No. of Printed Pages : 4

MMTE-002

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

00402

M.Sc. (MACS)

Term-End Examination

December, 2014

MMTE-002 : DESIGN AND ANALYSIS OF ALGORITHMS

Time : 2 hours *Maximum Marks : 50*

Note : *Do any **five** questions from questions no. **1** to **6**. Use of calculators is **not** allowed.*

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1. (a) Find 9^{560} (mod 561) using modular exponentiation algorithm. *4*

   (b) Compute the Discrete Fourier Transform of (2, 2, –1, 1). *2*

   (c) Describe counting sort algorithm. Is counting sort stable ? Justify your answer. *4*

2. (a) Show that if all edges of a graph have distinct weights, then there exists a unique minimum weight spanning tree. *5*

(b) Consider the following algorithm :

Algorithm Find Min (A[1, 2, ... , n])

```
min = A[1];
for i = 2 to n
    do if A[i] < min
        then min = A[i]
return min
```

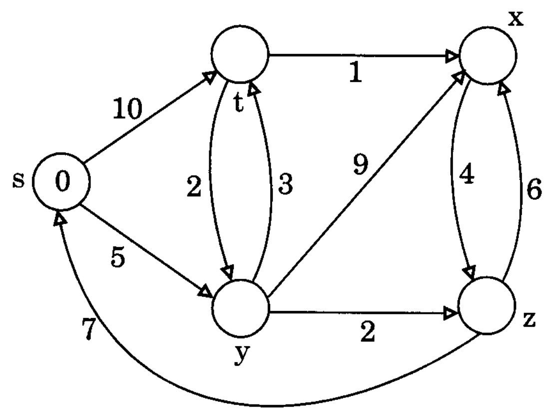
Formulate a loop invariant and using it prove that the algorithm correctly finds minimum element. 5

3. (a) Illustrate worst case performance of quicksort, through an example. 4

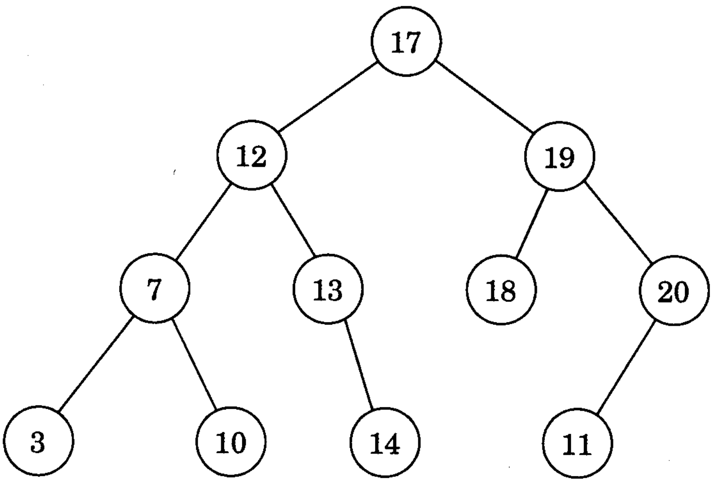
(b) Show that, if $n \geq 1$, then for any n-key B-tree T of height h and minimum degree $t \geq 2$ is given by $h \leq \log_t \frac{n+1}{2}$. 3

(c) Give the pseudocodes for MAKE-SET, UNION and LINK for finding disjoint-set forests. 3

4. (a) Simulate execution of Dijkstra's algorithm for the following example : 5



(b) Explain why the tree given in the figure below is not a binary search tree. Change the value of at most one key so that it becomes a binary search tree.



Also give the sequence of nodes examined if

(i) we apply the procedure Tree-Minimum.

(ii) we search the tree for the key 14.

(iii) we insert the key "9". *5*

5. (a) Find an optimal parenthesization of a matrix-chain product whose sequence of dimension is (5, 10, 3, 12, 5). *5*

(b) What is the Huffman Code for the following set of frequencies :

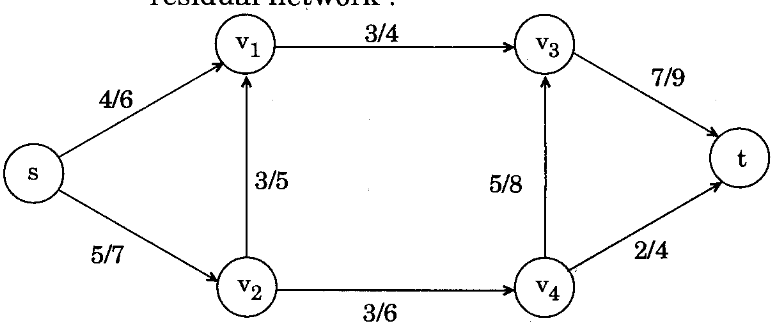
a	b	c	d	e	f
70	32	26	23	16	14

Show all the steps of the algorithm. Also, compute the number of bits required to encode the data. *5*

6. (a) Assuming that all elements in a max-heap are distinct, where could possibly the smallest element reside in a max-heap ? Justify your answer. *2*

(b) Define activity selection problem and describe a greedy algorithm for it. *3*

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



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