, or utility to in agent, and that the agent will prefer states with higher utility. The use utility theory to represent and reason with preferences.	**C313. 3**	BTL6
19	**Define conditional probability?** Once the agents has obtained some evidence concerning the previously unknown propositions making up the domain conditional or posterior probabilities with the notation p(A/B) is used. This is important that p(A/B) can only be used when all be is known.	**C313. 3**	BTL6
20	**What are the ways in which one can understand the semantics of a belief network?** There are two ways to see the network as a representation of the joint probability distribution to view it as an encoding of collection of conditional independence statements.	**C313. 3**	BTL6
21	**What is called as multiple connected graphs?** A multiple connected graph is one in which two nodes are connected by more than one path.	**C313. 3**	BTL6
22	**Define evidential support.** E-X is the evidential support for X- the evidence variables "below" X that are connected to X through its children.	**C313. 3**	BTL6
23	**What are called as Poly trees?** The algorithm that works only on singly connected networks known as Poly trees. Here at most one undirected path between any two nodes is present.	**C313. 3**	BTL6
24	**What is the basic task of a probabilistic inference?** The basic task is to reason in terms of prior probabilities of conjunctions, but for the most part, we will use conditional probabilities as a vehicle for probabilistic inference.	**C313. 3**	**BTL6**
25	**What Is Called As Decision Theory?** Preferences As Expressed by Utilities Are Combined with Probabilities in the General Theory ofRational Decisions Called Decision Theory.	**C313. 3**	BTL6

	Decision Theory = Probability Theory + Utility Theory.		
26	**What is called as principle of maximum expected utility?** The basic idea is that an agent is rational if and only if it chooses the action that yields the highest expected utility, averaged over all the possible outcomes of the action. This is known as MEU.	**C313. 3**	BTL6
27	**Define Transition Probability?** **Transition probability** - process moves from one state to another, as defined by the conditional distribution given the Markov blanket of the variable being sampled. Let ***q (x ->x')*** be the probability that process makes a transition from state ***x*** state ***x'.***	**C313. 3**	BTL6
28	**What is Likelihood Weighting?** Likelihood weighting avoids the inefficiency of rejection sampling by generating only events that are consistent with the evidence e.Each event is weighted by the likelihood that the event accords to the evidence, as measured by the product of the conditional probabilities for each evidence variable, given its parents. Query P (Rain /Sprinkler = true, Wet Grass = true).First, the weight w is set to 1.0.	**C313. 3**	BTL6
29	**What is clustering algorithm?** The basic idea of clustering is to join individual nodes of the network to form cluster nodes in such a way that the resulting network is a **poly tree.** Using **clustering algorithms** (also known as join tree algorithms), the time can be reduced to **O (n).**	**C313. 3**	BTL6
30	**Write the properties of fuzzy sets. [MAY/JUNE 2016]** 	**C313. 3**	K6
31	**What is Commutative production systems? [NOV/DEC 2017, APR/MAY 2018]** A commutative production system is a production system that is both monotonic and partially commutative. Partially commutative, monotonic production systems are useful for solving ignorable problems. Monotonic Production System: A commutative production system: A commutative production system is a production system that is both monotonic and partially commutative. Partially Commutative Production system: A partially commutative production system is a production system with the property that if the application of a particular sequence of rules transforms state x into state y then any permutation of those rules that is allowable (i.e. each rules preconditions are satisfied when it is applied) also transforms state x into state y.	**C313. 3**	BTL6
32	**Define Fuzzy reasoning. [NOV/DEC 2017].**	**C313.**	BTL6

