(b) Write the algorithm for Inorder traversal of a binary tree.

**(5 + 2 + 2) + 3 = 12**

## Group – E

8. (a) You are given a list of random numbers and asked to search for a particular number. Which searching algorithm you will use and why to find it in minimum time.

   (b) Write down the algorithm (not code) for Binary search and deduce the average case time complexity of Binary search algorithm.

   (c) A hash function f defined as f(key) = key mod 7, with linear probing, is used to insert the keys 37, 38, 72, 48, 98, 11, 56 into a table indexed from 0 to 6. What will be the location of key 11? Show your work.

   **3 + (4 + 2) + 3 = 12**

9. (a) Using Radix sort, show step by step how you will sort the following numbers

   170, 45, 75, 90, 802, 24, 2, 66

   What is the time complexity of Radix sort? Explain.

   (b) Write a c function to implement Insertion sort algorithm.
   Input parameters: A - an array of integers and n - the size of the input
   Output:- a sorted array in ascending order.

   **(5 + 2) + 5 = 12**

# DATA STRUCTURES & ALGORITHMS
# (CSEN 3106)

**Time Allotted : 3 hrs**          **Full Marks : 70**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and
<u>any 5 (five)</u> from Group B to E, taking <u>at least one</u> from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

## Group – A
## (Multiple Choice Type Questions)

1. Choose the correct alternative for the following:      **10 × 1 = 10**

   (i) Queue is also called
   (a) Last In First Out          (b) Last In Last Out
   (c) First In Last Out          (d) None of (a), (b) and (c).

   (ii) Linked List is considered as an example of _____ type of memory allocation.
   (a) dynamic          (b) static
   (c) compile time          (d) none of (a), (b) and (c).

   (iii) The average case time complexity of Selection sort is
   (a) $O(n)$          (b) $O(1)$
   (d) $O(n^2)$          (d) $O(n\log n)$.

   (iv) Convert the infix to postfix for A-(B+C)*(D/E)
   (a) ABC+DE/*          (b) ABC-DE/*
   (c) ABC-DE*/          (d) None of (a), (b) and (c).

   (v) The minimum number of edges required to create a cyclic graph of n vertices is
   (a) 2n          (b) n-1
   (c) n+1          (d) n.

   (vi) The situation when in a linked list HEAD = NULL is
   (a) underflow          (b) overflow
   (c) syntax error          (d) none of (a), (b) and (c).

   (vii) What data structure is used for breadth first traversal of a graph?
   (a) queue          (b) stack
   (c) linked list          (d) none of (a), (b) and (c).

(viii) When quick sort time complexity is $O(n^2)$?
    (a) average case scenario         (b) best case scenario
    (c) Worst case scenario          (d) never.

(ix) A full binary tree with 2n+1 nodes contain
    (a) n leaf nodes               (b) n non-leaf nodes
    (c) n-1 leaf nodes           (d) n-1 non-leaf nodes.

(x) When inorder traversal of a tree resulted E A C K F H D B G; the preorder traversal would return
    (a) FAEKCDBHG            (b) EAFKHDCBG
    (c) FAEKCDHGB            (d) FEAKDCHBG.

## Group – B

2. (a) Algorithm RSum(a,n)
```
{ if  (n <= 0) then
    return 0;
else
    return RSum(a, n-1) + a[n];
}
```
Deduce the time complexity of the above algorithm.

(b) An algorithm A requires $n^2$ days and another algorithm B requires $n^3$ secs. to solve a problem. Which algorithm would you prefer for a problem instance with $n=10^6$ ? Justify your answer.

(c) Let $f(n) = 3n^2 + 4n+1$. Show f(n) is $O(n^2)$.

**4 + 4 + 4 = 12**

3. (a) Explain with diagram, how the push operation takes place in case of a linked list implementation of Stack. Write down the algorithm for push operation in linked Stack.

(b) Write a C function to count the number of nodes in a singly linked list.

(c) Explain with a diagram how the head node (first node) of a circular linked list is deleted.

**(2 + 3) + 4 + 3 = 12**

## Group – C

4. (a) Suppose the following stack of integers is in memory where STACK is allocated N = 6 memory cells: Top = 3 and STACK: 5, 2, 9, -, -, -. Find the output of the following segment
    (i) Pop (STACK, item_A)         (ii) Pop (STACK, item_B)

    (iii) Push (STACK, itemB+2)       (iv) Push (Stack, item_A + item_B)
    (v) When overflow will occur.

(b) In Towers of Hanoi problem, you have to move 3 disks (marked as 1,2,3 where 1 being the smallest on the top and 3 being the largest at the bottom) from peg 1 to peg 2 using peg 3 as intermediate storage. Show using diagrams, every step to achieve your goal.

(c) Let a and b denote positive integers. Suppose a function Q is defined recursively as follows

$$Q(a,b) = \begin{cases} 0 & \text{if } a < b \\ Q(a-b, b) + 1 & \text{if } b <= a \end{cases}$$

Find the value of Q(3,5) and Q(21,5)

**5 + 5 + 2 = 12**

5. (a) Write a C function to add an element in a circular queue.

(b) Write a C function to delete an element in a circular queue.

(c) Evaluate the postfix expression using Stack: 6, 2, 3, -, +, 3, 8, 2, /,+,*, 2, *, 3,+
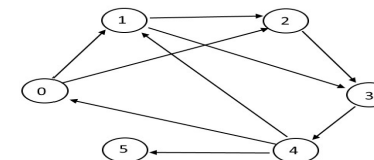Draw stack and show what happens with proper explanations.

**3 + 3 + 6 = 12**

## Group – D

6. (a) Construct a binary search tree from the following elements
        5, 7, 1, 15, 9, 2, 14, 8, 7, 3

(b) Traverse the following tree using pre-order, in-order and post-order traversal algorithm
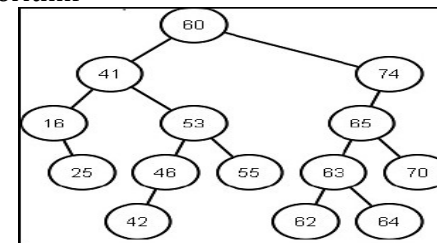


**6 + (2 + 2 + 2) = 12**

7. (a) Consider the following graph for BFS traversal. Starting from node 0, what will be BFS traversal? Show every steps .



What will be the Adjacency matrix and Adjacency list of the above graph?