

**2023/TDC(CBCS)/ODD/SEM/  
MTMSEC-301T/(A/B/C)/309**

**TDC (CBCS) Odd Semester Exam., 2023**

**MATHEMATICS**

**( 3rd Semester )**

**Course No. : MTMSEC-301T**

**Full Marks : 50**

**Pass Marks : 20**

**Time : 3 hours**

*The figures in the margin indicate full marks  
for the questions*

**Candidates have to answer question from either  
Option—A or Option—B or Option—C**

**OPTION—A**

**Course No. : MTMSEC-301T (A)**

**( Logic and Sets )**

**SECTION—A**

**Answer fifteen questions, taking any three from  
each Unit :  $1 \times 15 = 15$**

**Unit—I**

- 1. Write the negation of the following  
statement :**

$$x \in \mathbb{N} \text{ and } 3x + 7 = 0$$

**24J/309**

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( 2 )

2. If  $p$  is false,  $q$  is true, then what is the truth value of  $p \vee \sim q$ ?
3. If 1 denotes a tautology, then show that  $p \vee 1 \Leftrightarrow 1$ .
4. Let  $A = \{10, 20, 30, 40, 50, 60\}$ . How many subsets of  $A$  have four elements?

Unit—II

5. Write the following statement using quantifier :

“For all natural numbers,  $n+3 > 2$ .”

6. If 0 denotes a contradiction, then show that

$$p \wedge 0 \Rightarrow 0$$

7. Rewrite the following statement as an implication :

“The diagonals of a parallelogram bisect each other.”

8. Write the negation of each of the following :

(a) There exists an infinite set whose power subsets are all finite.

(b) For every real number  $x$ , there is an integer  $n$  such that  $n > x$ .

24J/309

( Continued )

( 3 )

Unit—III

9. Justify True or False :

$$A \subseteq B \Rightarrow A^c \subseteq B^c$$

10. What is  $N \cap (-3, 7)$ ?

11. If  $A = \phi$ , then write  $P(P(A))$  in roster form.

12. How many subsets of  $B$  of  $\{1, 2, 3, \dots, n\}$  have the property that  $B \cap \{1, 2\} = \phi$ ? Explain.

Unit—IV

13. Find the symmetric difference of the sets  $A = \{1, 2, 3, 4, 5, 6\}$ ,  $B = \{2, 4, 6, 8, 10\}$ .

14. Fill in the blank :

$$A \cap B = B \text{ iff } \underline{\hspace{2cm}}.$$

15. Draw the Venn diagram of  $(A \cap B^c \cap C)$  for any sets  $A$ ,  $B$  and  $C$

16. If  $A = \phi$ , then  $|P(P(A))| = ?$

24J/309

( Turn Over )

Unit—V

- 17. Define reflexive relation on a set.
- 18. Is every reflexive relation an identity relation? Justify.
- 19. Let  $X = \{a, b, c, d\}$ . Write a relation on  $X$  that is symmetric but neither transitive nor reflexive.
- 20. Define maximal element of a poset.

SECTION—B

Answer five questions, taking one from each Unit :

2×5=10

Unit—I

- 21. Construct the truth table for  $(\sim p) \wedge (q \vee \sim p)$ .
- 22. Show that  $(p \wedge q) \rightarrow (p \vee q)$  is a tautology.

Unit—II

- 23. What is the truth value of the quantification  $(\exists x), Q(x)$  if the statement  $Q(x)$  and universe of discourse is given as follows?  
 $Q(x): x^2 < 18, U = \{\text{positive integer not exceeding } 4\}$
- 24. Show that there is no largest integer.

Unit—III

- 25. Prove that  $(A \setminus B) \setminus C = A \setminus (B \cup C)$  for any sets  $A, B, C$ .
- 26. Prove or disprove :  
 $A \cap B = \phi \Rightarrow P(A) \cap P(B) = \phi$

Unit—IV

- 27. Let  $A_n = \{x \in \mathbb{Z} | x \geq n\}$  for each  $n \in \mathbb{N}$ . What is  $\bigcap_{n=1}^{\infty} A_n$ ?
- 28. Find the value of  $k$  for which  $A_3 \cap A_5 = A_k$ , when  $A_n = \{a \in \mathbb{Z} | a \leq n\}$ .

Unit—V

- 29. Draw the Hasse diagram for the partial order  $\leq$  on  $\{0, 1, 2, 3\}$ .
- 30. Show that the number of elements in the power set of a set having  $m$  elements is  $2^m$ .



## SECTION—C

Answer five questions, taking one from each Unit :  
5×5=25

## Unit—I

31. Using algebra of propositions, prove that  $(s \Rightarrow ((\neg p \wedge q) \wedge r))$  is logically equivalent to  $\neg((p \vee (\neg(q \wedge r))) \wedge s)$ .
32. (a) Prove that  $p \rightarrow q = \neg p \vee q$ . 2  
(b) Show that an implication and its contrapositive are logically equivalent. 3

## Unit—II

33. Using truth table, show that  $((p \Rightarrow q) \wedge (q \Rightarrow r)) \Rightarrow (p \Rightarrow r)$  is a tautology.
34. Using algebra of propositions, establish the following logical equivalences : 3+2  
(i)  $p \rightarrow (q \rightarrow r) \Leftrightarrow (p \wedge \neg r) \rightarrow \neg q$   
(ii)  $p \rightarrow (q \vee r) \Leftrightarrow (p \wedge \neg q) \rightarrow r$

