RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.Sc. THIRD SEMESTER EXAMINATION, DECEMBER 2014

SECOND YEAR

Date : 17/12/2014 **COMPUTER SCIENCE (Honours)**

Time : 11 am – 3 pm **Paper :** III Full Marks : 75

[Use a separate Answer Book for each group]

Group – A

(*Answer **any two** questions*)

1. a) For three nonempty sets A, B and C prove that $A \cap (B \Delta C) = (A \cap B) \Delta (A \cap C)$. [3]
   b) If $U = \{1,2,3,4,5,6,7,8,9\}$, use bit strings to find the union and intersection of the set.
   A = {1,2,3,4,5} and B = {3,4,5,6,7} [2]
   c) Determine whether the poset $(P(S), \subseteq)$ is lattice or not, where P(S) is the power set on S = {a,b,c}. [3]
   d) State and prove "Pigeon Hole Principle". [2]

2. a) How many bit strings contain exactly five 0s and fourteen 1s, if every 0 must be immediately followed by two 1s? [4]
   b) Using Warshall's algorithm, find the matrix of transitive closure of the relation R = {(1,1), (1,4), (2,1), (2,2), (3,4), (4,4)} on the set A = {1,2,3,4} [4]
   c) If R be a relation in the set of integers Z, defined by $R = \{(x, y) : x \in z, y \in z, (x - y)$ is divisible by 6}, then check whether R is equivalence relation or not. [2]

3. a) A computer system considers a string of decimal digits as a valid codeword if it contains an even number of 0 digits. If a_n be the number of valid n-digit codewords, then find a recurrence relation for a_n. [4]
   b) Solve the following recurrence relation using generating function,
   $a_n - 9a_{n-1} + 20a_{n-2} = 0; a_0 = -3, a_1 = -10$. [4]
   c) State and prove "Principle of Inclusion & Exclusion". [2]

4. a) Define Binomial & Normal Distribution with example. [2+2]
   b) On a five-item true of false test, Sachin has 80% chance of choosing the correct answers for any of the questions. Find the complete probability distribution for the number of correct answers that Sachin can get. Then determine the mean, standard deviation of the probability distribution. [4]
   c) What is the conditional probability that a randomly generated bit string of length five contains atleast three consecutive 0s, given that the first bit is a 1? (assume the probabilities of a 0 and a 1 are the same). [2]

Group – B

*Answer **any one** question* :

5. a) Define independence number of a graph with example. [2]
   b) How many simple connected graphs can be constructed with n vertices such that the degree of each vertex is even. Justify you answer. [3]

6. a) Define cutset of a graph with a proper example. [2]
   b) How many tournaments can be drawn with a n vertices. Justify your answer. [3]

*Answer **any one** question* :

7. a) Prove that if a connected planar graph G has exactly n vertices, e edges and f faces then $n - e + f = 2$. [5]

b) Prove that the number of edges in a bipartite graph with n vertices is atmost $\frac{n^2}{4}$.

Suppose all vertices in a graph have odd degree K. Show that the total number of edges in the graph is a multiple of K. [3+2]

8. a) If both G and $\bar{G}$ are trees, then prove that n = 4 or n = 1.

Here n is the number of vertices in the graph. G is the graph and $\bar{G}$ is complement graph of G. The complement of a graph G can be obtained by including all the vertices G and including all the edges that were not the edges in G. That is $\bar{G}$ will contain all the vertices of G and will contain all the edges that were not the edges in G. So $\bar{G}$ will not contain any edge that is included in the edge set of G. [5]

b) Prove that a connected graph G has $n \geq 3$ vertices and the degree of each vertex is at least $n/2$, the G is Hamiltonian. [5]

Group – C

(*Answer **any two** questions*)

9. a) Predict the output of the following C++ programs.

