Semester: Monsoon. Session: 2017-2018.
Examination & Semester: III Sem. B.Tech (Common). Time: 2 Hours.
Subject: Methods of Applied Mathematics-I. Max. Marks: 60.

Instructions: 1. Use separate answer sheet for each Part.
2. All questions are compulsory.
3. Figures in the margin indicate the respective marks.

## Part 1 (Complex Variables and Special Functions) Marks: 30

Q.1. Show that the function $f(z)=\begin{cases}\dfrac{xy^2z}{x^2+y^4}, & z\neq 0\\ 0, & z=0\end{cases}$ is continuous and satisfies the Cauchy-Riemann equations at 0 but the function $f(z)$ is not differentiable at 0. [6]

Q.2. Let $f(z)=u+iv$ be an analytic function. If $\frac{\partial u}{\partial x}=3x^2-4y-3y^2$ and $f(1+i)=0$, find the function $f(z)$. [6]

Q.3. Evaluate the integral $\int_C \frac{e^{i\frac{\pi z}{2}}}{(z-2)^2(z-4)}dz$, where $C$ denote the circle $|z-1|=2$, traversed once in anticlockwise direction. [6]

Q.4. Evaluate the integral $\int_\gamma \sin^2 z\, dz$, where $\gamma$ is the path from $-i\pi$ to $i\pi$, taken along the semi-circle $|z|=\pi$ in anticlockwise direction. [6]

Q.5. Find the Taylor and Laurent series expansions of the function $f(z)=\dfrac{1}{z^2+2iz+3}$ about $z=0$. [6]

## Part-II (Laplace Transform and PDE: 30 Marks)

**Q1.** Evaluate $L\left\{\sin\left(\sqrt{t}\right)\right\}$ and hence find $L\left\{\dfrac{\cos\sqrt{t}}{\sqrt{t}}\right\}$. **(4+2)**

**Q2.** Evaluate (i) $L^{-1}\left\{\dfrac{e^{-3s}}{s^2(s+2)}\right\}$, (ii) $L^{-1}\left\{\cot^{-1}\left(\dfrac{s+3}{2}\right)\right\}$ **(3+3)**

**Q3.** Using Laplace transform solve $\dfrac{dx}{dt}=2x-3y$, $\dfrac{dy}{dt}=y-2x$ subject to $x(0)=8$, $y(0)=3$. **(6)**

**Q4.** An inductor of 2 henrys, a resistor of 16 ohms, and a capacitor of 0.02 farads are connected in series with an e.m.f. of $100\sin 3t$ volts. At $t=0$, the charge on the capacitor and the current in the circuit are zero. Using transform technique find the charge and current at any time $t>0$. **(6)**

**Q5.** A beam whose ends are hinged at ends $x=0$ and $x=l$ has a load $W(x)$ given by $W(x)=\begin{cases}0, & 0<x<l/3\\ W_0, & l/3<x<l\end{cases}$. Using Laplace transform find the deflection at any point. **(6)**

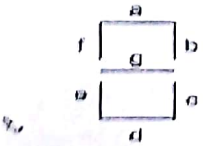
SESSION: 2017-2018

# INDIAN INSTITUTE OF TECHNOLOGY
## (INDIAN SCHOOL OF MINES), DHANBAD
## MID SEMESTER EXAMINATION (MONSOON SEMESTER)

Subject: Digital electronics (ECE 13101) Time: 2 hours Max. Marks: 60

(3rd Sem B.Tech and MT (CSE) Dual & 3rd Int MT (M&C))

