DHARMSINH DESAI UNIVERSITY, NADIAD
FACULTY OF TECHNOLOGY
FIRST SESSIONAL
SUBJECT: Machine Learning (CE622)

Examination	**: B.Tech Semester VI**	**Seat No.**	**: 103**
Date	**: 30/12/2024**	**Day**	**: Monday**
Time	**: 2:30 PM to 3:45 PM**	**Max. Marks**	**: 36**

INSTRUCTIONS:

1. Figures to the right indicate maximum marks for that question.
2. The symbols used carry their usual meanings.
3. Assume suitable data, if required & mention them clearly.
4. Draw neat sketches wherever necessary.

Q.1 Do as directed. **[12]**

CO1 U (a) State true of false and justify your answer, "Bayesian Network is a generative model." [2]

CO1 U (b) Describe a Bayesian network for the joint distribution given by the following equation, [2]

$$P(A, B, C, D, E) = P(A/B, D)^* P(B/C)^* P(D/B)^* P(C)$$

CO1 R (c) Give two applications of Naïve Bayes classifier. [2]

CO2 U (d) Consider the following dataset of 6 samples having **one feature Temperature and a class label.** Calculate the initial impurity of the system and the impurity of the system after splitting on **the splitting point 45**. Use Gini Impurity as an attribute selection measure. [2]

Sr. No	1	2	3	4	5	6
Temperature	40	35	47	70	25	43
Class Label	N	N	N	Y	N	Y

CO2 A (e) How does gain ratio improve attribute selection in decision trees, and what are its advantages compared to information gain? [2]

CO1 U (f) Compare Supervised and Unsupervised learning techniques using appropriate examples. [2]

Q.2 Attempt ***Any TWO*** from the following questions. **[12]**

CO2 C (a) Calculate conditional probability tables for the data shown in the table below, X1, X2, and X3 are feature variables and Y is the class label. Also, answer the inference query P(Y=1/X1=1, X2=0, X3=1). [6]

X1	0	0	1	1	0	0	1	1
X2	0	1	1	0	0	1	1	0
X3	0	1	0	1	1	0	1	0
Y	0	1	0	1	0	1	0	1

CO2 C (b) For the Bayesian Network shown in the figure (Figure 2.1) below, answer the following inference query: **P(Grade=1/letter=0, SAT=1)** [6]

