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B.M.S. College of Engineering, Bengaluru-560019

Autonomous Institute Affiliated to VTU

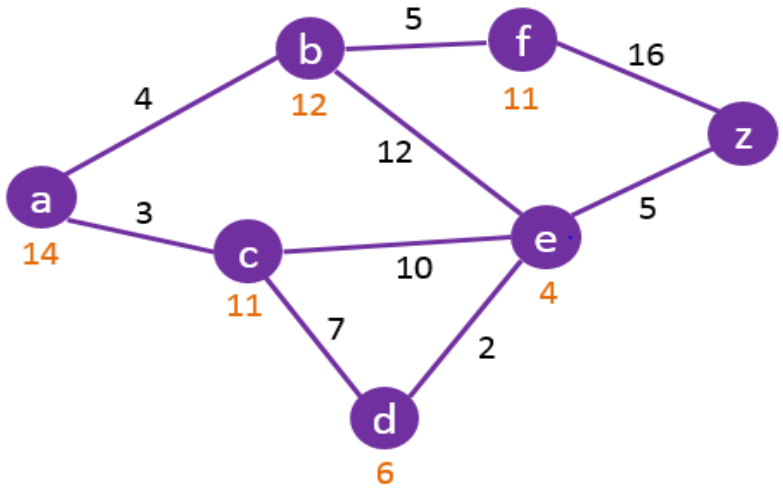
April 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: AIML **Duration: 3 hrs.**
Course Code: 22AM4PCIAI **Max Marks: 100**
Course: Introduction to Artificial Intelligence

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	For the following agents, give a PEAS description of the task environment: i. Hospital Management system ii. Interactive English Tutor iii. Satellite Image Analysis System iv. E-Shopping v. Taxi Driver	*1*	*1*	**10**
	b)	Describe the properties of the task environment.	*1*	*1*	**6**
	c)	Analyze Breadth-First Search with respect to the completeness, optimality, time and space complexity	*1*	*1*	**4**
		UNIT - II			
2	a)	Apply the A* heuristic search strategy on the following graph and obtain the optimal path from starting node 'a' to goal node 'z'. Heuristic values are provided corresponding to each node and in the Table. Further, explain the working and significance of using the A* algorithm.	*1*	*3*	**10**



Nodes	a	b	c	d	e	f
Heuristic Val	14	12	11	6	4	11

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		b)	Illustrate the working of the Hill Climbing heuristic search technique with an example and mention its disadvantages.	*1*	*1*	**6**
		c)	Write the algorithm for Best-first Search.	*1*	*1*	**4**
			OR			
	3	a)	Discuss the following heuristic search strategies: i. Problem Reduction ii. Constraint Satisfaction iii. Simulated Annealing	*1*	*1*	**12**
		b)	Illustrate how Means-Ends analysis could be used to solve the problem of a household Robot moving a desk with two things on it from one room to another.	*1*	*2*	**8**
			UNIT – III			
	4	a)	Distinguish between Forward and Backward reasoning.	*2*	*1*	**8**
		b)	Differentiate between Procedural and Declarative knowledge	*2*	*1*	**6**
		c)	Explain semantic network representation with an example and a neat sketch depicting concepts and relationships.	*2*	*1*	**6**
			OR			
	5	a)	Analyze the following set of statements I. If it rains, Joe brings his umbrella II. If Joe has an umbrella, he doesn't get wet III. If it doesn't rain, Joe doesn't get wet Prove that: "Joe doesn't get wet" using the propositional resolution principle.	*2*	*2*	**10**
		b)	Convert the following English sentences into First-order logic: I. All students are smart. II. Every student helps some student. III. There exists a smart student. IV. Every student takes at least one course. V. No student loves Bill.	*2*	*2*	**5**
		c)	Show that ¬ (p V (¬ p Λ q)) is logically equivalent to ¬p Λ ¬q	*2*	*2*	**5**
			UNIT - IV			
	6	a)	Demonstrate with a suitable example diagrammatically, how Bayesian Networks are used to represent and infer knowledge using joint probability.	*3*	*2*	**8**
		b)	Discriminate between Exact and Approximate inference in Bayesian Networks	*3*	*1*	**5**
		c)	Interpret Bayes rule for Bayesian inference. Consider a medical diagnosis problem in which the data is from a particular laboratory test with two possible outcomes: + (Cancer positive) and - (Cancer negative). Prior knowledge is that over the entire population of people, only **0.008** have this disease.	*3*	*3*	**7**

