K. K. Wagh Institute of Engineering Education and Research, Nashik
(An Autonomous Institute from A. Y. 2022-23)

Model Answer
End-Sem Examination- Winter 2025

Academic Year: 2025-2026	Semester: II
Name of Programme: MCA	Pattern: 2022
Name of Course: Elec-I: Artificial Intelligence	Course Code: MCA222003A
Max. Marks: 60	Duration: 2:30Hr.

Q. No.	Details	Max. Marks
1	What is an Agent Environment? Discuss the different types of environments (e.g., fully observable vs. partially observable, deterministic vs. stochastic). Provide examples from real-life AI systems. (6Marks)	[6]

Answer:

Agent Environment:
An Agent Environment is everything outside the agent that the agent interacts with. The agent receives percepts from the environment and performs actions to achieve goals.

Types of Environments

Type	Description	Example
Fully Observable	Agent has complete environment information	Chess game, Vacuum robot with full sensor coverage
Partially Observable	Limited or noisy percepts	Self-driving car in fog, Medical diagnosis
Deterministic	Next state fully determined by action	Solving a puzzle, Route planning with static map
Stochastic	Outcomes are uncertain & probabilistic	Stock trading AI, Robot in slippery surface
Static	Environment does not change when agent thinks	Crossword puzzle
Dynamic	Environment changes during decision-making	Real-time traffic navigation
Discrete	Finite possible states/actions	Tic-tac-toe
Continuous	Infinite possibilities	Robot arm movement

Conclusion:
Agent design depends on environment type to ensure intelligent behavior.

2	Apply Breadth-First Search (BFS) to the following graph to find the shortest path from S to G. Show OPEN/CLOSED list updates and final output. S → A, B A → C, D B → D, E C → G D → G E → G (6Marks) Answer: BFS Execution	[6]

Step	OPEN List	CLOSED List
1	S	—
2	A, B	S
3	B, C, D	S, A
4	C, D, E	S, A, B
5	D, E, G	S, A, B, C
6	E, G, G	S, A, B, C, D
7	G (Goal found)	—

Shortest Path Found:

S → A → C → G
(or) S → B → E → G
Both have length = 3 edges.

Final Answer: S → A → C → G

Q.3	a) Apply knowledge-based agent architecture to design an intelligent medical diagnosis system. Explain how percepts, knowledge base, and inference contribute to decision-making. (8 marks) Answer: A knowledge-based agent uses a structured knowledge base (KB) and inference to make intelligent decisions. A medical diagnosis system analyzes patient symptoms and suggests possible diseases. Components Applied	[16]

1Percepts

- Inputs: symptoms, patient history, test results
- Example: Fever, cold, body pain

2Knowledge Base

- Stores medical facts and rules in IF-THEN form
  Example rules:

IF Fever AND Cough THEN Possibly Flu

IF Fever AND Rash THEN Possibly Dengue

Inference Engine

- Performs logical reasoning
- Uses forward/backward chaining to apply rules
- Suggests disease + medication

4 Agent Program

- Maps percepts → actions (diagnosis + advice)

Working Example

Patient Percepts: Fever + Cough + Headache

Rule Matching:

IF Fever AND Cough → Flu

IF Flu AND Headache → Prescribe Paracetamol + Rest

Final Output: Diagnosis: Flu (Confidence: High)

Recommendation: Medication + Hydration

Benefits

✔ Reduces workload on doctors
✔ Quick and consistent diagnosis
✔ Useful in telemedicine

OR

b) Apply First-Order Logic to represent the following statements and derive one conclusion using inference rules:

- "All teachers are educated."
- "Some teachers are researchers."
- "All researchers publish papers."
  Show logical reasoning to conclude a valid statement.

(8 marks).

Answer:

Statement	FOL Representation
All teachers are educated.	∀x (Teacher(x) → Educated(x))
Some teachers are researchers.	∃x (Teacher(x) ∧ Researcher(x))
All researchers publish papers.	∀x (Researcher(x) → Publishes(x))

Inference

Let:
∃x (Teacher(x) ∧ Researcher(x)) → choose constant t

So,
Teacher(t) ∧ Researcher(t)

From rule 1:
Teacher(t) → Educated(t)
✔ Therefore: Educated(t)

From rule 3:
Researcher(t) → Publishes(t)
✔ Therefore: Publishes(t)

Conclusion

There exists at least one teacher who publishes papers.

c) Given a constraint satisfaction problem of Exam Scheduling (subjects vs. students), formulate variables, domains, and constraints. Solve with constraint propagation.
(8 marks)

Answer:

Goal: No two subjects with common students should have same timeslot.

Formulation

Variables: Subjects: {S1, S2, S3, S4}
Domain: {T1, T2, T3} (3 time slots)
Constraints (shared students):

- S1 conflicts with S2, S3 → S1 ≠ S2, S3
- S2 conflicts with S3 → S2 ≠ S3
- S3 conflicts with S4 → S3 ≠ S4

Constraint Graph

S1 ─ S2

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| S3 ─ S4

Solution using Constraint Propagation

Assign small-domain first:

S3 → T1
S1 ≠ S3 → S1 = T2
S2 ≠ S1, S3 → S2 = T3
S4 ≠ S3 → S4 = T2 or T3 → choose T2

Final Schedule

Subject	Timeslot
S1	T2

S2	T3
S3	T1
S4	T2

No conflicts remain → CSP solved

OR

d) Explain how non-monotonic reasoning resolves knowledge update conflicts. Illustrate using a scenario where conclusions change when new evidence is added (e.g., bird–penguin example).
(8 marks)

Answer:

Non-monotonic Reasoning – Bird-Penguin Example

Traditional logic is monotonic → once a conclusion is derived, it never changes.
But in real life, new knowledge may invalidate old conclusions.