	Human Reasoning means the action of thinking about something in a logical/sensible way. Fuzzy Logic (FL) is a method of reasoning that resembles human reasoning. The approach of FL imitates the way of decision making in humans that involves all intermediate possibilities between digital values YES and NO.	**3**	
33	**Compare production based system with frame based system. [NOV/DEC 2017]** <table><tr><th>Production based system</th><th>Frame based system</th></tr><tr><td>A production system (or production rule system) is a computer program typically used to provide some form of artificial intelligence, which consists primarily of a set of rules about behavior.</td><td>Frame-based systems are knowledge representation systems that use frames, means to represent domain knowledge. A frame is a structure for representing a CONCEPT or situation such as "living room" or "being in a living room."</td></tr></table>	**C313. 3**	BTL2
34	**Why does uncertainty arise ?** Agents almost never have access to the whole truth about their environment. Agents cannot find a caterorial answer. Uncertainty can also arise because of incompleteness, incorrectness in agents understanding of properties of environmen	**C313. 3**	BTL6
35	**Define the term utility?** The term utility is used in the sense of "the quality of being useful .", utility of a state is relative to the agents, whose preferences the utility function is supposed to represent.	**C313. 3**	BTL6
36	**What is the need for probability theory in uncertainty ?** Probability provides the way of summarizing the uncertainty that comes from our laziness and ignorance . Probability statements do not have quite the same kind of semantics known as evide	**C313. 3**	BTL6
37	**What is the need for utility theory in uncertainty?** Utility theory says that every state has a degree of usefulness, or utility to in agent, and that the agent will prefer states with higher utility. The use utility theory to represent and reason with prefere	**C313. 3**	BTL6
38	**Define conditional probability?** Once the agents has obtained some evidence concerning the previously unknown propositions making up the domain conditional or posterior probabilities with the notation p(A/B) is used. This is important that p(A/B) can only be used when all be is known.	**C313. 3**	BTL6
39	**What is an atomic event?** An atomic event is an assignment of particular values to all variables, in other words, the complete specifications of the state of domain.	**C313. 3**	BTL6
40	**What is the basic task of a probabilistic inference?** The basic task is to reason in terms of prior probabilities of conjunctions, but for the most part, we will use conditional probabilities as a vehicle for probabilistic inference	**C313. 3**	BTL6
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	conditional probability table for each node The graph has no directed cycles.		
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43	**What are the ways in which one can understand the semantics of a belief network?** There are two ways to see the network as a representation of the joint probability distribution to view it as an encoding of collection of conditional independence statemen	**C313.3**	BTL6
44	**Define joint probability distribution** This completely specifies an agent's probability assignments to all propositions in the domain.The joint probability distribution p(x1,x2,--------xn) assigns probabilities to all possible atomic events;where X1,X2------Xn 10 =variables.	**C313.3**	BTL6
45	**State the reason why first order, logic fails to cope with that the mind like medical diagnosis**. Three reasons a.laziness: o it is hard to lift complete set of antecedents of consequence, needed to ensure and exceptionless rule. b. Theoritical Ignorance: o medical science has no complete theory for the domain. Practical ignorance: even if we know all the rules, we may be uncertain about a particular item	**C313.3**	BTL6
46	**Define Prior Probability?** p(a) for the Unconditional or Prior Probability Is That the Proposition A is True. It is important to remember that p(a) can only be used when there is no other inform	**C313.3**	BTL6
47	**What are called as Poly trees?** The algorithm that works only on singly connected networks known as Poly trees. Here at most one undirected path between any two nodes is present.	**C313.3**	BTL6
48	**Define casual support** E+X is the casual support for X- the evidence variables "above" X that are connected to X through its parent	**C313.3**	BTL6
49	**Define evidential support** E-X is the evidential support for X- the evidence variables "below" X that are connected to X through its children	**C313.3**	BTL6
50	**Define probability distribution** Eg. P(weather) = (0.7,0.2,0.08,0.02). This type of notations simplifies many equations.	**C313.3**	BTL6
	PART – B		
1	Explain the production based knowledge representation techniques? **[NOV/DEC 2017]** Refer Page 30 in Kevin Night	**C313.3**	BTL5
2	Explain the frame based knowledge representation? [**APR/MAY 2018]** Refer Page 193 in Kevin Night	**C313.3**	BTL5
3	Write short notes on Backward Chaining and explain with example. **[MAY/ JUNE 2016 , APRIL/MAY 2017, NOV/DEC 2018]** Refer Page 137 in Kevin Night	**C313.3**	BTL6
4	Discuss briefly about Bayesian probability Refer 179 in Kevin Night	**C313.3**	BTL6

5	Write short notes on Rule value approach Refer 174 in Kevin Night	**C313. 3**	BTL6
6	Briefly discuss about reasoning done using fuzzy logic. **[MAY/JUNE 2016]** Refer Page 184 in Kevin Night	**C313. 3**	BTL6
7	Discuss the Dempster-Shafer Theory **[MAY/ JUNE 2016], [APRIL/MAY 2017, NOV/DEC 2017, APR/MAY 2018]** Refer Page 181 in Kevin Night	**C313. 3**	BTL6
8	Discuss about Bayesian Theory and Bayesian Network **[NOV/DEC 2017, APR/MAY 2018, NOV/DEC 2018]** Refer Page 179 in Kevin Night	**C313. 3**	BTL6
9	Write short notes on Forward chaining and explain with example. [MAY/ JUNE 2016 , APRIL/MAY 2017, NOV/DEC 2018] Refer Page 137 in Kevin Night	**C313. 3**	BTL6
10	Discuss briefly about Bayesian Networks Refer 179 in Kevin Night	**C313. 3**	BTL6
11	Write short notes on Certainty factor Refer Page 174 in Kevin Night	**C313. 3**	BTL6
12	Suppose the police is informed that one of the four terrorist organizations A,B, C or D has planted a bomb in a building. Draw the lattice of subsets of the universe of discourse, U. Assume that one evidence supports that groups A and C were responsible to a degree of m1({A,C})=0.6 and another evidnce supports the belief that groups A,B and D were involved to a degree m2({A,B,D})=0.7. Compute and create the tableau of combined values of belief for m1 and m2. **[APR/MAY 2018]**	**C313. 3**	BTL6
13	Construct a Bayesian Network and define the necessary CPTs for the given scenario. We have a bag of three biased coins a,b and c with probabilities of coming up heads of 20%, 60% and 80% respectively. One coin is drawn randomly from the bag (with equal likelihood of drawing each of the three coins) and then the coinis flipped three times to generate the outcomes X1, X2 and X3. **[NOV/DEC 2018]**	**C313. 3**	BTL6
14	Explain fuzzy logic. **[MAY/JUNE 2016]** Refer 184 in Kevin Night	**C313. 3**	BTL6
15	Explain the frames [**APR/MAY 2018]** Refer Page 193 in Kevin Night	**C313. 3**	BTL5

UNIT IV

PLANNING AND MACHINE LEARNING

Basic plan generation systems - Strips -Advanced plan generation systems – K strips -Strategic explanations -Why, Why not and how explanations. Learning- Machine learning, adaptive Learning.

