U.S.N.										

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

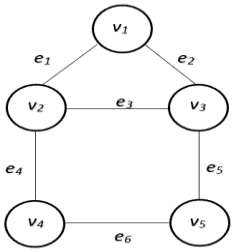
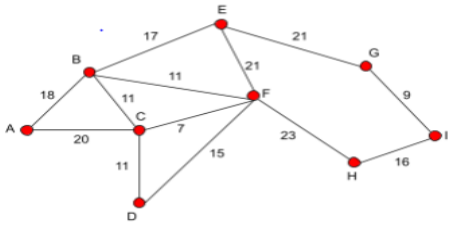
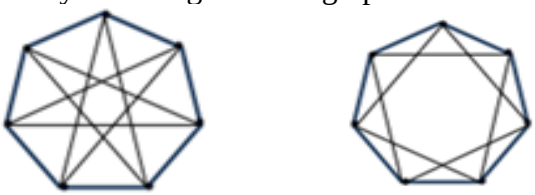
Autonomous Institute Affiliated to VTU

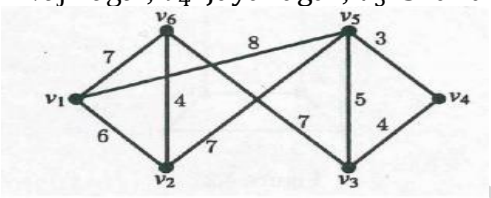
June 2025 Semester End Main Examinations

Programme: B.E. **Semester: III**
Branch: CSE/ISE/CS-DS/CS-IOT/AI-DS **Duration: 3 hrs.**
Course Code: 23MA3BSSDM **Max Marks: 100**
Course: STATISTICS AND DISCRETE MATHEMATICS

Instructions: 1. All questions have internal choices.
2. Missing data, if any, may be suitably assumed.
3. Use of Statistical tables is permitted.

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 - 1	CO	PO	Marks
1	a)	Prove that a connected graph G remains connected even after removing an edge e from G if and only if e is a part of some cycle in G.	1	1	6
	b)	For the given graph, write its adjacency and incidence matrix. Also write any one observation on incidence matrix. 	1	1	7
	c)	Apply Kruskal's algorithm, to find a minimal spanning tree for the following weighted graph and hence find its weight. 	1	1	7
		OR			
2	a)	Verify that the given two graphs are isomorphic or not. 	1	1	6

		b)	A social network is represented as a simple, undirected graph G with 10 vertices, where each vertex represents a person and each edge represents a handshake between two people. i) If the degree of each vertex is 4, how many handshakes(edges) are there in total? ii) If one vertex becomes isolated (degree 0) and the remaining vertices are of degree 4 each, how does it affect the number of edges?	*1*	*1*	**7**
		c)	The numbers on each arc of the given graph represent the distance, in miles, along each road. Vedanth lives in KR Puram and works at Jayanagar. Apply Dijkstra's algorithm to find the minimum distance for Vedanth's journey to Jayanagar. Here v_1: KR Puram, v_2: Hebbal, v_6: Halsur, v_3: Shivajinagar, v_4: Jayanagar, v_5: Shanthinagar.  	*1*	*1*	**7**
			UNIT - 2			
	3	a)	The probability that a news reader commits no mistake in reading the news is e^{-3} . Find the probability that on a particular news broadcast he commits: (i) only 2 mistakes (ii) more than 3 mistakes (iii) at most 3 mistakes.	*1*	*1*	**6**
		b)	The daily turnover in a medical shop is exponentially distributed with Rs.6000 as the average with a net profit of 8%. Find the probability that the net profit exceeds Rs.500on a randomly chosen day.	*1*	*1*	**7**
		c)	The mean height of 500 students is 151cm and the standard deviation is 15cm. Assuming that the heights are normally distributed, find (i) The number of students with heights between 120 and 155cm and (ii) The number of students with height more than 140cm.	*1*	*1*	**7**
			OR			
	4	a)	A person decides to continue placing a bet of Rs.5000 on the number 5 in consecutive spins of a roulette wheel until he wins. On any spin there is a 1 on 50 chances that the ball would land on the number 5. (i) What is the amount he is expected to spend until he has his first win? and (ii) What are the chances that it would take him more than 50 chances to win?	*1*	*1*	**6**
		b)	A bus travels between two cities A and B which are 100 miles apart. If the bus has a breakdown, the distance X of the point of breakdown from the city A has a uniform distribution $U[0,100]$. There are service garages in the city A, city B and midway between the two cities such that in case of a breakdown a tow truck is sent from the garage nearest to the point of breakdown. (i) What is the probability that the tow truck has to travel more than 10 miles to reach the bus? (ii) Would it be more "efficient" if the three service garages were placed at 25, 50 and 75 miles from city A along with service garages in the city A and city B.	*1*	*1*	**7**

