NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY
FACULTY OF APPLIED SCIENCE
COMPUTER SCIENCE DEPARTMENT
AUGUST EXAMINATIONS 2009

SUBJECT: DATA STRUCTURES AND ALGORITHMS

CODE: SCS2103

INSTRUCTION TO CANDIDATES

This question paper consists of seven[7] questions
Answer **five** questions only
Each question carries 20 Marks
Figure 5.1 should be used for questions 6&**7**

Time: 3 hours

QUESTION ONE

(a)   Explain the meaning of algorithmic complexity   [2]
(b)   Differentiate between Best case, Worst case and Average case   [4]
(c)   (i)   What does the big O represent   [2]
       (ii)Why are $O(n^2)$ and $O(n)$ not considered equivalent   [2]
(d)   Calculate the asymptotic complexity of the following code snippets below
       using (big O notation) with respect to problem size n

       (i)   for(i=0,i< n, i++)
                 for(j=0,j<n,j++)
                 k++
               }   [3]

       (ii)   for(i=0, i < n,i++)
                     k++
               for(i=0, i < n,i++)
               for(j=0,j < n;j++)
               k++
               }   [3]

       (iii)   Show that $f(n)=2n^2 +7n + 6$ is $O(n^2)$ using the definition of big O
                                                                       [4]

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QUESTION TWO

(a)   With the aid of diagrams explain the following
(i)   Single linked list   [2]
(ii)   Circular Linked list   [2]
(iii)   Doubly Linked list   [2]

(b)   How does a linked list avoid the draw backs of arrays   [2]
(c)   Write an algorithm that
      (i)   adds elements to a list   [4]
      (ii)   searches for elements within a list   [4]
      (ii)   deletes elements within a list   [4]

QUESTION THREE

(a)   Define a stack and give two applications of a stack   [4]
(b)   Assuming a stack is represented using a singly linked list with the top of
      the stack at the end of the list. The singly linked list only keeps track of
      the head of the list. Give the code for the push and pop methods   [10]
(c)   What is the running time of each method   [6]

QUESTION FOUR

(a)   What is a queue   [2]
(b)   Write a definition of
      (i)   the member function enqueue of a class Queue   [5]
      (ii)   the member function Dequeue of a class Queue   [5]
(c)   Discuss the advantages and disadvantages of a queue   [5]
(d)   There are many uses of queues in computer science. Explain how queues
      may be applied to printers   [3]

QUESTION FIVE

(a)   Insert the following numbers into a binary search tree in the order they
      are given and give the resultant tree.
      87, 36,22,15,56,85,48,90,72,6   [6]
(b)   Write simple code to delete 48 and draw the resultant tree   [7]
(c)   Write a short code for computing the depth of a node V in a Binary tree T
                                                                     [4]
(d)   Use the big O notation to characterize the worst case-running time of your
      method in terms of the number n of nodes in the binary tree T.   [3]

QUESTION SIX

a) What is a spanning tree [3]
b) Describe Kruskal's algorithm for finding minimum spanning tree [6]
c) Describe two methods for finding connected subgraphs [4]
d) Consider the following graph,using Kruskal's algorithm,calculate the minimum spanning tree,listing edges in the minimum spanning tree in the order they are ordered to the tree [7]
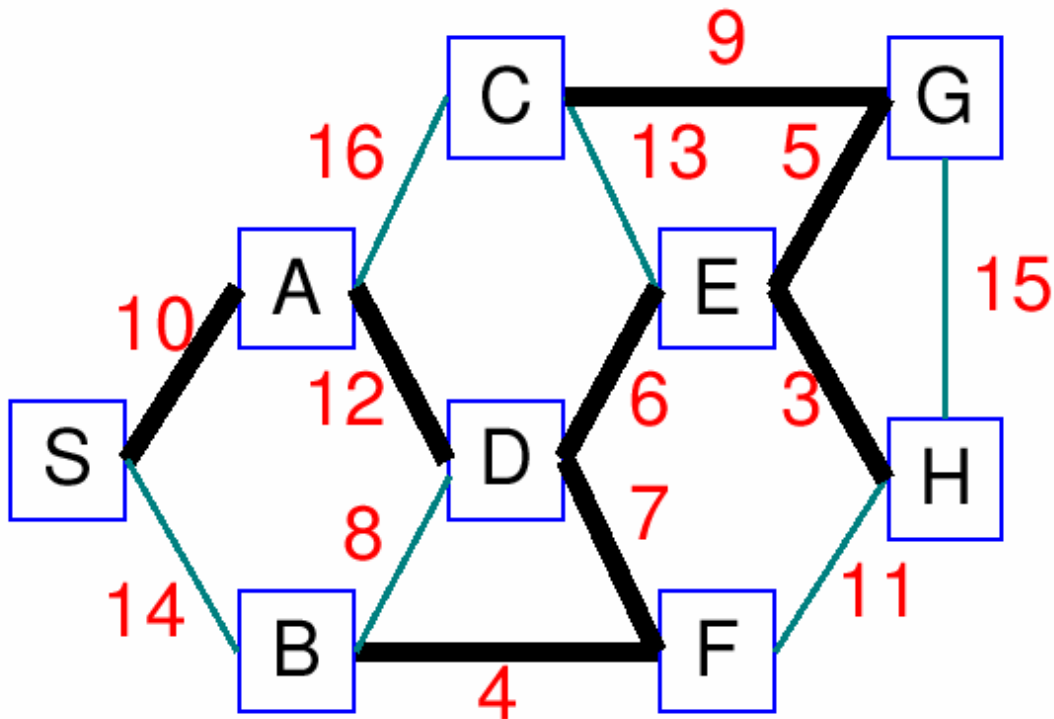

Figure 5.1 Graph (For Questions 6&7)

QUESTION SEVEN

a) Describe Djikstra's algorithm for finding the shortest path in a graph [6]

b) Consider Figure 5.1.Apply Dijkstra's algorithm for this graph to calculate the shortest path from S to every other node .Store the entries in the table, best Best-known Distances.
Show the entries in the table after you finish computing the shortest distance from S to nodes in the set (S,A,B). [9]
c) Which node would be processed next using Djikstra's algorithm [1]
d) Update the table BestKnownDistances after adding this node [4]

END OF QUESTION PAPER

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