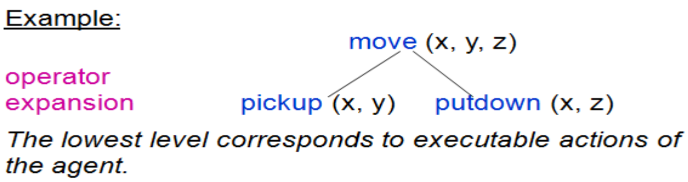
PART A

S. No.	Question	Course Outcome	Blooms Taxanomy Level
1	**What is learning?** Learning covers a wide range of phenomena.At one end of the spectrum is skill refinement.People get better at many tasks simply by practicing.At the other end of the spectrum lies knowledge acquisition.Knowledge is generally acquired through experience.	**C313.4**	BTL6
2	**What are types of learning?** • ROTE learning • Learning by taking advice • Learning in problem solving • Learning from examples • Explanation based learning	**C313.4**	BTL6
3	**What is ROTE learning? [MAY/ JUNE 2016, NOV/DEC 2018]** When computation is more expensive than recall,this strategy can save a significant amount of time.Caching has been used in Artificial Intelligence programs to produce some surprising performance improovement.Such caching is known as ROTE learning.	**C313.4**	BTL6
4	**Define Machine learning. [APR/MAY 2018]** Machine Learning, a branch of artificial intelligence, is about the construction and study of systems that can learn from data.The core of machine learning deals with representation and generalization. Representation of data instances and functions evaluated on these instances are part of all machine learning systems. Generalization is the property that the system will perform well on unseen data instances; the conditions under which this can be guaranteed are a key object of study in the subfield of computational learning theory	**C313.4**	BTL6
5	**What is Adaptive learning? [NOV/DEC 2017]** Adaptive learning has been partially driven by a realization that tailored learning cannot be achieved on a large-scale using traditional, non-adaptive approaches. Adaptive learning systems endeavor to transform the learner from passive receptor of information to collaborator in the educational process. Adaptive learning systems' primary application is in education, but another popular application is business training. They have been designed as both desktop computer applications and web applications	**C313.4**	BTL6
6	**What is planning?** Planning refers to the process of computing several steps of a problem solving procedure before executing any of them.	**C313.4**	BTL6
7	**What are K-Strips?** K-Strips is a modification of strips that uses a goal regression mechanism of circumventing goal interaction problems. A typical use of this mechanism prevents K-STRIPS from applying an F-rule,F1,that would interfere with an achieved precondition.	**C313.4**	BTL6
8	**What are Strips? [NOV/DEC 2018]** Strips or Stanford Reseach Institute Problem Solver is an automated planner.An strips instance consists of 1. An initial state;	**C313.4**	BTL6

	2. The specification of the goal states – situations which the planner is trying to reach; 3. A set of actions. For each action, the following are included: •preconditions (what must be established before the action is performed); •postconditions (what is established after the action is performed).		
9	**What is non linear planning?** It is not composed of a linear sequence of complete subplans. These are interwined plans which most problems require in which multiple sub problems are worked on simultaneously.	**C313.4**	BTL6
10	**What are the components of a planning system?** Components of a planning system are as follows: 1. Choose the best rule to apply next based on the best available heuristic information. 2. Apply the chosen rule to compute the new problem state that arises from its application. 3. Detect when a solution has been found. 4. Detect dead ends so that they can be abandoned and the system's effort directed in more fruitful directions. 5. Detect when an almost correct solution has been found and employ special techniques to make it totally correct.	**C313.4**	BTL6
11	**What do you mean by default reasoning?** Default reasoning refers to drawing conclusions based on what is most likely to be true	**C313.4**	BTL6
12	**What are singular extensions?** Singular extensions are a successful form of secondary search. If a leaf node is judged to be far superior to its siblings and if the value of the entire search depends critically on the correctness of that nodes value, then the node is expanded one extra ply. These are singular extensions.	**C313.4**	BTL6
13	**What do you mean by mapping problem?** If a set of input-output pairs is given corresponding to an arbitrary function transforming to a point in the M-dimensional input pattern space to a point in the N-dimensional output pattern space, then the problem of capturing the implied functional relationship is called mapping problem.	**C313.4**	BTL6
14	**What are the Fundamental concepts of machine learning?** 1. Induction, 2. Generalisation	**C313.4**	BTL6
15	**List out successful applications of machine learning?** ♣ Adaptable software system ♣ Bioinformatics ♣ Natural language processing ♣ Speech recognition ♣Pattern recognition ♣ Intelligent control ♣ Trend prediction	**C313.4**	BTL6
16	**What is the Need for Learning?** The general learning approach is to generate potential improvements, test them, and only use those that work well. Naturally, there are many ways we might generate the potential improvements, and many ways we can test their usefulness. At one extreme, there are model driven (top-down) generators of potential improvements, guided by an understanding of how	**C313.4**	BTL6

	the problem domain works. At the other, there are data driven (bottom-up) generators, guided by patterns in some set of training data.		
17	**What is the idea of Concept Learning and Classification?** The idea of concept learning and classification is that given a training set of positive and negative instances of some concept (which belongs to some pre-enumerated set of concepts), the task is to generate rules that classify the training set correctly, and that also 'recognize' unseen instances of that concept, i.e. generalize well. To do this we work with a set of patterns that describe the concepts, i.e. patterns which state those properties which are common to all individual instances of each concept.	**C313.4**	BTL6
18	**List the three Core Elements of Adaptive Learning Systems ?** **A content model -** This refers to the way the specific topic, or content domain, is structured, with thoroughly detailed learning outcomes and a definition of tasks that need to be learned. **A learner model -**In order to adapt, many adaptive systems make statistical inferences about the student's knowledge based on their performance; they must "model" the learner. **An instructional model -** The instructional model determines how a system selects specific content for a specific student at a specific time	**C313.4**	BTL6
19	**What is Supervised learning ? [NOV/DEC 2018]** The computer is presented with example inputs and their desired outputs, given by a "teacher", and the goal is to learn a general rule that maps inputs to outputs.	**C313.4**	BTL6
20	**What is Unsupervised learning? [NOV/DEC 2018]** No labels are given to the learning algorithm, leaving it on its own to find structure in its input. Unsupervised learning can be a goal in itself (discovering hidden patterns in data) or a means towards an end (feature learning).	**C313.4**	BTL6
21	**What is Reinforcement learning?** A computer program interacts with a dynamic environment in which it must perform a certain goal (such as driving a vehicle), without a teacher explicitly telling it whether it has come close to its goal. Another example is learning to play a game by playing against an opponent.	**C313.4**	BTL6
22	**What are Support vector machines?** Support vector machines (SVMs) are a set of related supervised learning methods used for classification and regression. Given a set of training examples, each marked as belonging to one of two categories, an SVM training algorithm builds a model that predicts whether a new example falls into one category or the other.	**C313.4**	BTL6
23	**What is Clobbering?** A clobberer is a potentially intervening step that destroys the condition achieved by a causal link.Example Go(Home) clobbers At(Supermarket)	**C313.4**	BTL6
24	**What is Resilience in Planning** After performing a wrong operation, if the system again goes towards the goal, then it has resilience with respect to that operation.	**C313.4**	BTL6
25	**Differentiate Search & planning.**	**C313.4**	BTL2

