B.C.S.E 3rd Year 2nd Semester Examination 2015

DESIGN AND ANALYSIS OF ALGORITHMS

Time: **Three hours**   Full Marks: **100**

Answer Question# 1 and any four from the rest

1. Provide an analysis for each of the following algorithms i) heap sort ii) selection sort iii) average case of quick sort and iv) average case of insertion sort.

    4+4+6+6

2. a) Using simple step-counting show how computations for matrix addition can be reduced.
    b) Show that the following equalities are correct:
    $5 * n^2 - 6 * n = \Theta(n^2)$, $n! = O(n^n)$,
    $2 * n^2 * 2^n + n * \log(n) = \Theta(n^2 * 2^n)$, $\Sigma^n_{i=0} i^2 = \Theta(n^3)$.
    c) Show that the following equalities are not correct:
    $10 * n^2 + 9 = O(n)$, $n^2 * \log(n) = \Theta(n^2)$, $n^2 / \log(n) = \Theta(n^2)$.

    6+8+6

3. Draw the game tree for Nim with 5 sticks stating clearly your rule set.

    20

4. a) Devise an algorithm for adding two natural numbers and provide a proof of correctness.
    b) Devise an algorithm for swapping the values of two variables and provide a proof of correctness.

    10+10

5. a) Find the minimum time any comparison-based sorting algorithm can take. If there are four data then what is the minimum number of comparisons that would sort them and by which algorithm? b) Provide a schematic algorithm for sorting disk files.

8+12

6. a) Write a program to find the smallest and the largest in an array by repeatedly taking two consecutive numbers and comparing them. What is its advantage over the common *if...then...else if...* logic?
b) Write a program to compute x^n where n is a +ve integer, taking advantage of the fact that the product is repeatable by nature.

10+10