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			Furthermore, the lab test is only an imperfect indicator of the disease. The test returns a correct positive result in only **98%** of the cases and a correct negative result in only **97%** of the cases. In other cases, the test returns the opposite result. For a new patient with lab test results, should the patient be diagnosed as cancer positive or negative based on Bayesian inference?			
			UNIT – V			
	7	a)	With a neat sketch, explain the basic components of the Expert system.	*3*	*1*	**10**
		b)	List and explain the various characteristics of the Expert system.	*3*	*1*	**6**
		c)	Describe MYCIN Expert system.	*3*	*1*	**4**

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B.M.S. College of Engineering, Bengaluru-560019

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April 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Artificial Intelligence and Machine Learning **Duration: 3 hrs.**
Course Code: 22AM4PCOPS **Max Marks: 100**
Course: Operating Systems

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	CO	PO	Marks
1	a)	i) Define and discuss the operating system with respect to resource management. ii) Illustrate multithreading with an example.	*CO 1*	*PO 1*	**10**
	b)	Enumerate the features of interprocess communication with an example. Describe the implementation of interprocess communication using shared memory and message passing with the help of a diagram.	*CO 1*	*PO 1*	**10**
		UNIT – II			
2	a)	Define race condition. Elaborate the possible solutions to avoid race condition?	*CO 2*	*PO 1*	**10**
	b)	Consider the following set of 5 processes, with the length of the CPU-burst time in milliseconds given below: Process | Burst Time | Priority P1 | 10 | 3 P2 | 1 | 1 P3 | 2 | 3 P4 | 1 | 4 P5 | 5 | 2 The processes are assumed to have arrived in the order P1, P2, P3, P4, P5, all at time 0. Apply priority scheduling algorithm (a smaller priority number implies a higher priority), and Round Robin (quantum= 1) to answer the following questions: i) Draw Gantt charts illustrating the execution of these processes. ii) Calculate the average turnaround time and average waiting for each of the scheduling algorithms.	*CO 3*	*PO 3*	**10**
		OR			
3	a)	Consider the set of 6 processes whose arrival time and burst time are given below-	*CO 3*	*PO 3*	**10**

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			<table><tr><th>Process Id</th><th>Arrival time</th><th>Burst time</th></tr><tr><td>P1</td><td>0</td><td>7</td></tr><tr><td>P2</td><td>1</td><td>5</td></tr><tr><td>P3</td><td>2</td><td>3</td></tr><tr><td>P4</td><td>3</td><td>1</td></tr><tr><td>P5</td><td>4</td><td>2</td></tr><tr><td>P6</td><td>5</td><td>1</td></tr></table> Draw Gantt charts illustrating the execution of these processes using shortest remaining time first (SRTF) scheduling algorithm and calculate the average waiting time and average turnaround time.			
	b)	i) Discuss the solution for Dining Philosopher's problem using semaphores. ii) If each user requires 400kb of memory (350kb code + 50kb data), how much memory is required for 50 users? Shared pages allow "multiple users to share the same memory pages for code" that is identical among them, so how much memory required for 50 users with considering shared pages?	***CO 2***	***PO2***	**10**
		UNIT – III			
4	a)	i) Describe the two ways to keep track of memory usage. ii) With a neat sketch explain the working of virtual memory and also emphasize on its benefits.	***CO 1***	***PO 1***	**10**
	b)	Discuss the working of Working set page replacement algorithm. Apply the same for the following page reference string with window size (W)=5 and calculate the number of page faults, page hits, hit ratio, and miss ratio: 2 ,6 ,1 ,5 ,7 ,7 ,7 ,5 ,1 ,6 ,2 ,3 ,4 ,1 ,2 ,3 ,4 ,4 ,4	***CO 3***	***PO 3***	**10**
		OR			
5	a)	Differentiate Second chance page replacement algorithm from FIFO page replacement algorithm. Apply the same algorithms for the following page reference string with 3-page frames and calculate the number of page faults, page hits, page hit ratio, and page miss ratio: 2 ,3 ,2 ,1 ,5 ,2 ,4 ,5 ,3 ,2 ,3 ,5	***CO 3***	***PO 3***	**10**
	b)	i) Elucidate the working of optimal page replacement algorithm with an example. ii) Explain the process of conversion of virtual addresses to physical addresses with an example.	***CO 1***	***PO1***	**10**
		UNIT – IV			
6	a)	i) With an example, illustrate the advantages and disadvantages of contiguous memory allocation. ii) Assume a hard disk with the following characteristics: a) Number of platters: 2	***CO 3***	***PO 3***	**8**