**Note: - Attempt all questions.**

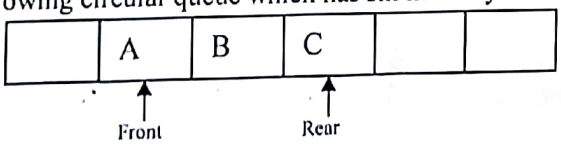
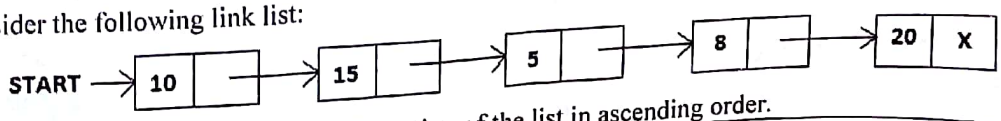
| | | |
|---|---|---|
| Q.1 | Perform the following<br>(a) $(10.111)_2 = (\quad\quad)_{10} = (\quad\quad)_8$<br>(b) $(56.7)_8 = (\quad\quad)_2 = (\quad\quad)_{10}$<br>(c) $(110110)_2 + (001101)_2$<br>(d) Convert the binary number 1001001 to gray code.<br>(e) Find the value of 'x' of the given equation.<br>$(135)_x + (144)_x = (323)_x$ | 2X5 |
| Q.2 | (i) Draw a logic diagram using only two input NAND gates to implement the following expression.<br>(a) $F = (AB+\bar{A}\bar{B})(C\bar{D}+\bar{C}D)$ (b) $F = \bar{A}B+A\bar{B}$<br>(ii) Design a combinational circuit, which is converting 3 bit binary to 3- bit Gray code. | 5<br>5 |
| Q.3 | (a) With the help of logic diagram and truth table, design a full Adder and realize a full Adder using half Adder.<br>(b) Design a 4X16 decoder using 3X8 decoder. | 5<br>5 |
| Q.4 | Implement all the basic logic gates i.e. NOT, AND, OR, NOR, NAND, EXOR and EXNOR using 2 X1 Multiplexer. | 10 |
| Q.5 | (i) Find the essential prime implicants.<br>$F = \sum m(0,1,2,6,8,10,12)$<br>(ii) Two products are sold from a vending machine, which has two push buttons $P_1$ and $P_2$. When a button is pressed, the price of the corresponding product is displayed in a 7-segment display. If no buttons are pressed, '0' is displayed, signifying 'Rs. 0'. If only $P_1$ is pressed, '2' is displayed, signifying 'Rs. 2'. If only $P_2$ is pressed, '5' is displayed, signifying 'Rs. 5'. If both $P_1$ and $P_2$ are pressed, 'E' is displayed, signifying 'Error'. The names of the segments in the seven segment display is shown below.<br>  <br><br>Consider:<br>(1) a button pressed/not pressed is equivalent to logic 1/0 respectively,<br>(2) a segment glowing/not glowing in the display is equivalent to logic 1/0 respectively<br>If segments 'a' to 'g' are considered as functions of $P_1$ and $P_2$, then find the expression for 'a' to 'g' and also prove that d = c + e. | (2+8) |
| Q.6 | (i) Simplify the Boolean function using K-map in SOP and POS forms:<br>$F=\sum m(0,1,2,4,7,8,12,14,15,16,17,18,20,24,28,30,31)$<br>(ii) Design a combinational circuit, which is converting 3 bit binary to Excess-3 code. | 5+5 |

# Monsoon Mid-Semester Examination, Session 2017-18

Examination & Semester: **B.Tech. & Dual Degree (Computer Science & Engineering) III Semester**
Subject: **Data Structures** Time: **2 Hours**
Instructions: Max. Marks: **60**

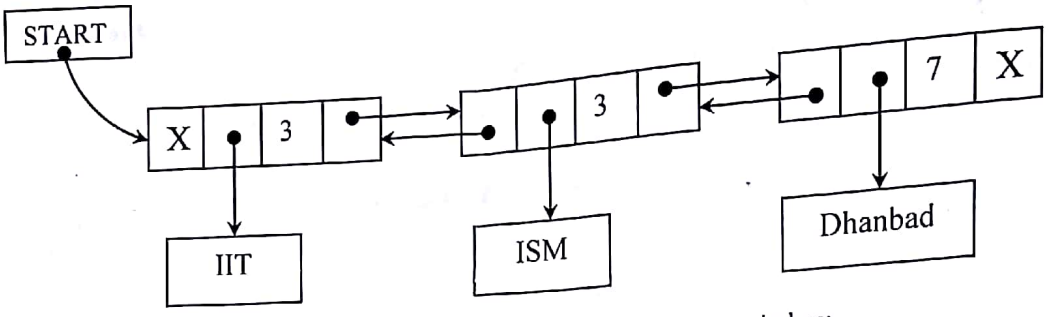
**(a) Part A is compulsory.**
**(b) Attempt any TWO questions from Part B.**
**(c) Answer the questions serially and to the point.**