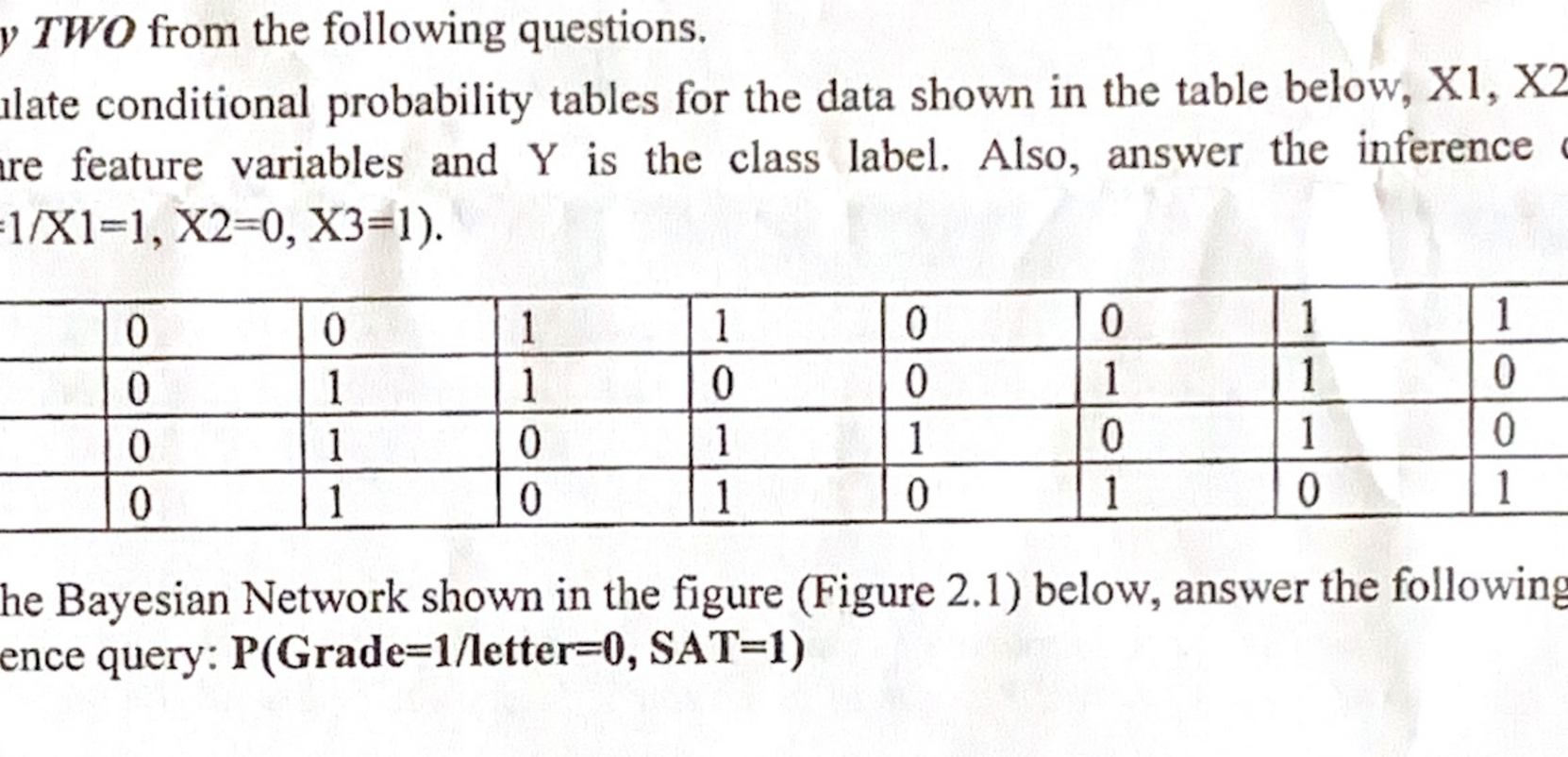

Figure 2.1

CO2 C (c) Design a Naïve Bayes classifier to classify fruit into three classes, e.g. Apple, Banana and other. Identify features, describe feature values and describe the working of the classifier with an example. [6]

Q.3 Attempt ~~Any ONE~~ from the following questions. [12]

CO2 C (a) **i)** Explain why accuracy is not ideal for imbalanced datasets and describe when precision, recall, FPR, and FNR are more appropriate with examples for each. [6]

ii) Suppose you have trained an image classifier with 3 classes: Iris1, Iris2 and Iris3. Consider the confusion matrix shown in table below:

	n=1025	**Iris1**	**Iris2**	**Iris3**
Predicted Labels	**Iris1**	130	170	90
	Iris2	150	150	25
	Iris3	100	60	150

Calculate Macro Precision and Micro Precision for the given Confusion matrix.

CO4 C (b) Consider the following samples in Table 3.1 with two features (Age and Gender) and **one class label (Drug).** [6]

Sr. No	Age?	Gender?	Drug?
1	Young	F	A
2	Young	F	A
3	Middle-age	F	B
4	Senior	F	B
5	Senior	M	B
6	Senior	M	A
7	Middle-age	M	B
8	Young	F	A
9	Young	M	B
10	Senior	M	B
11	Young	M	B
12	Middle-age	F	B
13	Middle-age	M	B
14	Senior	F	A

Table 3.1

i) Which attribute will be chosen as the root node of the decision tree? Use Information gain as an attribute selection measure.

ii) If the decision tree building process considers only binary split, identify the good splitting point for the attribute Age. Use Information gain as an attribute selection measure.

OR

CO2 C (a) What is Cost Complexity pruning? For the decision tree given in Figure 3.1, identify the subtrees which will be pruned in 1st and 2nd iteration. Show all the steps and calculations clearly. [6]

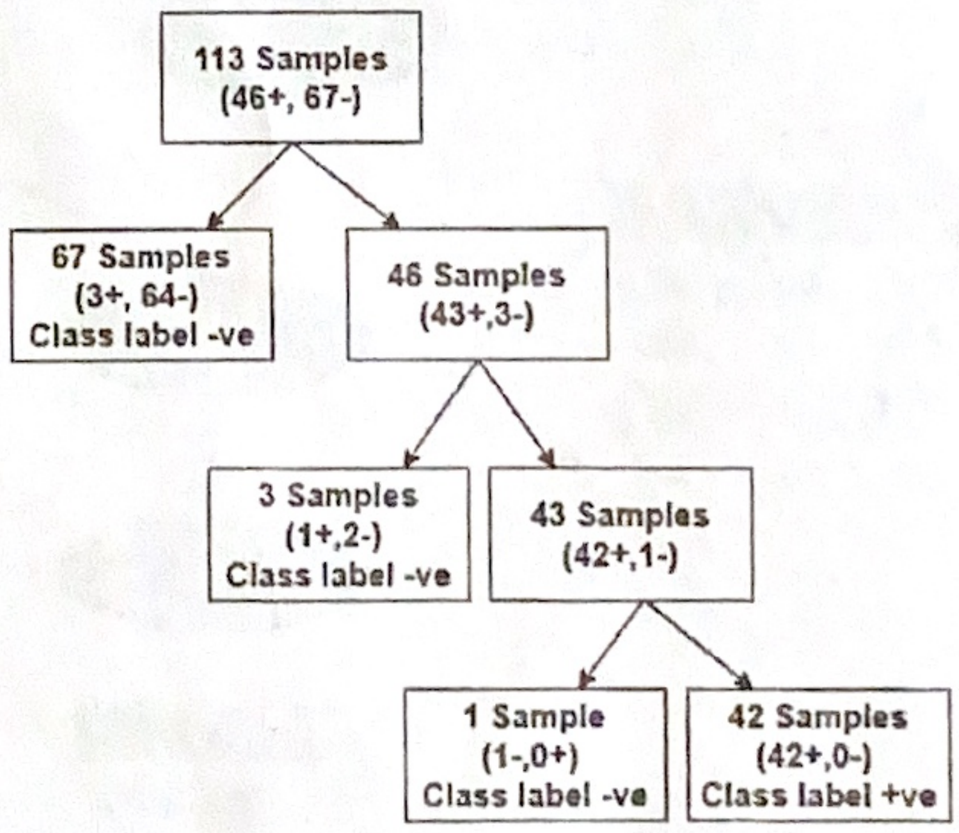

Figure 3.1

CO4 C (b) **i)** Define the terms Support Vectors, Margin Distance in context of Support Vector Machine. What is Hard Margin and Soft Margin SVM? Explain the intuition behind Dual form of Hard Margin SVM. Write all the necessary equations. [6]

ii) What is Kernel trick in SVM? For the given data points x1= [4 1] and x2= [1 4] compute the Kernel Matrix K (Xi,Xj), where K is given by $(1+x_i x_j)^3$.