Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY 2025

Date: 22 - 05- 2025 **Time:** 09:30 am –12:30 pm

School: SOCSE	**Program:** CSE (AI&ML)	
Course Code: CSE3122	**Course Name:** Pattern Recognition	
Semester: VI	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**24**	**24**	**26**	**26**	**-**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

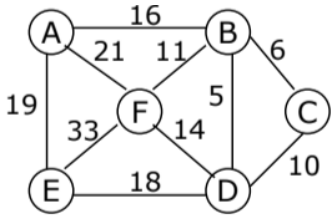
1.	Explain the key applications of pattern recognition.	2 Marks	L2	CO1
2.	Describe Feature vector of a pattern by considering an example	2 Marks	L2	CO1
3.	Identify the data structures used for representing the patterns.	2 Marks	L1	CO2
4.	List the advantages of using rough sets and fuzzy sets for pattern representation.	2 Marks	L1	CO2
5.	Explain the components of Bayesian Belief Networks.	2 Marks	L2	CO3
6.	List the issues of KNN classifier	2 Marks	L1	CO3
7.	Interpret the relation between joint probability and conditional probability	2 Marks	L2	CO3
8.	List the advantages and disadvantages of Hidden Markov's model	2 Marks	L1	CO4
9.	Decision tree algorithm is a greedy algorithm, justify.	2 Marks	L2	CO4
10.	Explain an application of Hidden Markov's model	2 Marks	L2	CO4

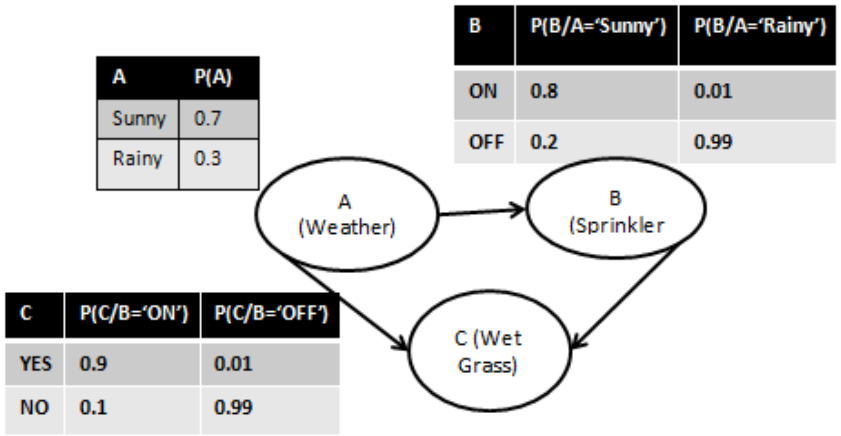
Part B

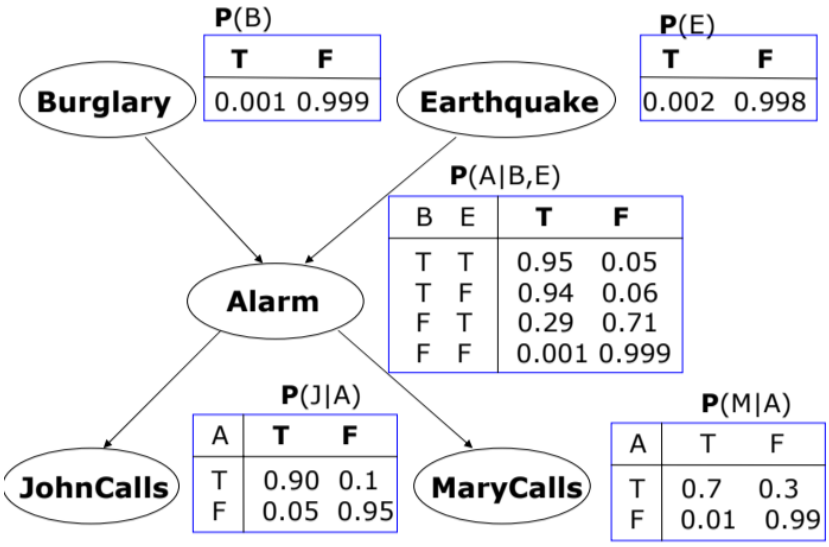
Answer the Questions. **Total Marks 80M**