## Section A (Marks: 40)

| Q. No. | Questions | Marks |
|---|---|---|
| 1. (a) | Explain the methods used to represent a real number. | 5 |
| (b) | Consider a 3D array Number ($L_1$:$U_1$, $L_2$:$U_2$, $L_3$:$U_3$) and the base address of Number is 'M'.<br>(i) Find out the total number of elements in Number.<br>(ii) Suppose an element Z($K_1$, $K_2$, $K_3$) is in Number and each element occupies 'w' storage. Find the address of Z. | 5 |
| 2. (a) | Let us consider a tri-diagonal matrix of 'n' rows and 'n' columns; the staring location of the first element of the matrix is 'M', i.e. of $a_{11}$=M; number of bytes occupied by each element of the matrix is 'w'. Obtain the indexing formula for the row-major and column-major ordering of the tri-diagonal matrix. | 5 |
| (b) | Illustrate, with a suitable algorithm, the use of stack for Decimal to Binary conversion. | 5 |
| 3. (a) | List the various techniques used to represent queue in memory. Suppose the data is stored in a circular array with 'N' memory cells. Find the number of elements in a queue in terms of FRONT and REAR pointer. | 5 |
| (b) | Consider the following circular queue which has six memory cells to store the data elements.<br>  <br>Show the queue as the following operations take place:<br>(i) Symbols D and E are added.<br>(ii) Symbol F is added.<br>(iii) Two symbols are deleted.<br>(iv) Symbol I is added and one symbol is deleted.<br>(v) One symbol is deleted and one symbol K is added | 5 |
| 4. (a) | Let **PTR** be a pointer to the first node in a singly linked list and '**x**' is an arbitrary node in the list. Write an algorithm to delete the node '**x**' from the list. | 5 |
| (b) | Consider the following link list:<br>  <br>Write an algorithm to arrange the information of the list in ascending order. | 5 |

## Section B (Marks: 20)

**5. (a)** Consider the following simple Multi-linked list:




Each node has three pointers namely BACK, NAME, and FORW as given below.

| BACK | NAME | LEN | FORW |
|---|---|---|---|

BACK pointer points to the previous node. NAME pointer points to the string of characters. FORW pointer points to the next node. The field LEN represents the number of characters in the string pointed by pointer NAME. Null pointer has been represented by 'X'. Pointer START points to the first node of the multi-linked list. Write an algorithm to delete the second node and copy the string of second node into first node. The string of first node should become IIT(ISM).

**(b)** Explain the needs of prefix & postfix expression. Consider the following infix expression: **6**

((a + b) + c * (d + e) + f) * (g + h)

Convert the expression to equivalent prefix expression and postfix expression.

**6. (a)** Discuss the advantages, if any, of a two-way list over a one-way list for each of the following operations: **4**

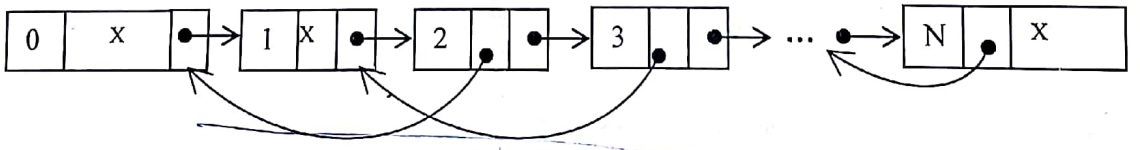
(i) Traversing the list to process each node