i)
```
Class Test
    {    int x;
         Public :
         Test (int x = 0)
              {
                   this → x = x;
              }
         void change (test *t)
              {
                   this = t;
              }
         void Print ( )
              {
                   cout << "x=" << x << endl;
              }
    };
int main ( )
    {
        Test obj (5);
        Test *Ptr = new Test (10);
        obj. change (Ptr);
        obj. Print ( );
        return 0;
    }
```
[2]

ii)
```
Class Base
    {
        Public :
            Virtual void show ( ) = 0;
    };
Class Derived : Public Base
    {
        Public :
```

```
        void show ( )
            {
                cout << "In Derived";
            }
    };
int main ( )
    {
        Derived d;
        Base &br = d;
        br. show ( );
        return 0;
    }
```
[2]

b) What do you mean by Polymorphism? How is it achieved in C++? [2+3]

c) Give an example where "main()" function can be used as a friend function. [1]

10. a) State the drawback of multiple inheritance. How can you overcome it? [5]

b) Critically comment : "There should be a single catch block followed by a single try block in a program". [3]

c) Give the difference between structure & class construction in C++ with example. [2]

11. a)
```
Test a(5);
Test b;
Test c = a;
b = c;
Test d(c);
```
In the above code segment a, b, c & d are objects of class Test. Discuss when copy constructor & assignment operator overloading will be used in the above code segment. [3]

b) Critically comment : "Class & Function Templates are the tool of code re-use". [3]

c) "Virtual destructor is required while creating a derived class object dynamically through base class pointer"— Comment on it. [4]

12. a) What do you mean by Pure Abstract class? Why we cannot create an object of an Abstract class? [2+2]

b) What do you mean by Explicit class Specializations? [2]

c) Write a program to overload the "new" & "delete" operator. [4]

Group – D

(*Answer **any two** questions*)

13. a) Prove that, the maximum number of nodes in a binary tree of height h is : $2^{(h+1)}-1$ (h >= 0). [3]

b) The inorder and preorder traversal sequence of a binary tree is given below. Construct the binary tree.

Inorder : 4, 7, 2, 8, 5, 1, 6, 10, 9, 3

Preorder : 1, 2, 4, 7, 5, 8, 3, 6, 9, 10 [4]

c) A binary search tree (BST) stores values in the range 37 to 573. Consider the following sequence of keys.

i) 81, 537, 102, 439, 285, 376, 305

ii) 52, 97, 121, 195, 242, 381, 472

iii) 142, 248, 520, 386, 345, 270, 307

Now suppose we are searching for the key 273. Which sequence or sequences of the above are possible. Justify your answer. [3]

14. a) A 3-ary tree is a tree in which every internal node has exactly three (3) children. Prove that the number of leaves in a 3-ary tree with n internal node is 2(n–1)+3.
Here internal node means non leaf nodes. [2]

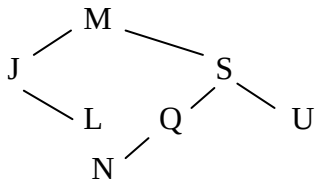
b) Draw two different binary trees with five (5) nodes which when traversed in inorder, gives the same inorder traversal sequence.
What is the number of binary trees with three (3) nodes which when traversed in postorder give the sequence C, B, A.? Draw all such trees. [1+2]

c) N number of files, each containing sorted integers (in ascending order), are stored in the secondary memory. The number of records in each file is so large that you can not process a single file entirely. Give an algorithm to perform merging of the N files such that a single sorted file (in ascending order) gets created. [5]

15. a) Define a Red-Black tree. [2]

b) Construct an AVL tree with the following sequence of numbers. Draw each steps—
5, 6, 9, 7, 8, 10, 4, 3, 2, 1, 11 [4]

c) From the following AVL tree delete L.



Draw the resulting AVL tree after deleting L. You should mention what types of rotations you are using. [2]

d) Briefly mention the differences between B tree and B^+ tree. [2]

16. a) Consider a hash table of size 11. It uses open addressing with linear probing. Let the hash function is defined by h(k) = k% 11. A sequence of records with keys 43, 36, 92, 87, 11, 4, 71, 13, 14 are inserted into an initially empty hash table, the cells of which are indexed from 0 to 10. What is the index of the cell into which the last record is inserted? [4]

b) Discuss double hashing as a collision resolution technique. [3]

c) Construct a heap from the following set of numbers : [3]
5,4,2,7,6,3,1,8,9,10

——— × ———