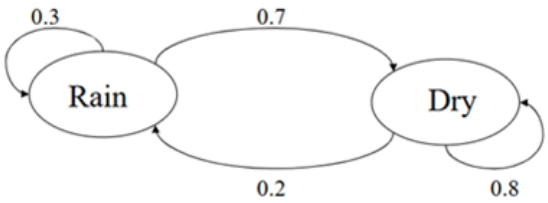
<table>
<tr><td>11.</td><td>a.</td><td>Describe joint probability and conditional probability. Explain the relation between joint probability and conditional probability with example.</td><td>6 Marks</td><td>L2</td><td>CO1</td></tr>
<tr><td></td><td>b.</td><td>The joint distribution of p(x, y) of X (number of cars) and Y (the number of buses) per signal cycle at a traffic signal is given by
<table>
<tr><td></td><td colspan="4">y</td></tr>
<tr><td>p(x,y)</td><td></td><td>0</td><td>1</td><td>2</td></tr>
<tr><td rowspan="6">x</td><td>0</td><td>0.025</td><td>0.015</td><td>0.010</td></tr>
<tr><td>1</td><td>0.050</td><td>0.030</td><td>0.020</td></tr>
<tr><td>2</td><td>0.125</td><td>0.075</td><td>0.050</td></tr>
<tr><td>3</td><td>0.150</td><td>0.090</td><td>0.060</td></tr>
<tr><td>4</td><td>0.100</td><td>0.060</td><td>0.040</td></tr>
<tr><td>5</td><td>0.050</td><td>0.030</td><td>0.020</td></tr>
</table>
i. Find P(X > Y).
ii. Calculate the marginal distribution of X and Y.
iii. Suppose a bus occupies two vehicle spaces and a car occupies just one. What is the mean number of vehicle spaces occupied during a signal cycles? Calculate the mean or expected value of h(X, Y) = X + 2Y.</td><td>7 marks</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>c.</td><td>Use python code to print a number pyramid pattern and write the steps.</td><td>7 marks</td><td>L3</td><td>CO1</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>12.</td><td>a.</td><td>Explain the concept of conditional probability for two discrete random variables. Let X and Y are two random variables representing the number of heads observed in two coin tosses. The joint probability distribution P(X,Y) is given below:
<table>
<tr><td>X\Y</td><td>0</td><td>1</td><td>2</td></tr>
<tr><td>0</td><td>0.1</td><td>0.2</td><td>0.1</td></tr>
<tr><td>1</td><td>0.2</td><td>0.3</td><td>0.1</td></tr>
<tr><td>2</td><td>0.1</td><td>0.1</td><td>0.1</td></tr>
</table>
Compute the conditional probability P(X=1|Y=1).</td><td>6 Marks</td><td>L2</td><td>CO1</td></tr>
<tr><td></td><td>b.</td><td>A company makes phones. Out of 100 phones, one is faulty. For each phone, the company makes a profit of Rs 2,000 and a loss of Rs. 10,000 for the faulty phone. Calculate the expected profit.</td><td>7 marks</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>c.</td><td>Implement a python code to print a kite pattern as output by considering n=5 and write the steps.</td><td>7 marks</td><td>L3</td><td>CO1</td></tr>
</table>

13.	**a.**	Distinguish pattern and vector with suitable examples	6 Marks	L2	**CO2**
	b.	Let's assume the following transactional database, with a minimum support threshold of 50% (i.e., item sets appearing in at least 3 transactions are considered frequent): Interpret the frequent pattern tree and list the frequent elements from the item list.	7 marks	L3	**CO2**

		<table><tr><td>Transaction ID</td><td>Items</td></tr><tr><td>T1</td><td>{E,K,M,N,O,Y}</td></tr><tr><td>T2</td><td>{D,E,K,N,O,Y}</td></tr><tr><td>T3</td><td>{A,E,K,M}</td></tr><tr><td>T4</td><td>{C,K,M,U,Y}</td></tr><tr><td>T5</td><td>{C,E,I,K,O,O}</td></tr></table>			
	c.	Implement the Gaussian distribution curve by considering the linear data values and visualize the results. (Hint: np.random.randint() for generating data values)	7 marks	L3	**CO2**
		OR			
14.	**a.**	Describe the different proximity measures in pattern recognition.	6 Marks	L2	**CO2**
	b.	Consider the following undirected weighted graph:  Illustrate the minimum spanning tree for the given graph and write the steps.	7 marks	L3	**CO2**
	c.	Implement linear perceptron learning for synthetic data and visualize the accuracy of the model. (Hint: Use make_blob() function for generating synthetic data)	7 marks	L3	**CO2**