Example

Rules:

Bird(x) → CanFly(x)
Penguin(x) → Bird(x)
Penguin(x) → CannotFly(x)

Initial fact:

Bird(Tweety)

Inference:

Tweety can fly ✔

New evidence added:

Penguin(Tweety)

Updating reasoning:
→ Penguins cannot fly → Tweety cannot fly

Why non-monotonic?

✔ Knowledge update changes previous results

	✔ Supports truth maintenance systems (TMS)	
Q.4	a) Apply forward state-space search to solve the Blocks World planning problem where Block A must be stacked on Block B, and Block B on Block C. Define initial and goal states and show all intermediate planning steps. (8marks) Answer: Goal: Stack A on B, and B on C Initial State: A, B, C all on table separately Goal State: A on B B on C C on table Sequence 1 Move B → on C State: (B on C) 2 Move A → on B State: (A on B on C) Planning Graph Initial: A| B| C| Step1: A| B→C Step2: A→B→C (Goal) Goal Achieved in 2 steps OR b) Compare supervised, unsupervised, and reinforcement learning by applying each to suitable real-life case studies such as spam detection, customer segmentation, and game playing. (8marks) Answer: Compare Learning Types with Examples	[16]

Learning	Definition	Real-Life Application
Supervised	Train with labeled data	Spam detection (spam/not-spam)
Unsupervised	No labels → find hidden patterns	Customer segmentation (clustering)
Reinforcement	Learn via rewards	Game playing (Chess, AlphaGo)

c) Describe the basic components of an Artificial Neural Network (ANN) and explain their respective roles.
(8 marks)

Answer:

Components of ANN

A neural network models brain neurons for learning patterns.

Core Components

1 Input Layer – receives data features
2 Weights – adjust learning influence
3 Activation Function – introduces non-linearity
4 Hidden Layer(s) – feature transformation
5 Output Layer – classification/regression result
6 Bias – shifts activation threshold
7 Learning Rule (Backpropagation) – error correction

ANN Block Diagram

Inputs → Hidden Layer → Output
(weights applied at each layer)

✔ Enables pattern recognition, speech, image processing

OR

d) Describe Nonlinear Planning using constraint posting. Explain how constraints help in reducing dependency between tasks. (8 marks)

Answer:

Nonlinear Planning using Constraint Posting

Nonlinear planning allows actions to be performed independently where possible.

	Process • Identify actions for goals • Post constraints: ordering, resource usage • Resolve conflicts only when needed (flexible) Constraint Types • Ordering (Action A before B) • Causal dependencies • Resource limits Benefits ✔ Tasks run parallel → less time ✔ Reduces unnecessary ordering ✔ Efficient for large planning domains (e.g., robotics)	
Q.5	a) Explain the different steps involved in Natural Language Processing (NLP) with a suitable block diagram. (8 marks) Answer: Steps in NLP (with Block Diagram) Pipeline 1 Text Acquisition 2 Tokenization 3 Morphological Analysis 4 Syntactic Parsing 5 Semantic Analysis 6 Discourse & Pragmatics 7 Output Interpretation Block Diagram Text → Tokenization → Parsing → Semantics → Pragmatics → Output ✔ Converts raw language → structured meaning OR b) Discuss discourse and pragmatic processing in NLP with suitable examples showing context handling. (8 marks)	[16]

Answer:

Discourse & Pragmatic Processing

Deals with context-dependent understanding.

Discourse → Multi-sentence meaning

Example:

Ram fell. He broke his leg.
"He" refers to Ram → anaphora resolution

Pragmatics → Speaker intention

Example:

"Can you pass the salt?" → Request, not ability question

✔ Used in chatbots, translation, question answering
✔ Reduces ambiguity and misinterpretation

c) Create an Expert System block diagram for Medical Diagnosis and explain flow of reasoning using an example (fever, cold, etc.).
(8 marks)

Answer:

Expert System – Medical Diagnosis

Block Diagram

User → UI ↔ Inference Engine ↔ Knowledge Base
↑
Explanation System

Example Case
Input: Fever, Ache
Rules apply:

IF Fever AND Ache → Flu

Output: Suggested Flu + Treatment advice

✔ Demonstrates reasoning clearly

OR

d) Explain the major components of an Expert System: knowledge base, inference engine, user interface, etc.
(8 marks)

Answer:

Components of Expert System

Component	Function
Knowledge Base	Stores domain rules and facts
Inference Engine	Applies reasoning (forward/backward chaining)
User Interface	Communication with user
Explanation Facility	Shows reasoning steps
Knowledge Acquisition	Adds new rules

✔ Enables experts' intelligence digitally