

**Bangabasi College**  
**Test Examination 2015**  
**2<sup>nd</sup> Year Honours**  
**Subject: Computer science (H)**

*Semin*  
*2014-15*

**Full Marks: 100**

**Time: 4 Hrs**

1. **Answer any ten:**

10 X 2 = 20

- a) What is Konigsberg bridge problem?
- b) What do you mean by Bipartite graph?
- c) What is Universal quantifier of a Predicate?
- d) What is Euler Graph?
- e) Define cut-set of a graph.
- f) What are Big-Omega notations?
- g) What is a minimal spanning tree?
- h) What do you mean by context free language?
- i) Define Mealy Machine?
- j) What do you mean by DFA?
- k) What is a grammar?
- l) Give an example of a context free grammar stating why it is context free.
- m) Define full binary tree.
- n) Prove that the time complexity of binary search is  $O(\log n)$ .

**Answer any eight questions taking at least one from each group.**

**Group-A**

2. a) Find minimum and maximum possible height of a binary tree with  $n$  vertices.  
b) Explain Depth-First-Search (DFS) algorithm with a non-trivial example. What modifications are to be done to get Breadth-First-Search (BFS) algorithm from it?  

4 + (4+2) = 10
3. a) Prove that if the graph  $G$  does not have any isolated vertices, then it has all Euler cycle if and only if  $G$  is connected and the degree of each vertex is even.  
b) Prove that a simple graph with  $n$  vertices and  $k$  components can have at most  $(n-k)(n-k+1)/2$  edges.  

6+4=10
4. a) Define in-degree and out-degree of a vertex in a digraph. Give example.  
b) Describe Dijkstra's Algorithm with suitable example.  

(2+2)+6=10

**Group-B**

5. a) State and prove generalized pigeon hole principle.  
b) Find the number of subsets (with 10 elements) of the set  $S = \{1, 2, \dots, 100\}$  that do not contain a pair of consecutive integers.  
c) How can you relate big-Oh, big-Omega and big-Theta notations? Justify your answer.  

(2+2)+3+3=10
6. a) Show that  $(p \rightarrow q) \vee (q \rightarrow r)$  and  $(p \vee q) \rightarrow r$  are logically equivalent.  
b) Show that  $((p \vee q) \vee r) \rightarrow (p \vee (q \vee r))$  is a tautology.  
c) Give examples of relations that are:  
i) Only Reflexive  
ii) Only Transitive  

3+3+ (2X2) = 10
7. a) Represent the primal L.P.P.  
Maximum  $Z = c \cdot x$ ,  $c \in R^n$  subject to  
A.  $x \leq b$ ,  $b^T \in R^m$ ,  $x \geq 0$  in its dual form.  
b) Obtain the dual problem of the following L.P.P.  
Max  $f(x) = 2x_1 + 5x_2 + 6x_3$   
Subject to the constraints.

$$5x_1 + 6x_2 - x_3 \leq 3,$$

$$-2x_1 + x_2 + 4x_3 \leq 4,$$

$$x_1 - 5x_2 + 3x_3 \geq 1,$$

$$-3x_1 - 3x_2 + 7x_3 \leq 6,$$

And  $x_1, x_2, x_3 \geq 0$

- c) State when the Newton's Forward formula cannot be used for computing the function  $f(x)$ .  
4+4+2=10

**Group-C**

8. Given the following NDFA: 3 + 2 + 5 = 10

State	Next State		
	Input=a	Input=b	Input=c
→q0	q1 q3	q3	q1 q2
q1	q0 q1	q1 q3	q0
q2	q1 q3	q0	q1 q2
q3	-	q2	-

- a) Test whether the string *aabbcc* and *ccbbaa* are accepted by the transition system.  
b) Construct transition diagram for the NDFA.  
c) Construct a DFA equivalent to the NDFA.
9. a) Find the language equivalent to the grammar  $G = (\{S, A\}, \{0, 1\}, \{S \rightarrow 0S0 | A, A \rightarrow 1A1 | 0\}, S)$ .  
b) Construct a grammar generating  $\{a^n b^m c^n \mid n \geq 1, m \geq 0\}$ .  
c) What is a regular expression? 4 + 4 + 2 = 10
10. a) State Chomsky's Classification of grammars citing one example for each type.  
b) Give regular expressions of the following:  
i.  $\{00, 01, 10, 11\}$   
ii. All strings over the set  $\{a, b\}$  starting with *aba* and ending with *bb*.  
iii. All strings containing an even number of *1*s.  
iv. All strings over  $\{0, 1\}$  containing exactly three *0*s. 6 + 4 = 10

**Group - D**

11. a) The following list of array elements is given:-  
54, 33, 21, 75, 69, 50, 80, 29  
Assume that the array index starts from 1. Explain with the above list of elements how stacks are implemented to sort the array using quick sort technique (No formal algorithm is required). Can the concept of queue be implemented instead of stack in quick sort algorithm? Justify your answer.  
b) Define heap. Construct a max-heap with the following array of elements:-  
17, 25, 10, 7, 16, 19, 23, 42, 37, 4, 33, 1, 5, 11, 21  
Show with explanation, the different intermediate stages in the process of forming the heap. (3+2) + (1+4) = 10
12. a) Explain the concept of hashing technique. What are the criteria for choosing a good hash function?  
b) Explain collision in hashing. What are the broad classes of collision resolution techniques?  
c) Write a C-function to insert an element in the hash table using linear probing.  
(2+2) + (2+2) + 2=10
13. a) Construct a binary search tree from the following traversals:  
preorder: a b d e i j c f h g  
In order: d b i e j a f h c j  
b) Construct a regular grammar from the following regular expression  $R = a^*(a+b)b^*$  (5+5)=10