RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. SECOND SEMESTER EXAMINATION, SEPTEMBER 2020

FIRST YEAR [BATCH 2019-22]

Date : 25/09/2020 **COMPUTER SCIENCE (Honours)**

Time : 11.00 am – 7.00 pm **Paper : III [CC3] & IV [CC4]** Full Marks : 50+50

Paper : III [CC3]

Answer **all** questions [10 × 5]

1. a) Explain the following terms with respect to Binary trees (i) Strictly Binary Tree (ii) Complete Binary Tree (iii) Almost Complete Binary Tree. [2+2+2]

   b) Given a set of input representing the nodes of a binary tree, write a non recursive algorithm that must be able to output the three traversal orders. [4]

2. a) Show the AVL tree that results after each of the integer keys 5, 30, 44, 13, 4, 22, and 37 are inserted, in that order, into an initially empty AVL tree. Clearly show the tree that results after each insertion, and make clear any rotations that must be performed. [5]

   b) Compare and contrast between linear search and binary search in terms of their performance and complexity. [5]

3. a) Draw the Binary Tree using the following Preorder and Postorder traversal.
   Preorder: M,S,A,K,Y,C,H,E,D,F,L
   Postorder: A,Y,C,K,S,D,E,F,L,H,M [6]

   b) The degree of a node is the number of children it has. Show that in any binary tree, the numbers of leaves are one more than the number of nodes of degree 2. [4]

4. a) Apply the quick sort algorithm for data set 1, 4, 7, 3, 12, 9, 10, 15, 29, 19. [5]

   b) Write a C program to implement the Merge sort algorithm. [5]

5. a) What do you mean by stack overflow, stack underflow, queue overflow, queue underflow. [4]

   b) Write a C program to implement basic operation of circular queue. [6]

Paper : IV [CC4]

Answer **all** questions [10 × 5]

6. a) Let R be the set of all real numbers. Using the fact that every cubic equation with real coefficients has at least one real root, show that $x \rightarrow (x^3 - x)$ defines a mapping of R onto R. Also check whether this mapping is one-one or not. [5]

   b) Prove that the set $G = \{ (\text{Cos}\Theta + i\ \text{Sin}\Theta) : \Theta$ runs over all rational numbers$\}$ forms an infinite abelian group with respect to ordinary multiplication . [5]

7. a) Let m be any fixed positive integer. Then an integer a is said to be congruent to another integer b modulo m, if (a-b) is divisible by m. Show that the relation ‘ congruent modulo m ‘ is an equivalence relation in the set of integers. [4]

b) Evaluate the number of integers between 1 and 100, which are divisible by only 3 or only 4 or only 5. [4]

c) Write down the conditions by which a Ring can be turned into a Field. [2]

8. a) For the six-a-side football tournament, a team of 6 players has to be chosen from 12 players consisting of 5 forwards, 5 defenders and 2 goalkeepers. The team must include at least 2 forwards, 2 defenders and 1 goalkeeper. Find the number of different ways in which the team can be formed. [4]

b) Find a generating function for the following sequence

0, 1, -2, 4, -8, 16, -32, 64, . . . [3]

c) Suppose a person takes minimum one egg in every day. If he took 50 eggs in a month, then show that he took exactly 9 eggs in consecutive days. [3]

9. a) Solve the following recurrence relation satisfying the given initial conditions

$a_n - 4a_{n-1} + 3a_{n-2} = 2^n$ where $a_1 = 1$, $a_2 = 11$ [5]

b) Let S = {a, b, c}. Show that (P(S), $\supseteq$) forms a poset , where P(S) is the power set of S. Also draw the Hasse diagram representing this poset. [5]

10. a) Show that maximum number of edges in a simple graph with n vertices is n(n - 1)/2. [4]

b) With an example show that two graphs may not be isomorphic even though they satisfy all three conditions of isomorphism [4]

c) Let D be a simple graph on 10 vertices such that there is a vertex of degree 1, a vertex of degree 2, a vertex of degree 3, a vertex of degree 4, a vertex of degree 5, a vertex of degree 6, a vertex of degree 7, a vertex of degree 8 and a vertex of degree 9. What is degree of the last vertex? [2]

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