

JAYPEE UNIVERSITY OF INFORMATION TECHNOLOGY, WAKNAGHAT

Test 3 Examination-May-2025

B.Tech -VIII Semester (CSE/IT)

COURSE CODE (CREDITS): 19B1WCI832 (3)

MAX. MARKS: 35

COURSE NAME: Probabilistic Graphical Models

COURSE INSTRUCTORS: Vivek Kumar Sehgal,

MAX. TIME: 2 Hr.

*Note: (a) All questions are compulsory.*

*(b) All the parts of a question should be attempted together and in sequence.*

Q.No	Question	CO	Marks
Q1	(a) Explain how the conditioning algorithm works in probabilistic graphical models. In what way does it offer a time-space tradeoff compared to the variable elimination (VE) algorithm?	CO-3	3
	(b) Given a set of factors $\Phi$ over variables $X$ and a query $Y$ , describe the steps to compute $P_{\Phi}(Y)$ using the conditioning algorithm. Include the role of reduced networks $H_{\Phi}[u]$ in your explanation.		4
Q2	(a) What is the theoretical relationship between the number of operations performed by conditioning and by variable elimination? Under what circumstances does conditioning become less efficient?	CO-3	3
	(b) Suppose you're given a Bayesian network and are required to compute $P(J)$ by conditioning on a variable $G$ . Describe how you would construct the induced graph for the conditioning algorithm and discuss how this graph influences computational complexity.		4
Q3	(a) Derive the time and space complexity for the conditioning algorithm, and explain how the size of the largest clique in the induced graph affects it.	CO-3,4	3
	(b) Discuss how alternating between variable elimination and conditioning, or using network decomposition, can improve the efficiency of the conditioning algorithm. Provide an example scenario where this strategy would be beneficial.		4
Q4	Explain the running intersection property in clique trees. Prove that a cluster tree induced by Variable Elimination satisfies the running intersection property. Why is this property important for exact inference in graphical models?	CO-4	7
Q5	Given a set of factors and a corresponding Bayesian network, construct a clique tree and demonstrate message passing using the sum-product algorithm to compute the marginal probability of a given variable. How does the choice of root affect the execution order?	CO-4	7