<table>
<tr><td></td><td>Planning systems do the following:
1) open up action and goal representation to allow selection
2) divide-and-conquer by subgoaling
3) relax requirement for sequential construction of solutions
<table><tr><th></th><th>Search</th><th>Planning</th></tr><tr><td>States</td><td>Lisp data structures</td><td>Logical sentences</td></tr><tr><td>Actions</td><td>Lisp code</td><td>Preconditions/outcomes</td></tr><tr><td>Goal</td><td>Lisp code</td><td>Logical sentence (conjunction)</td></tr><tr><td>Plan</td><td>Sequence from S_0</td><td>Constraints on actions</td></tr></table></td><td></td><td></td></tr>
<tr><td>26</td><td>What are the types of planner?
Situation space planner: search through possible situations
Progression planner: start with initial state, apply operators until goal is reached Regression planner: start from goal state and apply operators until start state reached.</td><td>C313.4</td><td>BTL6</td></tr>
<tr><td>27</td><td>What are the differences and similarities between problem solving and planning? <u>[MAY 2011, NOV/DEC 2012, APRIL/MAY 2017]</u>
Problem solving and planning involves finding sequences of action that lead to desirable states. But planning is also capable of working back from an explicit goal description to minimize irrelevant actions, possess autonomy and can take advantage of problem decomposition</td><td>C313.4</td><td>BTL6</td></tr>
<tr><td>28</td><td>What is contingency planning? <u>[MAY 2012][</u> <u>MAY/JUNE 2014]</u>
It is otherwise called as conditional planning. It deals with incomplete information by constructing a conditional plan that accounts for each possible situation or contingency that could arise.
Conditional planning: Also known as contingency planning, conditional planning deals with incomplete information by constructing a conditional plan that accounts for each possible situation or contingency that could arise. The agent finds out which part of the plan to execute by including sensing actions in the plan to test for the appropriate conditions. For example, the shopping agent might want to include a sensing action in its shopping plan to check the price of some object in case it is too expensive.</td><td>C313.4</td><td>BTL6</td></tr>
<tr><td>29</td><td>What are the functions of planning systems? [<u>MAY 2011</u>]
Planning systems are problem-solving algorithms that operate on explicit propositional (or first-order) representations of states and actions. These representations make possible the derivation of effective heuristics and the development of powerful and flexible algorithms for solving problems.</td><td>C313.4</td><td>BTL6</td></tr>
<tr><td>30</td><td>What is the need of POP algorithms? [<u>MAY 2011, NOV/DEC 2011 , NOV/DEC 2012</u>]
Partial-order planning (POP) algorithms explore the space of plans without committing to a totally ordered sequence of actions. They work back from the goal, adding actions to the plan to achieve each subgoal. They are particularly effective on problems amenable to a divide-and-conquer approach.</td><td>C313.4</td><td>BTL6</td></tr>
<tr><td>31</td><td>List out the various planning techniques. [<u>MAY/JUNE 2014</u> , APRIL/MAY 2017]</td><td>C313.4</td><td>BTL6</td></tr>
</table>

	The different types of planning are as follows: i. Situation space planning. ii. Progressive planning. iii. Regressive planning. iv. Partial order planning. v. Fully instantiated planning		
32	**What is hierarchical planning? [NOV/DEC 2017]** ▪ planning starts with complex action on top ▪ plan constructed through action decomposition ▪ substitute complex action with plan of less complex actions (pre-defined plan schemata; or learning of plans/plan abstraction) ▪ overall plan must generate effect of complex action 	**C313.4**	BTL6
33	**What is the purpose of learning?** The idea behind learning is that percepts should be used not only for acting but also for improving the agent's ability to act in the future.	**C313.4**	BTL6
34	**What are issues in learning element?** i. Component ii. Feedback iii. Representation	**C313.4**	BTL6
35	**What are the types of machine learning?** i. Supervised Learning ii. Unsupervised Learning iii. Reinforcement Learning	**C313.4**	BTL6
36	**Define Reinforcement Learning.** This Learning is rather than being told what to do by teacher, a reinforcement learning agent must learn from occasional rewards. Example If taxi driver does not get a tip at the end of journey, it gives him a indication that his behaviour is undesirable.	**C313.4**	BTL6
37	**Define Inductive Learning.** An algorithm for supervised learning is given as input the correct value of the unknown function for particular inputs and it must try to recover the unknown function.	**C313.4**	BTL6
38	**Define Classification Learning.** Learning a discrete valued function is called is called classification learning.	**C313.4**	BTL6
39	**What is parity and majority function?** Parity Function : It Returns 1 if and only if an even number of inputs are 1. Majority function : It Returns 1 if more than half of its inputs are 1.	**C313.4**	BTL6
40	**What is training set?** The complete set of examples is called the training set. Example Restaurant problem Goal predicate "will wait"	**C313.4**	BTL6
41	**Define Information gain.** Information gain from the attribute test is the difference between the original information requirement and the new requirement. Gain (A) = I(p/(p+n)), n/ (p+n)) – Remainder(A)	**C313.4**	BTL6