		c)	Daily consumption of milk in a town in excess of 20,000 liters is approximately given by Gamma distribution with $\alpha = 2$ and $\beta = 10{,}000$. The town has a daily stock of 40,000 liters. Find the probability that the stock is sufficient on a given day.	*1*	*1*	**7**
			UNIT – 3			
	5	a)	If $f(x,y)$ is a joint probability density function of two continuous random variables X and Y. $$f(x,y) = \begin{cases} c(x^2+y^2), & 0 \le x \le 1, 0 \le y \le 1, c \ge 0 \\ 0 & otherwise \end{cases}$$ Determine (i) the value of the constant c (ii) $P\left(y > \frac{1}{2}\right)$.	*1*	*1*	**6**
		b)	If X and Y are independent random variables. X takes values $2, 5, 7$ with probabilities $\frac{1}{2}, \frac{1}{4}, \frac{1}{4}$ respectively. Y takes values $3, 4, 5$ with probabilities $\frac{1}{3}, \frac{1}{3}, \frac{1}{3}$ respectively. Show that $Cov(X,Y) = 0$.	*1*	*1*	**7**
		c)	Find the value of b for which the matrix $P = \begin{bmatrix} 0 & 2/3 & b \\ 1/2 & 0 & 1/2 \\ 1/2 & 1/2 & 0 \end{bmatrix}$ is a stochastic matrix. Also find the unique fixed probability vector.	*1*	*1*	**7**
			OR			
	6	a)	An ecologist selects a point inside a circular sampling region according to a uniform distribution. Let X be the x-coordinate of the point selected and Y be the y-coordinate of the point selected. If the circle is centered at (0,0) and has radius r, then the joint probability density function of X and Y is $f(x,y) = \begin{cases} c^2 & x^2+y^2 \le r^2 \\ 0 & otherwise \end{cases}$. i) Determine the value of c that makes this a valid joint probability density function. ii) What is the probability that the selected point is within $r/2$ of the center of the circular region? iii) What is the probability that both X and Y differ from 0 by at most $r/2$?	*1*	*1*	**6**
		b)	Two fruits are selected at random from a bag containing 3 Apples, 2 Oranges and 4 Mangoes. If X and Y are respectively, the number of Apples and the number of Oranges included among the two fruits drawn from the bag, then find i) $P(X = Y)$ and ii) $Cov(X,Y)$.	*1*	*1*	**7**
		c)	A housewife buys 3 kinds of cereals A, B and C. She never buys the same cereal in successive weeks. If she buys cereal A, the next week she buys cereal B. However, if she buys cereal B or C, the next week she is three times as likely to buy cereal A as the other cereal. Suppose that she buys cereal A in the first week, find the probability of her buying each of the three brands in the third week.	*1*	*1*	**7**

			UNIT - 4			
	7	a)	If random sample data show that 42 men earn on the average $\overline{x}_1 = 744.85$ with standard deviation $s_1 = 397.7$. While 32 women earn on the average $\overline{x}_2 = 516.78$ with standard deviation $s_2 = 162.523$. Test at 0.05 level of significance whether the average income for men exceeds that of women.	*1*	*1*	**6**
		b)	The average weekly losses of man-hours due to strikes in an institute before and after a disciplinary program was implemented are as follows: Is there a reason to believe that the disciplinary program is effective at 5% level of significance? Before: 45, 73, 46, 124, 33, 57, 83, 34, 26, 17 After: 36, 60, 44, 119, 35, 51, 77, 29, 24, 11	*1*	*1*	**7**
		c)	In one sample of 8 observations, the sum of square of deviation of the sample values from the sample mean was 84.4 and in the other sample of 10 observations it was 102.6. Test whether their variability is same or not at 5% level of significance.	*1*	*1*	**7**
			OR			
	8	a)	Mice with an average lifespan of 32 months will live up to 40 months when fed by a certain nutritious food. If 64 mice fed on this diet have an average lifespan of 38 months and standard deviation of 5.8 months, is there any reason to believe that average lifespan is less than 40 months at 0.01 level of significance.	*1*	*1*	**6**
		b)	In a study on the influence of habitation, the intelligent quotients (IQs) of 16 students from urban area was found to have a mean of 107 and standard deviation of 10, while the IQs of 14 students from a rural area showed a mean of 112 and standard deviation of 8. Determine whether the average IQs differ significantly at 0.01 level of significance.	*1*	*1*	**7**
		c)	A machine is supposed to mix peanuts, hazelnuts, cashews and pecans in the ratio 5:2:2:1. A can containing 500 of these mixed nuts was found to have 269 peanuts, 112 hazel nuts, 74 cashews and 45 pecans. Can we conclude that the machine is mixing the nuts in the stated ratio at 0.05 level of significance?	*1*	*1*	**7**
			UNIT - 5			
	9	a)	Determine the coefficient of $a^2b^3c^2d^5$ in the expansion of $(a + 2b - 3c + 2d + 5)^{16}$.	*1*	*1*	**6**
		b)	Out of 1200 students at a college, 582 took economics, 627 took English, 543 took mathematics, 217 took both economics and English, 307 took both economics and mathematics, 250 took both mathematics and English, and 222 took all three courses. How many took none of the three courses?	*1*	*1*	**7**

		c)	Thirty students take a quiz. Then for the purpose of grading, the teacher asks the students to exchange papers. Find the probability that (i) No one is grading his own paper. (ii) Every student gets his own paper. (iii) Exactly one student gets his own paper.	*1*	*1*	**7**
			OR			
	10	a)	Find the coefficient of (i) x^9y^3 in the expansion of $(2x-3y)^{12}$. (ii) x^0 in the expansion of $\left(3x^2-\frac{2}{x}\right)^{15}$.	*1*	*1*	**6**
		b)	Find the number of permutations of the letters *a, b, c …x, y, z* in which none of the pattern's *spin*, *game*, *path* or *net* occurs.	*1*	*1*	**7**
		c)	Define Catalan number. Using the moves $R:(x,y)\rightarrow(x+1,y)$ and $U:(x,y)\rightarrow(x,y+1)$. Find in how many ways can one go from $(3,8)$ to $(11,16)$ and not rise above the line $y=x+5$.	*1*	*1*	**7**

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