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&  
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## International Institute of Information Technology Naya Raipur

(A Joint Initiative of NTPC & Govt. of Chhattisgarh)

Email: [iiitnr@iiitnr.ac.in](mailto:iiitnr@iiitnr.ac.in), Tel: (0771) 2474040, Web: [www.iiitnr.ac.in](http://www.iiitnr.ac.in), Est. 2015

### END TERM EXAMINATION, Autumn 2023

Branch : CSE, DSAI & ECE      Year : I      Semester : I  
Subject : Probability & Statistics      Subject Code : MA105C      Instructor Code : Rk  
Time : 150 min      Date : 13.12.2023      Maximum Marks : 50

#### PART A - 14 Marks

- Prove or disprove that two random variables  $X$  and  $Y$  with  $Cov(X, Y) = 0$  are independent. [3]
- What is the Weak Law of Large Numbers? [2]
- Define a random variable. Give an example of a random variable on a sample space of at least four elements. [3]
- Define binomial distribution and find its mean. [3]
- A random variable  $X$  has density function  $f_X(x) = ce^{-3x}$  for  $x \geq 0$ . Find  $p(1 \leq X \leq 2)$ . [3]

#### PART B - 35 Marks

- A random variable  $X$  has the density function  $f_X(x) = ce^{-\frac{x}{2}}$  for  $x \geq 0$ . Find an upper bound on the  $p(|X - 2| > 3)$ . Also, find the actual value of  $p(|X - 2| > 3)$ . [6+6]
- Find the Skewness coefficient of a standard normal random variable. [6]
- Dr Bandi believes the average time required to complete this exam is 135 minutes, with an S.D. of 25. A random sample of 60 students completed their exam in 140 minutes. Can you support Dr. Band's hypothesis? [6]
- The following table gives joint probability  $p(x, y)$  of two random variables  $X$  and  $Y$ . Find the correlation coefficient of  $X$  and  $Y$ . [6]

$X \backslash Y$	1	2	3	4
1	$\frac{1}{8}$	$\frac{1}{16}$	$\frac{1}{32}$	$\frac{1}{32}$
2	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{1}{32}$	$\frac{1}{32}$
3	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$	$\frac{1}{16}$
4	$\frac{1}{4}$	0	0	0

- A group of 10 friends, including you, plan to spend Rs 600 in the college canteen after the exam. If the chance of spending more than Rs 600 is only 25%, find the average amount one has to contribute with a standard deviation of Rs 15 using the Central limit theorem. [6]



डॉ. श्यामा प्रसाद मुखर्जी अंतरराष्ट्रीय सूचना प्रौद्योगिकी संस्थान  
Dr. Shyama Prasad Mukherjee International Institute of Information  
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**END SEM EXAMINATION, Autumn-2023**

**Branch & Year:** ECE/ CSE/ DSAI; 2023

**Semester:** I

**Subject:** Digital Logic Design

**Subject Code:** EC101C

**Instructor Code:** MA

**Max Marks:** 50

**Duration:** 3 Hours

**Date:** 20.12.2023

**The figures in the right margin indicate full marks.**

**Answer all the parts of a question together in a single place.**

**Candidates are required to give their answer in their own words as far as applicable.**

**Unless otherwise specified, the notations / symbols have their usual meanings.**

1. Anwar any 10

[ $10 \times 2 = 20$ ]

1 (a). Convert the hexadecimal number 9C.DB to base 2 and base 4.

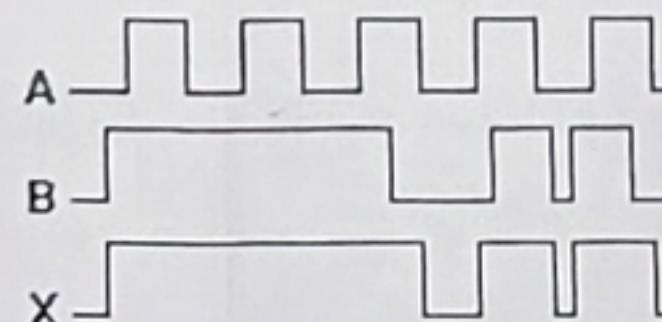
1 (b). State the De Morgan's Theorem.

1 (c). Which gates are called as Universal gate and what are its advantages?

1 (d). Write the simplest equation ( $X =$ ) which implements the K-map shown below

	$\bar{C}$	$C$
$\bar{A} \bar{B}$	0	0
$\bar{A} B$	1	1
$A \bar{B}$	1	1
$A B$	0	1

1 (e). Write the output ( $X$ ) with respect to two inputs (A and B) of the following waveform pattern



1 (f). What is the Don't-care condition in K-maps?

