REG.NO.:

SLOT: D2+TD2

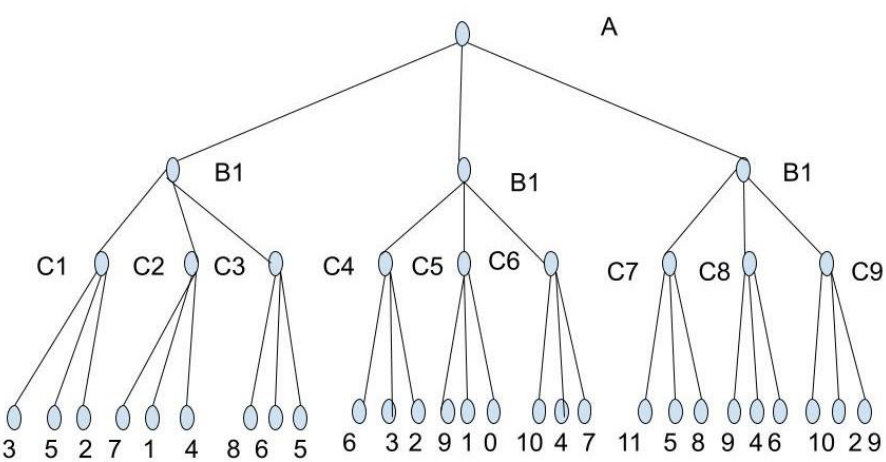
Vellore Institute of Technology
(Deemed to be University under section 3 of UGC Act, 1956)

SCHOOL OF COMPUTER SCIENCE AND ENGINEERING
CONTINUOUS ASSESSMENT TEST - II
FALL SEMESTER 2025-2026

Programme Name & Branch : **B.Tech(CSE)**
Course Code and Course Name : **BCSE306L and Artificial Intelligence**
Faculty Name(s) : **Common to all**
Class Number(s) : **Common to all**
Exam Duration : **90 minutes** **Maximum Marks: 50**

General instruction(s):

- Answer All Questions
- M - Max mark; CO – Course Outcome; BL – Blooms Taxonomy Level (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)
- Course Outcomes: (Type the CO statements covered in this question paper. Use the CO number as per the syllabus copy)
  CO1- Evaluate Artificial Intelligence (AI) methods and describe their foundations.
  CO2-Apply basic principles of AI in solutions that require problem-solving, inference, perception, knowledge representation and learning.
  CO4-Analyse and illustrate how search algorithms play a vital role in problem-solving

<table>
<tr><th>Q. No</th><th>Question</th><th>M</th><th>CO</th><th>BL</th></tr>
<tr><td>1.</td><td>Consider the game tree given below