42	**What is over fitting?** Whenever there is a large set of possible hypotheses, one has to be careful not to use the resulting freedom to find meaningless "regularity" in the data. This problem is called over fitting.	**C313.4**	BTL6
43	**What is the purpose of cross validation?** It reduces over fitting. It can be applied to any learning algorithm, not just decision tree learning. The basic idea is to estimate how well each hypotheses will predict unseen data.	**C313.4**	BTL6
44	**Mention the exercises which broaden the applications of decision trees**. i. Missing data ii. Multivalued attributes iii. Continuous and integer valued input attributes iv. Continuous valued output attributes.	**C313.4**	BTL6
45	**Define knowledge based Inductive learning.** KBIL algorithm finds inductive hypotheses that explain sets of observations with the help of background knowledge.	**C313.4**	BTL6
46	**Define Bayesian Learning.** It calculates the probability of each hypotheses, given the data and makes predictions on that basis, (i.e.) predictions are made by using all the hypotheses, weighted by their probabilities rather than by using just single "best" hypotheses.	**C313.4**	BTL6
47	**What is Maximum – Likelihood hypotheses?** ML – it is reasonable approach when there is no reason to prefer one hypotheses over another a prior	**C313.4**	BTL6
48	**Define Passive learning.** The agent's policy is fixed and the task is to learn the utilities of states, this could also involve learning a model of the environment.	**C313.4**	BTL6
49	**Define Active Learning**. The agent must learn what to do. An agent must experience as much as possible of its environment in order to learn how to behave in it.	**C313.4**	BTL6
50	**What are the two functions in Neural network's Activation functions?** i. Threshold function i. Sigmoid function	**C313.4**	BTL6
	PART – B		
1	Explain the Strategic Explanation in detail. Refer notes	**C313.4**	BTL5
2	Explain the basic plan generation in detail? Refer Page 403 in Stuart Russelll	**C313.4**	BTL5
3	List out the planning terminologies and components of planning **[MAY / JUNE 2016]** Refer Page 410 in Stuart Russelll	**C313.4**	BTL6
4	Explain in detail about Machine learning? [**APRIL/MAY 2017, NOV/DEC 2017, APR/MAY 2018, NOV/DEC 2018**] Refer Page 31 in Stuart Russelll	**C313.4**	BTL5
5	Explain about Adaptive learning with example? [**MAY/ JUNE 2016**] Refer Page 718 in Stuart Russelll	**C313.4**	BTL5
6	What is ID3? Write the drawback of ID3. [**MAY/ JUNE 2016**] Refer Page 106 in Stuart Russelll	**C313.4**	BTL6
7	Describe the Learning with macro-operators [**MAY/ JUNE 2016**] Refer Page 706 in Stuart Russelll	**C313.4**	BTL6

8	Explain in detail the STRIPS. [**APRIL/MAY 2017**, **APR/MAY 2018, NOV/DEC 2018**] Refer Notes	**C313.4**	BTL5
9	Write short notes on the **[NOV/DEC 2017]** Learning by Parameter Adjustment	**C313.4**	BTL6
10	Write down STRIPs-style operators that corresponds to the following blocks world description. **[NOV/DEC 2017]** A — ON(A,B,S0) ^ B — ONTABLE(B,S0) ^ CLEAR(A,S0) Refer Notes	**C313.4**	BTL6
11	Write short notes on Nonlinear Planning using Constraint Posting. **[NOV/DEC 2017]** Refer Page 430 in Stuart Russelll	**C313.4**	BTL1
12	Write short notes on the **[NOV/DEC 2017]** Learning with Macro-Operaors , Learning by Chunking	**C313.4**	BTL6
13	Consider the problem of changing a flat tire. The goal is to have a good spare tire properly mounted onto the car's axle, where the initial state has a flat tire on the axle and a good spare tire in the trunk. To keep it simple, our version of the problem is an abstract one, with no sticky lug nuts or other complications. There are just four actions: removing the spare from the trunk, removing the flat tire from the axle, putting the spare on the axle and leaving the car unattended overnight. Write the STRIPS and find out the solution.	**C313.4**	BTL6
14	Explain about Hierarchical planning method with example? [**MAY/ JUNE 2016**] Refer Page 718 in Stuart Russelll	**C313.4**	BTL5
15	Explain in detail about STRIPS and write the components of STRIPS for the given scenario: "Consider a flight journey in a luxurious flight fom India to US" **[NOV/DEC 2018]**	**C313.4**	BTL6

UNIT V

EXPERT SYSTEMS

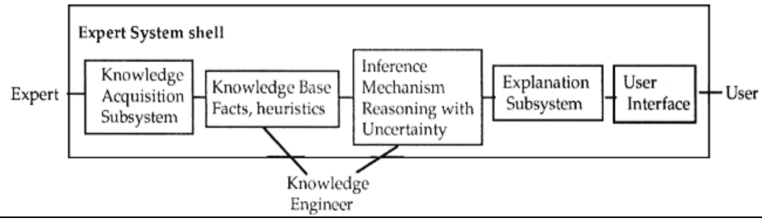
Expert systems - Architecture of expert systems, Roles of expert systems - Knowledge Acquisition –Meta knowledge, Heuristics. Typical expert systems - MYCIN, DART, XOON, Expert systems shells.

