2018

COMPUTER SCIENCE- PAPER-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 given either in English or in Bengali but all answers must be in one and the same language.

Answer any five questions

1. (a) Minimize the sum of products (SOP) expression for the following function :-

$$F(A,B,C,D) = \sum m\,(1,3,8,9,15) + \sum d(6,7,12)$$

(b) Design a combinational circuit that accepts a 3-bit number as input and generates an output binary number equal to square of the input number.

(c) Find the decimal equivalent of the following IEEE 754 32-bit floating-point number :-

0 10000000 110 0000 0000 0000 0000 0000

(d) Implement the following Boolean functions using a decoder and OR gates :-

$$F_1\,(A,B,C) = \sum m(0,3,4)$$
$$F_2\,(A,B,C) = \sum m(1,2,7)$$
$$F_3\,(A,B,C) = \sum m(0,1,2,4)$$

(e) Convert $(56)_{10}$ to its equivalent gray code. 10+10+5+10+5

2. (a) What is the maximum and minimum height of a tree of n nodes ?

(b) Given the inorder and pre-order traversal of a binary tree :-

Inorder : D B E A F C G

Pre-Order : A B D E C F G

(i) Constructt the binary tree.

(ii) Find the post order traversal of the binary tree.

(c) Draw a binary search tree (BST) for the input 8,13,27,16,39, 44,55,82,70. Trace the algorithm to insert the node 20 into the BST.

(d) Design a recursive algorithm to compute 2^n for any non-negative integer using the formula :-

$$2^n = 2^{n-1} + 2^{n-1}$$

Draw a tree of recursive calls for 2^4 generated by the algorithm.

8+12+10+10

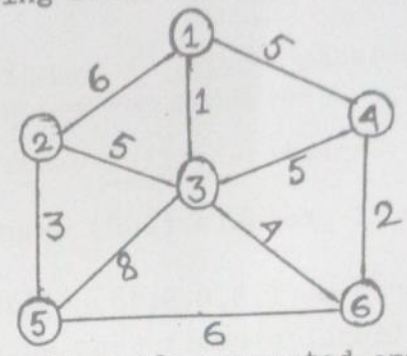
3. (a) Draw the directed graph that correaponds to the following adjacency matrix :-

	v_0	v_1	v_2	v_3
v_0	1	0	1	0
v_1	1	0	0	0
v_2	0	0	0	1
v_3	1	0	1	0

(b) State the quick sort algorithm and compute its worst case and best case time complexity. Illustrate the working principle of the quick sort algorithm using the following array :-

$$[5, 3, 1, 9, 8, 2, 4, 7]$$

(c) Distinguish between spanning tree and minimum spanning tree. Find minimum spanning free for the following weighted graph :-



(d) Explain how one can identify connected and strongly connected components of a graph using DFS and BFS. 10 x 4

4. (a) Evaluate $\int_0^1 \frac{dx}{1+x^2}$ using Simpson's 1/3rd rule taking 6 intervals. Hence, obtain the approximate value of π.

(b) Using the following data find the value of $\sqrt{2}$ correct upto five significant figures.

x	1.9	2.1	2.3	2.5	2.7
$\sqrt{x}$	1.3784	1.4491	1.5166	1.5811	1.6432

(c) Use Runge-Kutta method of fourth order to find y(0.2) and y(0.4) where

$$\frac{dy}{dx} = 1 + y^2 \quad \text{and} \quad y = 0 \quad \text{when } x = 0$$ 15+15+10

5. (a) Solve the following LP problem :-

Maximize $Z = 5x_1 + 7x_2$

Subject to : $x_1 + x_2 \leq 4$

$3x_1 + 8x_2 \leq 24$

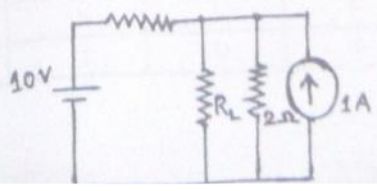
$10x_1 + 7x_2 \leq 35$

$x_1, x_2 \geq 0$

(b) ABC Ltd. has two products : 'X' and 'Y'. To produce one unit of 'X', 2 units of materil P and 4 units of material Q are required and to produce one unit of 'Y' 3 units of material P and 2 units of material Q are required. At least 16 units of each material must be used in order to meet the committed sales of the two products. Cost per unit of paterial P and material Q are Rs.2.50 and Rs.0.25 respectively. Formulate the problem as LPP and solve it graphically to minimize the total cost. 20 + 20

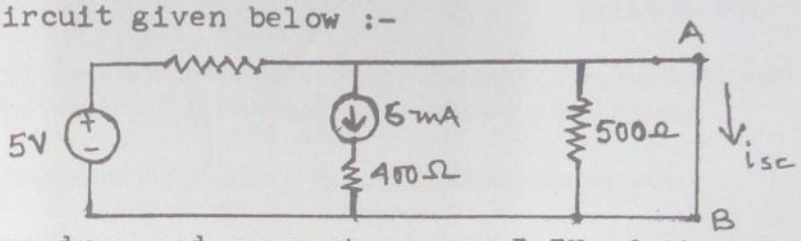
6. (a) State the Maximum Power Transfer Theorem.

(b) Calculate the value of the load resistance R_L which will transfer maximum power to the load for the circuit shown in Fig. below. Also calculate the value of the maximum power thus transferred to the load.

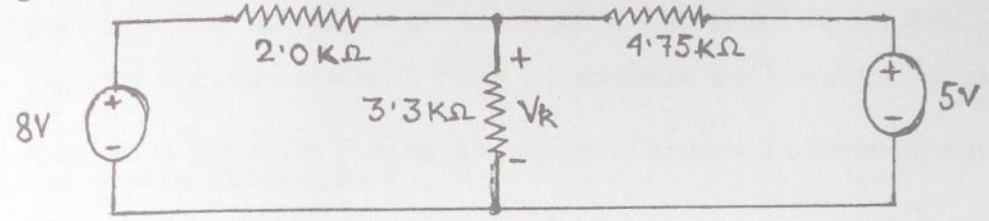


...F/3.

(c) Find the short-circuit current i_{sc} between the terminals A and B of the circuit given below :-



(d) Find the voltage drop and current across 3.3K of the circuit given below using Superposition theorem



8+12+10+10

7. (a) Explain schemes of Parity and CRC as used for error detection.

(b) Distinguish between adaptive and non-adaptive routing algorithm.

(c) Consider a 2.5 Mbps token ring LAN and frame size of 180 bytes. If the ring latency is 210μ_s, then calculate the effective data rate of the LAN.

(d) Implement the function $f(A,B,C,D) = \sum m(1,2,5,7,9,14)$ using MUX.

(e) Calculate the minimum number of gates required to implement the Boolean function XY + Z using 2-input NOR gates. 10 x 4

8. Write short notes on <u>any four</u> of the following :-

(a) Carry Look-ahead Adder

(b) Merge sort algorithm and its time complexity

(c) Kruskal Algorith

(d) Synchronous counter

(e) Pushdown Automata

(f) Sliding Window Protocol. 10 x 4

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