a) Apply the Minimax Algorithm to calculate the Min Max value for each node and display in graph with a neat diagram. (3 Marks)</td><td>10</td><td>4</td><td>3</td></tr>
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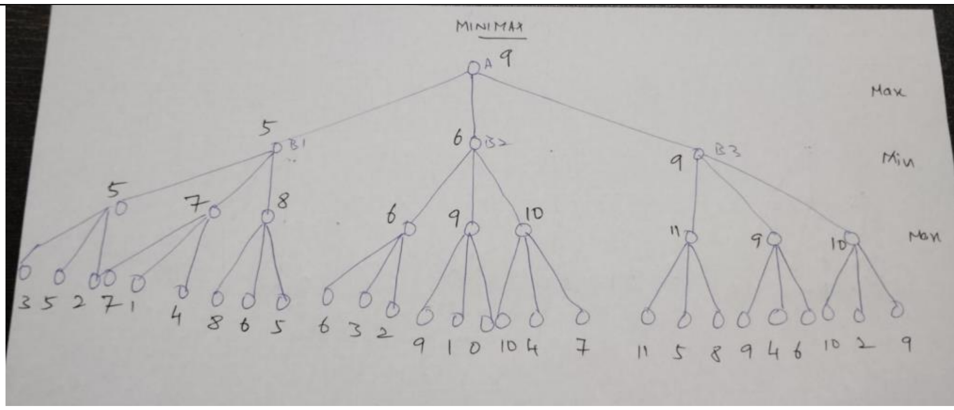
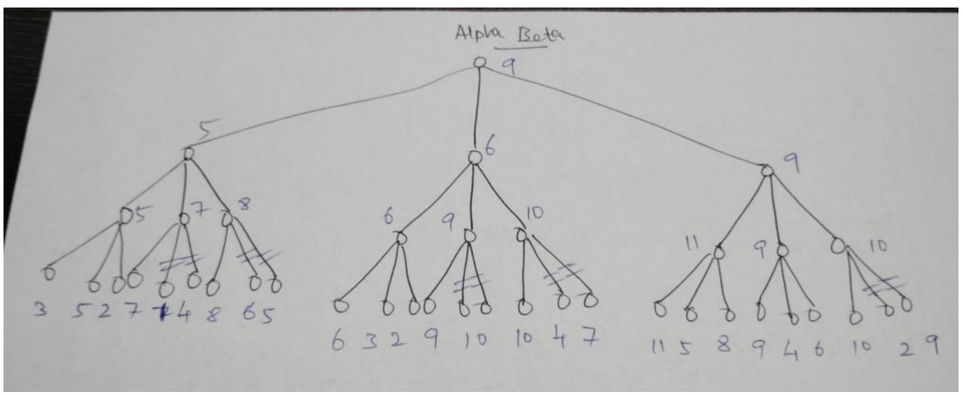


b) Apply Alpha-Beta Pruning to prune the nodes that do not change the outcome of the game. (7 Marks)



</td><td></td><td></td><td></td></tr>
<tr><td>2.A</td><td>
Consider the following story of the "hardworking student": "Anyone who writes the thesis and passes the viva graduates. But anyone who is hardworking or has a guide writes the thesis. If someone has a guide they get support. Anyone who gets support passes the viva. Alice is not hardworking but she has a guide. Prove using resolution that Alice graduates." (6 Marks)

Ans:
1. First-order formalization
1. ∀X (write(X,thesis) ∧ pass(X,viva) ⇒ graduate(X))
2. ∀X (hardworking(X) ∨ guide(X) ⇒ write(X,thesis))
3. ∀X (guide(X) ⇒ support(X))
4. ∀X (support(X) ⇒ pass(X,viva))
5. ¬hardworking(alice) ∧ guide(alice)

Goal: graduate(alice).
Use proof by refutation: add ¬graduate(alice) and derive contradiction.
2. Convert to clausal form (CNF)
C1. ¬write(X,thesis) ∨ ¬pass(X,viva) ∨ graduate(X)
C2a. ¬hardworking(X) ∨ write(X,thesis)
C2b. ¬guide(X) ∨ write(X,thesis)
</td><td>10</td><td>4</td><td>4</td></tr>
</table>