PART A

S. No.	Question	Course Outcome	Blooms Taxanomy

			Level
1	**What is Expert system?** Expert systems are computer programs that are derived from a branch of computer science research called AI. The programs that achieve expert level competence in solving problems in task areas by bringing to bear a body of knowledge about specific tasks are called expert systems or knowledge base.	**C313.5**	BTL6
2	**What are the most important aspects of expert systems?** The knowledge base The reasoning or inference engine	**C313.5**	BTL6
3	**What are the characteristics of expert systems? [NOV/DEC 2017]** 1. Expert systems use the knowledge rather than data to control the solution process. 2. The knowledge is encoded and maintained as an entity separate from the control program. 3. They explain how a particular conclusion was reached. 4. They use symbolic representations for knowledge and perform their inference through symbolic computation. 5. They often reason with Meta knowledge.	**C313.5**	BTL6
4	**Explain the role of domain expert?** The role of the domain expert is to discover and cumulate the knowledge of the task domain. The domain knowledge consists of both formal, textbook knowledge and experimental knowledge.	**C313.5**	BTL5
5	**What is the use of expert systems building tools?** The use of expert system building tools is to build an expert system using a piece of development software known as a tool or shell.	**C313.5**	BTL6
6	**Define the knowledge acquisition process.** Knowledge acquisition is the programs that interact with the domain experts to extract expert knowledge efficiently.These programs provides support for the following activities – Entering knowledge. – Maintain knowledge base consistency. – Ensuring knowledge base completeness.	**C313.5**	BTL6
7	**Name the programming languages used for expert systems application**. PROLOG, LISP	**C313.5**	BTL6
8	**What are the stages in the development of expert system tools?** Knowledge base. Inference process. Explaining how and why. Building a knowledge base. The I/O interface.	**C313.5**	BTL6
9	**What is metaknowledge? [MAY / JUNE 2016 , APRIL/MAY 2017, NOV/DEC 2018]** The term *meta-knowledge* is possible to interpret as knowledge about knowledge. These search control knowledge can be represented declaratively using rules.	**C313.5**	BTL6
10	**Define Heuristic.** In human computer-interaction, heuristic evaluation is a usability testing	**C313.5**	BTL6

	technique devised by expert usability consultants. In heuristic evaluation, the user interface is reviewed by experts and its compliance to usability heuristics (broadly stated characteristics of a good user interface, based on prior experience) is assessed, and any violating aspects are recorded.		
11	**What are the players in expert system?** Players in expert system are: Expert, Knowledge Engineer, User	**C313.5**	BTL6
12	**What are the advantages of Expert system? [MAY / JUNE 2016]** – **Availability:** Expert systems are available easily due to mass production software. – **Cheaper:** The cost of providing expertise is not expensive. – **Reduced danger:** They can be used in any risky environments where humans cannot work with. – **Permanence:** The knowledge will last long indefinitely. – **Multiple expertises:** It can be designed to have knowledge of many experts.	**C313.5**	BTL6
13	**List out the limitations of expert system?** • Not widely used or tested • Limited to relatively narrow problems • Cannot readily deal with “mixed” knowledge • Possibility of error • Cannot refine own knowledge base • Difficult to maintain • May have high development costs • Raise legal and ethical concerns	**C313.5**	BTL6
14	**What are applications of Expert Systems? [MAY/JUNE 2016]** – Credit granting – Information management and retrieval – AI and expert systems embedded in products – Plant layout – Hospitals and medical facilities – Help desks and assistance – Employee performance evaluation – Loan analysis	**C313.5**	BTL6
15	**What is expert system shell? [APR/MAY 2018]** The Expert System Shell is essentially a special purpose toolthat is built in line with the requirements and standards ofparticular domain or expert-knowledge area applications. Itmay be defined as a software package that facilitates thebuilding of knowledge-based expert systems by providing aknowledge representation scheme and an inference engineThe Shell refers to the software module containing aninterface, an inference engine, and a structured skeleton of aknowledge base (in its empty state) with the appropriateknowledge representation facilities.	**C313.5**	BTL6
16	**Sketch the Components of an Expert System Shell. [MAY/JUNE 2016]**	**C313.5**	BTL6

			
17	**What is XCON? [MAY/JUNE 2016]** The **R1** (internally called **XCON**, for e**X**pert**CON**figurer) program is a production-rule-based system written in OPS5 by John P. McDermott of CMU in 1978 to assist in the ordering of DEC's VAX computer systems by automatically selecting the computer system components based on the customer's requirements. The development of XCON followed two previous unsuccessful efforts to write an expert system for this task, in FORTRAN and BASIC.	**C313.5**	BTL6
18	**Define DART? [MAY/JUNE 2016]** The **Dynamic Analysis and Replanning Tool**, commonly abbreviated to **DART**, is an artificial intelligence program used by the U.S. military to optimize and schedule the transportation of supplies or personnel and solve other logistical problems. DART uses intelligent agents to aid decision support systems located at the U.S. Transportation and European Commands	**C313.5**	BTL6
19	**What is MYCIN? [MAY/JUNE 2016]** **MYCIN** was an early expert system that used artificial intelligence to identify bacteria causing severe infections, such as bacteremia and meningitis, and to recommend antibiotics, with the dosage adjusted for patient's body weight — the name derived from the antibiotics themselves, as many antibiotics have the suffix "-mycin". The Mycin system was also used for the diagnosis of blood clotting diseases.	**C313.5**	BTL6
20	**Mention the benefits of Meta knowledge?** Reuse and knowledge sharing Reliability	**C313.5**	BTL6
21	**Mention the guidelines to be considered while planning for knowledge Acquisition** a. Domain selection b. Selection of knowledge engineer c. Selection of expert d. The initial meeting e. Organization of follow-on meetings f. Conducting follow on meetings	**C313.5**	BTL6
22	**List out the issues in knowledge Acquisition. [APR/MAY 2018]** ▪ knowledge is in the head of experts ▪ Experts have vast amounts of knowledge ▪ Experts have a lot of tacit knowledge ▪ Experts are very busy and valuable people ▪ One expert does not know everything ▪ Knowledge has a "shelf life	**C313.5**	BTL6
23	**What is the role of inference engine?** 1. Combines the facts of a specific case with the knowledge contained in the knowledge base to come up with a recommendation.	**C313.5**	BTL6

