

(2 ½ Hours)

[Total Marks: 75]

- N.B. 1) All questions are compulsory.
 2) Figures to the right indicate marks.
 3) Illustrations, in-depth answers and diagrams will be appreciated.
 4) Mixing of sub-questions is not allowed.

Q. 1 Attempt All (Each of 5 Marks)

(15M)

(a) Select correct answer from the following:

1. A set with zero characters as a string is called _____ string.
 (a) Null (b) Unit (c) binary (d) ternary
2. A set of minimum edges required to delete for disconnected graph.
 (a) Flow (b) Cut set (c) bridges (d) none
3. Chromatic number of a complete graph with n vertices is _____.
 (a) $n!$ (b) n (c) $n+1$ (d) $n-1$
4. A network is a _____ graph.
 (a) discrete (b) Regular (c) Connected (d) Multigraph
5. The amount of material flowing into a vertex v must _____ to the amount flows out of the vertex.
 a) equal (b) Less than (c) Greater than (d) None

(b) Fill in the blanks:

(Degree, string, $8!$, $\sqrt{11}$, increase, saturated, Flow, 9, Parallel)

1. The number of permutations of the letters in the word COMPUTER is _____.
2. The value of $C(7, 2)$ is _____.
3. If $N = (V, E)$ is a transport network, a function f from E to the nonnegative integers is called a _____.
4. If two or more edges have same terminal vertices then these edges are called _____ edges.
5. Ramsey number, $R(3, 4) =$ _____.

(c) Define the following.

1. Binomial Theorem
2. Addition rule in counting problems
3. Planar graph
4. Clique
5. Saturated edge

Q. 2 Attempt the following (Any THREE)

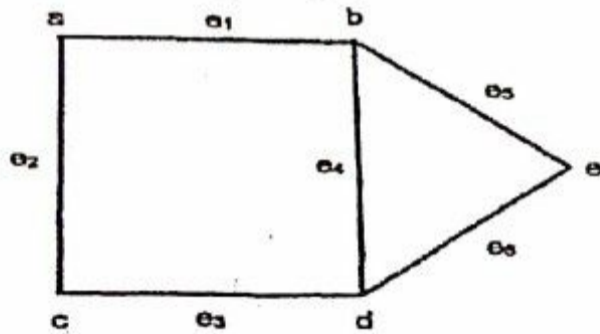
(15M)

- (a) A farmer buys 3 cows, 2 goats and 4 hens from a man who has 4 cows, 3 goats and 8 hens. How many choices does the farmer have?
- (b) Determine the coefficient on xyz^5 in the expansion of $(x + y + z)^7$
- (c) Prove that the sum of first n natural numbers is $\frac{n(n+1)}{2}$.
- (d) Determine all integer solutions to the equation $x_1 + x_2 + x_3 + x_4 = 7$, where $x_i \geq 0$ for all $1 \leq i \leq 4$

- (e) What is Sudoku puzzle? Explain the easiest way to solve Sudoku puzzle and write its three benefits.
- (f) For each $n > 0$, prove that
$$\binom{n}{0} + \binom{n}{1} + \binom{n}{2} + \dots + \binom{n}{n} = 2^n$$

Q. 3 Attempt the following (Any THREE) (15M)

- (a) Explain colouring of graph and Chromatic numbers? Find the chromatic number of the given graph

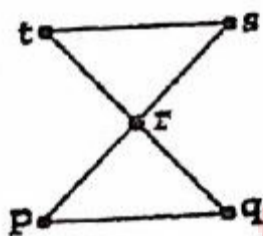


- (b) Define a regular graph. Draw a regular graph with five vertices
- (c) State and prove Ramsey's theorem.
- (d) Define adjacency matrix representation of a graph also draw the graph for

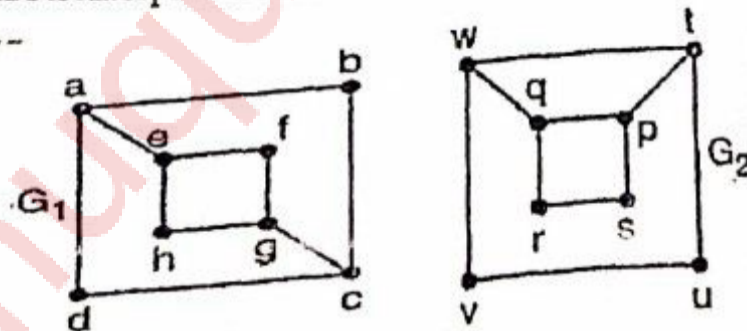
the given adjacency matrix.

$$\begin{bmatrix} 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 \\ 1 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 \end{bmatrix}$$

- (e) Define Euler's path, Euler's circuit and Euler's graph also find an Eulerian circuit in the given graph.