1 (g). What are the differences between combinational circuit and sequential circuit?

1 (h). Implement Boolean functions  $F = A(\bar{B} + \bar{C}D) + B\bar{C}$  using only NAND gates.

1 (i). What are the differences between synchronous counter and asynchronous counter?

1 (j). Write the characteristic equation of a JK flip-flop.

- 1 (k). What is the maximum possible range of bit-count specifically in n-bit binary counter consisting of 'n' number of flip-flops

**Answer any 5 of the following questions**

**[5× 6 = 30]**

2. Using Quine Mc Cluskey method (Tabular method), minimize the following function (Show the detailed steps):  $F(A,B,C,D) = \sum m(0,1,3,4,5,6,11,13,14,15)$  [6]

3. The four variable function F is given in terms of min-terms as  $F(A,B,C,D) = \sum m(1,3,4,5,9,11,14,15)$ . Using the K-map minimize the function in the sum of products and product of sum forms. [3+3]

4. Write a short note on (i) 2-bit Magnitude Comparator, (ii) 4-bit PISO shift register [3+3]

5. Write short note on any three of the following questions: [2+2+2 = 6]

- (a). Master slave JK Flip-flop
- (b). Ring Counter
- (c). Implement:  $F(A,B,C,D) = \sum(1,4,5,7,9,12,13)$  using 4:1 MUX
- (d). Design of BCD-to-excess-3 code converter

6. Convert a SR Flip Flop to JK Flip? [6]

7. Design the 4-bit synchronous up/down counter with state, timing, and logic diagrams. [6]

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**END TERM EXAMINATION AUTUMN, 2023**

**Branch & Academic Year:** ECE/CSE/DSAI (2022-23)

**Semester:** I

**Subject:** Environmental Engg & SDG

**Subject Code:** HS103C

**Instructor Code:** PPP/PKS

**Max Marks:** 50

**Duration:** 90 Minutes

**Date:** 15/12/2023

**Instruction:** (Read the instructions under each section **very** carefully)

**Section A (All questions are compulsory)**

**Choose the most appropriate option**

1. Neo-Malthusians are the peoples believes [1]  
A. Humans will find the solution of all problems  
B. Technology can enhance the carrying capacity  
C. Population growth has disastrous effects  
D. None of these
2. The earth's atmosphere is divided into layers based on the vertical profile of [1]  
A. Air pressure  
B. Air temperature  
C. Air density  
D. Wind speed
3. Which horizon is the most valuable for agriculture? [1]  
A. A horizon  
B. E horizon  
C. B horizon  
D. R horizon
4. Endemic species are [1]  
A. rare species  
B. species localised in a specific region  
C. cosmopolitan in distribution  
D. critically endangered species
5. The complex network of interconnected food chains is called \_\_\_\_\_ [1]  
A. Trophic level  
B. Food web  
C. Ecological pyramid  
D. Ecology chain
6. The Red Data Book contains data of [1]  
A. all plant species  
B. all animal species  
C. economically important species  
D. threatened species
7. Which sustainable farming method involves planting different crops from year to year? [1]  
A. Terracing  
B. Crop rotation  
C. Shelterbelts  
D. Contour farming
8. Biodiversity [1]  
A. Increases towards the equator  
B. Decreases towards the equator  
C. Remains the same throughout the planet  
D. Has no effect on change in latitude
9. The ozone layer in the atmosphere acts as an efficient filter for: [1]  
A. UV-A Rays  
B. UV-B Rays  
C. Gamma Rays  
D. Infrared rays
10. A transitional zone between two ecosystems is a(n): [1]  
A. Conservation zone  
B. Corridor  
C. Reservoir  
D. Ecotone
11. In the context of MDG & SDG declared by the United Nations, MDG stands for [1]  
A. Minimum Development Goals  
B. Millennium Development Goals  
C. Modal Development Goals  
D. Moderate Development Goals
12. Which of the following is not under the five P's [1]  
A. Planet  
B. People  
C. Poverty  
D. Peace
13. In \_\_\_\_\_ stage both birth and death rates are high [1]  
A. post-industrial stage  
B. industrial stage  
C. transitional stage  
D. pre-industrial stage
14. The SDG's are accepted in 70th United Nations General Assembly Meeting held in \_\_\_\_\_. [1]  
A. Geneva  
B. Kyoto  
C. New York  
D. Rio de Janeiro



