	<b>COLLEGE OF COMPUTING AND INFORMATION SCIENCES</b>		
	<b>Final-Term Assessment Fall 2020 Semester</b>		
<b>Class Id</b>	105067/105088	<b>Course Title</b>	Data Structures and Algorithms
<b>Program</b>	BSCS	<b>Campus / Shift</b>	Main Campus / Evening
<b>Date</b>	05-12-2020	<b>Total Marks</b>	60
<b>Duration</b>	03 hours	<b>Faculty Name</b>	Muhammad Naveed
<b>Student Id</b>		<b>Student Name</b>	

#### **Instructions of Online submission**

- Filling out Student-ID and Student-Name on exam header is mandatory.
- Do not remove or change any part of exam header or question paper.
- Write down your answers in given space or at the end of exam paper with proper title "Answer for Question# \_ \_".
- Answers should be formatted correctly (font size, alignment and etc.)
- Handwritten text or image should be on A4 size page with clear visibility of contents.
- Only PDF format is accepted (Student are advise to install necessary software)
- In case of CHEATING, COPIED material or any unfair means would result in negative marking or ZERO.
- A mandatory recorded viva session will be conducted to ascertain the quality of answer scripts where deemed necessary.

**Caution:** Duration to perform Final-Term Assessment is **03 hours only**. Extra 01 hours are given to cater all kinds of odds in submission of Answer-sheet. **Therefore, if you failed to upload answer sheet on LMS (in PDF format) within 04 hours limit, you would be considered as ABSENT/FAILED.**

#### **Instruction of Paper:**

- Attempt all parts of the same question in the given order.
- Attempt all questions on the answer sheet.
- You're not allowed to assume anything. Strictly stick to the mentioned requirements.

#### **QUESTION#1 – STACKS**

**[06 points]**

##### **Part (a) [04]**

Show the progress of converting the infix expression " $((8+2^5) * (9-3))/2$ " to its postfix expression using a stack.

##### **Part (b) [02]**

Suppose an initially empty stack  $S$  has executed a total of 25 push operations, 12 top operations, and 10 pop operations, 3 of which raised Empty errors that were caught and ignored. What is the current count of elements in the stack  $S$ ?

#### **QUESTION#2 – Recursion**

**[19 points]**

##### **Part (a) [02+04+04]**

Let ' $a$ ' and ' $b$ ' are two positive integers. A function  $Q$  is defined recursively as follows

$$Q(a, b) = 0 \quad \text{if } a < b$$

$$Q(a-b, b) + 1 \quad \text{if } b \leq a$$

- (a) What does this function do? Explain in your own words.  
 (b) Write a recursive algorithm using above recursive formula  
 (c) Find the value of  $Q(2, 3)$  and  $Q(14, 3)$

**Part (b) [03+03+03]**

Consider below given recursive algorithm and answer the following questions:

- (a) Draw the recursive tree  
 (b) what would be the output(print) for  $n = 6$ .  
 (c) How many stack spaces are required for this algorithm

```

A_DS(n)
{
  if  $n \geq 2$ 
  {
    A_DS( $n-1$ )
    print( $n$ )
    A_DS( $n-2$ )
  }
}
  
```

**QUESTION#3 – Queue**

**[06 points]**

**Part(a) [06]**

Suppose data is inserted in a circular queue (array implementation). Write the condition(s) and corresponding action (rear and front) for following. Don't write the whole algorithm.

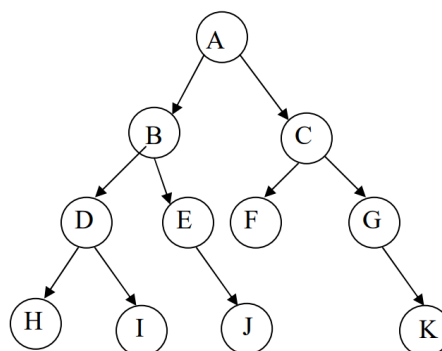
- (a) How to check the overflow condition(s).  
 (b) How to check the underflow condition(s).  
 (c) What action is taken for insertion, if the rear has reached the last index and front is somewhere in the middle of the array?  
 (d) What action is taken for insertion if the queue is initially empty?

**QUESTION#4 – Tree**

**[23 points]**

**Part (a) [03 + 02 + 03 + 04]**

Use the following binary tree for this part.

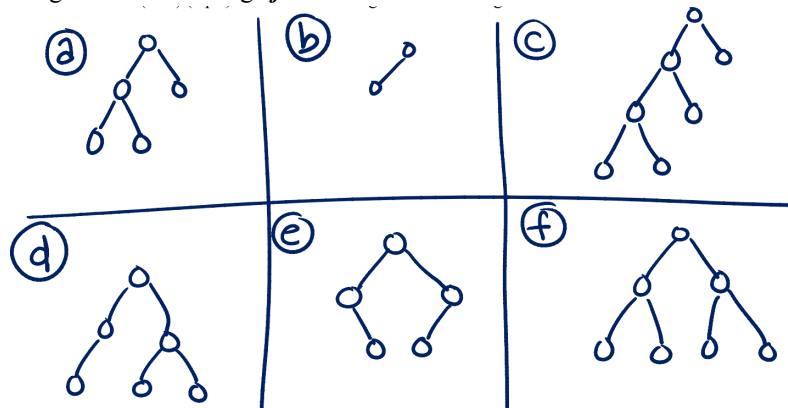


- (a) Perform post-order  
 (b) What is the height of the tree?  
 (c) Give the sequential (array) representation of the given tree. (don't show all empty cell of array)

- (d) Write an algorithm for a procedure that given the above array (part c) as input prints the data of all left child nodes.

**Part (b) [03]**

Given the following six trees *a* through *f*.



List the letters of all of the trees that have the following properties: (Note: It is possible that none of the trees above have the given property, it is also possible that some trees have more than one of the following properties.)

- (a) Full: \_\_\_\_\_  
 (b) Complete: \_\_\_\_\_  
 (c) Balanced: \_\_\_\_\_

**Part (c) [08]**

Suppose you have a random data in a linear array of size  $n$ . Write the algorithm for following problems:

1. Construct a complete tree using sequential array (without recursion)
2. Construct a binary search tree using sequential array (not for searching, without recursion)

**QUESTION#5 – RUNNING TIME ANALYSIS**

**[06 points]**

Give the worst case running time for each of the following in terms of  $N$ .

- (i) Pop a value off a stack containing  $N$  elements implemented as an array.
- (ii) Insertion a data into a linked list
- (iii) Finding an item at position  $i$  in the array of size  $N$ ?
- (iv) Searching an item in a binary search tree (BST) when the tree is unbalanced
- (v) Traversing in a two-dimensional array of order  $m \times n$
- (vi) Preorder traversing without recursion