

THE OPEN UNIVERSITY OF SRI LANKA  
 DEPARTMENT OF MATHEMATICS & COMPUTER SCIENCE  
 B.Sc. DEGREE PROGRAMME : LEVEL 03  
 CPU1142- DATA STRUCTURES & ALGORITHMS  
 FINAL EXAMINATION – 2014/2015



DURATION: Two Hours (2 Hours)

Date: 25.10.2015

Time: 1.30p.m. – 3.30 p.m.

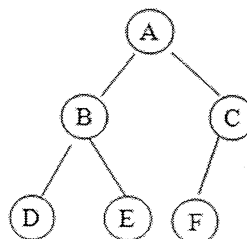
Answer FOUR (4) Questions ONLY.

**QUESTION 01**

- 1) What is an **Abstract data type**?
- 2) Write the following tasks using programming language “C”.
  - a. Create a data structure of a **stack**. The structure should contain a variable to store the top position of the stack and an array to hold numeric data elements in the stack.
  - b. Using the structure that you have created, declare a stack with the name “**mystack**”.
  - c. Write a function to **delete** a data item from “mystack”. You can use **int stackdelete()** as a function header (Check stack underflow condition before you delete a data item).
  - d. Write a function to **print all** the data items of “mystack”. You can use **void printstack()** as a function header. Check stack underflow condition before you print a data item.
- 3) Using **big O** notation, determine the running time of the following C program segment. State any assumptions you made.

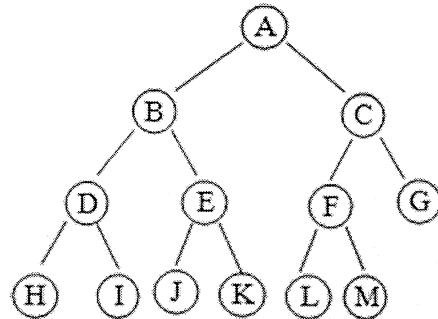
```
for(i=0; i<n; i++)
  for(j=0; j<n; j++) printf("(%d,%d)\n",i,j);
```

- 4) What is the task of the `freeptr()` function in “C”?
- 5) Define a “**strictly binary tree**”. Is the following tree a strictly binary tree? Give reasons.



**QUESTION 02**

- 1) Define a “**Complete Binary Tree**”. Is the following tree a complete binary tree? Give reasons.



- 2)
- Construct a binary search tree for the following set of integers.  
12, 08, 06, 07, 14, 20, 04, 18, 02, 15, 01, 30, 16, 25, 10, 17
  - What will be the output when you traverse the above constructed binary search tree in the following orders?
    - Pre-order
    - In-order
    - Post-order
  - What is the **depth** of the above constructed binary search tree?
  - What are the **non-leaf** nodes with a single child of the above constructed binary search tree?
- 3) Describe the following terms with respect to **GRAPH** data structure.
- Complete graph
  - In degree vertex
  - Out degree vertex
  - Weighted graph
- 4) What is an ascending priority queue? Briefly explain it.

**QUESTION 03**

- Write a C function to implement the **Selection Sort**. Use **void selectionSort (int numbers[], int array\_size)** where “**numbers[]**” array has the elements to be sorted and “**array\_size**” gives the number of elements.
- What is the running time of the selection sort (Use **big O** notation)?

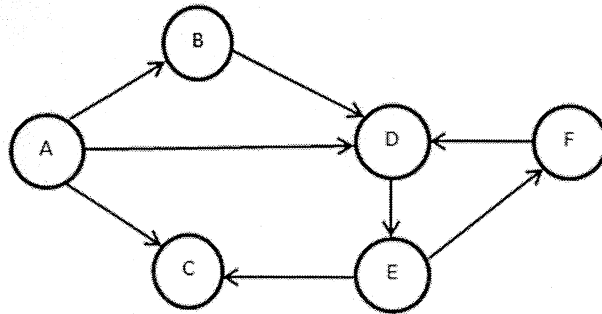
- 3) What will be the output of the following function if we pass "5" as the value for **n**.

```
int fib(int n)
{
    if (n == 0)
        return 0;
    else if (n == 1)
        return 1;
    else
        return fib(n-1) + fib(n-2);
}
```

- 4) Write the following tasks using programming language "C".
- Create a data structure of a **queue** by using **array implementation** of a queue (array size is **100**).
  - Write a function to **Enqueue** an element to the queue that declares in part (a).

#### QUESTION 04

- What is an algorithm? Briefly explain it.
- Show the **adjacency matrix** of the following graph.



- Using the graph given in **part 2** of the question, show the order of vertices visited in the "**Depth first**" and "**Breadth first**" traversals. Select "**A**" as the starting node.
- Graphically show the steps of sorting the following data set by using **insertion sort**.

30	20	35	10	100	25	32
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**QUESTION 05**

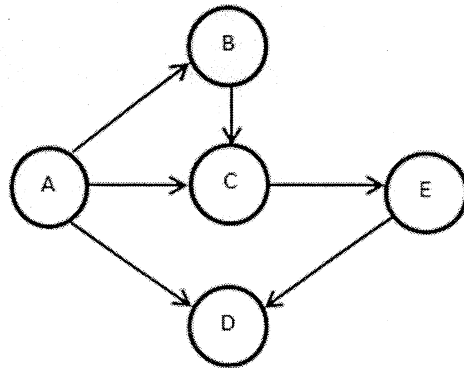
- 1) What are the two main parts of sorting methods?
- 2) Write the following tasks using programming language "C".
  - a) Create a data structure of a **doubly linked list** by using **pointer implementation**.
  - b) Write a function to **Delete** an element at the **beginning** of the doubly linked list that declares in part (a).
- 3) Consider the following expression in **Infix** form and convert it into the **Postfix** form. Clearly show the **7 steps** required for the conversion. (\$ is for exponentiation)

$$A\$B/C+D/E-F*(G-H)$$

- 4) What is the definition of a **Height Balanced Tree** (AVL Tree)?

**QUESTION 06**

- 1) What is "**Divide and conquer**" method and give one example for that.
- 2) Show the **multi-list** representation of the following graph.



- 3) Assume we are having the following data set.

30	62	53	42	17	97	91	38
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- a) Create the **heap** by inserting elements correctly using the **tree** representation of the heap.
- b) Show the **array** representation of the heap, you created in part (a) above.

4) Consider the steps of running times  $O(f(n))$  and  $O(g(n))$  where

$$f(n) = n^8 \text{ if } n \text{ is even}$$
$$n^3 \text{ if } n \text{ is odd}$$

$$g(n) = n^2 \text{ if } n \text{ is even}$$
$$n^6 \text{ if } n \text{ is odd}$$

Consider also that  $f(n)$  and  $g(n)$  placed sequentially.

- a) Calculate the time complexity for both **odd n** and **even n** separately.
- b) What is the name of the **rule** that required for calculating the time complexity?

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