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15. \_\_\_\_\_ is a diversity index that quantifies how equal the populations are numerically. [1]  
A. Species richness      B. Species evenness      C. Ecosystem diversity      D. Species diversity
16. In the context of Green Manufacturing, RoHS stands for: [1]  
A. Recycling of Harmful Substances      B. Reuse of Harmless Substances  
C. Rescue of Hazardous Substances      D. Restriction of Hazardous Substances
17. Why should anyone pursue green computing? [1]  
A. For business efficiency      B. For social obligation  
C. Only (a) above      D. Both (a) and (b) above
18. Which of the following is considered non-hazardous substance for manufacturing electronic goods: [1]  
A. Mercury      B. Cadmium      C. Sulphur      D. Copper
19. To optimize electric power consumption, cloud computing data centres often use a technique by which one large server computer is used for running multiple applications. This technique is called: [1]  
A. Visualization      B. Virtualization      C. Green Computing      D. Big data Computing
20. Which of the following is considered hazardous substance for manufacturing electronic equipment: [1]  
A. Zinc      B. Lead      C. Germanium      D. Tin

**Section B (All questions are compulsory)**

**Short Answers [not more than 30 words]:**

1. Defined Hypoxia. [2]
2. Definition of Sustainable development as given by G.H Brundtland, (Norwegian Prime Minister and Director of World Health Organisation). [2]
3. Defined Eutrophication. [2]
4. 3-R approach for protecting the environment. [2]
5. Defined Coevolution. [2]

**Section C (Answer any four)**

**Essay-type questions [Answer needs to be strictly in line with the contents covered during the classes].**

6. Explain the term Carbon foot prints. Justify the statement "Why the peoples are non-vegetarian, if a system can support more vegetarians over the non-vegetarians". [2+3]
7. Discuss the various values of biodiversity and measures for its conservation. [3+2]
8. Under what conditions a biomass (as a source of energy) is considered to be carbon negative/neutral? The major cause of air pollution in Delhi is stubble burning in neighbouring states, what is your opinion on the same matter as an environmental Student? [2+3]
9. Name the different type of relationships two species may have in any ecosystem. justify the statement "Herbivory although is a exploitative relationship but in some special case it is a mutualist relationship". [2+3]
10. What are biogeochemical cycles? Explain by taking an example of one biogeochemical cycle. [5]

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**END-TERM EXAMINATION (2023-24)**

**Branch: CSE, DSAI, ECE**

**Subject Code: HS103C Subject: Study of Human Values Semester: 1<sup>st</sup>**

**Instructor Name: Dr. Manish Jha**

**Max Marks: 50**

**Duration: 2 Hrs.**

**Date: 13-12-2023**

**Attempts all questions.**

**Each question carries 10 marks.**

**Word Limit: 400 words for each question.**

**Q1. Discuss the various steps towards achieving and fulfilling basic aspiration of fulfilling life.**

**Q2. Explain the role of right understanding about relationship and its order of priority for achieving a happy, fulfilling, and prosperous life.**

**Q3. Human being is the co-existence of the Self and the Body, and its proper understanding is essential for ensuring holistic development. Examine the statement.**

**Q4. How, in your opinion, does understanding help in clearly identifying the meaning of full human potential? Support your answer in the light of concerns about peer pressure and its resolution.**

**Q5. Discuss the concept of holistic health and its various determinants.**

\*\*\*\*\* ALL THE BEST \*\*\*\*\*



**END TERM EXAMINATION AUTUMN, 2023**

**Branch:** BTech(CSE/DSAI/ECE)

**Semester:** I

**Subject:** Software Development

**Instructor Code:** KJ

**Max Marks:** 50

**Duration:** 2.5 hrs

**Date:** 14/12/2023

- Instruction:**
- SECTION A: All questions are compulsory and each carry 2 marks
  - SECTION B: All questions are compulsory and each carry 3 marks

**Section-A**

Q.1 Mention the use of /, //, \*\*, % operator in Python

Q.2 How is an empty class created in python?

Q.3 Write python function which takes a variable number of arguments.

Q.4 What is List Comprehension? Give an Example.

Q.5 How to delete a file using Python?

Q.6 What is the use of dir() function?

