70

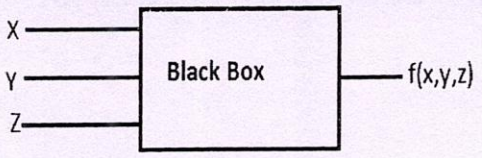
B. Tech. Mid Sem Examination-2018
Digital Logic Design
CS 302

Full marks: 30. Duration: 2 hours

PART-A

[Answer all the Questions].

1. The black box in the following figure consists of a minimum complexity circuit that uses only AND, OR and NOT gates. The function $f(x, y, z) = 1$ whenever x, y are different and 0 otherwise. In addition, the 3 inputs x, y, z are never all the same value. Derive equation that lead to the correct design for the minimum complexity circuit? **2**



2. The minimal sum for the function $F2(a, b, c, d)$ is_____, such that $F(a,b,c,d)=F1(a,b,c,d).F2(a,b,c,d)$, where $F(a,b,c,d)=\Sigma(1,3,4,12,13)$ and $F1(a,b,c,d)=\Sigma(0,1,3,4,6,8,10,11,12,13)$. **2**

3. Total number of essential prime implicants of the function and find the minimal sum,

$f(a,b,c,d) =\Sigma(0,1,2,5,6,7,8,9,10,13,14,15)$.

2

4. What is the minimal form (expression) of the Karnaugh map shown below. Assume that X denotes a don't care term

cd \ ab	00	01	11	10
00	1	X	X	1
01	X			1
11				
10	1			X

2

5. Simplify the following Boolean function: $f(A,B,C,D) = \Pi(1, 3, 5, 7, 13, 15)$

2

PART-B

[Answer any 4 (four) questions]

6. Implement the following four Boolean expressions with three half adders.

$\mathbf{D = A \oplus B \oplus C}$
$\mathbf{E = A'BC + AB'C}$
$\mathbf{F = ABC' + (A' + B')C}$
$\mathbf{G = ABC}$

5

7. Implement a full adder with two 4x1 multiplexers. 5

8. A 8×1 multiplexer has inputs A, B, and C connected to the selection inputs S_2, S_1 and S_0 respectively. The data inputs I_0 through I_7 are as: $\boldsymbol{I_1 = I_2 = I_7 = 0}$; $\boldsymbol{I_3 = I_5 = 1}$; $\boldsymbol{I_0 = I_4 = D}$; **and** $\boldsymbol{I_6 = D}$. Find the Boolean function that multiplexer implements. **5**

9. Implement the following using NAND gates only. (Provide circuit diagram) **5**

$$Y = (a + c)(\overline{b} + \overline{d})(\overline{a} + \overline{b} + \overline{c})$$

10. Minimize the following switching function using the Quine McCuskey method. **5**

$$f(x_1, x_2, x_3, x_4) = \sum_m(0, 5, 7, 8, 9, 10, 11, 14, 15)$$

14/90

449

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

1st Semester B.Tech - Mid Semester Examination Session 2018-19

~~CS-01~~ Introduction to Computing

CSC-01

Full Marks: 30 **Time: 2 hours**

Answer any three from 1 to 5

1. a) What is booting? Explain the activities taken place during booting.
   b) Draw the block diagram of computer system and explain each of its component. 3+7=10

2. a) (i) (24)8 = (?)2, (ii) (187)10 = (?)2
   b) Draw a flowchart to find the factorial of an input number 3+7=10

3. a) (i) (1001.0010)2 = (?)10. (ii) (10.25)10 = (?)8
   b) Draw a flowchart to print n fibonacci number. Where n is an input. 3+7=10

4. Draw a Algorithm, flowchart and C code of pyramid of digits 2+2+6 =10

```
            1
        2   3   2
    3   4   5   4   3
4   5   6   7   6   5   4
```

5. a) Write a C program to find three different roots of quadratic equation. 5
   b) Write a C program to find biggest number among three numbers using conditional operator. 5

* * * BEST WISHES * * *

24/05/18.

B.Tech/CSE/ 3rd Sem (Mid-Semester Exam) / 2018-19
Subject: Discrete Mathematics
70
Subject Code: CSC 301
Time-2 hours Full Marks-30

The figures in the margin indicate full marks.
Answer any three questions.
(**Answer subparts of a question together and in order**.)

1. a) Determine the truth value of each proposition, where P (x, y) : $y > x^2$, and x and y are real numbers.