15.	**a.**	Explain Nearest Neighbour (NN) algorithm for classification. List advantages and disadvantages of KNN	6 Marks	L2	**CO3**
	b.	Implement KNN algorithm from the scratch (without using built-in function). Write the steps.	7 marks	L3	**CO3**
	c.	 For the above conditional probabilities, calculate the probability of wet grass	7 marks	L3	**CO3**
		OR			
16.	**a.**	Explain BBN (Bayesian Belief Network) with example. List the advantages and disadvantages.	6 Marks	L2	**CO3**
	b.	Implement BBN (Bayesian Belief Network) for the following DAG (Directed Acyclic Graph).	7 marks	L3	**CO3**

					
	c.	Consider the data set given below consists of the patterns X1 = (1.0, 1.0, 1), X2 = (1.0, 2.0, 1), X3 = (1.5, 1.5, 1) X4 = (2.0, 2.0, 1), X5 = (1.0, 3.0, 2), X6 = (3.0, 2.0, 2) X7 = (4.0, 2.0, 2), X8 = (5.0, 2.5, 2), X9 = (3.0, 3.5, 2) X10 = (2.0, 3.0, 3), X11 = (2.0, 4.0, 3), X12 = (3.0, 4.5, 3) X13 = (4.0, 3.0, 3) for KNN classification where each triplet consists of the x-coordinate, y-coordinate and the class label. Classify the pattern P(3.0, 1.2)	7 marks	L3	**CO3**

17.	**a.**	Explain C4.5 algorithm steps for pattern classification. List its advantages and disadvantages	6 Marks	L2	**CO4**
	b.	Consider the given two state Markov chain model and calculate the probability of sequence({ ‘Dry’, ‘Dry’, ‘Dry’, ‘Rain’, ‘Rain’} 	7 marks	L3	**CO4**
	c.	Consider Jeeves training set. Complete one branch of the decision tree where Temperature is Hot, Wind is Weak, and Humidity is High using ID3 decision tree algorithm.	7 marks	L3	**CO4**

Day	Outlook	Temp	Humidity	Wind	Tennis?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cool	Normal	Weak	Yes
6	Rain	Cool	Normal	Strong	No
7	Overcast	Cool	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cool	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No
15	Sunny	Hot	High	Weak	No

		OR			
18.	**a.**	Compare ID3 and C4.5 decision tree algorithms with examples	6 Marks	L2	**CO4**
	b.	Calculate the expected information gain if we select Outlook as the root node of the tree. Use C4.5 algorithm for the calculation	7 marks	L3	**CO4**
	c.	Consider two hidden states, **Sunny** and **Rainy** and We observe two possible outcomes, **Walk** and **Shop**. Given Transition Probabilities are P(Sunny|Sunny)=0.8, P(Sunny|Rainy)=0.2, P(Rainy|Sunny)=0.4, P(Rainy|Rainy)=0.6 and Observation Probabilities are P(Walk|Sunny)=0.6, P(Shop|Sunny)=0.4, P(Walk|Rainy)=0.3, P(Shop|Rainy)=0.7. Given the observed sequence **Shop, Walk**, calculate the probability of this sequence occurring, assuming the initial state is Sunny.	7 marks	L3	**CO4**

Day	Outlook	Temp	Humidity	Wind	Tennis?
1	Sunny	Hot	High	Weak	No
2	Sunny	Hot	High	Strong	No
3	Overcast	Hot	High	Weak	Yes
4	Rain	Mild	High	Weak	Yes
5	Rain	Cool	Normal	Weak	Yes
6	Rain	Cool	Normal	Strong	No
7	Overcast	Cool	Normal	Strong	Yes
8	Sunny	Mild	High	Weak	No
9	Sunny	Cool	Normal	Weak	Yes
10	Rain	Mild	Normal	Weak	Yes
11	Sunny	Mild	Normal	Strong	Yes
12	Overcast	Mild	High	Strong	Yes
13	Overcast	Hot	Normal	Weak	Yes
14	Rain	Mild	High	Strong	No
15	Sunny	Hot	High	Weak	No