Q.7 What will be the output of the following code?

```
x = (100,)
```

```
print(x * 3.5)
```

Q.8 Observe the following Python code very carefully and rewrite it after removing all syntactical errors with each correction underlined.

```
def execmain():
    x = input("Enter a number:")
    if (abs(x)= x):
        print"You entered a positive number"
    else:
        x=*-1
        print"Number made positive:"x
execmain()
```

Q.9 Observe the following code and answer the questions that follow:

```
File = open("Mydata","a") _____ #Blank1 File.close()
```

- (i) What type (Text/Binary) of file is Mydata?
- (ii) Fill in Blank 1 with a statement to write “ABC” in the file “Mydata”.



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Q.10 Write the output for the following if the variable fruit='banana':

>>>fruit[:3]

>>>fruit[3:]

>>>fruit[3:3]

>>>fruit[:]

### Section-B

Q.11 Describe the difference between lists, tuples, set and dictionary. Explain with an example.

Q.12 Describe the difference between instance variables and class variables. Explain with an example.

Q.13 Explain different approaches for reversing a string in Python. Give an Example

Q.14 Explain inheritance and its types in Python. Give an Example.

Q.15 Write a user-defined function to generate odd numbers between a and b (including b). Note: a and b are received as an argument by the function.

Q.16 Write a NumPy program to create a null vector of size 10 and update sixth value to 11.

Q.17 A=['SDP', 'Sensors', 'DLD', 'Probability', 'C']. What will be the built-in function (in correct syntax without using print) to remove and display the item 'DLD'? Now convert the above list to a set. If I want to remove only the item 'Probability' from the set, what will be the correct syntax for the corresponding built-in function?

Q.18 Construct logical expressions for representing the following conditions:

a. marks scored should be greater than 300 and less than 400.

b. Whether the value of grade is an uppercase letter.

c. The post is engineer and experience is more than four years.

Q.19 Find the output of the following:

```
L1 = [100,900,300,400,500]
```

```
START = 1
```

```
SUM = 0
```

```
for C in range(START,4):
```

```
    SUM = SUM + L1[C]
```

```
    print(C, ":", SUM)
```

```
    SUM = SUM + L1[0]*10
```

```
print(SUM)
```



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Q.20 Write the definition of a function Reverse(X) in Python to display the elements in reverse order such that each displayed element is twice of the original element (element \*2) of the List X in the following manner:

Example:

If List X contains 7 integers as follows:

X[0]	X[1]	X[2]	X[3]	X[4]	X[5]	X[6]
4	8	7	5	6	2	10

After executing the function, the list content should be displayed as follows: 20 4 12 10 14 16 8



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END SEMESTER EXAMINATION (Dec, 2023)

~~Signature~~

**Branch & Year:** ECE, CSE, DSAI 2023

**Semester:** 1<sup>st</sup>

**Subject:** Sensors & Actuators

**Instructor Code:** DD & BCM

**Max Marks:** 50

**Duration:** 3.00 hr

**Date:** 20/12/23

**Instruction:** Answer all the parts of a question in same place. Answer to the point. Scientific calculator may be used for calculation.

1. (a) Explain the “loading effect” and how does it affect the accuracy of measurement? [3]  
(b) The following resistance values of a platinum resistance thermometer were measured at a range of temperatures. Determine the measurement sensitivity of the instrument in ohms/ $^{\circ}\text{C}$ . [3]

Resistance (ohm)	Temperature ( $^{\circ}\text{C}$ )
307	200
314	230
321	260
328	290

1. (c) A pressure gauge with a measurement range of 0-10 bar has a quoted inaccuracy of  $\pm 1.0\%$  of the full-scale reading. What is the likely measurement error expressed as a percentage of the output reading if this pressure gauge is measuring a pressure of 1 bar? [4]

2. (a) Describe the principles of MQ-3 gas sensor. [3]  
(b) Explain with proper schematic diagram the working principle of cantilever type explosive detector. [3]  
(c) What is the working mechanism of blood glucose sensor? [4]
3. (a) How does Bell's microphone work? What was the disadvantage of Bell's microphone? How did Edison resolve that? [2+1+2]  
(b) Explain the working mechanism of dynamic microphone with a suitable schematic diagram. [2]  
(c) A sinusoidal current of amplitude 1 A at a frequency of 1 kHz was supposed to be converted in acoustic signal using a speaker. Assume the loudspeaker is working under Lorentz force and has a coil of 60 mm in diameter, 40 copper coil turns, and a permanent magnet producing a magnetic flux density of 0.9 T. The coil and the diaphragm have a total mass of 25 gm. What will be the acceleration of the diaphragm movement? [5]

