Government College of Engineering, Amravati
(An Autonomous Institute of Government of Maharashtra)

Sixth Semester B. Tech. (CS / IT)

Summer – 2017

Course Code: ITU601

Course Name: Design and Analysis of Algorithms

Time: 2 Hrs. 30 Min.   **Max. Marks: 60**

Instructions to Candidate
1) All questions are compulsory.
2) Assume suitable data wherever necessary and clearly state the assumptions made.
3) Diagrams/sketches should be given wherever necessary.
4) Use of logarithmic table, drawing instruments and non-programmable calculators is permitted.
5) Figures to the right indicate full marks.

1.   Solve any two:

a)   Give Asymptotic upper bound for T(n).Make your upper bound as tight as possible. You may assume that n is power of 2.   6
1) $T(1) = 1$
   $T(n) = T(n/2) + 1$ if n>1
2) $T(1) = 1$
   $T(n) = 2.T(n/2)+n$ if n>1

b)   Let $f(n)$ and $g(n)$ be asymptotically nonnegative functions. Using the basic definition of Θ notation, prove that
$\max(f(n),g(n)) = \Theta(f(n) + g(n))$.   6

c) What is empirical analysis & theoretical Analys
an algorithm? Explain pros and cons of the empi
& theoretical analysis of an algorithm

2. **Solve any two**

a) Solve the recurrence : $T(n) = 4\,T\left(\frac{n}{2}\right) + n^2$
When n is a power of 2, n≥ 2.

b) What is binomial heap? Explain following opera
on binomial heap H & Also find the time ta'
these operations:
i)Deleting the largest item of a binomial heap H
ii)Inserting a new item into a binomial heap H

c) Find the minimum spanning tree for the given gr
using Prim's algorithm & draw the correspond
weight matrix which shows the updating of weig
after each iteration.
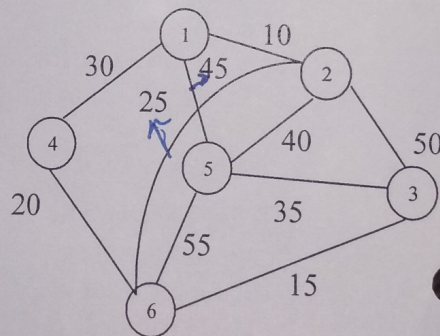
3. **Solve any two**

a) Write algorithm for greedy strategies for the knapsac
problem & find optimal solution to the knapsack
instance n=3, m=20

(p1,p2,p3) = (25,24,15)

(w1, w2,w3) = (18, 15, 10).

b) Expl
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b) Explain the Floyd's algorithm for computing all pairs   **6**
shortest path. Also find the matrix D that gives
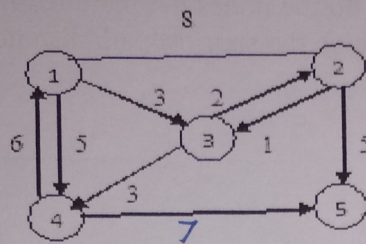
c) Prove that Quick sort takes a time in O(n log n) to sort   **6**
n elements on the average.

Solve the following

4.

a) **Multiple Choice question(Each Carry Two Marks)**   **6**

1) Assume that the algorithms considered here sort the
input sequences in ascending order. If the input is
already in ascending order, which of the following are
TRUE ?

I.   Quicksort runs in $\Theta(n^2)$ time

II. Bubblesort runs in $\Theta(n^2)$ time

III. Mergesort runs in $\Theta(n)$ time

IV. Insertion sort runs in $\Theta(n)$ time

a)I and II only   b) I and III only
c) II and IV only d) I and IV only

2)   Let A1, A2, A3, and A4 be four matrices of
dimensions 10 x 5, 5 x 20, 20 x 10, and 10 x 5,
respectively. The minimum number of scalar
multiplications required to find the product
A1A2A3A4 using the basic matrix multiplication
method is

a) 1500   b) 2000 c) 500   d) 100

3) Suppose we run Dijkstra's single source shortest-

path algorithm on the following edge weighted directed graph with vertex P as the source. In what order do the nodes get included into the set of vertices for which the shortest path distances are finalized?
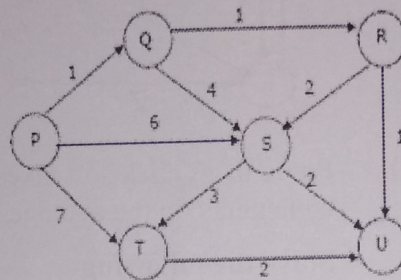
a) P, Q, R, S, T, U

b) P, Q, R, U, S, T

c) P, Q, R, U, T, S   d) P, Q, T, R, U, S

b)   **Multiple Choice question(Each Carry one Marks)**

1) Given an unsorted array. The array has this property that every element in array is at most k distance from its position in sorted array where k is a positive integer smaller than size of array. Which sorting algorithm can be easily modified for sorting this array and what is the obtainable time complexity?

(A) Insertion Sort with time complexity $O(kn)$
(B) Heap Sort with time complexity $O(nLogk)$
(C) Quick Sort with time complexity $O(kLogk)$
(D) Merge Sort with time complexity $O(kLogk)$

2)If every square of the board is visited, then the total number of knight moves of 8-queen problem is

(A) 64   (B) 62

(C) 61   (D) 63

3)The total running time of knapsack problem for a simple approach

Contd..

(A) O(n)   (B) O(log n)

(C) $O(2^n \log n)$ (D) $O(2^n)$

4) Which of the following method is computing total cost of an algorithm in amortized analysis?

(A) Aggregate method

(B) accounting method

(C) potential method

(D) both (C) and (B)

5) The running time of merge sort can be recursively represented by

(A) $T(n)=2T(n/2) + n$

(B) $T(n)=3T(n/2) + n$

(C) $T(n)=4T(n/2) + n$

(D) $T(n)=2T(n/4) + n$

6) If a problem Q is known as NP-hard, then which of the following is true?

(A) if Q is NP then Q is NP Complete

(B) Q is not NP complete

(C) Q is not in NP

(D) Not all problems in NP reduce to Q

5.   **Solve the following**

a)   What is branch and bound technique? Using branch and bound solve the following assignment problem. Also draw the completely explored tree.   6

Agent/ Task	1	2	3	4
A	11	12	18	40
B	14	15	13	22
C	11	17	19	23
D	17	14	20	28

b)   Give the relation between P, NP and NP complete.   6