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			b) Number of surfaces per platter: 2 (upper and lower) c) Number of tracks per surface: 200 d) Number of sectors per track: 50 e) Size of each sector: 512 bytes Find the disk size in terms of KB, MB, and GB?			
		b)	A disk drive has 5000 cylinders, numbered 0 to 4999. The drive is currently serving a request at cylinder 143. The queue of pending requests in FIFO order is: 86, 1470, 913, 1774, 948, 1509, 1022, 1750, 130 Starting from current head position, find is a total distance travelled (in cylinders) by the Disk arm to satisfy the requests using FCFS, SSTF, SCAN and LOOK algorithms.	***CO** 3*	***PO** 3*	**12**
			UNIT – V			
	7	a)	i) Define deadlock. Examine the necessary conditions for the deadlock to occur? ii) Illustrate master – slave shared-memory multiprocessor system with an example.	***CO** 1*	***PO** 1*	**10**
		b)	Consider the following snapshot of a system: Process | Allocation (A B C D) | Max (A B C D) | Available (A B C D) P0 | 2 0 0 1 | 4 2 1 2 | 3 3 2 1 P1 | 3 1 2 1 | 5 2 5 2 | P2 | 2 1 0 3 | 2 3 1 6 | P3 | 1 3 1 2 | 1 4 2 4 | P4 | 1 4 3 2 | 3 6 6 5 | Apply Banker's algorithm to find: i) Is the system being safe? If so, give the safe sequence. ii) If process P2 requests (0, 1, 1, 3) resources, can it be granted immediately?	***CO** 3*	***PO** 3*	**10**

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April 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Artificial Intelligence and Machine Learning **Duration: 3 hrs.**
Course Code: 22AM4PCPSM **Max Marks: 100**
Course: Probability and Statistics for Machine Learning

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

			UNIT - I	CO	PO	Marks
1	a)		You have a standard deck of 52 playing cards. You draw two cards from the deck, one at a time, without replacement. What is the probability that both cards drawn are aces?	CO1	PO2	**06**
	b)		In a certain town, 60% of the residents own a car, 40% own a bicycle, and 25% own both a car and a bicycle. Given this information: i) What percentage of the residents own either a car or a bicycle or both? ii) What percentage of the residents own neither a car nor a bicycle?	CO1	PO2	**06**
	c)		Felicity attends Modesto JC in Modesto, CA. The probability that Felicity enrolls in a M class is 0.2 and the probability that she enrolls in a S class is 0.65. The probability that she enrolls in a M class given that she enrolls in S class is 0.25. i) What is the probability that Felicity enrolls in M and S? ii) What is the probability that Felicity enrolls in M or S classes? iii) Are M and S independent? iv) Are M and S mutually exclusive?	CO1	PO2	**08**
			UNIT - II			
2	a)		Prove that the Geometric distribution has expectation $\mu = 1/p$ and variance $\sigma^2 = (1 - p)/p^2$	CO1	PO2	**10**
	b)		Suppose you are modeling the time between arrivals of bus at a bus stop, and you know that the average time between arrivals is 10 minutes ($\lambda = 1/10$). i) What is the probability that the next bus will arrive within 5 minutes of the previous one? ii) What is the probability that the next two buses will arrive within 15 minutes of each other?	CO1	PO2	**10**

