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

**Autonomous Institute Affiliated to VTU**

## June / July 2024 Semester End Make-Up Examinations

**Programme: B.E.** **Semester: III**
**Branch: CSE/ISE/CS-IOT/AI-DS/CS-DS** **Duration: 3 hrs.**
**Course Code: 23MA3BSSDM** **Max Marks: 100**
**Course: Statistics and Discrete Mathematics**

**Instructions**: 1. Answer any FIVE full questions, choosing one full question from each unit.
2. Missing data, if any, may be suitably assumed.
3. Use of Statistical table is permitted





| | | UNIT - 1 | CO | PO | Marks |
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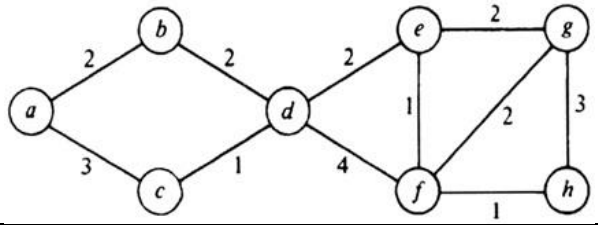
| 1 | a) | The land area is divided into four sections, A, B, C and D by a river. Seven bridges connect these land areas as follows: The bridges 1 and 2 connect A and B, the bridges 3 and 4 connect B and C, the bridge 7 connects A and D, the bridge 6 connects B and D, and the bridge 5 connects C and D.<br>(i) Model the above situation as a graph.<br>(ii) Is it possible to walk across all the bridges exactly once and come back to the same land area? Justify your answer. | CO1 | PO1 | **06** |
| | b) | Construct the graph G for the below incidence matrix and also write the adjacency matrix for the graph G.<br>$\begin{array}{c} \\ v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \end{array}\begin{array}{c} \begin{array}{cccccc} a & b & c & d & e & f \end{array} \\ \begin{bmatrix} 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 1 & 1 \end{bmatrix} \end{array}$ | CO1 | PO1 | **07** |
| | c) | Suppose a telecommunications company wants to connect several cities with fiber optic cables. Apply Kruskal's Algorithm to find the optimal layout of cables to connect all cities minimizing the overall cost. Also find the minimum cost.<br>  | CO1 | PO1 | **07** |
| | | **OR** | | | |
| 2 | a) | Suppose a committee has seven members, these members meet each day for lunch at a round table. They decide to sit in such a way that every member has different neighbours at each lunch. Apply Graph theory to explain the distinct ways of seating arrangements and also list those arrangements. | CO1 | PO1 | **06** |

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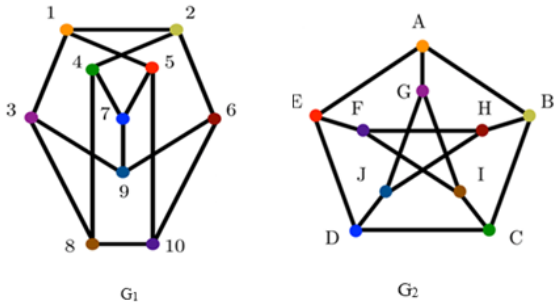
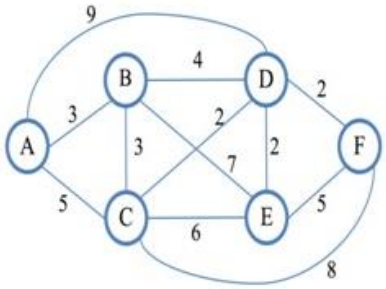
| | | b) | Chemists use molecular graphs to model chemical compounds. When a new compound is synthesized, a database of molecular graphs is given below. Check whether the graph($G_1$) representing the new compound is isomorphic to the graph of a compound($G_2$).<br>  <br><br>$G_1$ $G_2$ | *CO1* | *PO1* | **07** |
| | | c) | The diagram below shows a network of cycle tracks within a national park. The number on each arc represents the time taken, in minutes, to cycle along the corresponding track. Use Dijkstra's algorithm to find the quickest route from A to F. State your quickest route and the time it takes.<br>  <br> | *CO1* | *PO1* | **07** |
| | | | **UNIT - 2** | | | |
| | 3 | a) | A patient suffers kidney failure and requires a transplant from a suitable donor. The probability that a random donor will match this patient's requirements is 0.2.<br>(i) Suppose that no donor matches the patient's requirements until a fifth donor comes in. What is the probability of this scenario?<br>(ii) Find the probability of the patient requiring 10 or fewer donors until a match is found. | *CO1* | *PO1* | **06** |
| | | b) | The lifetime (in months) of a computer has a gamma distribution with mean 24 months and standard deviation 12 months. Find the probability that the computer will<br>(i) last between 12 and 24 months<br>(ii) last at least 24 months. | *CO1* | *PO1* | **07** |
| | | c) | Suppose you order a pizza from your favorite pizzeria at 7:00 pm, knowing that the time it takes for your pizza to be ready is uniformly distributed between 7:00 pm and 7:30 pm.<br>(i) What is the probability that you will have to wait longer than 10 minutes for your pizza?<br>(ii) If at 7:15pm, the pizza has not yet arrived, what is the probability that you will have to wait at least an additional 10 minutes? | *CO1* | *PO1* | **07** |