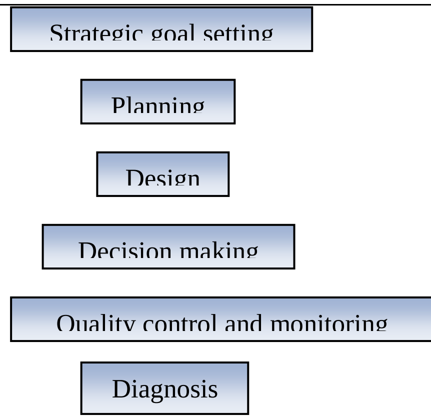
	In a rule-based expert system, the inference engine controls the order in which production rules are applied and resolves conflicts if more than one rule is applicable at a given time 2. Directs the user interface to query the user for any information it needs for further inferencing.		
24	**What is rule based knowledge representation.** The rule based system uses knowledge encoded in the form of production rules, that is if then rules. The rules have an antecedent or condition part, the left hand side, and a conclusion or action part, the right hand side. Each rule represents a small chunk of knowledge relating to the domain of expertise.	**C313.5**	BTL6
25	**Differentiate Human Expert and Expert system?**	**C313.5**	BTL2

Human Experts	*Expert Systems*	*Conventional Programs*
Use knowledge in the form of rules of thumb or heuristics to solve problems in a narrow domain.	Process knowledge expressed in the form of rules and use symbolic reasoning to solve problems in a *narrow domain*.	Process data and use algorithms, a series of well-defined operations, to solve general numerical problems.
In a human brain, knowledge exists in a compiled form.	Provide a *clear separation of knowledge from its processing.*	Do not separate knowledge from the control structure to process this knowledge.
Capable of explaining a line of reasoning and providing the details.	*Trace the rules fired* during a problem-solving session and *explain how* a particular conclusion was reached and *why* specific data was needed.	Do not explain how a particular result was obtained and why input data was needed.

26	**Define Knowledge base** It is a set of sentences that represents some assertions about the world.	**C313.5**	BTL6
27	**List out the classes of Expert system / List out the problem areas addressed by Expert systems [APRIL/MAY 2017]**	**C313.5**	BTL6

Category	**Problem Addressed**
Interpretation	Inferring situation descriptions from sensor data
Prediction	Inferring likely consequences of given situations
Diagnosis	Inferring system malfunctions from observables
Design	Configuring objects under constraints
Planning	Designing actions
Monitoring	Comparing observations to plan vulnerabilities
Debugging	Providing incremental solutions for complex problems
Repair	Executing a plan to administer a prescribed remedy
Instruction	Diagnosing, assessing, and repairing student behavior
Control	Interpreting, predicting, repairing, and monitoring system behaviors

28	**What are the capabilities of Expert system?**	**C313.5**	BTL6

			
29	**Name some early expert systems? <u>[MAY / JUNE 2016]</u>** • DENDRAL – used in chemical mass spectroscopy to identify chemical constituents • MYCIN – medical diagnosis of illness • DIPMETER – geological data analysis for oil • PROSPECTOR – geological data analysis for minerals • XCON/R1 – configuring computer systems	**C313.5**	BTL6
30	**What is forward chaining in rule based system?** **Forward chaining** - is a data-driven strategy. The inferencing process moves from the facts of the case to a goal (conclusion). The strategy is thus driven by the facts available in the working memory and by the premises that can be satisfied	**C313.5**	BTL6
31	**What are the advantages of the MYCIN. [APRIL/MAY 2017]** - It reduces the time taken to solve the problem • It includes the knowledge of many experts , its more accurate than a single expert • It improves customer/patient services and the standing of the expert • Can predict future problems and solve current ones • It saves the company money due to faster service time	**C313.5**	BTL6
32	**What is MOLE? [NOV/DEC 2017]** MOLE works for systems which classify cases as instances of fixed categories, such as a fixed number of possible diagnoses. It builds an inference network similar to belief networks.	**C313.5**	BTL6
33	**List out the problem areas addressed by Expert systems [APRIL/MAY 2017]** **Category** — **Problem Addressed** Interpretation — Inferring situation descriptions from sensor data Prediction — Inferring likely consequences of given situations Diagnosis — Inferring system malfunctions from observables Design — Configuring objects under constraints Planning — Designing actions Monitoring — Comparing observations to plan vulnerabilities Debugging — Providing incremental solutions for complex problems	**C313.5**	BTL6

	Repair — Executing a plan to administer a prescribed remedy Instruction — Diagnosing, assessing, and repairing student behavior Control — Interpreting, predicting, repairing, and monitoring system behaviors		
34	**Define Facts** A definite clause with no negative literals simply asserts a given preposition	**C313.5**	BTL6
35	**Define Rules** knowledge representation formalises and organises the knowledge. One widely used representation is called rule.	**C313.5**	BTL6
36	**Define Interpreter** An interpreter is used to interpret the program line by line.	**C313.5**	BTL6
37	**Define Scheduler** The actual determination of which KS should be activated next is done by a special KS, called the scheduler.	**C313.5**	BTL6
38	**Define Inference engine** The inference engine enables the expert system to draw deductions from the rule in knowledge base.	**C313.5**	BTL6
39	**What is backward chaining in rule based system?** **Backward chaining-** the inference engine attempts to match the assumed (hypothesized) conclusion - the goal or subgoal state - with the conclusion (THEN) part of the rule. If such a rule is found, its premise becomes the new subgoal.	**C313.5**	BTL6
40	**How meta knowledge is represented in rule-based expert systems? [MAY / JUNE 2016 , APRIL/MAY 2017, NOV/DEC 2018]** The term *meta-knowledge* is possible to interpret as knowledge about knowledge. These search control knowledge can be represented declaratively using rules.	**C313.5**	BTL6
41	**What are the roles of expert system? [NOV/DEC 2017]** Expert systems use the knowledge rather than data to control the solution process. The knowledge is encoded and maintained as an entity separate from the control program. They explain how a particular conclusion was reached. They use symbolic representations for knowledge and perform their inference through symbolic computation. They often reason with Meta knowledge.	**C313.5**	BTL6
42	**What are the properties of Expert system? [MAY / JUNE 2016]** – **Availability:** Expert systems are available easily due to mass production software. – **Cheaper:** The cost of providing expertise is not expensive. – **Reduced danger:** They can be used in any risky environments where humans cannot work with. – **Permanence:** The knowledge will last long indefinitely. – **Multiple expertises:** It can be designed to have knowledge of many experts. – **Explanation:** They are capable of explaining in detail the reasoning that led to a conclusion. – **Fast response:** They can respond at great speed due to the	**C313.5**	BTL6