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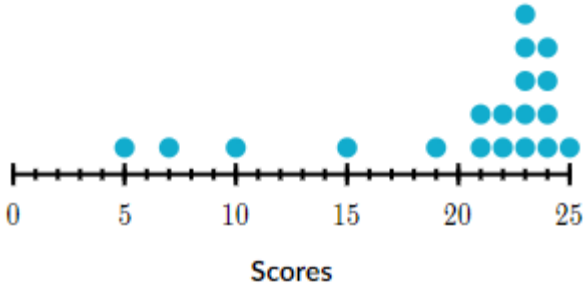
			UNIT - III			
	3	a)	Listed are 29 ages for Academy Award winning best actors in order from smallest to largest. 18; 21; 22; 25; 26; 27; 29; 30; 31; 33; 36; 37; 41; 42; 47; 52; 55; 57; 58; 62; 64; 67; 69; 71; 72; 73; 74; 76; 77 i) Find the percentile for 58. ii) Find the decile for 74.	*CO2*	*PO4*	**06**
		b)	The below figure plots marks scored by students in quiz. Find the outliers?  	*CO2*	*PO4*	**06**
		c)	Prove the unbiasedness, consistency and asymptotic normality properties of the sample means.	*CO2*	*PO4*	**08**
			UNIT - IV			
	4	a)	Find the best estimator of exponential distribution using the method of maximum likelihood estimator.	*CO2*	*PO4*	**08**
		b)	The lifetime of a certain type of automobile component follows a gamma distribution (α, β). The values of α, β are unknown. Assume that three of these components are tried in an independent way and the following lifetimes are measured: 120, 130, 128 hours. Obtain a moment estimator of α, β and solve it for the measured lifetimes. The mean and variance of Gamma distribution is α/β and α/β^2 respectively.	*CO2*	*PO4*	**12**
			OR			
	5	a)	Scores in an exam were normally distributed with a population standard deviation of 5.6. A random sample of 40 scores has a mean of 32. Estimate the population mean with i) 80% confidence. ii) 90% confidence. iii) 98% confidence. Also conclude what effect does increase in confidence level has on critical value, Margin of error and width of confidence interval.	*CO2*	*PO4*	**10**
		b)	A coffee house ABC in Bengaluru had an average rating of customer satisfaction. Later, the coffee house changed their menu and overall ambience of their outlets across the city and conducted a random survey of 225 customers. The question asked was: "Compared to other coffee houses in Bengaluru, would you say the customer satisfaction at ABC is much better than average (5), better than average (4), average (3), worse than average (2), or	*CO2*	*PO4*	**10**

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			much worse than average (1)?" The mean rating was determined to be 3.25. Based on previous study done by the coffee house ABC, it is assumed that σ = 1.5 and it has not changed. Does it indicate, at a 1% level of significance, that the mean customer satisfaction has improved? Explain. Also find the mean customer satisfaction value at $z_{critical}$ = 2.33.			
			UNIT - V			
	6	a)	The time it takes to transmit a file always depends on the file size. Suppose you transmitted 30 files, with the average size of 126 Kbytes and the standard deviation of 35 Kbytes, the average transmittance time was 0.04 seconds with the standard deviation of 0.01 seconds. The correlation coefficient between the time and the size was 0.86. Based on this data, fit a linear regression model and predict the time it will take to transmit a 400 Kbyte file.	*CO3*	*PO3*	**06**
		b)	The following statistics were obtained from a sample of size n = 75: – the predictor variable X has mean 32.2, variance 6.4; – the response variable Y has mean 8.4, variance 2.8; and – the sample covariance between X and Y is 3.6. i) Estimate the linear regression equation for predicting Y based on X. ii) Compute the ANOVA table.	*CO3*	*PO3*	**08**
		c)	At a gas station, 180 drivers were asked to record the mileage of their cars and the number of miles per gallon. The results are summarized in the table. | | Sample mean | Standard deviation | | Mileage | 24598 | 14634 | | Miles per gallon | 23.8 | 3.4 | The sample correlation coefficient is r = -0.17 i) Compute the least squares regression line which describes how the number of miles per gallon depends on the mileage. ii) What does the obtained slope and intercept mean in this situation? iii) Use R^2 to evaluate its goodness of fit. Is this a good model?	*CO3*	*PO3*	**6**
			OR			
	7	a)	Following is the data given about study hours, Sleep hours and marks scored. | Study hours (x_1) | Sleep hours (x_2) | Marks scored (y) | | 3 | 8 | 85 | | 5 | 7 | 89 | | 6 | 7 | 92 | | 8 | 6 | 87 | | 7 | 5 | 84 | Compute the least squares regression equation which describes how the marks scored depend on study hours and sleep hours.	*CO3*	*PO3*	**12**