(i) $(\forall x)(\forall y)P(x, y)$ (ii) $(\exists x)(\exists y)P(x, y)$
(iii) $(\forall x)(\exists y)P(x, y)$ (iv) $(\forall y)(\exists x)P(x, y)$
(v) $(\exists x)(\forall y)P(x, y)$ (vi) $(\exists y)(\forall x)P(x, y)$ (6)

b) Prove that the regions formed by n circles in the plane can be colored with red and blue in such a way that any two regions that share a common boundary arc will be colored differently. (4)

2. a) Prove that in a sequence of 626 distinct integers, there is either an increasing subsequence of length 26 or a decreasing subsequence of length 26. (4)

b) From the integers 1,2,3,..., 200, we choose 101 integers. Show that, among the integers chosen, there are two such that one of them is divisible by the other. (3)

c) Prove that there exist two irrational numbers x and y such that x^y is rational. (3)

3. a) Find how many solutions there are to the following equation that satisfy the given condition

$a + b + c + d + e = 500$, each of a, b, c, d, and e is an integer that is at least 10.

You must explain your answer (4)

b) You are visiting a country of **knights** (who always speak truth) and **knaves** (who always lies) and have the following encounters with natives.

i) Two natives A and B address you as follows:
A says: Both of us are knights. **B says**: A is a knave.
What are A and B? Explain your answer.

ii) Another two natives C and D approach you but only C speaks.
C says: Both of us are knaves.
What are C and D? Explain your answer.

iii) You then encounter natives E and F.
E says: F is a knave. **F says:** E is a knave.
How many knaves are there? Explain your answer. (6)

P. T. O.

4. a) Prove that among 6 persons, there are either 3 mutual friends or 3 strangers to each other. (4)

b) Derive a **recurrence equation** and solve it to compute the **Josephus number J(n)** for the simplified version of **Josephus Problem** where there are n persons forming a circle and every second person is deleted from the circle until the last one exists. (4)

c) Compute the number of well balanced parantheses expressions, if there are 5 number of left parentheses and 5 number of right parentheses. (2)

5. a) Consider 5 distinct points (xi, yi) with integer values where i=1, 2, 3, 4 and 5. Show that the midpoint of at least one pair of these five points also has the integer coordinates. (3)

b) Consider the binary relation R ={(x,y),(x,z),(z,x),(z,y)}on the set (x,y,z) .Which one of the following is true?

(i) R is Symmetric but NOT Antisymmetric. (ii) R is NOT Symmetric but Antisymmetric.

(iii) R is both Symmetric and Antisymmetric. (iv) R is neither Symmetric nor Antisymmetric.

Explain your answer properly. (3)

c) How many times will the statement **printf ("CSE ")** be iterated, when the algorithm segment below is implemented and run? (Assume n is a positive integer.) Your answer must be exact and will be a function of n only.

```
for k := 1 to n
        for j := 1 to k
                for i := 1 to j
                        printf ("CSE ");
                next i
        next j
next k
```

You must explain your answer. (4)

----------END----------

Department of Computer Science and Engineering

NIT Durgapur

Data Structures (CSC 303)

2018-19

Time: 2 Hrs. Total Marks: 30

Answer all questions

1. (a) Write the recursive definition of binary tree.

   (b) Find a relation between the number of null pointers and number of non-null pointers required for implementing a binary tree using linked list. (2+2)

2. Write the algorithm for insertion sort using linked list. (5)

3. (a) Write the algorithm for sequential search in an array using only one comparison, and without using 'for loop', 'break', 'continue' and 'go to'. (4)

   (b) If you know the probability of occurrences of the elements for search, how would you store the elements in the array? Justify your answer mathematically. (4)

4. Write merge sort algorithm and compute the time complexity using recursion tree. (8)

5. Why we prefer to use AVL tree data structure over BST data structure for search, insertion and deletion operations? If we consider a 2-3 tree and an AVL tree for same operations, then what sorts of advantages would be determined for using a 2-3 tree data structure over AVL tree? Explain with suitable examples. (5)

075

NATIONAL INSTITUTE OF TECHNOLOGY, DURGAPUR

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Midterm Examination

B.Tech. IT (3rd Sem 2018) — Discrete Mathematics (ITC 301)
Time: 2hour — Full Marks: 30

Answers any five questions

1. (a) Let A, B and C be subsets of an universal set U. Prove that

$$(A \cup B) \times C = (A \times C) \cup (B \times C)$$

(b) If A and B are two non-empty sets having n elements in common, then prove that $A \times B$ has n^2 elements in common. (3+3)

2. (a) In the set Z of integers, defined a relation R by aRb in and only if (a – b) is an odd integer. Investigate whether R is equivalence relation or not.

(b) Let A = {1, 2,3} and R = {(1,1), (1,3), (2,2), (3,1)}. Find the transitive closure of R using Warshall's Algorithm. (3+3)

3. (a) Let $f: R \to R$ be a function defined by $f(x) = x^2 + x$. Determine whether f is invertible. If so, determine the inverse function.

