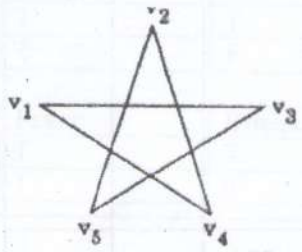
K. J. Somaiya Institute of Technology, Sion, Mumbai-22
(Autonomous College Affiliated to University of Mumbai)

Nov – Dec 2024
(B. Tech.) Program: Computer Engineering Scheme: IIB
Regular Examination: TY Semester: V
Course Code: CEDLC5054 and Course Name: Probabilistic Graphical Models
Date of Exam: 29/11/24 Duration: 02.5 Hours Max. Marks: 60

Instructions:
(1)All questions are compulsory.
(2)Draw neat diagrams wherever applicable.
(3)Assume suitable data, if necessary.

Q. No.	Question	Max. Marks	CO	BT level
Q 1	**Solve any two questions out of three: (05 marks each)**	**10**		
a)	List and explain advantages of probabilistic graphical modeling with suitable examples.		CO1	U
b)	Differentiate between Bayesian Networks and Markov Networks.		CO2	U
c)	What are the properties of Markov Networks?		CO3	U
Q 2	**Solve any two questions out of three: (05 marks each)**	**10**		
a)	What is the causal model? Highlight the difference between causation and correlation with an example.		CO4	U
b)	Differentiate between the concepts of Expected Value and Expected Utility with a suitable example.		CO5	U
c)	Enlist the applications of Hidden Markov Model (HMM). Write in detail application of Part of Speech tagging using HMM.		CO6	U
Q.3	**Solve any two questions out of three. (10 marks each)**	20		
a)	i. Explain Complete Graph and Complement of Graph. Draw Complement of graph for the graph mentioned below: (5 Marks) 		CO1, CO3	Ap

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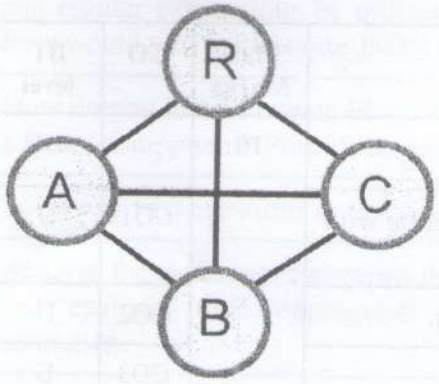
	ii. Explain factor graph concept. Write factors for following Markov network. (5 Marks) 			
b)	i. Illustrate the graph for the given probability distribution: (5 Marks) P(B, A, D, E, M, I) = P(A) . P(B) . P(D|A). P(E|B,A) . P(I|D) . P(M|E) Can the graph be considered as a Bayesian Network Model? If yes, justify your answer. ii. Explain D-Separation concept with example.		CO2	Ap
c)	There is a Mouse moving around a maze. The maze is a closed space containing nine rooms numbered from 1 to 9 and there are doorways connecting the rooms. There are doors leading to adjacent rooms, i.e. there are doors: 1. from 1 to 2, 4 2. from 2 to 1, 3, 5 3. from 3 to 2, 6 4. from 4 to 1, 5, 7 5. from 5 to 2, 4, 6, 8 6. from 6 to 3, 5, 9 7. from 7 to 4, 8 8. from 8 to 5, 7, 9 9. from 9 to 6,8 i. Generate Transition Matrix based on the above information. (5 Marks) ii. What is the probability of the mouse starting from room 2 and reaching room 2 again in two transitions? (5 Marks)		CO3	Ap
Q.4	**Solve any two questions out of three. (10 marks each)**	**20**		

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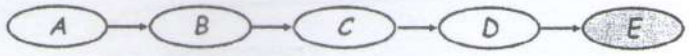
a)	i. Evaluate P(E=e) using variable elimination method method for the given directed graph. (5 Marks)  ii. Elucidate the difference between causal reasoning and evidential reasoning patterns. (5 Marks)		CO4	Ap
b)	i. Explain Maximum Expected Utility (EU) concepts along with its example with mathematical expression. (5 Marks) ii. Calculate the Expected payoff for following scenario using decision tree:(5 Marks) **Scenario:** Suppose the oil company needs to drill for oil wells. They need to decide whether to drill or not on the given site. 1. Drilling cost = \$200 2. If oil found, it's worth of \$900 If the well is dry, the company will get nothing.		CO5	Ap
c)	i. Given a Bayesian network representing a medical diagnosis system with nodes for symptoms (e.g., cough, fever) and diseases (e.g., flu, pneumonia), demonstrate how you would calculate the probability of a patient having the flu given that they have a cough and a fever. Show the steps and explain how conditional probabilities are used in this calculation. ii. Use following probability values and calculate the probability that a patient has the flu given that they have both a cough and a fever, i.e., P(D=Flu|C=Yes,F=Yes)		CO2, CO6	Ap

Disease	P(D)
Flu	0.1
No Flu	0.9

Cough	Flu	P(C|D)
T	T	0.8
T	F	0.2

Fever	Disease	P(F|D)
T	T	0.7
T	F	0.1

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