PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

Department of Applied Mathematics and Computational Sciences

MSc Cyber Security Semester V

CONTINUOUS ASSESSMENT TEST II Date: 30.10.2025

23XCE7- Artificial Intelligence

Time: 1 Hour 30 min. **Maximum Marks: 40**

INSTRUCTIONS:

1. Answer **ALL** questions. Each question carries 20 Marks.
2. Subdivisions (a)(i) and (a)(ii) carries 2 marks each, subdivision (b) carries 6 marks each and subdivision (c) carries 10 marks each.
3. Course Outcome Table

Qn.1	CO3.	Qn.2	CO4.

1.(a) (i) Write the converse and inverse of the statement "If you eat apple every day, then you are healthy". **L2**

(ii) If $(\neg X \wedge \neg Y \wedge \neg Z) \vee (\neg X \wedge Y \wedge Z) \vee (X \wedge Y \wedge Z) \vee (\neg X \wedge \neg Y \wedge Z)$ is a formula (with three variables X,Y,Z) in PDNF, convert it to PCNF. **L2**

(b) A certain type of virus attacks cells of the human body. The infected cells is visualized using a special microscope and a digital image process is applied to the image. This processing generates two variables: the first variable, P gives the number of black spots (pixels) and the second variable, S, is related to the shape of the black spot (The black spots may be circular or elliptic). Since, it is difficult to count the number of black spots, or to identify a perfect circular cluster of pixels, both these variables are estimated in a linguistic way. Therefore, we define two fuzzy sets $\tilde{P}$ and $\tilde{S}$ where $\tilde{P}$ represents the quantity of black pixels (C1 - none with black pixels, C2- a few with black pixels, and C3- a lot of black pixels) and $\tilde{S}$ represents the shape of the black pixel clusters, e.g., S1 is an ellipse and S2 is a circle. These fuzzy sets are denoted as $\tilde{P} = \left\{\frac{0.1}{C1}, \frac{0.5}{C2}, \frac{1.0}{C3}\right\}$ and $\tilde{S} = \left\{\frac{0.3}{S1}, \frac{0.8}{S2}\right\}$.

(i) Obtain a fuzzy relation $\tilde{R}$ between quantity of black pixels in the virus and the shape of the black pixel clusters using fuzzy Cartesian product.

(ii) Consider another microscope image in which the quantity of black pixels is slightly different. Let this be defined by a fuzzy set, $\tilde{P}'$ given by $\tilde{P}' = \left\{\frac{0.4}{C1}, \frac{0.7}{C2}, \frac{1.0}{C3}\right\}$. Obtain the max-min composition of the fuzzy set $\tilde{P}'$ and $\tilde{R}$. **L3**

(c) Convert the following statements in to symbolic form. Assuming each of the following is true, check if you end up doing your homework. **L4**

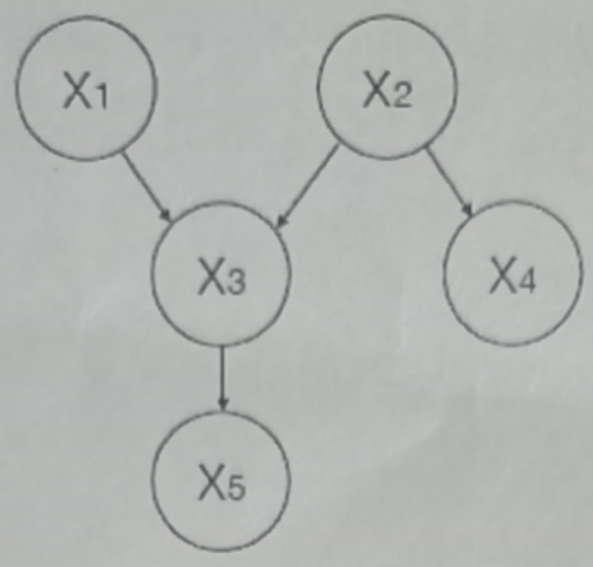
- If it is raining, then you will be tired.
- If you are tired you will nap.
- If you do not do your homework, then you will take a nap.
- If you nap or it rains, then you will not do your homework.
- If you do not do your homework, then it will rain.
- Either it will rain, you will take a nap or you will not be tired.

