ROLL NO. ___________________

Code: AC64/AT64 Subject: DESIGN & ANALYSIS OF ALGORITHMS

AMIETE – CS/IT (Current Scheme)

Time: 3 Hours **JUNE 2015** **Max. Marks: 100**

PLEASE WRITE YOUR ROLL NO. AT THE SPACE PROVIDED ON EACH PAGE IMMEDIATELY AFTER RECEIVING THE QUESTION PAPER.

NOTE: There are 9 Questions in all.

- **Question 1 is compulsory and carries 20 marks. Answer to Q.1 must be written in the space provided for it in the answer book supplied and nowhere else.**
- **The answer sheet for the Q.1 will be collected by the invigilator after 45 minutes of the commencement of the examination.**
- **Out of the remaining EIGHT Questions answer any FIVE Questions. Each question carries 16 marks.**
- **Any required data not explicitly given, may be suitably assumed and stated.**

Q.1 Choose the correct or the best alternative in the following: (2×10)

a. An abstract collection of objects with several operations that can be performed on them is called

(A) Algorithm **(B)** Pseudo-code
(C) Programme **(D)** ADT

b. The efficiency of a recursive algorithm can be analyzed using

(A) Graphs **(B)** Recurrence Relations
(C) Arrays **(D)** Greedy Techniques

c. Selection Sort can be considered as

(A) Brute-Force Algorithm **(B)** Decrease and Conquer Algorithm
(C) Divide and Conquer Algorithm **(D)** Dynamic Programming

d. If Quick Sort is applied to the list 33, 1, 5, 16, 28, 16, 7, 21, 82, find the element whose position will remain unchanged:

(A) 1 **(B)** 21
(C) 5 **(D)** 7

e. The Pre-order and Post-order traversal of a Binary tree generates the same output. The tree can have maximum

(A) Three nodes **(B)** One node
(C) Two nodes **(D)** Any number of nodes

f. The number of edges of a complete Binary Tree with 16 leaf nodes are

(A) 16 **(B)** 30
(C) 8 **(D)** 32

g. If **h** is any hashing function and is used to hash **n** keys in to a table of size **m** where n > m, then the expected number of collisions involving a particular key x is:

(A) log n **(B)** log m
(C) n/m **(D)** m/n

h. The complexity of multiplying two square matrices of order n*n is

(A) n^2 **(B)** 2n
(C) 3n **(D)** n^3

i. Commercial implementation of Gaussian Elimination is based on

(A) Computing LU decomposition **(B)** Computing Matrix Inverse
(C) Computing Determinant **(D)** Computing Transpose

j. The class of decision problems that can be solved by nondeterministic polynomial algorithms is called

(A) NP Complete **(B)** NP hard
(C) NP **(D)** P

Answer any FIVE Questions out of EIGHT Questions.
Each question carries 16 marks.

Q.2 a. Write down Euclid's algorithm for computing **GCD** of two non-negative integer numbers. What does this algorithm do for a pair of numbers in which the first number is smaller than the second one? Execute your algorithm on **GCD**(4121, 5369) **(8)**

b. There are **n** lockers in a hallway, numbered sequentially from 1 to n. Initially all the locker-doors are closed. You make n passes by the lockers, each time starting with locker no: 1. On the i^{th} pass (for i = 1 to n), you toggle the door of every i^{th} locker. That is, if the door is open you close it and if it is closed, you open it. Write a pseudo code to implement these operations. Execute your algorithm for n = 10 **(8)**

Q.3 a. Explain the different asymptotic notations used in expressing the complexity of algorithms? What is the complexity of an algorithm that has only sequential statements? Compare the two functions n^3 and 2^n for various values of n and determine when the second function will become larger than the first function. **(8)**

b. Design a recursive algorithm for computing $2^n=2^{n-1}+2^{n-1}$. Draw a tree of recursive calls for this algorithm and compute the number of calls made for computing 2^n **(8)**

Q.4 a. You have to compute **x mod m** where x is a very large positive integer that your computer can not process. How will you overcome this issue? Write down a pseudo code for your algorithm. **(6)**

b. Write down Strassen's algorithm for multiplying two matrices. Use the algorithm to compute the product of the following two matrices. How would you modify Strassen's algorithm to multiply n x n matrices in which n is not an exact power of 2? **(10)**

$$A = \begin{bmatrix} 2 & 8 \\ 13 & -5 \end{bmatrix} \qquad B = \begin{bmatrix} 6 & -9 \\ -3 & 4 \end{bmatrix}$$

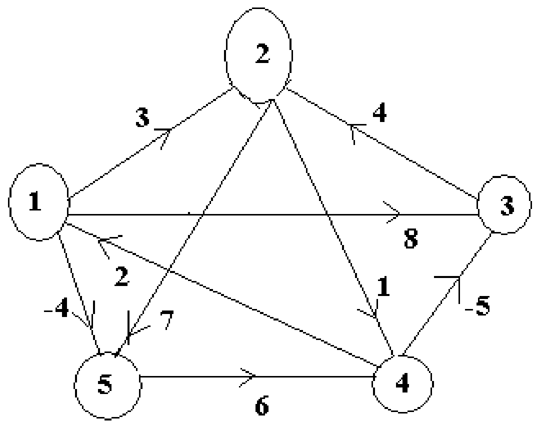
Q.5 a. The first half of an array contains 1 in each cell and the second half contains 2 in each cell. Write an algorithm that shuffles the contents of the array properly with minimum number of exchanges. That is, after shuffling the contents of the array should be 1,2,1,2,1,2… and so on. **(6)**

b. Write an algorithm for finding the k^{th} smallest element (k^{th} order statistic) in a list of n numbers. **(10)**

Q.6 a. Construct a heap for the list 11,8,3,9,25,30,4 by (i) Bottom-up algorithm (ii) Successive key insertion(Top down algorithm). Is it always true that the bottom up and successive key insertion algorithms yield the same heap for the same input? **(10)**

b. Apply Horner's rule to evaluate the polynomial $P(x) = 3x^5 + 2x^4 - 5x^3 + x^2 + 7x + 12$ at $x = 2$. How many multiplications and additions are required to evaluate a polynomial of degree n? **(6)**

Q.7 a. Write down Floyd's algorithm to find the all pairs shortest path of a digraph. Execute your algorithm on the following graph. **(8)**



b. Write down the recursive algorithm for solving Knap Sack problem. Apply your algorithm to solve the following instance of the Knap Sack problem. Capacity of the Knap Sack is 5. **(8)**

Item	**Weight**	**Value**
1	2	Rs.12
2	1	Rs.10
3	3	Rs.20
4	2	Rs.15

Q.8 a. Write down Distribution Counting Sort algorithm. Assuming that the set of possible list-values is [a,b,c,d], sort the following list in alphabetical order by the Distribution Counting Sort algorithm: b,c,d,c,b,a,a,b **(8)**

b. Explain the two parameters that determine the shift size in Boyer Moore string matching algorithm. Apply Boyer Moore algorithm to search for the pattern **aabac** in the text **aaababbaabaaabbbccaabac.** **(8)**

Q.9 a. Apply back tracking search for finding solution to the Four Queen's problem. Explain how this algorithm can be used to find the second solution to the problem. **(8)**

b. Write a pseudo code for the Bisection method for solving non-linear equations. Apply this method to find the root of the equation x^3-x-1 = 0. **(8)**