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		b)	Following is the data given about students' marks. Classify whether student will be admitted to a university or not based on their exam scores. Consider the threshold as 0.5 to classify the students as admitted (1) or not admitted (0) by considering the predicted probabilities. Assume the estimated coefficients are $b_0 = -6.0$ and $b_1 = 0.15$.	*CO3*	*PO3*	**08**

Student name	Marks scored
ABC	34
PQR	45
LMN	67
PQR	78
XYZ	89

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B.M.S. College of Engineering, Bengaluru-560019

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April 2024 Semester End Main Examinations

Programme: B.E. **Semester: IV**
Branch: Artificial Intelligence and Machine Learning **Duration: 3 hrs.**
Course Code: 22AM4PCDAA **Max Marks: 100**
Course: Design and Analysis of Algorithms

Instructions: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.

Important Note: Completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages. Revealing of identification, appeal to evaluator will be treated as malpractice.

		UNIT - I	*CO*	*PO*	Marks

1	a)	Consider the ComparisonCountingSort algorithm given below and answer the following questions:
		
		Algorithm ComparisonCountingSort(A[0..n−1],S[0..n−1])
		//Sorts an array by comparison counting
		//Input: Array A[0..n−1] of orderable values
		//Output: Array S[0..n−1] of A's elements sorted in nondecreasing order
		for i←0 to n−1 do
		Count[i]←0
		for i←0 to n−2 do
		for j←i+1 to n−1 do
		if A[i] < A[j]
		Count[j] ← Count[j] +1
		else
		Count[i] ← Count[i] + 1
		for i←0 to n−1 do
		S[Count[i]] ←A[i]
		i. Analyze the working of ComparisonCountingSort algorithm.
		ii. Apply this algorithm to sort the list 60, 35, 81, 98, 14, 47.
		iii. Is the algorithm stable and in place?
		iv. d. Identify the basic operation. Derive the time complexity based on number of times basic operation is executed.
			CO1	*PO3*	**10**

	b)	Illustrate algorithm design and analysis process with the help of a neat diagram.	*Co1*	*PO1*	**10**
		UNIT - II			
2	a)	Describe quick sort algorithm. Sort the following numbers using quick sort. Derive its time complexities and write recursive call tree for the same. **3,2,1,5,8,4,3,7**	*CO1*	*PO3*	**12**

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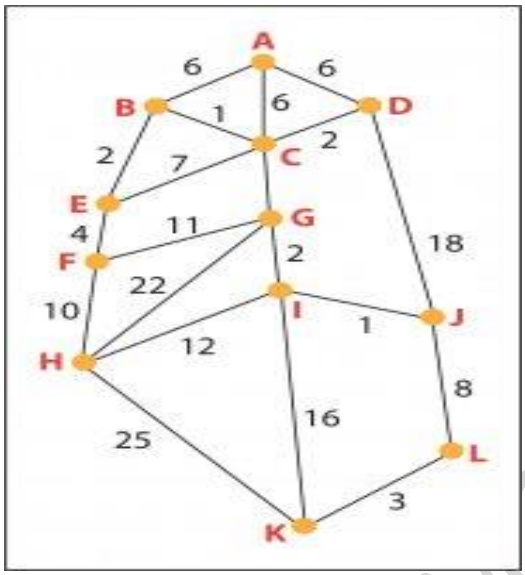
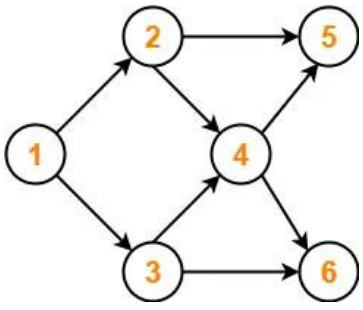
		b)	Consider the graph below where nodes are places and edges are distance between two places. Using greedy approach, provide the best route which help to visit places without any cycles and with the minimum possible total edge weight. Note: Subgraphs can be disjoint graphs.  	*CO1*	*PO3*	**8**
			OR			
	3	a)	Write brute force string matching algorithm. Calculate the number of character comparisons in the worst case, best case and average case with suitable example. Find the Pattern String in the text given below. Text [] = **"no substitute for hard work"** Pattern [] = **"work"**	*CO1*	*PO3*	**12**
		b)	Sort the list {Q, U, E, S, T, I, O, N} in alphabetical order using Bubble sort algorithm. Prove that if bubble sort makes no exchanges on its pass through a list, the list is sorted, and the algorithm can be stopped.	*CO1*	*PO3*	**8**
			UNIT – III			
	4	a)	Find all possible topological sort orderings for the given graph using source removal method-  	*CO3*	*PO3*	**10**
		b)	Generate all permutations of {1,2,3,4} using: i. Lexicographic permute algorithm ii. Johnson trotter algorithm	*CO3*	*PO3*	**10**

