

2016

Computer Science-I

Time Allowed : 3 Hours

Full Marks : 200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in English or in Bengali but all answers must be in one and the same language.

Answer any five questions

1. (a) Convert to POS form using Boolean identities:

$$\bar{A}\bar{B}C + \bar{A}BC + A\bar{B}\bar{C} + ABC + ABC$$

(b) Design a combinational circuit to check whether a given input is greater than or equal to  $5_{10}$ .

(c) Consider a base-26 number system where  $A=0, B=1, C=2, \dots, Z=25$  in base ten. Calculate

TWO+TWO in this system. Express your answer in base ten.

10+20+10

2. (a) Define: data structure. Is it different from ADT? Explain with an illustration.

(b) Show that  $2^n + n^2$  is  $O(2^n)$ .

(c) Solve the Fibonacci recurrence:  $F_n = F_{n-1} + F_{n-2}$  with  $F_0=0, F_1=1$ .

15+10+15

3. (a) Find the adjacency matrix and the incidence matrix of the graph  $G = (V, E)$  where

$$V = \{a, b, c, d, e\} \text{ and } E = \{ab, ac, bc, bd, cd, ce, de\}.$$

(b) Show that a simple graph  $G$  with  $n$  vertices is connected if  $d(v) \geq \frac{1}{2}(n-1)$  for all  $v \in V$ .

(c) What is the total number of distinct binary trees possible with  $n$  vertices?

(d) Define: Hamiltonian cycle of a directed graph.

10+20+5+5

4. (a) What is a complete binary tree? Illustrate.

(b) Show that when each node of a binary tree with  $n$  nodes is represented with the standard Linked LL—INFO—RL representation, (LL being the pointer to the left child and RL being the pointer to the right child and INFO is the content of the node) then the number of null pointers is  $n+1$ .

(c) How can we effectively use these pointers to reduce the time and space requirement of some operation on a binary tree? State the operation and show how you can do it. 10+10+20

5. (a) What do you understand by similarity transformation of a square matrix? Show that the characteristic polynomial of a matrix, after performing similarity transformation, remains the same.
- (b) Use Simpson's rule to approximate the following integral using a regular partition with  $n=4$ :

$$\int_0^2 \sqrt{x} dx$$

Compare the estimate with the exact value.

(5+10)+25

6. Solve the following LP problem:

$$\text{Minimize } z = 50x_1 + 100x_2$$

such that:

$$7x_1 + 2x_2 \geq 28$$

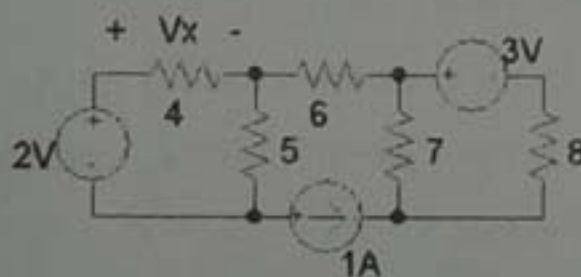
$$2x_1 + 12x_2 \geq 24$$

$$x_1, x_2 \geq 0$$

40

7. (a) State the Maximum Power Transfer Theorem.

(b) Find the voltage  $V_x$  in the given circuit:



10+30

8. Write short notes on any four of the following:

(a) Differential Manchester Encoding.

(b) Frequency Division Multiplexing.

(c) Average case behavior of Quicksort.

(d) S-R Flip flop.

(e) Pipelined processors.

(f) Collision resolution with simple chaining.

10 × 4