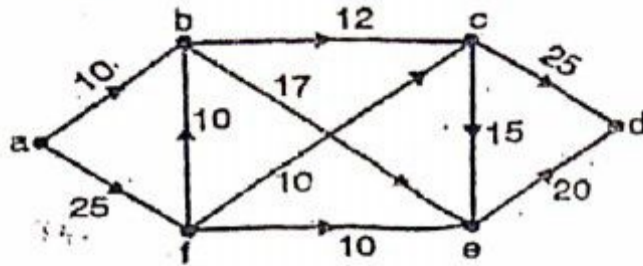
- (f) Explain isomorphism of graphs, Check whether the two graphs G_1 and G_2 are isomorphic or not.



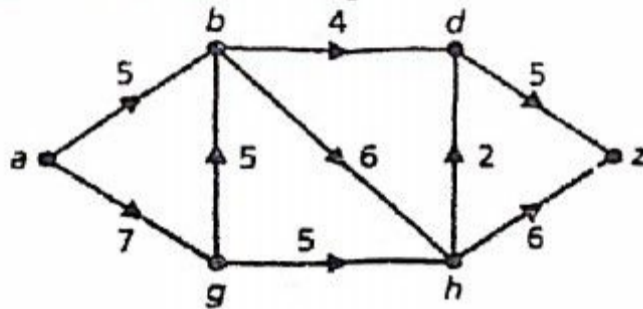
Q. 4 Attempt the following (Any THREE)

(15)

- (a) Use Ford- Fulkerson algorithm to find the maximum flow for the following network:



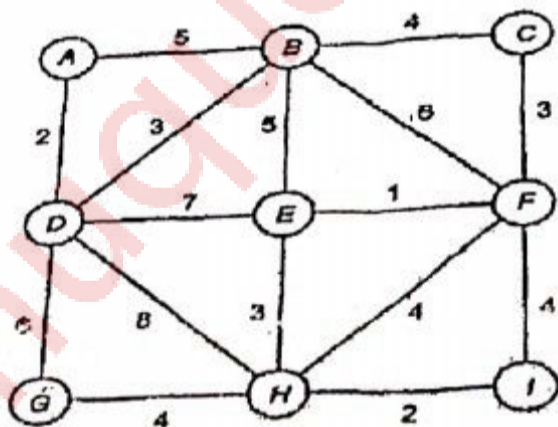
- (b) Define the capacity of cuts. Find the capacity of the cut (P,Q), where $P=\{a, b\}$ and $Q=\{d, g, h, z\}$



- (c) What is a complete matching? Explain with an example.
- (d) Write permutations shown below in cycle notation, compute $\pi_1\pi_2$ (product of two permutations) and inverse of π_1 .
 $\pi_1 = \begin{pmatrix} a & b & c & d & e & f \\ e & f & d & a & b & c \end{pmatrix}, \pi_2 = \begin{pmatrix} a & b & c & d & e & f \\ f & c & a & e & d & b \end{pmatrix}$
- (e) Suppose we are colouring the vertices of the square using black and white colour. Draw the colouring fixed by all possible transformations and explain it in brief.
- (f) What is the integer solution of linear programming problems?

Q. 5 Attempt the following (Any THREE) (15)

- (a) From a standard deck 52 cards, In how many ways we can draw three cards in succession without replacement?
- (b) Find minimum spanning tree of following graph using Kruskal's algorithm.



- (c) Explain Polya's enumeration formula.

- (d) Explain Burnside's Lemma
- (e) Expand $(x + y)^7$ using binomial theorem and find the coefficient of x^4y .

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