B.Sc. Engg. / HD CSE 3rd Semester (67)

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ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

SEMESTER FINAL EXAMINATION — **WINTER SEMESTER, 2015-2016**

DURATION: 3 Hours — **FULL MARKS: 150**

CSE 4303: Data Structures

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **8 (eight)** questions. Answer any **6 (six)** of them.

Figures in the right margin indicate marks.

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1. a) Consider a source code structure where you are building several libraries (DLLs) and they have dependencies on each other. For example, to build DLL A you must have built DLL B, to build DLL C you must have built DLL A and D, to build DLL D you must have built DLL A and B, to build DLL E you must have built DLLs C and D. Now answer the following questions: 3+2+10

   i. Construct a graph that shows the dependency among different DLL files.

   ii. What property does the resulting graph possess in order for the build system to successfully build all the DLL files?

   iii. Show a step by step procedure to find a linear ordering of DLL files.

   b) Apply radix sort on the following set of Hexadecimal numbers: 10

   CD0 , 015, C16, 8BE, AA2, F21, CE1, 899, A2A, B4B

   How many comparison does it require for a radix sort algorithm to sort 10^6 Hexadecimal numbers where the highest Hexadecimal value is FFFF?

2. a) Use Kruskal's algorithm to find the minimum spanning tree from the Figure 1. 15

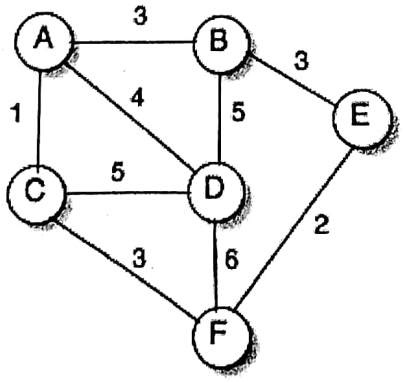

Figure 1: Figure for the question no. 2 (a)

   b) Suppose you have a set of symbols E, G, R, Y, L and their probability of occurring in a text document are 30%, 10%, 18%, 20% and 22% respectively. Now use variable length coding to represent each of the symbol. Calculate the total number of bits required if the number of times E, G, R, Y, L symbols appear in a text document are 7,10,20,12 and 5 respectively. 10

3. a) What does hashing mean? Describe different ways in which we can minimize the impact of collision in hashing? 10

   b) Write down the pseudo code for Warshall algorithm to find the shortest path from a weighted graph. 8

   c) Analyze the complexity of Heapsort algorithm in two phases. 7

4. The time required by a recursive algorithm is defined by the following equation:

$$T(n) = T(n/3) + T(2n/3) + cn$$

a) Draw a recursion tree from the following equation. 5
b) What will be the height of that tree? Will it be a complete binary tree? 5
c) Calculate the time complexity of the algorithm. 5
d) Write a recursive program that has the same time function as this one. 10

15

5. a) Apply merge sort algorithm on the following set of input values:

100, 22, 45, 78, 43, 65, 89, 123, 56, 7, 45, 12

Also compare the best case and worst case complexity of the merge sort and quick sort algorithm. 10

b) Write a recursive procedure to solve the Tower Of Hanoi problem. Draw the complete recursion tree for n=3 where n is the number of disks.

13

6. a) Consider the following polynomial equation:

$$P(x) = -7x^8 + 3x^5 - 2x^4 + 12x^2 - 67$$

Now represent this equation using a linked list. Write a program that will add a polynomial term with this equation given the co-efficient and the exponent of that term. 6

b) What do you understand by the term garbage collection? When does overflow and underflow occur during programming? 6

c) Write an algorithm that will delete an item from a doubly linked list.

4x5

7. a) Consider the following postfix expression:

3 6 + 1 + 2 5 * 4 + * 8 7 + *

Now answer the following questions:

i. Evaluate this postfix expression using a STACK.
ii. Construct a tree from this expression where internal nodes represent operators and external nodes represent operands.
iii. Write down the preorder traversal of the tree constructed by you.
iv. Show how a STACK can be used to implement a preorder traversal. 5

b) Suppose information of several data items are encoded in Table 1:

Table 1 : Table for Question 1(d)

Age	Gender	SSN
7 bits	1 bits	8 bits

Now write down the set of operations required to set Age value to 30 and gender value to 1 without changing the rest of the information.

8. a) Write an algorithm (pseudo code) to delete the root node of a max heap tree. 10
b) Analyze the time complexity of the iterative program of the Figure 2. 8

```
void A(){
      int i,j,n;
      for (i=1;i<=n;i++){
            for(j=1;j<=n;j=j+i){
                  printf("final exam");
            }
      }
}
```

Figure 2: Code for Question no. 8(b)

c) Consider the directed graph in Figure 3. 7

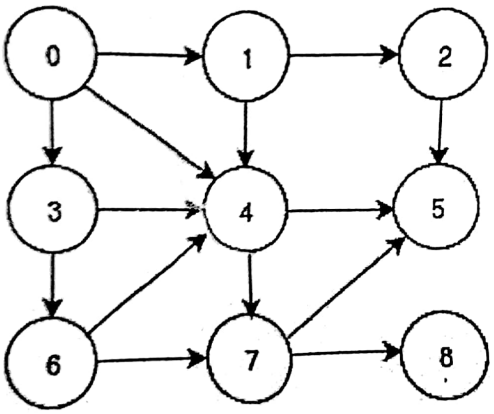

Figure 3: Figure for question no. 8 (c)

Now calculate the shortest path required to go from node 0 to node 8. (Show the step by step process.)