(Knowledge for Development)

KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

SPECIAL/SUPPLEMENTARY EXAMINATIONS
YEAR TWO SEMESTER TWO EXAMINATIONS

FOR THE DEGREE OF
(COMPUTER SCIENCE)

COURSE CODE : CSC 225

COURSE TITLE : DATA STRUCTURES

DATE: 27/07/2022 **TIME:** 08.00 A.M – 10.00 A.M

INSTRUCTIONS TO CANDIDATES

ANSWER **QUESTIONS ONE AND ANY OTHER TWO.**

QUESTION ONE (COMPULSORY) [30 MARKS]

a) What is an Abstract Data type? **[1 marks]**

b) How are arrays different from linked lists? **[2 marks]**

c) Briefly describe one situation each where an array would be the data structure of choice and one situation where a linked list would be preferable. **[2 marks]**

d) Describe an implementation strategy for each of the following data structures: **[4 marks]**

   i. Stack

   ii. Queue

e) Name any two methods of sorting. **[2 marks]**

f) Illustrate the operation of any one of the sorting algorithms described in part (e) above on the following list of integers **[2 marks]**

   67, 33, 21, 84, 49, 50, 75

g) What is a binary search tree data structure? **[2 marks]**

h) What are the three general categories of data management operations? **[3 marks]**

i) What is the main difference between a stack and a queue? **[2 marks]**

Suppose we begin with an empty stack, and perform the following operations: push 7, push 2, push 9, push 6, pop, pop, peek, push 1, push 3, peek, push 8, pop, peek, pop, pop, push 5, push 4, pop, pop, pop, push 8. What is contained on the stack when we are done? Write out the contents from top to bottom. 7 8 **[3 marks]**

j) The diagram below shows an array representation of a binary tree. Draw the tree. [3 marks]

K	I	B	A	B	I	I		C	A	M	P	U	S

k) Explain how a stack can be used to determine if an infix expression is correctly parenthesized. **[2 marks]**

Time complexity and space complexity

l) Name and describe the two types of algorithm efficiency. **[2 marks]**

QUESTION TWO [20 MARKS]

a) Distinguish between a tree and a graph **[2 marks]**

b) Draw the directed graph that is represented by the following and determine if the resulting graph is i) connected, ii) complete: **[6 marks]**

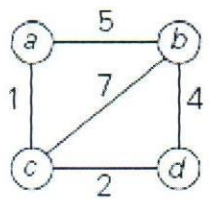
Vertices: 1, 2, 3, 4, 5, 6, 7

Edges: (1, 2), (1, 4), (2, 3), (2, 4), (3, 7), (4, 7), (4, 6), (5, 6), (5, 7), (6, 7)

c) Describe two principal methods for representing graphs for computer algorithms stating with reasons which method you would use for a sparse graph. **[6 marks]**

d) Consider the weighted graph given below:

Given the graph below, represent the weighted graph using the two representation methods described in part i) of (c) above. **[6 marks]**



QUESTION THREE [20 MARKS]