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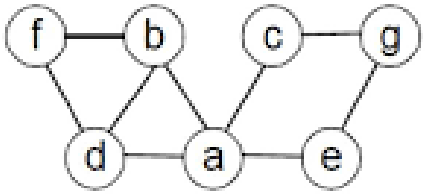
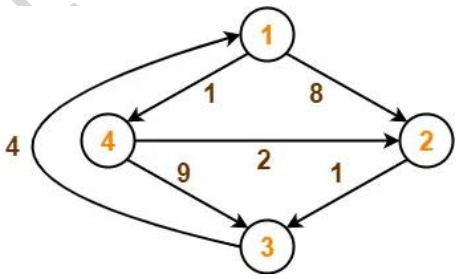
			OR			
	5	a)	Consider the following graph, starting at vertex 'a' and resolving ties by the vertex alphabetical order, traverse the graph by: i. Depth-first search and construct the corresponding depth-first search tree. Reproduce the method followed as an algorithm. ii. Breadth-first search and construct the corresponding breadth-first search tree. 	*CO3*	*PO3*	**10**
		b)	Explain separate chaining and open addressing methods of hashing. Demonstrate the methods by constructing the hash table for the following numbers for the hash function h(x)=x mod 7. **50, 700, 76, 85, 92, 73, 101**	*CO3*	*PO3*	**10**
			UNIT - IV			
	6	a)	Write Heap sort algorithm. Show how the following numbers are sorted by Heap Sort. Provide tree representation of each step. 81, 89,9,11,14,76,54,22	*CO2*	*PO2*	**10**
		b)	i. Write the algorithm to find all pair shortest path using dynamic programming design technique and analyze its efficiency. ii. Identify the shortest path between all pair of vertices for the below graph. 	*CO2*	*PO2*	**10**
			UNIT - V			
	7	a)	Write an algorithm for Backtracking and Derive all possible solutions for 4-Queens problem using Backtracking.	*CO2*	*PO2*	**10**
		b)	Solve the following instance of the Travelling salesman Problem below, assume nodes as cities and distance between them as edges using the Branch and Bound algorithmic design technique.	*CO2*	*PO2*	**10**

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			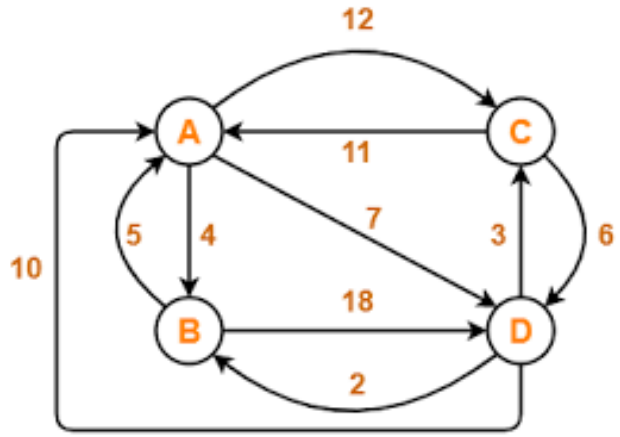			

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