(b) Let f(x) = 2x and g(x) = 2x -3 be function from R to R. Find $(gof)^{-1}$, $(fog)^{-1}$. (3+3)

4. (a) Let $S = \{x \in R: -1 < x < 1\}$ and $f: R \to S$ be defined by $f(x) = \frac{x}{1+|x|}, x \in R$. Show that f is a bijection.

(b) Write PDNF and PCNF of $(P \to R) \wedge (Q \to R)$. (3+3)

5. (a) Without constructing truth table, show that $((P \to Q) \vee R) \leftrightarrow ((P \vee R) \to (Q \vee R))$ is a tautology.

(b) Given the following statements as premises, all referring to an arbitrary meal:

If he takes coffee, he does not drink milk.

He eats crackers only if he drinks milk.

He does not take soup unless he eats crackers.

At noon today, he had coffee.

Whether ıe took soup at noon today? If so what is the correct conclusion. (3+3)

6. (a) Prove that $7^{2n} + 2^{3n-3}.3^{n-1}$ is divisible by 25 for all positive integers.

(b) Prove that there is no largest integer that is a multiple of 5.

(3+3)

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23.5.18

073

Digital Electronics

~~Digital Logic Design~~

B.Tech/Mid-Term/Odd
2018-2019/Reg. 2018-2019

ITC-302

Full Marks: 30

Time: 2 hour

Answer all questions in order as given in the question paper.
The figures in the margin indicate full marks.

1. Choose the correct answer (Give proper explanation in favour of your answer). $5 \times 2 = 10$

(i) If 73 (in base x number system) is equal to 54 (in base y number system), the possible values of x and y are

(a) 11,8 (b) 8,13 (c) 11,11 (d) 8,11

(ii) $(8B3F)_{16} = (?)_2$

(a) 111101101111 (b) 01110101111 (c) 1011001111101111 (d) 1000101100111111

(iii) For the circuit shown in Fig. 1, the output f of second 2:1 multiplexer is given by the function

(a) $\bar{x}_1\bar{x}_2 + x_1x_2$ (b) $x_1\bar{x}_2 + x_2\bar{x}_1$ (c) $\bar{x}_1 + x_2$ (d) $\bar{x}_1 + \bar{x}_2$

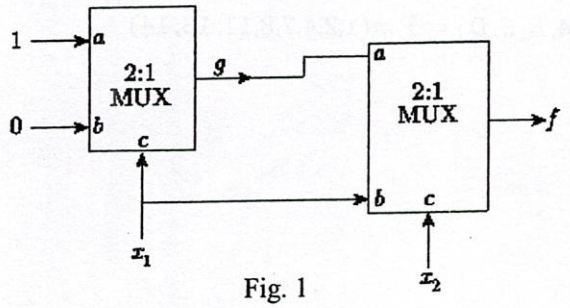


Fig. 1

(iv) Consider the following logic circuit in Fig.2 whose inputs are functions f_1, f_2, f_3 and output f. Given that $f_1 = \sum m(0,1,3,5)$, $f_2 = \sum m(6,7)$ and $f_3 = \sum m(1,4,5)$, the output f will be

(a) $\sum m(4,5,7)$ (b) $\sum m(3,4,7)$ (c) $\sum m(1,4,5)$ (d) $\sum m(0,6,7)$

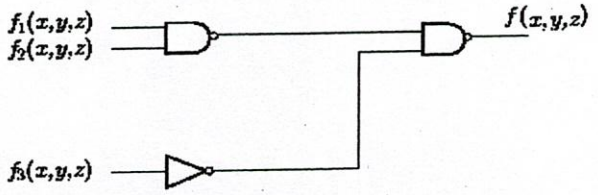


Fig. 2

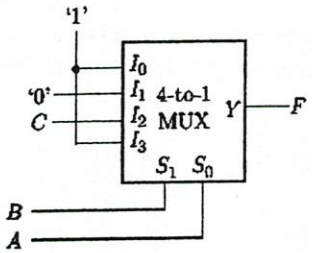
(v) The minimal form of the Karnaugh map shown below (Assume that × denotes a don't care term) is

(a) $\bar{b}(\bar{c} + \bar{d})$ (b) $\bar{a}\bar{c} + \bar{b}\bar{d}$ (c) $\bar{c} + \bar{d}$ (d) $\bar{a} + \bar{d}$

cd \ ab	00	01	11	10
00	1	X	X	1
01	X			1
11				
10	1			X

24/08/18

2. Find out the output of the following MUX in terms of Boolean expression. 3



3. Design a two bit comparator using logical gates. 7

4. Design a full adder using only two input NAND gates. (Use minimum number of gates). 5

5. Realize the given minterm expression using two input XOR gates only. 5

$$F(A,B,C,D) = \sum m(1,2,4,7,8,11,13,14)$$

24/08/18

074

NATIONAL INSTITUTE OF TECHNOLOGY, DURGAPUR
Department of Computer Science & Engineering
Mid-Term Examination 2018
Subject: Data Structures and Algorithms ~~(IT 301)~~ (ITC - 303)
Class: B. Tech. Semester: 3rd Full marks: 30