4. (a) Explain the working principle of photo resistor (LDR). What is dark current? [3]  
(b) What is piezo-resistive effect? Derive the relation between Gauge factor and poison ratio. [4]  
(c) A piezo-electric crystal having dimensions of  $5 \text{ mm} \times 5 \text{ mm} \times 1.25 \text{ mm}$ . The charge sensitivity of the crystal is  $150 \text{ pC/N}$  and its permittivity is  $12.5 \times 10^{-9} \text{ F/m}$ . If a force of  $5 \text{ N}$  is applied on the crystal, calculate the generated voltage from it. [3]
5. (a) How can ultrasonic sensor be used to measure the thickness of paint on wall? [3]  
(b) Describe the working principle of capacitive comb type accelerometer with proper schematic. What is the advantage of having multiple numbers of fixed and movable fingers on it? [4]  
(c) Explain the law of intermediate temperature of T/C using schematic diagram. [3]



### End Term Examination

Branch: CSE/ECE/DSAI  
Subject: LA&MA  
Maximum Mark: 50

Semester: B.Tech. I  
Subject Code: MA102C  
Duration: 3 hours

Academic Year: 2023-24  
Tutor Code: MKC  
Date: 15-12-2023

**Note:** Answer all the questions.

#### Section-A

[2\*10=20]

1. Determine whether vectors  $u = (1, 1, 0), v = (1, 3, 2), w = (4, 9, 5)$  are linearly dependent or independent.
2. Let  $W = \left\{ \begin{bmatrix} a \\ a+1 \end{bmatrix} \mid a \in \mathbb{R} \right\}$  be a subset of the vector space  $V = \mathbb{R}^2$  with the standard definitions of addition and scalar multiplication. Determine whether  $W$  is a subspace of  $V$ .
3. Find the eigenvalues of the matrix  $\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 5 & -10 \\ 1 & 0 & 2 & 0 \\ 1 & 0 & 0 & 3 \end{bmatrix}$
4. Express the matrix  $\begin{bmatrix} 2 & 6 \\ -3 & -7 \end{bmatrix}$  as a product of elementary matrices.
5. Find the dimension of the subspace  $W$  of  $\mathbb{R}^3$  where  $W = \{(a, b, c) : a + b + c = 0\}$ .
6. Find the values of  $k$  for which the system of equations

$$\begin{cases} x + ky = 1 \\ kx + y = 1 \end{cases}$$

has (a) no solution (b) infinitely many solutions.

7. Determine whether map  $T : \mathbb{R}^2 \rightarrow \mathbb{R}^2$  defined by  $T(x, y) = (x + y, x - y)$  is linear transformation or not.
8. Determine whether vector  $v = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$  is linear combination of vectors  $v_1 = \begin{bmatrix} 1 \\ 2 \end{bmatrix}$  and  $v_2 = \begin{bmatrix} 3 \\ 4 \end{bmatrix}$  or not.
9. State the rank-nullity theorem for the linear transformation.

10. Find the rank of the matrix  $\begin{bmatrix} 1 & 2 & 0 \\ 4 & 1 & 2 \\ 8 & 2 & 4 \end{bmatrix}$ .

**Section-B**

[5\*6=30]

11. If the following system is consistent, solve it using the Gaussian elimination method.

$$\begin{cases} x - 3y - 2z = 6 \\ 2x - 4y - 3z = 8 \\ -3x + 6y + 8z = -5 \end{cases}$$

12. Determine whether matrix  $M = \begin{bmatrix} 2 & 7 & 6 \\ 9 & 5 & 1 \\ 4 & 3 & 8 \end{bmatrix}$  is invertible or not. If invertible, find the inverse using the Gauss-Jordan method.

13. Find an LU factorization of the matrix  $A = \begin{bmatrix} 1 & 2 & -3 \\ -3 & -4 & 13 \\ 2 & 1 & -5 \end{bmatrix}$ .

14. Let  $T : \mathbb{R}^2 \rightarrow \mathbb{R}^3$  be the linear transformation defined by  $T(v) = T\left(\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}\right) = \begin{bmatrix} x_2 \\ x_1 + x_2 \\ x_1 - x_2 \end{bmatrix}$

and let  $B = \left\{ \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 3 \\ 1 \end{bmatrix} \right\}$ ,  $B' = \left\{ \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 0 \end{bmatrix}, \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} \right\}$  be ordered bases for  $\mathbb{R}^2$  and  $\mathbb{R}^3$ , respectively.

find the transition matrix  $[T]_B^{B'}$ .