2. (a) (i) A test for a certain rare disease is assumed to be correct 95% of the time: if a person has the disease, the test results are positive with probability 0.95, and if the person does not have the disease, the test results are negative with probability 0.95. A random person drawn from

2

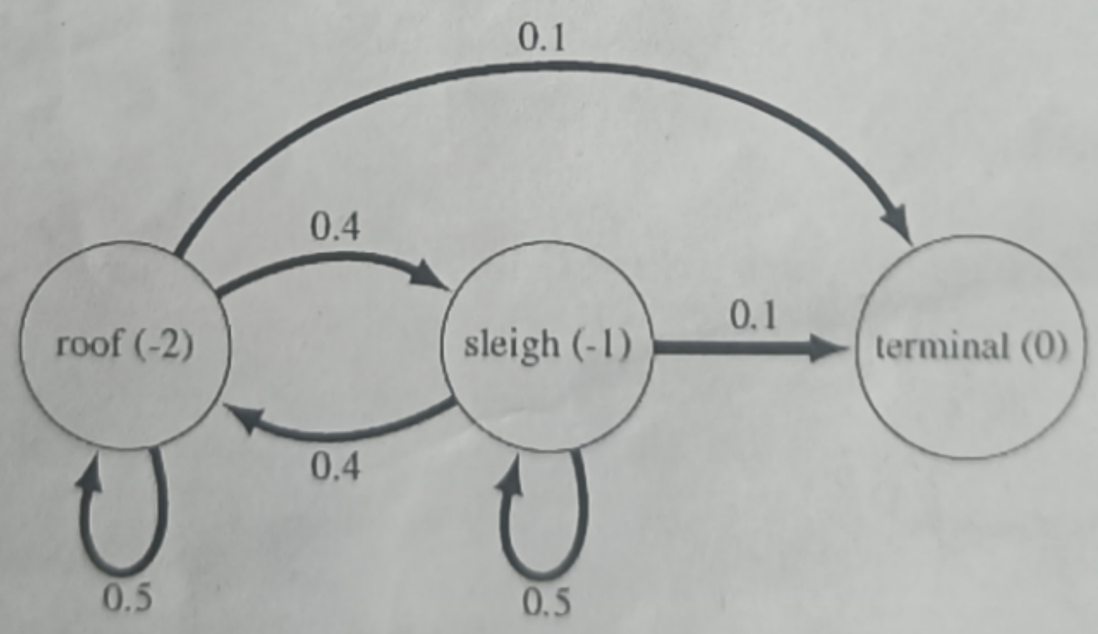
the population has probability 0.001 of having the disease. Given that the person just tested positive, what is the probability of having the disease? **L2**

(ii) From the Bayesian network given below, find whether X_5 and X_2 are conditionally independent given evidence about X_3. State reasons for your answer **L2**



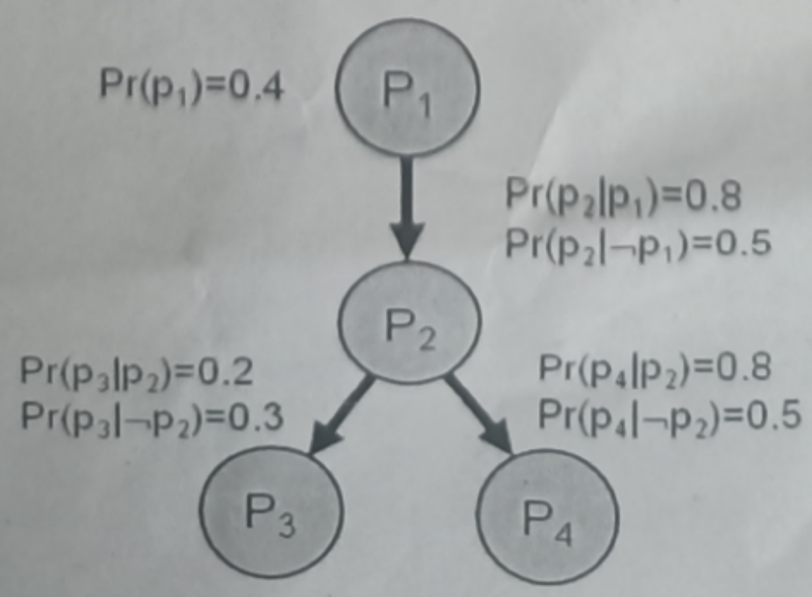
2

(b) On Christmas Eve, Santa has to deliver all presents to their recipients. To do so, he moves from house to house. Santa can try to throw a present into the chimney either directly from his sleigh or from the house's roof. After each throw, Santa decides that he has delivered enough presents and is done with the current house (terminal state) with probability 0.1. Otherwise, he switches his position from the sleigh to the roof or vice versa (probability 0.4) or stays put (probability 0.5). Throwing the presents from the sleigh is a bit difficult, since Santa has to consider all winds and turbulences in the air. However, he is very experienced so that he will always hit the chimney successfully. The cost (negative reward) for throwing presents from the sleigh is thus -1. By contrast, the roofs are usually slippery and it may happen that Santa slips and falls to the ground so that he has to climb up again to deliver the present. Therefore, the cost for delivering presents from the roof is -2. The terminal state has a cost of 0. The Markov reward process representing Santa's work is shown below. Compute the expected discounted future rewards (utilities) for the states "roof", "sleigh" and "terminal" using the Bellman equation (with $\gamma = 1$). **L5**



4

(c) From the Bayesian network given below, compute P(p2|¬p3) using variable elimination. **L5**



7