(ii) Deleting a node whose location is given

(iii) Searching an unsorted list for a given element

(iv) Inserting a node before the node with a given location

**(b)** Write an algorithm for creation of the following data structure: **6**




Each node has two pointers namely BACK and FORW as given below:

| INFO | BACK | FORW |
|---|---|---|

**7. (a)** Write an algorithm to merge two sorted array and create a third array in the sorted order. **4**

**(b)** Discuss the main attributes of recursion and write a *recursive algorithm* for Tower of Hanoi problem. **6**

# INDIAN INSTITUTE OF TECHNOLOGY (INDIAN SCHOOL OF MINES), DHANBAD
## Monsoon Mid-Semester Examination, Session 2017-18

Examination: **III B.Tech + Dual (CSE)**
Subject: **Discrete Mathematics (CSC13103)**

Time: **2 Hours**
Max. Marks: **60**

**Instructions:** (i) Answer ALL questions.
(ii) Attempt all sub-parts of a same question at same place and in order.
(iii) Assume suitable data wherever not provided.

| Q. No. | Question | Mark |
|---|---|---|
| 1. (a) | There are two restaurants next to each other. One has a sign that says, "Good food is not cheap," and the other has a sign that says, "Cheap food is not good." A customer read these sings and understood that these two signs saying the same thing. Justify customer's understanding using propositional calculus. | 6 |
| (b) | Thirty cars were assembled in a factory. The options available were a radio, an air conditioner, and white-wall tires. It is known that 15 of the cars have radios, 8 of them have air conditioners, and 6 of them have white-wall tires. Moreover, 3 of them have all three options. Calculate at least how many cars do not have any options at all. | 6 |
| 2. (a) | Use rules of inference to show that if $\forall x(P(x) \vee Q(x))$, $\forall x(\sim Q(x) \vee S(x))$, $\forall x(R(x) \rightarrow \sim S(x))$, and $\exists x \sim P(x)$ are true, then $\exists x \sim R(x)$ is also true, where the domains of quantifiers are the same. | 6 |
| (b) | Let $p$, $q$, and $r$ stand for the following propositions:<br>$p$: It is raining.<br>$q$: I have a headache.<br>$r$: I attend the lecture.<br>The proposition $P = (\neg p \wedge \neg q) \rightarrow r$ is rendered in English as follows: "If it is not raining and I do not have a headache, then I attend the lecture."<br>i. Write in English the negation of $P$.<br>ii. Write in English the contrapositive of $P$. | 3+3 |
| 3. (a) | Use mathematical induction to prove that $(\cos(x) + i\sin(x))^n = \cos(nx) + i\sin(nx)$, where $x$ is a complex number and $n$ is a positive integer. | 6 |
| (b) | If $A = A_1 \cup A_2 \cup A_3$, where $A_1 = \{1, 2\}$, $A_2 = \{2, 3, 4\}$, and $A_3 = \{5\}$, define relation $R$ on $A$ by $x\ R\ y$ if $x$ and $y$ are in the same subset of $A_i$, for $1 \leq i \leq 3$. Is $R$ an equivalence relation? Justify your answer. | 6 |
| 4. (a) | Let $(A, \mid)$ be a poset in which "$\mid$" be the relation on $A$ defined as "$x$ divides $y$", written as $x \mid y$. Draw the Hasse diagram and determine which of the following posets is lattice and why?<br>i. $A = \{1, 2, 3, 4, 6, 12\}$<br>ii. $A = \{1, 2, 3, 4, 6\}$ | 3+3 |
| (b) | Let $f_1(x) = x + 4$, $f_2(x) = x - 4$, and $f_3(x) = 4x$ for $x \in \mathbb{R}$, where $\mathbb{R}$ is the set of real numbers. Find $f_1 \circ f_3$; $f_3 \circ f_1$; and $f_1 \circ f_3 \circ f_2$. | 6 |
| 5. | For $n \geq 0$, let $S = \{1, 2, 3, \ldots, n\}$ (when $n = 0$, $S = \emptyset$), and let $a_n$ denotes the number of subsets of $S$ that contain no consecutive integers. Find and solve a recurrence relation for $a_n$. | 6+6 |