

Note: (i) All questions are compulsory.

(ii) Figures to the right indicate marks.

(iii) Illustrations, in-depth answers and diagrams will be appreciated.

(iv) Mixing of sub-questions is not allowed.

Q1. Attempt any four of the following:

(20 marks)

- Given $A = \{1, 2, 3, 4\}$ and $B = \{x, y, z\}$. Let R be the following relation from A to B : $R = \{(1, y), (1, z), (3, y), (4, x), (4, z)\}$
 - Determine the matrix of relation.
 - Find the inverse relation of R .
 - Determine domain and range of R .
- Let $A = \{1, 2, 3, 4, 5\}$ and R be partial order relation defined as $R = \{(1, 1), (2, 2), (3, 3), (4, 4), (5, 5), (5, 3), (5, 1), (4, 3), (4, 2), (4, 1), (3, 1), (2, 1)\}$. Find Hasse diagram of poset A .
- Check whether the function $f: \mathbb{R} \rightarrow \mathbb{R}$ s.t. $f(x) = 3x - 2$ is bijective or not. If yes, find the inverse of f .
- $f(x) = x^2, g(x) = x - 3$.
 - Find $f \circ g$ and $g \circ f$.
 - Find $f \circ g(5)$ and $g \circ f(7)$.
- Solve the following recurrence relation: $a_n = 6a_{n-1} - 9a_{n-2}; a_0 = 1, a_1 = 6$
- Formulate and solve Tower of Hanoi problem.

Q2. Attempt any four of the following:

(20 marks)

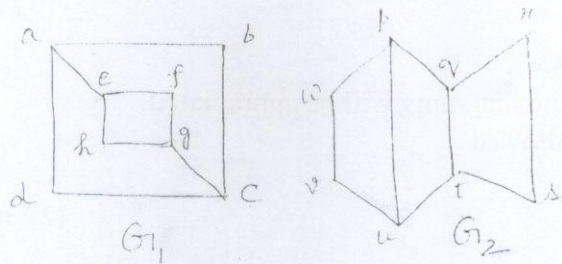
- How many 3 digit numbers can be formed using the digits 0 – 9 if
 - Repetition of digits is allowed.
 - Repetition of digits is not allowed.
- What is the coefficient of $a^3 b^3 c^2$ in the expansion of $(a + 2b - 3c)^6$
- How many minimum numbers must be selected from the set $\{1, 2, 3, 4, 5, 6, 7, 8\}$ to guarantee that atleast one pair of these numbers sums to 9?
- Among 100 students, 55 students passed in Mathematics, 30 passed in Science and 15 passed in both Mathematics and Science. How many students passed in
 - Atleast one subject
 - Only in Mathematics.
- Let G be the phase structure grammar where $T = \{a, b, c\}$, S is the starting symbol and productions are $\{S \rightarrow aSb, aS \rightarrow Aa, Aab \rightarrow c\}$. Find $L(G)$.
- State and prove Pascal's identity.

Q3. Attempt any four of the following:

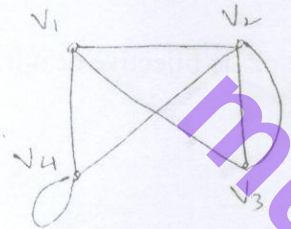
(20 marks)

- Define binary search tree, complete binary tree and extended binary tree using examples.

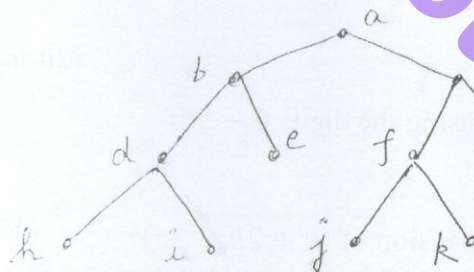
- b. Check whether the following 2 graphs are isomorphic or not.



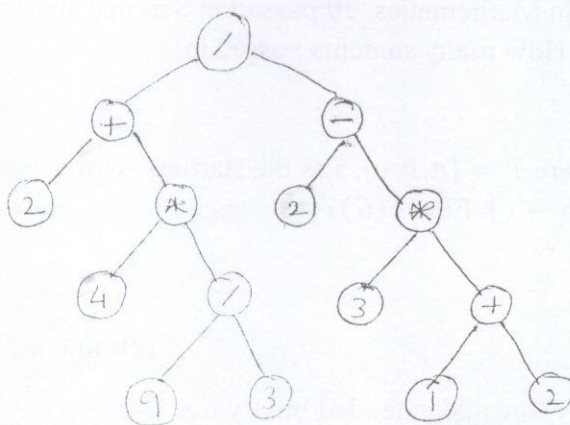
- c. (i) What do you mean by chromatic number of a graph?
 (ii) What is the chromatic number of K_5 (complete graph on 5 vertices) and a complete bipartite graph $K_{3,3}$?
 d. For the following graph, find the degree of all the vertices and the degree of graph.



- e. Traverse the following tree using pre order and post order algorithm



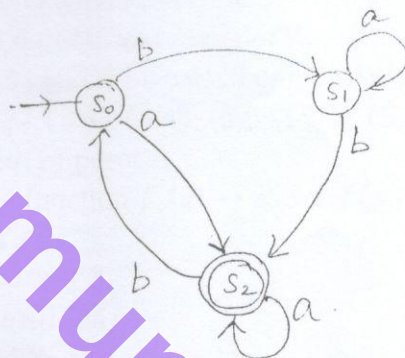
- f. Determine the value of the expression.



Q4. Attempt any three of the following:

(15 marks)

- Formulate and solve recurrence relation representing number of regions in which plane is divided by n number of lines where no two lines are parallel and no three lines intersect at a common point.
- Let A be the set of lines in a plane. Define the relation R on A by $a R b$ if and only if line a is parallel to line b . Show that R is an equivalence relation.
- In how many ways can a committee of 3 men and 2 women be chosen from 7 men and 5 women?
- Consider the following state diagram of finite state automata. Find (a) states (b) input letters (c) Initial State (d) accepting state (e) $f(S_1, b)$ (f) Find State table



- Define the following with examples (i) Isolated Vertex (ii) Simple graph (iii) Regular graph (iv) Complete graph (v) Planar Graph
- Represent the following expressions using binary tree :
 - $(a - b) \div (cd + e)$
 - $(x - xy) + \left(\frac{x}{y}\right)$