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**KIRIRI WOMENS' UNIVERSITY OF SCIENCE AND TECHNOLOGY
UNIVERSITY EXAMINATIONS, 2020/2021 ACADEMIC YEAR
FIRST YEAR, FIRST SEMESTER EXAMINATION
FOR THE DEGREE OF BACHELOR OF BUSINESS INFORMATION
TECHNOLOGY**

KBI 2104 THEORY OF ALGORITHMS

Date: 18th December, 2020

Time: 8.30am – 10.30am

INSTRUCTIONS TO CANDIDATES

ANSWER QUESTION ONE (COMPULSORY) AND ANY OTHER TWO QUESTIONS

QUESTION ONE (30 MARKS)

- a) Define the following terms;
- i) Data structure
 - ii) Abstract data structure
 - iii) Asymptotic algorithm analysis
 - iv) Algorithm
- (4 Marks)
- b) Convert the expression $((A + B) * C - (D - E) ^ (F + G))$ to equivalent Prefix and Postfix notations.
- (6 Marks)
- c) Draw the symbolic representation of the **stack** data structure after implementation of the following sequence of member function calls.
- ```
S.push(5);
S.push(17);
S.push(35);
S.pop();
S.push(53);
S.push(35);
S.pop();
S.pop();
```

(4 Marks)

- d) Given the following scenarios, state and explain the most suitable ADT to use.
- i) Maintaining a banks customer accounts where “accounts’ updates” (deposits and withdrawals via ATMs) are more than “account additions and deletions” (account opening and closing).
  - ii) Maintaining the history of web sites visited in a browser.
  - iii) Checking if expression has the correct set of delimiters.
- (5 Marks)
- e) Giving an example of application area in each case, briefly describe the following data structures
- i) Queue
  - ii) Stack
  - iii) Priority queue
- (6 Marks)
- f) Explain two benefits and limitations of using arrays as form of implementing ADTs.
- (4 Marks)

### **QUESTION TWO (20 MARKS)**

- a) For a tree data structure and using a suitable diagram, briefly explain the following concepts.
- i) Degree
  - ii) Level or depth of a node
  - iii) Leaf
  - iv) Child
- (8 Marks)
- b) Describe the following algorithm design techniques.
- i) Divide & conquer algorithm design
  - ii) Greedy algorithm algorithm design
  - iii) Dynamic programming
- (9 Marks)
- c) Give the advantages and disadvantages of both selection and bubble sort algorithms.
- (3 Marks)

### **QUESTION THREE (20 MARKS)**

- a) Given an array  $int\ LA() = \{1,3,5,7,8\}$ ; Write the algorithms to:-
- i) Traverse the array
  - ii) Insert item = 10 in to the array
  - iii) Delete item at array index  $k = 3$
- (12 Marks)
- b) With the help of diagrams, describe three types of linked lists.
- (8 Marks)

**QUESTION FOUR (20 MARKS)**

- a) Briefly describe the Binary Tree data structure. (2 Marks)
- b) Draw the binary search tree you get by inserting the following sequence into an initially empty tree:  
14, 15, 4, 9, 7, 18, 3, 5, 16, 4, 20, 17, 9, 14, 5 (7 Marks)
- c) Conduct the following tree traversals.  
i) Preorder traversal  
ii) Inorder traversal  
iii) Postorder traversal (9 Marks)
- d) Deduce the significance of constructing a BST and conducting an inorder traversal on it. (2 Marks)

**QUESTION FIVE (20 MARKS)**

- a) Briefly explain five basic properties of an algorithm. (5 Marks)
- b) Consider a search for the key value 9 in the following array of size 15.

|        |   |   |   |   |    |    |    |    |    |    |    |    |    |    |    |       |
|--------|---|---|---|---|----|----|----|----|----|----|----|----|----|----|----|-------|
| 3      | 5 | 6 | 8 | 9 | 11 | 12 | 14 | 17 | 20 | 28 | 29 | 33 | 36 | 42 |    |       |
| first= | 0 | 1 | 2 | 3 | 4  | 5  | 6  | 7  | 8  | 9  | 10 | 11 | 12 | 13 | 14 | =last |

- (i) Write a binary search algorithm. (5 Marks)
- (ii) Using diagrams, illustrate the process of locating key value 9 using binary search. (10 Marks)