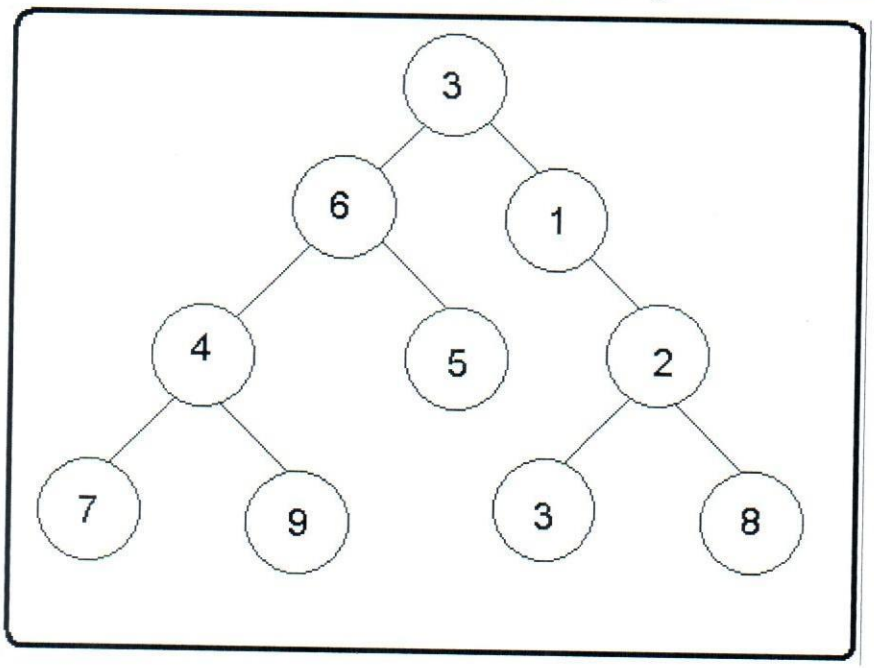
a) Name and describe clearly two ways in which binary trees can be implemented in a computer program outlining conditions under which would you choose one over the other. **[6 marks]**

b) Construct a binary search tree (BST) to hold the following letters K, C, B, D, R, Q, U **[3 marks]**

The binary search tree is said to suffer from lopsidedness. What does this mean? **[2 marks]**

c) Name the three traversal orders. **[3 marks]**

d) If during traversal of a tree, the value of the visited node is printed, what would be the output of the traversing the following tree using the three traversal orders: **[6 marks]**



QUESTION FOUR [20 MARKS]

a) Explain how the stack data structure can be used in the evaluation of postfix expressions **[4 marks]**

b) Determine the expression tree for the following expression:

(2 * x) / (5 + 3 * y) - (4 * z - 1) [6 marks]

c) Construct a Huffman code for the following data: **[6 marks]**

Character	A	B	C	D	E
Probability	0.1	0.1	0.2	0.2	0.4

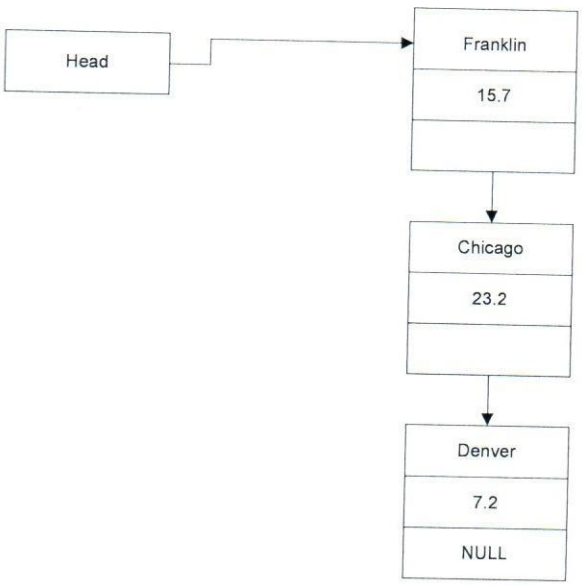
d) Encode the text ABACABAD using the code of question c) above. **[2 marks]**

e) Decode the text whose encoding is 100010111001010 in the code of question b). **[2 marks]**

QUESTION FIVE [20 MARKS]

a) Draw a diagram of a linked list that contains nodes with data items of type String that contains the name of a county and type double that contains a poverty index. Include an instance variable named head to indicate the beginning of the list. Insert the following nodes: Kisumu, 15.7, Kilifi, 23.2, Kajiado, 7.2.

[4 marks]



b) Write a method `searchList` that recursively outputs the items in a linked list object in reverse order. Write a test program that creates a list of integers and prints the list in reverse order.

[6 marks]

c) Create a generic Node class in Java to represent the linked list depicted in your diagrams above.

[10 marks]