	inherent advantages of computers over humans. – **Unemotional and response at all times:** Unlike humans, they do not get tense, fatigue or panic and work steadily during emergency situations.		
43	**What are the disadvantages of the MYCIN. [APRIL/MAY 2017]** Expert systems cost alot to set up - The user (mechanics /patients/doctors) will need training in how to use it, which takes time and money – It will need continuous updating... which can take it temporarily out of use – In a company or doctors practice, there will need to be one in every garage/branch/ surgery	**C313.5**	BTL6
44	**What are the roles in expert system?** Expert Knowledge Engineer User	**C313.5**	BTL6
45	**Compare forward chaining and backward chaining in rule based system?** **Forward chaining** - is a data-driven strategy. The inferencing process moves from the facts of the case to a goal (conclusion). The strategy is thus driven by the facts available in the working memory and by the premises that can be satisfied. **Backward chaining-** the inference engine attempts to match the assumed (hypothesized) conclusion - the goal or subgoal state - with the conclusion (THEN) part of the rule. If such a rule is found, its premise becomes the new subgoal.	**C313.5**	BTL6
46	**Mention the guidelines to be considered while planning for knowledge Acquisition** a. Domain selection b. Selection of knowledge engineer c. Selection of expert d. The initial meeting e. Organization of follow-on meetings f. Conducting follow on meetings	**C313.5**	BTL6
47	**Give the classification of learning process**. The learning process can be classified as: Process which is based on coupling new information to previously acquired knowledge a. Learning by analyzing differences. b. Learning by managing models. c. Learning by correcting mistakes. d. Learning by explaining experience. Process which is based on digging useful regularity out of data, usually called as Data base mining: a. Learning by recording cases. b. Learning by building identification trees	**C313.5**	BTL6
48	**What are the different types of induction heuristics?** There are two different types of induction heuristics. They are: i. Require-link heuristics. ii. Forbid-link heuristics.	**C313.5**	BTL6
49	**Define a solution**. A solution is defined as a plan that an agent can execute and that guarantees the achievement of goal.	**C313.5**	BTL6

50	**Define conditional planning.** Conditional planning is a way in which the incompleteness of information is incorporated in terms of adding a conditional step, which involves if – then rules.	**C313.5**	BTL6
PART – B			
1	With neat sketch explain the architecture, characteristic features and roles of expert system. **[MAY / JUNE 2016 , APR/MAY 2018]** Refer Page 422 in Kevin Knight	**C313.5**	BTL5
2	Discuss about the Knowledge Acquisition process in expert systems **[MAY / JUNE 2016]** Refer Page 427 in Kevin Knight	**C313.5**	BTL6
3	Write notes on Meta Knowledge and Heuristics in Knowledge Acquisition Refer Page 427 in Kevin Knight	**C313.5**	BTL6
4	Explain in detail about the expert system shell.[**NOV/DEC 2018]** Refer Page 424 in Kevin Knight	**C313.5**	BTL5
5	Write notes on expert systems MYCIN, DART and XCON and how it works? Explain. **[NOV/DEC 2017, APR/MAY 2018]** Refer Page 422 in Kevin Knight	**C313.5**	BTL5
6	Explain the basic components and applications of expert system. **[MAY / JUNE 2016]** Refer Page 424 in Kevin Knight	**C313.5**	BTL5
7	Define Expert system. Explain the architecture of an expert system in detail with a neat diagram and an example**. [APRIL/MAY 2017]** Refer Page 422 in Kevin Knight	**C313.5**	BTL6
8	Write the applications of expert systems**. [MAY / JUNE 2016]** Refer Page 425 in Kevin Knight	**C313.5**	BTL6
9	Explain the need, significance and evolution of XCON expert system. **[APRIL/MAY 2017]** Refer Page 425 in Kevin Knight	**C313.5**	BTL5
10	Explain the expert system architectures**: [NOV/DEC 2017]** 1. Rule-based system architecture 2. Associative or semantic Network Architecture 3. Network architecture 4 Blackboard system Architectures Refer Page 422 in Kevin Knight	**C313.5**	BTL5
11	Design an expert system for Travel recommendation and discuss its roles. : **[NOV/DEC 2017]** Refer Page 422 in Kevin Knight	**C313.5**	BTL6
12	Explain the architecture of an expert system in detail with a neat diagram and an example**. [APRIL/MAY 2017]** Refer Page 422 in Kevin Knight	**C313.5**	BTL6
13	Explain the XCON expert system. **[APRIL/MAY 2017]** Refer Page 425 in Kevin Knight	**C313.5**	BTL5
14	Explain the applications of expert system. **[MAY / JUNE 2016]** Refer Page 424 in Kevin Knight	**C313.5**	BTL5
15	Explain the architecture of expert system. **[MAY / JUNE 2016 , APR/MAY 2018]**	**C313.5**	BTL5

	Refer Page 422 in Kevin Knight		