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| | | | **UNIT - 3** | | | |
| | 4 | a) | The joint probability distribution of two random variables $X$ and $Y$ is given below:<br>$\downarrow X/Y \rightarrow$ \| 1 \| 3 \| 9<br>2 \| $1/8$ \| $1/24$ \| $1/12$<br>4 \| $1/4$ \| $1/4$ \| 0<br>6 \| $1/8$ \| $1/24$ \| $1/12$<br>Find the marginal distributions of $X$ and $Y$. Also evaluate $Cov\,(X,Y)$. | *CO1* | *PO1* | **06** |
| | | b) | Suppose the joint probability density function of $f(x,y)$ is given by $f(x,y)=\begin{cases}\frac{4x+6y}{5} & 0\le x\le 1,\ 0\le y\le 1\\ 0 & \text{otherwise}\end{cases}$.<br>Find (i) the marginal density function of $x$ (ii) the marginal density function of $y$ and (iii) Evaluate $P\left(0<x<1/2\ ,\ 1/4<y<1/2\right)$. | *CO1* | *PO1* | **07** |
| | | c) | Assume that a man's profession can be classified as professional, skilled labourer, or unskilled labourer. Assume that, of the sons of professional men, 80 percent are professional, 10 percent are skilled labourers, and 10 percent are unskilled labourers. In the case of sons of skilled labourers, 60 percent are skilled labourers, 20 percent are professional, and 20 percent are unskilled. Finally, in the case of unskilled labourers, 50 percent of the sons are unskilled labourers, and 25 percent each are in the other two categories. Assume that every man has at least one son, and form a Markov chain by following the profession of a randomly chosen son of a given family through several generations.<br>(i) Write the transition matrix of this Markov chain.<br>(ii) In the long run, what is the probability that a great grandson of a skilled labourer is a professional man. | *CO1* | *PO1* | **07** |
| | | | **UNIT - 4** | | | |
| | 5 | a) | Memory capacity of students was tested before and after giving the nourishing food (Chavanprash). Test at 5% level of significance whether Chavanprash was effective or not for the following data:<br>*Before* \| 12 \| 14 \| 11 \| 8 \| 7 \| 10 \| 3<br>*After* \| 15 \| 16 \| 10 \| 7 \| 5 \| 12 \| 10 | *CO1* | *PO1* | **06** |
| | | b) | A nutritionist is interested in whether two proposed diets, A and B work equally well in providing weight-loss for customers. In order to assess a difference between the two diets, she puts 50 customers on Diet A and 60 other customers on the Diet B diet for two weeks. Those on the former had weight losses with an average of 11 pounds and a standard deviation of 3 pounds, while those on the latter lost an average of 8 pounds with a standard deviation of 2 pounds. Test at 1% level of significance that the diet A is better than diet B in terms of their average weight loss? | *CO1* | *PO1* | **07** |

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| | c) | Two types of instruments for measuring the amount of Sulphur monoxide in the atmosphere are being compared in an air pollution experiment. The following readings were recorded for the two instruments.<br>*Instrument A*: 0.86, 0.82, 0.75, 0.61, 0.89, 0.64, 0.81<br>*Instrument B*: 0.87, 0.74, 0.63, 0.55, 0.76, 0.7, 0.69<br>Assuming the populations of measurements to be approximately normally distributed, test whether the two types of instruments yield measurements having the same variability at 5% level of significance. | *CO1* | *PO1* | **07** |
| | | **OR** | | | |
| 6 | a) | It has previously been recorded that the average depth of ocean at a particular region is 67.4 fathoms. Is there reason to believe this at 0.01 level of significance if the readings at 40 random locations in that particular region showed a mean of 69.3 with standard deviation of 5.4 fathoms? | *CO1* | *PO1* | **06** |
| | b) | A group of 10 rats fed on a *diet A* and another group of 8 rats fed on a different *diet B*, recorded the following increase in weights.<br>*Diet A*: 5, 6, 8, 1, 12, 4, 3<br>*Diet B*: 2, 3, 6, 8, 10, –, –<br>Does it show the superiority of *diet A* over that of *B* in terms of their average increase in weight? Assuming that the two distributions are normally distributed with equal variances. Use 5% level of significance. | *CO1* | *PO1* | **07** |
| | c) | The number of cars passing a given point in 100 five second interval was observed as follows.<br>*No. of cars*: 0, 1, 2, 3, 4, 5<br>*No. of intervals*: 40, 23, 15, 5, 7, 10<br>Fit a Poisson distribution and test for its goodness of fit. Use 1% level of significance. | *CO1* | *PO1* | **07** |
| | | **UNIT – 5** | | | |
| 7 | a) | Define Catalan number. In how many ways can one move from the point $(3,8)$ to the point $(11,16)$ in the $xy$-plane by using the moves $R:(x,y)\to(x+1,y)$ and $U:(x,y)\to(x,y+1)$ moves and without crossing the line $y=x+5$. | *CO1* | *PO1* | **06** |
| | b) | Find the coefficient of<br>(i) $x^{12}y^{13}$ in the expansion of $(2x-3y)^{25}$,<br>(ii) $x^2y^2z^3$ in the expansion of $(3x-2y-4z)^7$. | *CO1* | *PO1* | **07** |
| | c) | In how many ways can the integers 1, 2, 3,…,10 be arranged in a line so that no even integer is in its natural place. | *CO1* | *PO1* | **07** |



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