INDIAN INSTITUE OF TECHNOLOGY KHARAGPUR
Department of Electronics & E.Communication Engg.
Data Structure and Object Representation, EC 60011
Mid-Semester Examination, 2015

Answer all questions | Time: 2 hrs. | Full Marks: 60

1. (a) Prove each of the following by applying directly the definition of big Oh: (3*3)
(i) n^2 is $O(2^n)$ (ii) $n(\log_2(n))^2$ is $O(n^2)$ (iii) n^{100} is $O(2^n)$

(b) Two arrays A[1]...A[n] and B[1]...B[n] are used in the following section of a program. Analyse its time complexity. Explain in what way the elements of array A is copied to array B. (1+5)

```
for 1 <= i <= n do begin
   count [i] := 0
   for j := i to n do
       if A[ j ] < A[ i ] or ( j < i and A[ j ] = A[ i ] ) then count[i] := count[i] +1
end
for i := 1 to n do
   B[ 1+count[i] ] := A[ i ]
```

2. (a) Let there be an array of *n* (even number) elements that needs to be arranged in the same array as follows: The even number positioned elements should be in positions *0* through *n/2* and the odd number positioned elements should be in positions *n/2+1* through *n*. Assume position *0* as even number position. Use data structures (like *stacks* and/or *queues*) to do the arrangement (You need not implement the basic operations like *push, pop, insert* or *delete* of these data structures). (6)

(b) What is the infix form of the *prefix* expression $+ + + + + a\ b\ c\ d - e\ f$? Write a C function to convert an *infix* expression to a *prefix* expression. (2+7)

3. (a) Draw any Binary Tree with 12 nodes which is *Right Post-Threaded*. Write a C code to implement the post order traversal of the right post-threaded binary tree. (3+5)

(b) Write the three conditions for a binary tree to become a Huffman tree. Using the botom-up greedy algorithm, draw a Huffman tree that contains the weights (no code required):
0.01, 0.35, 0.22, 0.05, 0.06, 0.08, 0.15, 0.08
Find the codes of each of the nodes having these weights from the tree.
Write a C code only for the section that computes the Huffman code assuming that the tree is already constructed. (1+2+1+3)

4. (a) Consider a special general tree in which the children of any node will keep its own children arranged in the reverse order from that of its parent node. e.g., if any node keeps its children arranged as eldest to youngest , its children have to arrange their own children from youngest to the eldest. Write a C function *add_child (parent_node)* for such a tree. Assume the node structure as having only two pointers (one for child and another for a sibling) as usual. Also assume that the root arranges its children from eldest to youngest. (9)

(b) Analyse each line of the program given below and state what the program is intended to do. Take an example input and show each step of execution till the end. If you are asked to replace the name of the routine (Action), what name would you suggest? What is the complexity of the program in terms of n? (4+2)

```
Action (x, n)
int x[ ], n;
{
        int i, indx, j, value;
        for ( i = n-1; i > 0; i - - ) {
                value = x [ 0 ];
                indx = 0;
                for (j = 1; j < = i ; j ++)
                        if (x [ j ] > value) {
                        value = x [ j ];
                        indx = j;
                        }
                x [ indx ] = x [ i ];
                x [ i ] = value;
        }
}
```

*****Write comments for C program lines***Write all answers of a question in one place***