[Instructions: Attempt any three questions. Read the questions carefully and answer accordingly. Provide all the information as asked]

1.

a. A program P reads in 70 integers in the range [0…50] representing the semester marks obtained by 70 students of a class. It then prints the frequency of each score above 20. What would be the best way for P to store the frequencies? Choose the best option. Justify your choice
   i. An array of 20 numbers
   ii. An array of 50 numbers
   iii. An array of 30 numbers
   iv. An array of 70 numbers

b. Let $f(n) = n^2$. Prove form the basic definition of small-oh asymptotic notation that $f(n) \neq$ small-oh(n^2). [1] [2]

c. Design an efficient algorithm to find the closest value to a given target number in a sorted array of n distinct integers.
   [Example : Array : 2,5,6,7,8,8,9
   Target number : 5 Output : 5
   Target number : 11 Output : 9
   Target Number : 4 Output : 5]
   Write down a clean pseudocode for your algorithm. Also analyze the time complexity of your algorithm. [3 + 2]

d. Two matrices M1 and M2 are to be stored in two two-dimnensional arrays A and B respectively. Each array can be stored either in row-major or column-major order in contiguous memory locations. The time complexity of an algorithm to compute M1 × M2 will be
   i. best if A is in row-major, and B is in column- major order
   ii. best if both are in row-major order
   iii. best if both are in column-major order
   iv. independent of the storage scheme
   Choose the appropriate option. Justify your choice. [2]

2.

a. Let us define a sparse matrix of size $n \times n$ where non zero elements will be appear on the main diagonal and immediately below of the main diagonal and rest of the elements are zero's. Write an algorithm to store non-zero elements of this sparse matrix in 1-D array say B, and display in matrix form. [4]

b. Why stack is called ADT? Write an algorithm that uses stack to convert a given infix expression to its equivalent postfix expression. Convert the following infix expression into postfix expression using your algorithm: A+(B*C-(D/E^F))
   Where +, -, *, /, and ^ are used as addition, subtraction, multiplication, division, and exponentiation operator, respectively. [6]

[P.T.O]

3.

a. Write an algorithm to create a singly linked list with n elements and explain your algorithm with suitable example. [4]

b. What is AVAIL list? Write an algorithm to insert a new node at the i^{th} position of a singly linked list without using the concept of AVAIL list. Modify the insertion algorithm using AVAIL list concept. [5]

c. What are the advantages and disadvantages of doubly linked list over linear linked list? [1]

4.

a. Suppose that a dynamic set S is represented by a direct-addressed table T of length m. Describe a procedure that finds the maximum element of S. What is the worst-case performance of your procedure? [3]

b. Consider inserting the keys 10, 22, 31, 4, 15, 28, 17, 88, 59 into a hash table of length m=11 using double hashing with the primary hash function $h_1(k) = k \bmod m$ and the secondary hash function $h_2(k) = 1 + (k \bmod (m\text{-}1))$ [3]

c. A binary tree is termed as strictly binary tree if every non leaf node has nonempty left and right subtrees. What will be the total number of nodes in a strictly binary tree with n leaf nodes? [2]

d. The nodes of a binary tree are labeled with a, b, c, …, h. The preorder and inorder traversals are "a b c d e f g h" and "c d b a g f e h" respectively. Draw the tree. [2]

5.

a. Suppose that we have numbers between 1 and 1000 in a binary search tree and want to search for the number 363. Which of the following sequences could not be the sequence of node examined? Justify your answer.

   i. 2, 252, 401, 398, 330, 344, 397, 363.

   ii. 924, 220, 911, 244, 898, 258, 362, 363.

   iii. 925, 202, 911, 240, 912, 245, 363.

   iv. 935, 278, 347, 621, 299, 392, 358, 363. [2]

b. Start with an empty height-balanced binary search (AVL) tree and insert the elements with following keys in the given order: 3, 2, 1, 4, 5, 6, 7, 16, 15, 14. Draw figures to depict your tree immediately after each insertion and following the rebalancing rotations (if any). At each step, label all nodes with their balance factors and identify the rotation type (if any) that is done. [3]

c. Use basic properties of Red Black tree to prove the following: "The path from the root to the furthest leaf in a Red Black tree is no more than twice as long as the path from the root to the nearest leaf." [2]

d. Explain why the array given below cannot be considered as a Max-Heap.

19	42	33	44	31	19	35	15	26	14

Transform it into a heap without using any sorting algorithm. Insert 35 into the heap thus obtained. Draw the new heap. Also, show the array representing the new heap. [3]

25/100