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MMTE-002

M.Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)
M.Sc. (MACS)

00825

Term-End Examination

June, 2018

MMTE-002 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 2 hours *Maximum Marks : 50*

Note : *Question no.* ***6*** *is* ***compulsory****. Answer any* ***four*** *questions from questions no. 1 to 5. Calculators are* ***not*** *allowed.*

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1. (a) Sort the following numbers using the Quick Sort algorithm : *5*

43, 27, 33, 11, 75, 22

(b) Show the results of inserting the keys

B, R, A, U, H, S, F, T, K, P, M, L, N, W, Q

in order into an empty B-tree with minimum degree 3. *5*

2. (a) Find the gcd of 21 and 35 using the recursive extended Euclidean algorithm. *5*

(b) Construct the Huffman tree for the following data :

Character	A	B	C	D	E
Probability	0·35	0·1	0·2	0·2	0·15

Obtain the codes for the characters. 5

3. (a) Determine a longest common subsequence of the following sequences using dynamic programming : 5

X : (0, 1, 1, 0, 1, 0)

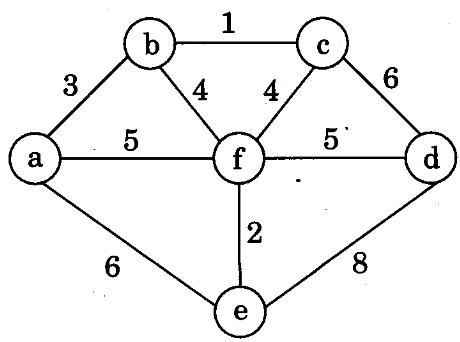
Y : (1, 1, 0, 0, 0, 1)

(b) Construct the max-heap for the following array :

20	8	14	18	11	13	7	6	12	5

Show all the steps, while doing so. Further, sort the array using heap-sort. 5

4. (a) Draw the minimum spanning tree using Prim's algorithm for the following graph, starting with vertex c : 5



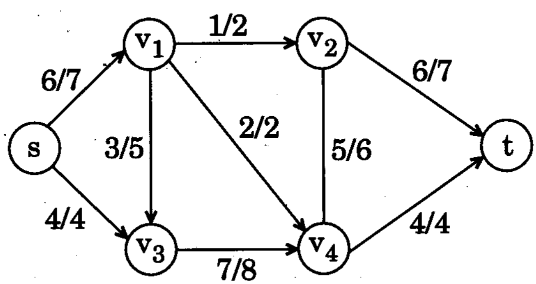
(b) Solve the recurrence relation

$$T(n) = T\left(\frac{n}{4}\right) + T\left(\frac{3n}{4}\right) + O(n),$$

using the recursion tree method. 5

5. (a) Multiply the polynomials $A(x) = x^2 + x + 1$ and $B(x) = x^2 - 3x + 1$, using their point value representation. 5

(b) For the following network flow, draw the residual network :



Find an augmenting path p and use it to augment the flow. Draw the flow network of the augmented flow. 5

6. Which of the following statements are *True* and which are *False* ? Give reasons for your answers. 10

(a) Any array in ascending order is a min-heap.

(b) The fractional knapsack problem can be solved optimally using a dynamic programming based strategy.

(c) The number of keys in a B-tree of minimum degree t and depth d is at most $((2t-1)^{d+1}-1)/2^d$.

(d) The congruence $ax \equiv b \pmod{n}$ has at least one solution for any natural number a, b and n.

(e) For any weighted graph, there is a unique minimal spanning tree.