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

Jan-Feb ~~Nov – Dec~~ 2026
(B. Tech.) Program: Computer Engineering Scheme: III
Supplementary ~~Regular~~ Examination: TY Semester: V
Course Code: CEDLC5054 and Course Name: Probabilistic Graphical Models
Date of Exam: 02/02/26 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)	Differentiate between marginal and joint distributions with an example.		CO1	U
b)	Explain Bayesian network development process for any real life scenario.		CO2	U
c)	Discuss different inference methods in PGM systems with a suitable examples		CO3	U
Q 2	**Solve any two questions out of three: (05 marks each)**	**10**		
a)	What are Template-Based Graph Models? Give a real-life example and explain how templates make it easier to build large Bayesian or Markov networks.		CO4	U
b)	Frank the Weatherman's computer has malfunctioned, so he needs to predict the 7-day weather forecast by hand. To simplify his task, he decides to report only 3 different states, rain (R), cloudy (C), or sunny (S) respectively. From college, he remembers that the transition probabilities for the different weather states are given below. If it is sunny today, what is the probability that the observed weather for the next 7 days is S(today)SSRRSCS? Consider Initial probability of sunny weather Sunny as 0.6. $$A = \{a_{ij}\} = \begin{bmatrix} 0.4 & 0.3 & 0.3 \\ 0.2 & 0.6 & 0.2 \\ 0.1 & 0.1 & 0.8 \end{bmatrix}$$		CO5	Ap
c)	Illustrate the application of PGM systems in Portfolio Optimization.		CO6	U

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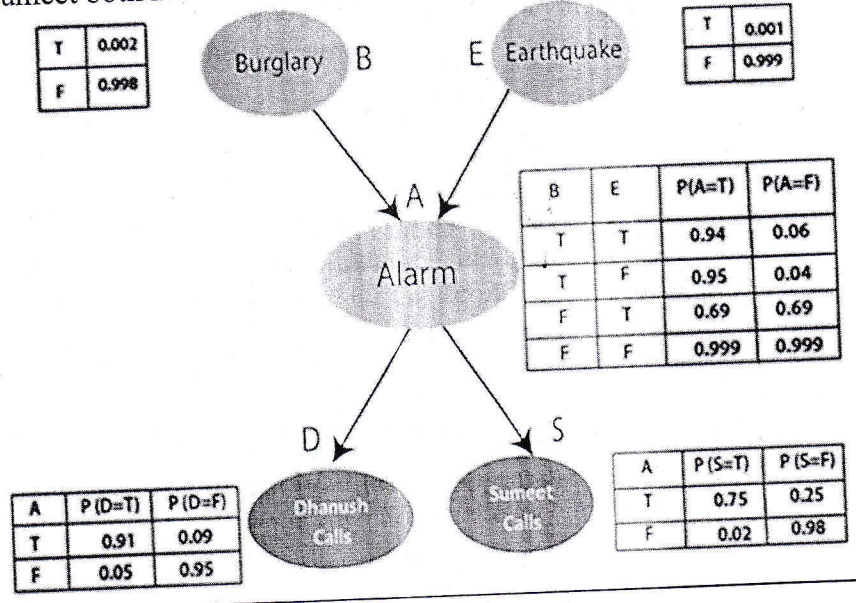
Q.3	Solve any two questions out of three. (10 marks each)	20		
a)	With a suitable example illustrate how Hidden Markov Model can be used for speech recognition.		CO1	U
b)	Amit installed a new burglary alarm at his home to detect burglary. The alarm reliably responds at detecting a burglary but also responds for minor earthquakes. Harry has two neighbors Dhanush and Sumeet, who have taken a responsibility to inform Amit at work when they hear the alarm. Dhanush always calls Amit when he hears the alarm, but sometimes she gets confused with the phone ringing and calls at that time too. On the other hand, Sumeet likes to listen to high music, so sometimes he misses hearing the alarm. Here we would like to compute the probability of Burglary Alarm. Calculate the probability that the alarm has sounded, but there is neither a burglary, nor an earthquake occurred, and Dhanush and Sumeet both have called Amit.		CO2	Ap
c)	A robotic vacuum cleaner moves in an apartment that has 6 rooms. The doors between rooms are: • Room 1 → 2, 4 • Room 2 → 1, 3, 5 • Room 3 → 2, 6		CO3	Ap



T	0.002
F	0.998

T	0.001
F	0.999

B	E	P(A=T)	P(A=F)
T	T	0.94	0.06
T	F	0.95	0.04
F	T	0.69	0.69
F	F	0.999	0.999

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

A	P(S=T)	P(S=F)
T	0.75	0.25
F	0.02	0.98

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	• Room 4 → 1, 5 • Room 5 → 2, 4, 6 • Room 6 → 3, 5 The vacuum always moves randomly to one of the connected rooms. i. Write the transition matrix for this movement. ii. If the vacuum starts in Room 3, what is the probability that it will be in Room 3 again after two moves?			
Q.4	Solve any **two** questions out of three. (10 marks each)	20		
a)	Explain the concept of Template-Based Graph Models with suitable real-time examples. How do templates help in constructing large Bayesian Networks or Markov Networks efficiently?		CO4	U
b)	Explain the role of the Viterbi algorithm in Hidden Markov Model decoding.		CO5	U
c)	Calculate probability for POS tags for sentence 'Book is in the park. Given data:		CO6	Ap

<S>	Book	a	car	</S>			
	Verb	Det.	Noun				
<S>	Park	the	car	</S>			
	Verb	Det.	Noun				
<S>	The	book	is	in	the	car	</S>
	Det.	Noun	Verb	Prep.	Det.	Noun	
<S>	The	car	is	in	a	park	</S>
	Det.	Noun	Verb	Prep.	Det.	Noun	

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