

(Time: 2 1/2 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 5Marks)

(a) Choose the best choice for the following questions:

- (i) The number of equivalence relations of the set $\{1,2,3,4\}$ is
 a) 4 b) 15 c) 16 d) 24
- (ii) Let $S = \{1,2,3,4\}$. A relation R defined in S as, $R = \{(1,2), (4,3), (2,2), (2,1), (3,1)\}$ is ___
 a) Transitive b) symmetric c) anti-symmetric d) none of the above
- (iii) The set $\{1,2,3\}$ is not equal to
 a) $\{2,1,3\}$ b) $\{3,2,1\}$ c) $\{1,2,3,4\}$ d) $\{1,2,3,1\}$
- (iv) Which of the following regular expressions identifiers are true?
 a) $(r^*)^* = r^*$ b) $(r+s)^* = r^* + s^*$ c) $r^* \cdot s^* = r^* + s^*$ d) All of these
- (v) In any undirected graph, the sum of degrees of all the nodes ___
 a) Must be even b) Need not be odd c) Must be odd d) Need not be even

(15M)
(5M)

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①

(b) Fill in the blanks. Use following pool to answer question.

(5M)

- Pool(two, zero, universal, warshall's, simple, closed, equal, onto, invertible)
- (i) A ___ path has the same first and last vertices.
- (ii) ___ Algorithm is use to find shortest path.
- (iii) A function $f: A \rightarrow B$ is said be ___ function if each element of B is the image of some element of A .
- (iv) A Type ___ grammar has no restrictions on its production.
- (v) The sum of the degrees of the vertices of a graph G is ___ to twice the number of edges in G .

(5M)

(c) Answer the following questions:

- (i) If ${}^n C_{12} = {}^n C_8$, then n is equal to?
- (ii) Define: Complete Graph.
- (iii) In How many ways can five examinations be scheduled in a week so that no two examinations are scheduled on the same day considering Sunday as holiday?
- (iv) Which of the traversal technique lists the nodes of binary search tree in ascending order?
- (v) What is n , if n is minimum number of integers to be selected from $I = \{1,2,3, \dots, 9\}$ such that the sum of two of the n integers is even?

Q. 2 Attempt the following (Any THREE)(Each of 5Marks)

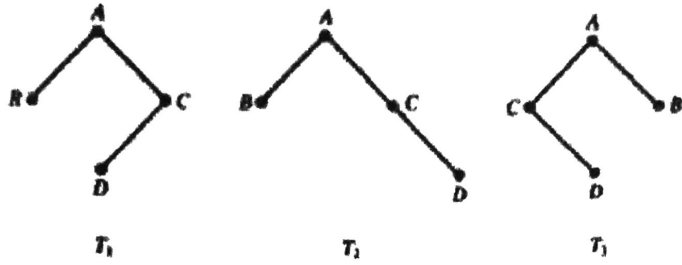
- (a) Determine whether the relation R on the set A is an equivalence relation.
 $A = \{1, 2, 3\}$ $R = \{(1, 1), (1, 2), (2, 1), (3, 3)\}$
- (b) State whether given functions are invertible or not.
 (i) A function $f: Z \rightarrow Z$, $f(x) = x + 5$
 (ii) A function $f: Z \rightarrow Z$, $f(x) = x^2$
- (c) Given $A = \{1, 2, 3, 4\}$ and $B = \{x, y, z\}$. Let R be the following relation from A to B :
 $R = \{(1, y), (1, z), (3, y), (4, x), (4, z)\}$
 (i) determine matrix of relation (ii) Draw the arrow diagram of R
 (iii) Find the inverse relation of R (iv) Determine the domain and range of R
- (d) Let R and S be the following relations on $A = \{1, 2, 3\}$:
 $R = \{(1, 2), (2, 3), (3, 1)\}$, $S = \{(1, 2), (2, 1), (3, 3)\}$
 Find (i) $R \cup S$ (ii) $R \cap S$ (iii) R^{-1}
- (e) Consider the relation $R = \{(1, 3), (1, 4), (3, 2), (3, 3), (3, 4)\}$ on
 $A = \{1, 2, 3, 4\}$.
 (i) Draw its directed graph. (ii) Find the matrix M_R of R
- (f) f, g, h are functions on $X = \{1, 2, 3\}$ as
 $f = \{(1, 2), (2, 3), (3, 1)\}$; $g = \{(1, 2), (2, 1), (3, 3)\}$; $h = \{(1, 1), (2, 2), (3, 1)\}$
 Compute (i) $f \circ g$ (ii) $f \circ g \circ h$

Q. 3 Attempt the following (Any THREE) (Each of 5Marks)

(15M)

- (a) In a certain programming language, variable should be of length three and should be made up of two letters followed by a digit or of length two made up of a letter followed by a digit. How many possible variables? What if letters are not to be repeated?
- (b) How many distinguishable permutations of the letters in the word RADAR are there?
- (c) Of 32 people who save paper or bottles (or both) for recycling, 30 save paper and 14 save bottles. Find the number m of people who (i) save both, (ii) save only paper, and (iii) save only bottles.
- (d) Find the number of ways that a party of seven persons can arrange themselves:
 (i) in a row of seven chairs (ii) around a circular table
- (e) Let $L = \{a^2, ab\}$ and $M = \{a, ab, b^2\}$ be languages over $A = \{a, b\}$.
 Find (i) LM (ii) ML
- (f) Let G be a grammar where $T = \{a, b\}$ and $N = \{S, A, B\}$ with starting symbol S .
 The set of production
 $P = \{S \rightarrow AB, B \rightarrow Bb, B \rightarrow b, A \rightarrow Aa, A \rightarrow a\}$. Find $L(G)$.

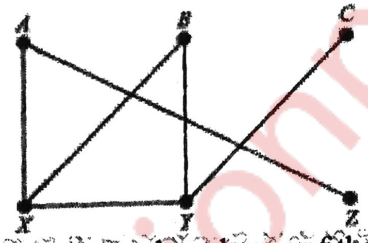
- Q. 4 Attempt the following (Any THREE) (Each of 5Marks) (15)**
- (a) Consider the trees T_1, T_2, T_3 in figure. Identify those which represents the same:
 (i) rooted tree (ii) ordered rooted tree (iii) binary tree



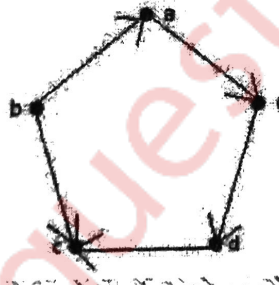
- (b) Construct a preorder sequence for given inorder: 1 2 4 7 3 5 6 8 9
 (c) Draw a tree for the given polish form: $E = / - a b + * c d$
 (d) Draw a multigraph G corresponding to the following adjacency matrix.

$$A = \begin{bmatrix} 0 & 2 & 0 & 1 \\ 2 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ 1 & 1 & 1 & 0 \end{bmatrix};$$

- (e) Let G be a graph. Find all simple paths from A to C and all cycles.



- (f) Find the indegree and outdegree of the vertices given in the figure.



- Q. 5 Attempt the following (Any THREE) (Each of 5Marks) (15)**
- (a) Give first four terms for the given recurrence relation as linear homogenous and find its degree.
 $b_n = -3b_{n-1} - 2b_{n-2}, b_1 = -2, b_2 = 4.$
- (b) In how many ways can a committee consisting of three men and two women be chosen from seven men and five women?