	C3. ¬guide(X) ∨ support(X) C4. ¬support(X) ∨ pass(X,viva) C5a. ¬hardworking(alice) C5b. guide(alice) C6. ¬graduate(alice) 3. Resolution derivation (instantiate X = alice) A. From C2b and C5b → R1: write(alice,thesis) B. From C3 and C5b → R2: support(alice) C. From C4 and R2 → R3: pass(alice,viva) D. From C1 and C6 → R4: ¬write(alice,thesis) ∨ ¬pass(alice,viva) E. From R4 and R1 → R5: ¬pass(alice,viva) F. From R5 and R3 → □ (empty clause) 4. Conclusion Empty clause reached ⇒ contradiction. Therefore the knowledge base entails graduate Alice.			
2.B	Convert the following English Statements into FOL (4 Marks) i) Any smartphone cheaper than every laptop is a budget phone. ii) For every city there exists a hospital that is open 24 hours. iii) Every student enrolled in a course has a professor. iv) If a person is a doctor, then that person has treated at least one patient. **Ans:** **Notation (Predicates & Relations):** Smartphone(x), Laptop(y), Cheaper(x,y), BudgetPhone(x) City(c), Hospital(h), Open24(h), LocatedIn(h,c) Student(s), Course(k), Enrolled(s,k), Professor(p), HasProfessor(s,p), Teaches(p,k) Doctor(x), Patient(y), Treated(x,y) **Formal Statements:** i) ∀x [(Smartphone(x) ∧ ∀y (Laptop(y) → Cheaper(x,y))) → BudgetPhone(x)] ii) ∀c [City(c) → ∃h (Hospital(h) ∧ Open24(h) ∧ LocatedIn(h,c))] iii-a) ∀s∀k [(Student(s) ∧ Course(k) ∧ Enrolled(s,k)) → ∃p (Professor(p) ∧ HasProfessor(s,p))] (Equivalently, making the course existential inside:) iii-b) ∀s [(Student(s) ∧ ∃k (Course(k) ∧ Enrolled(s,k))) → ∃p (Professor(p) ∧ HasProfessor(s,p))] iv) ∀x [Doctor(x) → ∃y (Patient(y) ∧ Treated(x,y))]			
3.A	In a hospital, doctors follow these rules: if a patient has either a fever or a cough, then the patient is considered to have an infection. If a patient has an infection, then antibiotics are prescribed. Additionally, if the patient has a fever, they are also sent for a blood test. Now, suppose a patient has a cough but no fever.	10		

	Using propositional logic and applying both forward and backward chaining, determine whether the patient will be prescribed antibiotics. (6 Marks) **Ans:** **Symbols** F: patient has fever C: patient has cough I: patient has infection A: antibiotics prescribed B: sent for blood test **Rules (Knowledge Base)** 1. (F ∨ C) → I 2. I → A 3. F → B **Facts (Given Case)** C is true F is false **Forward Chaining** 1. From C and rule (1): Since F ∨ C is true (because C is true), infer I. 2. From I and rule (2): infer A. → Therefore, antibiotics will be prescribed. Also, since F is false, rule (3) doesn't trigger → no blood test. **Backward Chaining** Goal: prove A. 1. To get A, use rule (2): need I. 2. To get I, use rule (1): need F ∨ C. 3. Given C is true, so F ∨ C is true ⇒ I holds ⇒ A holds. → Therefore, antibiotics will be prescribed. Yes, the patient will be prescribed antibiotics because having a cough implies infection, and infection implies antibiotics. The patient will not be sent for a blood test since they do not have a fever.	4	3
3. B	Given the knowledge base. Prove the given using Inference Rules in Propositional Logic (4 Marks) i)KB:		

1. M → N
2. N → O
3. M
4. P ∨ O
5. ¬P

Prove N ∧ O.

Ans:

1. From (1) and (3): By Modus Ponens, we derive N.
   - Reason: M is true, and M → N, hence N must be true.

2. From (2) and (1): By chaining implications, (M → N) and (N → O) imply (M → O).
   - This shows that if M is true, then O is also true.

3. From (3) and (2): By Modus Ponens again, since M is true and M → O, we derive O.

4. Alternatively, using (4) and (5):
   - P ∨ O and ¬P allow us to conclude O (Disjunctive Syllogism).

5. Finally, from steps (1) and (3) (N and O are both true):
   - By Conjunction Introduction, we get N ∧ O.

ii) KB:

1. P ∨ Q
2. P → R
3. Q → S
4. R → T
5. S → T

Prove T.

Ans:

1. From (1): We have two possible cases —
   Case 1: P is true
   Case 2: Q is true

Case 1: Assume P is true

2. From (2): P → R and P → infer R (Modus Ponens).
3. From (4): R → T and R → infer T (Modus Ponens).

Hence, if P is true → T is true.

