

# RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College affiliated to University of Calcutta)

B.A./B.Sc. THIRD SEMESTER EXAMINATION, DECEMBER 2015

SECOND YEAR [BATCH 2014-17]

COMPUTER SCIENCE [Hons]

Date : 15/12/2015

Time : 11 am – 3 pm

Paper : III

Full Marks : 75

[Use a separate Answer Book for each group]

## Group – A

Answer **any one** question :

1. Explain the following terms : [2×2·5]
  - a) equivalence relation
  - b) bijective function
2. Define the following terms :
  - a) Mutually exclusive and exhaustive events [2]
  - b) State the Pigeon-Hole principle [3]

Answer **any two** questions :

3.
  - a) For three non empty sets A, B and C prove that  $A - (B \cap C) = (A - B) \cup (A - C)$ . [3]
  - b) How many seven-digit telephone numbers are there that begin with 256 and contain at least one 1 and at least one 0? [3]
  - c) Show that the relation  $(x, y)R(a, b) \Leftrightarrow x^2 + y^2 = a^2 + b^2$  is an equivalence relation on the plane and describe the equivalence classes. [2+2]
4.
  - a) Find a recurrence relation and give initial conditions for the number of bit strings of length n, that do not have two consecutive 0s.  
How many such bit strings are there of length five? [3+1]
  - b) During a month with 30 days, a baseball team play at least one game a day, but no more than 45 games. Show that there must be a period of some number of consecutive days during which the team must play exactly 14 games. [3]
  - c) Find a closed form for the generating function of the following sequence :  
3, 0, -3, 0, 3, 0, -3, 0, 3, ... [3]
5.
  - a) What is conditional probability? State and prove Baye's theorem. [2+3]
  - b) A particle that moves in unit step starting from the origin. Each step is one unit in the positive direction, with probability p along the x-axis and probability  $q = (1 - p)$  along the y-axis. We further assume that each step is taken independently of the others. What is the probability distribution of the position of this particle after five steps? [5]
6.
  - a) Define Ring. [4]
  - b) Show that the set R of all real valued continuous function of x defined over the interval (0,1) form a ring with respect to addition and multiplication defined as follows  
 $(f + g)(x) = f(x) + g(x)$  and  $(f \cdot g)(x) = f(x) \cdot g(x)$ . [6]

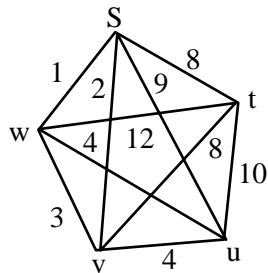
## Group – B

Answer **any one** question :

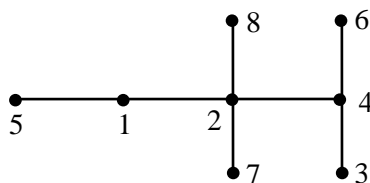
7.
  - a) Define chromatic number of a graph with an example. [2]
  - b) How many distinct hamiltonian cycles are there in a complete graph  $K_n$  ( $n \geq 3$ )? Justify your answer. [3]
8. What do you mean by a degree sequence? Where and how can it be used? [5]

Answer **any one** question :

9. a) Prove that for any graph  $G$ ,  $\alpha_0(G) + \beta_0(G) = n(G)$ ,  $n(G)$  is the number of vertices in the graph  $G$ .  $\alpha_0(G)$  is the maximum size of independent set in  $G$ .  $\beta_0(G)$  is the minimum size of vertex cover in  $G$ . [3]
- b) Find the minimum spanning tree of the following weighted graph using Kruskal's algorithm. Show the construction step by step. [4]



- c) Give the conceptual difference between the Kruskal's and Prim's algorithm to find the minimum spanning tree of a simple graph. [3]
10. a) Prove that every tournament has a hamiltonian directed path. [4]
- b) Prove that every tree  $T$  on  $n$  vertices ( $n \geq 2$ ) contains at least two vertices of degree 1. [3]
- c) How many perfect matchings are there in  $K_{n,n}$  graph. [3]
11. a) Prove that if  $G$  is a simple planar graph with at least three vertices, then  $m < 3n - 6$ . If also  $G$  is triangle free then  $m < 2n - 4$ .  $n$  is the number of vertices in the graph.  $m$  is the number of edges in the graph. [5]
- b) Prove that in any directed graph, the sum of all in-degrees is equal to the sum of all out-degrees. [2]
- c) What is the prufer code of the following tree? [3]



### Group – C

Answer **any one** question :

12. Explain the concept of pure virtual destructor with suitable example. Does its presence make a class Abstract? Justify. [3+2]
13. a) What do you mean by object slicing? [2]
- b) Explain the inheritance property of object oriented programming. [3]

Answer **any one** question :

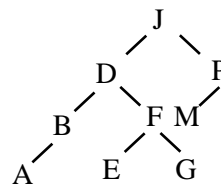
14. a) "Static member functions can only use static data members within it" —Justify. Explain the concept of static object in C++. [3+2]
- b) What do you mean by Name-space? Can Name-space be nested? [2+3]
15. a) What do you mean by 'Handling an exception'? How can you catch multiple exceptions using a single catch block? [2+2]
- b) Explain the concept of template function over loading using suitable example. [3]
- c) What do you mean by name-mangling? Explain with examples. [3]

### Group – D

Answer **any two** questions :

16. a) Consider a non-empty binary tree with " $n$ " nodes. Let  $n_i$  be the no of nodes with  $i$  children ( $i = 0, 1, 2$ ). Then prove that :  $n_2 = n_0 - 1$ . [3]

- b) Select a data structure and give an outline to solve the following problem :  
 “You are supplied with n(given) number of positive integers. The problem is to find the  $k^{\text{th}}$  smallest of the given list of integers. Note that the list of given integers may contain repeated values also.” [4]
- c) Given the root of a binary tree, write an algorithm (or, C code) to find the distance between two given keys  $K_1$  and  $K_2$ . Your algorithm should give appropriate message in case  $K_1$  or  $K_2$  is absent in the tree. [3]
17. a) Sort the following number using heap sort : 2, 3, 81, 64, 4, 25, 36, 16, 9, 49. Show each steps. [5]  
 b) Given the postorder of a binary search tree as follows :  
 20 42 40 38 44 33 22 77 66 99 55  
 If possible, construct the binary search tree. Otherwise, give reasons why it is not possible? [5]
18. a) Define a B tree. Discuss about the advantage and disadvantage of using B-tree. [3]  
 b) From the given AVL tree, delete M indicating the type of rotations used. [2]



- c) Suppose we have a 10,000 character data file :  
 The file contains only 6 characters, appearing with the following frequencies :

Frequency in 100s	a	b	c	d	e	f
	45	5	9	12	16	13

Use Huffman coding to compress the data. How much space will be needed to store this compressed data? [5]

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