ARTIFICIAL INTELLIGENCE
(ECEN 3134)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) An AI agent perceives and acts upon the environment using ___
(a) Sensors (b) Perceiver (c) Actuators (d) Both (a) and (c).

(ii) Select the most appropriate situation for that a blind search can be used
(a) Real-life situation (b) Small Search Space
(c) Complex game (d) All of the above.

(iii) In state-space, the set of actions for a given problem is expressed by the _____
(a) Intermediate States
(b) Successor function that takes current action and returns next state
(c) Initial States
(d) None of the above.

(iv) The PEAS in the task environment is about _____.
(a) Peer, Environment, Actuators, Sense
(b) Performance, Environment, Actuators, Sensors
(c) Perceiving, Environment, Actuators, Sensors
(d) None of the above

(v) A hybrid Bayesian Network consist of _____.
(a) Discrete variables only (b) Discontinuous Variable
(c) Both Discrete and Continuous variables (d) Continuous Variable only

(vi) Translate the following statement into FOL:
"For every a, if a is a philosopher, then a is a scholar"
(a) ∀ a philosopher(a) →scholar(a) (b) ∃ a philosopher(a)→ scholar(a)
(c) all of the mentioned (d) none of the mentioned

(vii) The probabilistic reasoning depends upon _____.
(a) estimation (b) observations
(c) likelihood (d) all of the above

(viii) The problem of finding hidden structure in unlabelled data is called
(a) unsupervised learning (b) supervised learning
(c) reinforcement learning (d) active learning.

(ix) The most widely used metrics and tools to assess a classification model are
(a) Confusion matrix (b) Cost-sensitive accuracy
(c) Area under the ROC curve (d) All of the above.

(x) Which dimensionality reduction technique is suitable for supervised learning tasks?
(a) PCA (b) LDA (c) t-SNE (d) Autoencoder.

Fill in the blanks with the correct word

(xi) The search implemented with an empty first-in-first-out queue is _____

(xii) The space complexity of Depth-first search is _____

(xiii) Heuristic function h(n) is _____

(xiv) The sentences of Propositional logic can have answers other than True or False: True / False? _____

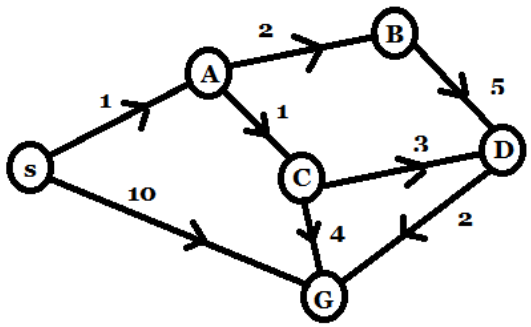
(xv) Identify whether true or false: In PCA the number of input dimensions is equal to principal components _____.

Group - B

2. (a) What is time complexity of an algorithm. Explain Depth First Search with an example. Find the time complexity of Depth First Search.
[(CO2)(Remember/LOCQ)]

(b) For the following graph, identify the shortest path and the corresponding cost using A* algorithm. *[(CO2)(Evaluate/HOCQ)]*

State	h(n)
S	5
A	3
B	4
C	2
D	6
G	0



Symbols have their usual meaning.

(1 + 4 + 3) + 4 = 12

3. (a) Define completeness of a searching algorithm. Distinguish between informed and uninformed searching. *[(CO2)(Remember/LOCQ)]*

(b) Identify the fundamental differences between Hill Climbing & Simulated Annealing algorithms. Follow the Simulated Annealing algorithm to find the minimum value of the function $f(x) = 500 - 20x_1 - 25x_2 - 4x_1 * x_2$. $-2 < x_1 < 10$; $-1 < x_2 < 11$. Perform single iteration only. *[(CO2)(Analyse/IOCQ)]*

(1 + 4) + (3 + 4) = 12

Group - C

4. (a) What is atomic proposition? Site an example. Identify the limitations in propositional logic. *[(CO2)(Remember/LOCQ)]*

   (b) Represent the following information using predicate logic
   (i) All red flowers are beautiful. (ii) Every man is either loyal to a leader or hates leader. (iii) No dog eats vegetables. *[(CO3)(Apply/IOCQ)]*

(2 + 1 + 3) + 6 = 12

5. (a) Explain Bayesian network. Also mention the probable area of application. *[(CO3)(Analyse/HOCQ)]*

   (b) Harry installed a new burglar alarm at his home to detect burglary. The alarm reliably responds at detecting a burglary but also responds for minor earthquakes. Harry has two neighbours David and Sophia, who have taken a responsibility to inform Harry at work when they hear the alarm. David always calls Harry when he hears the alarm, but sometimes he got confused with the phone ringing and calls at that time too. On the other hand, Sophia likes to listen to high music, so sometimes she misses to hear the alarm. Here we would like to compute the probability of Burglary Alarm. Draw the Bayesian network. Calculate the probability that alarm has sounded, but there is neither a burglary, nor an earthquake occurred, and David and Sophia both called the Harry using the Bayesian network.
   Given

Burglary (B)	
T	0.002
F	0.998

Earthquake E	
T	0.001
F	0.999

Alarm (A)

B	E	P(A=T)	P(A=F)
T	T	0.94	0.06
T	F	0.95	0.05
F	T	0.69	0.31
F	F	0.001	0.999

David Calls (D)

A	P(D=T)	P(D=F)
T	0.91	0.09
F	0.05	0.95

Sophia Calls (D)

A	P(S=T)	P(S=F)
T	0.91	0.09
F	0.05	0.95

[(CO3)(Evaluate/HOCQ)]

(2 + 2) + 8 = 12

Group - D

6. (a) Explain the difference between Classification and Regression. *[(CO5)(Analysis/IOCQ)]*

   (b) What do you mean by Clustering? Explain the Hierarchical Clustering algorithm with the help of an example. *[(CO5)(Remember/LOCQ)]*

   (c) Compare Hierarchical Clustering and Density-based Clustering. *[(CO5)(Analysis/IOCQ)]*

3 + (2 + 4) + 3 = 12

7. (a) Explain k-Means clustering with an example. *[(CO5)(Analyse/HOCQ)]*

   (b) Apply K-Mean clustering for the following dataset for two cluster. Tabulate all the assignments.

Sample No	X	Y
1	185	72
2	170	56
3	168	60
4	179	68
5	182	72
6	188	77

[(CO5)(Apply/IOCQ)]

4 + 8 = 12

Group - E

8. (a) Define Independent Component Analysis (ICA). How does it differ from Principal Component Analysis (PCA)? *[(CO5)(Analyse/IOCQ)]*

   (b) Discuss the limitations of ICA. What are some common issues one might face while applying ICA to real-world data? *[(CO5)(Create/HOCQ)]*

(2 + 3) + (4 + 3) = 12

9. (a) Explain the Convolutional Neural Network (CNN). How does a CNN differ from a fully connected neural network? *[(CO6)(Analyse/IOCQ)]*

   (b) Discuss the application of CNNs in medical image analysis. Provide examples of how CNNs are used in disease diagnosis. *[(CO6)(Create/HOCQ)]*

(3 + 3) + (3 + 3) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	26.04	39.58	34.38