AIN SHAMS UNIVERSITY
FACULTY OF ENGINEERING
Computer and Systems Engineering Department
Third Year Computer Engineering Students

2nd Semester, 2014-2015	Course Code: CSE32 3	Time : 3.00 Hrs

Programming and Data Structures

The exam consists of **six** Questions in **Three** Pages.   **Total Marks: 110 Marks**   1/3

Question 1 [14 Marks]

State True or False and <u>justify</u> your answer:

a) The maximum number of nodes in a tree (where each node has maximum B children) that has L levels is B^L (B to the power L)

b) A queue should be used when implementing Breadth First Search (BFS).

c) In a binary tree, every node has exactly two children.

d) Binary Search Tree (BST) operation like insert typically run in $O(d)$ time where d is the number of nodes in the tree.

e) In a heap, the left child of a node is always less than the right child of a node.

f) The linked-list implementation of a graph is more efficient than matrix representation in finding whether two vertices are directly connected or not.

g) The order in which elements are inserted in a binary search tree in unimportant.

h) An inorder traversal always processes the elements of a tree in the same order, regardless of the order in which the elements were inserted.

i) The running time of finding the maximum element in a heap is $O(logN)$ where N is the number of elements in the heap.

j) The largest value in a binary search tree (BST) is always stored at the root of the tree.

k) An $O(logN)$ algorithm is slower than an $O(N)$ algorithm.

l) Adding an element to existing heap -and reheaping- takes $O(N)$ time.

m) To delete a dynamically allocated tree, the best traversal method is postorder

n) Implementing a priority queue using a heap is more efficient than using a linked-list.

Question 2 [18 Marks]

Given the following infix expression $((x-4)*y+3)/2$

a) Represent the expression using binary tree that contains either operand like x, 4, 3 or operator like * , + [do not represent the parentheses]   [4 Marks]

b) If x= 10 and y = 2, evaluate the expression   [2 Marks]

c) Translate the expression into postfix   [4 Marks]

d) Show how to use the expression tree to generate postfix translation of the given expression   [4 Marks]

e) Using stack show step by step how to evaluate this expression   [4 Marks]

Question 3 [16 Marks]

It is required to count the nodes of a binary search tree of integer values.

a) Write down a class for the single node of the binary search tree   **[4 Marks]**

b) Write down a recursive function in C++ to find the total number of nodes **[4 Marks]**

c) Write down an iterative function in C++ to find the total number of nodes **[4 Marks]**

d) Compare recursion with iteration in terms of (i) big O and (ii) simplicity   **[4 Marks]**

Question 4 [20 Marks]

**Write C++ code or an algorithm to**

a) Check if a given array is a heap or not   **[5 Marks]**

b) Add the values inside the nodes of a linked list of integers   **[5 Marks]**

c) Print a linked list content in a reverse order   **[5 Marks]**

d) Print a binary tree in postorder   **[5 Marks]**

Question 5 [24 Marks]

Given the following undirected graph

a) Represent this graph using matrix or linked list **[4 Marks]** and justify your choice **[2 Marks]**

b) Using **Prim** algorithm, show step by step how to find Minimum spanning tree for the given graph **[6 marks]**
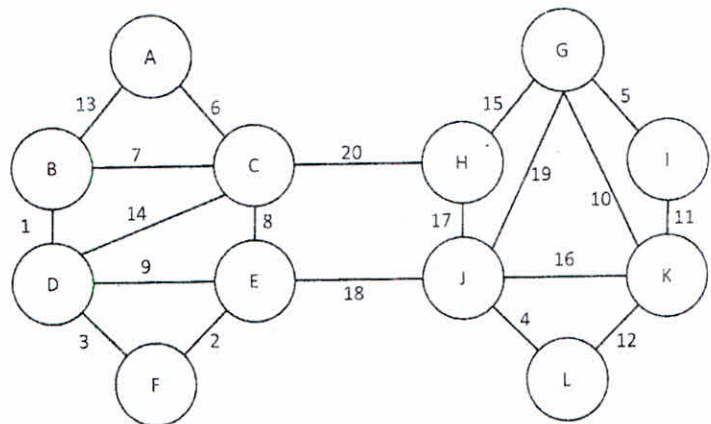
c) Starting from node A, Traverse this graph using breadth first search (BFS), show the order of the nodes visited and the queue contents (<u>assume</u> nodes appear alphabetically i.e. A→B→C→D→E→F→G→H→I→J→K→L) <u>mark</u> the node once you add it to the queue, <u>do not</u> add already visited/marked nodes   **[6 marks]**

d) Using **Dijkstra** algorithm, find the shortest path starting from node B and ending at node K   **[6 marks]**

Exam. Date : 31May 2015
*Dr. Islam El-Maddah*

Question 6 [18 Marks]

Complete the following statements with short answers or choose one answer from between parentheses. In your answer sheet write the short answer and the question number.

a) In a single linked list, the operation of deleting the last node has big O of _____

b) Perfect hash table should have find operation with big O of _____

c) Two different binary search trees (with the same elements but different arrangement) have the same _____ traverse

d) Suppose that a heap containing 85 elements and it is stored in an array. The heap root is in index 0, the left child of node with index 5 is _____ and the parent of the child with index 37 is at index_____ the first leaf node is found at index_____ .

e) The largest value of a binary search tree is always stored at _____

f) A complete directed graph with 8 vertices has _____ edges.

g) The height L of a balanced full binary tree with 15 nodes is _____ .

h) A hash table with the hash function **h(i) = i – Offset**, where offset is a constant is has a disadvantage of _____
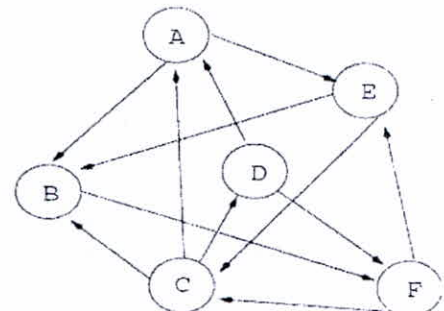
i) Given the following binary tree

The depth of the node with value 11 is _____
This binary tree is (left justified, balanced, heap, binary search tree)
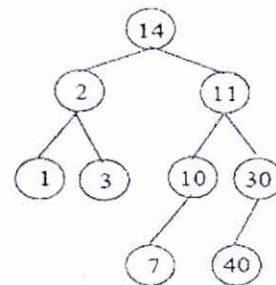
j) Given the following graph:
   - This is a (connected, complete, connected and complete) graph it is (directed, undirected) graph

   - Draw its linked-list representation (store the vertices in alphabetical order).

   - Draw one possible spanning tree starting from node A

GOOD LUCK