15. Determine whether the matrix  $\begin{bmatrix} 1 & 2 & 0 \\ 2 & 1 & 0 \\ 0 & 0 & -3 \end{bmatrix}$  is diagonalizable or not. If diagonalizable, then diagonalize it.

16. Let  $F : \mathbb{R}^4 \rightarrow \mathbb{R}^3$  be the linear mapping defined by  $F(x, y, z, t) = (x - y + z + t, 2x - 2y + 3z + 4t, 3x - 3y + 4z + 5t)$

(a) Find a basis and the dimension of the image of the map  $F$ .

(b) Find a basis and the dimension of the kernel of the map  $F$ .



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**End Term Examination, Spring 2023-24**

Branch & Academic Year: CSE/ECE/DSAI, Spring 2023-24 Semester: I  
Subject: Introduction to Programming Subject Code: CS101C Instructor Code: KGS  
Max Marks: 50 Duration: 180 Minutes

**Instruction:**

- All questions are compulsory.
- In all the cases, you need to write first the flow chart followed by C code. Each question carries 5 Marks. 2.5 Marks is allocated for flow chart and rest 2.5 Marks will be allocated for C code.
- Write the flow chart neatly, so that your logic is clear. Divide the answer sheet into two columns, in left column write the flow chart and in the right column write the C code.

Q1. Write a program to calculate salary of an employee, given his basic pay (to be entered by the user), HRA = 10% of the basic pay, TA = 5% of basic pay. Define HRA and TA as constants and use them to calculate the salary of an employee.

Q2. A class has 50 students. Every student is supposed to give three examinations. Write a program to read the marks obtained by each student in all three examinations. Calculate and display the total marks and average of each student in the class.

Q3. Write a program using switch case to display a menu that offers 5 options: read three numbers, calculate total, calculate average, display the smallest, and display the largest value.

Q4. Write a program to swap two integers using call-by-reference method of passing arguments to a function.

Q5. Write a program to calculate factorial of a number using recursion.

Q6. Write a program to multiply two  $m \times n$  matrices.

Q7. In a class there are 20 students. Each student is supposed to appear in three tests and two quizzes throughout the year. Make an array that stores the names of all these 20 students. Make five arrays that store marks of three subjects as well as scores of two quizzes for all the students. Calculate the average and total marks of each student. Display the result. Use string functions where ever applicable.

Q8. Write a program to reverse a string using pointers.

Q9. Using structures, write a program to read and display the information about entire faculty of a particular department?

Q10. Write a program to read the contents of a text file.

—All the Best—



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### END TERM EXAMINATION AUTUMN, 2023

**Branch & Academic Year:** CSE+ECE+DSAI (2023-24)

**Semester:** I

**Subject:** Discrete Mathematics

**Subject Code:** MA101C

**Max Marks:** 50

**Duration:** 10 am to 1 pm

**Date:** 14/12/2023

**Instruction: (if any):** All questions are Compulsory.

**Q1.** (a) ~~✓~~ Describe countable and uncountable sets giving one example each. [5 Marks]

    (b) ~~✓~~ Draw the Hasse diagram of power set of A, where  $A = \{1, 2, 3\}$  with superset relation. [5 Marks]

**Q2.** (a) ~~✓~~ Prove  $\sim(p \wedge q) \equiv \sim p \vee \sim q$  using truth tables. [5 Marks]

    (b) ~~✓~~ Test the validity of the following argument: [5 Marks]

If two sides of a triangle are equal, then the opposite angles are equal.

Two sides of a triangle are not equal.

Therefore,

The opposite angles are not equal.

**Q3.** ~~✓~~ State pigeonhole principle. Find the minimum number of students in a class to be sure that three of them are born in the same month. [10 Marks]

$$\frac{12}{12} = 3$$

**Q4.** What is the nth order, linear homogeneous recurrence relation with constant coefficients? Give one example.

Hence model and solve the following: It is given that the number of patients infected by COVID-19 for the month of May 2021 in Raipur is 30 at time  $n = 0$  and 32 at time  $n = 1$ . This scenario is modelled by the recurrence relation  $a_n = 3a_{n-1} - 2a_{n-2}$ . Solve the recurrence relation subject to the given conditions for determining the COVID-19 patients in Raipur in May 2021. [10 Marks]

**Q5.** ~~✓~~ Show that the set  $M = \left\{ \begin{bmatrix} a & b \\ c & d \end{bmatrix} : a, b, c, d \in \mathbb{R} \text{ and } ad - bc \neq 0 \right\}$  under matrix multiplication is a group. [10 Marks]