Case 2: Assume Q is true

4. From (3): Q → S and Q → infer S (Modus Ponens).
5. From (5): S → T and S → infer T (Modus Ponens).

Hence, if Q is true → T is true.

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4.A An AI-based medical assistant uses Bayes' theorem to diagnose flu (F) given symptoms fever (V) and cough (C).

Given:
P(F) = 0.05
P(V|F) = 0.9, P(C|F) = 0.8
P(V|¬F) = 0.1, P(C|¬F) = 0.2

Assume V and C are conditionally independent given F. If a patient shows both symptoms, compute P(F | V ∧ C). (5 Marks)

10 | 3 | 3

Ans:

P(F) = 0.05
P(¬F) = 0.95
P(V|F) = 0.9, P(C|F) = 0.8
P(V|¬F) = 0.1, P(C|¬F) = 0.2

Step 1: Conditional Independence
Since V and C are conditionally independent given F:
P(V ∧ C | F) = P(V|F) × P(C|F) = 0.9 × 0.8 = 0.72
P(V ∧ C | ¬F) = P(V|¬F) × P(C|¬F) = 0.1 × 0.2 = 0.02
Step 2: Apply Bayes' Theorem
P(F | V ∧ C) = [P(V ∧ C | F) × P(F)] / [P(V ∧ C | F) × P(F) + P(V ∧ C | ¬F) × P(¬F)]
Step 3: Substitute Values

P(F | V ∧ C) = (0.72 × 0.05) / [(0.72 × 0.05) + (0.02 × 0.95)]
= 0.036 / (0.036 + 0.019)
= 0.036 / 0.055
= 0.6545
P(F | V ∧ C) ≈ 0.65

4.B Use the Naïve Bayes classifier for the dataset below.
Compute the required conditional probabilities and predict the class of the new instance (P=0, Q=1, R=0) (5 Marks)

Record	P	Q	R	Class
1	0	0	0	+
2	0	0	1	-
3	0	1	1	-
4	0	1	1	-
5	0	0	1	+
6	1	0	1	+
7	1	0	1	-
8	1	0	1	-
9	1	1	1	+
10	1	0	1	+

Ans:

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	Priors: P(+)=0.5, P(-)=0.5 Conditional Probabilities (MLE): - For +: P(P=0|+)=0.4, P(Q=1|+)=0.4, P(R=0|+)=0.4 - For -: P(P=0|-)=0.6, P(Q=1|-)=0.4, P(R=0|-)=0 Without smoothing: Score(+)=0.032, Score(-)=0 → Posterior(+)=1 → Predict '+' With Laplace smoothing: Score(+)=0.0394, Score(-)=0.0175 → P(+)=0.693, P(-)=0.307 → Predict '+' Final Answer: New instance (P=0,Q=1,R=0) is classified as Positive (+).			
5	For the Bayesian network given below: An office is monitored with five binary variables: Employee presence (E): Employees are present 20% of the time. Delivery person (D): Deliveries occur 5% of the time. **Lights (L):** If employee present → Lights on 95% of the time. If only delivery person present → Lights on 80% of the time. If no one present → Lights on 5% of the time. **Window (W):** With delivery → Window breaks 12% of the time. Without delivery → Window breaks 1% of the time. **Alarm (A):** Window broken & lights on → Alarm 99% chance. Window broken & lights off → Alarm 85% chance. Window intact & lights on → Alarm 2% chance. Window intact & lights off → Alarm 0.1% chance. Compute: a) An employee is present, no delivery occurs, lights are on, window intact, and alarm not triggered. What is the probability of this situation? b) No one is present, lights are off, window intact, and alarm not triggered. What is the probability of this situation? **Ans:** a) Probability = 0.1751 (≈ 17.5%) b) Probability = 0.7141 (≈ 71.4%)	10	3	4

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