## Unit—III

35. Show that the union of two finite sets is finite.
36. (a) For any sets  $A, B, C$ , show that  $(A \cap B) \times C = (A \times C) \cap (B \times C)$  3  
(b) Show that  $P(A \cap B) = P(A) \cap P(B)$ . 2

## Unit—IV

37. (a) Show that  $\bigcap_{n=1}^{\infty} [0, \frac{1}{n}] = \{0\}$  3  
(b) If  $P(A) = P(B)$ , then show that  $A = B$ . 2
38. (a) If  $A$  and  $B$  are nonempty sets, then show that  $A \times B = B \times A$  iff  $A = B$ . 2  
(b) Let  $n \geq 1$  be a natural number. How many elements are in the set  $\{(a, b) \in N \times N \mid a \leq b \leq n\}$ ? Explain. 3

## Unit—V

39. State and prove the fundamental theorem of equivalence relations.
40. Construct bijection from  $(1, 2)$  to  $(21, 2021)$ . Justify your answer.

( 8 )

OPTION—B

Course No. : MTMSEC-301T (B)

( Programming in C )

SECTION—A

Answer fifteen questions, taking any three from each Unit :  $1 \times 15 = 15$

Unit—I

1. Write the syntax to declare an integer variable.
2. How are comments written in a C program?
3. Mention two C library functions.
4. Write the syntax for scanf statement.

Unit—II

5. Write a C program to print the following line of text :

Welcome to C

6. Convert the following equation to corresponding C statement :

$$A = \frac{(x+y)^2}{6} + xy^2$$

24J/309

( Continued )

( 9 )

7. Identify the error, if any, in the following C statement :

```
printf (x = % d, x);
```

8. What are the three logical operators in C?

Unit—III

9. Write the syntax of if-else statement.
10. What is the purpose of break statement?
11. If the initial value of x is 2, then what will be its value after execution of the statement  $x++$  ; ?
12. Write the syntax of while loop.

Unit—IV

13. Write two advantages of using functions in C.
14. What are recursive functions?
15. What is the maximum number of arguments a function can have in C?
16. What should be the return type of a function that does not return any value?

24J/309

( Turn Over )

( 10 )

Unit—V

17. Define an array.
18. What should be the type of an array index?
19. Point out errors, if any, in the following array declaration :  

```
float y(3);
```
20. Write the syntax to declare an integer array of size 10.

SECTION—B

Answer *five* questions, taking *one* from each Unit.

2×5=10

Unit—I

21. Write the rules for naming an identifier.
22. Distinguish between local and global variables.

Unit—II

23. Write a C program to input two integers and print their sum.

24J/309

( Continued )

( 11 )

24. What will be the value of  $x$  when the following segment is executed?

```
int x = 10, y = 15;
```

```
x = (x < y) ? (y + x) : y;
```

Unit—III

25. Describe switch statement with a suitable example.
26. Write a C program to check whether a number (integer) is divisible by 2.

Unit—IV

27. Write a short note on function prototypes.
28. Distinguish between actual and formal arguments with regard to C functions.

Unit—V

29. What is the difference between an array and an ordinary variable? Explain with an example.
30. Write two advantages of using a multi-dimensional array in a C program.

24J/309

( Turn Over )



( 12 )

SECTION—C

Answer five questions, taking one from each Unit :

5×5=25

Unit—I

31. Write a note on C data types.
32. Explain formatted input and output statements in C with suitable examples.

Unit—II

33. Write notes on logical and relational operators in C.
34. Write a C program to compute the area and perimeter of a rectangle, taking length and breadth as inputs.

Unit—III

35. Write a note on various conditional statements in C.
36. Discuss briefly about various loop control statements in C.

24J/309

( Continued )

( 13 )

Unit—IV

37. Write a C program to find the factorial of a positive integer using recursion.
38. Discuss briefly about various types of functions in C, with suitable examples.

Unit—V

39. Discuss one-dimensional and multi-dimensional arrays.
40. Write a C program to find the least element in an array of integers.

24J/309

( Turn Over )

( 14 )

OPTION—C

Course No. : MTMSEC-301T (C)

( Classical Algebra and Trigonometry )

SECTION—A

Answer fifteen questions, taking any three from each Unit :  $1 \times 15 = 15$

Unit—I

1. Define idempotent matrix.
2. Define nilpotent matrix.
3. Define skew symmetric matrix.
4. Define unitary matrix.

Unit—II

5. Define normal form of a matrix.
6. Discuss consistency of a given system of equations.
7. What is the rank of zero matrix?
8. Define Echelon form of a matrix.

( 15 )

Unit—III

9. When is a polynomial equation said to be a reciprocal equation?
10. Write down the equation whose roots are 1, -2, 3, -4.
11. Write down the sum of the roots of  $x^3 - px^2 + qx - p = 0$ .
12. Write the cubic equation, given roots are 1 and  $1+i$ .

Unit—IV

13. Write Gregory's series.
14. Find the value of  $e^{i\pi/4}$ .
15. State de Moivre's theorem.
16. If  $x = \cos\theta + i\sin\theta$ , then find  $x^2$ .

Unit—V

17. Expand  $\cos(\alpha - i\beta)$  in the form of  $a + ib$ .
18. Define hyperbolic function.
19. Define  $\sinh x$ .
20. Write the relation between  $\tan ix$  and  $\tan hx$ .



( 16 )

SECTION—B

Answer five questions, taking one from each Unit :

2×5=10

Unit—I

21. If  $A$  is a non-singular square matrix, then prove that  $(A^1)^{-1} = (A^{-1})^1$ .

22. Obtain the relation between rank of original matrix and its transpose.

Unit—II

23. Find the rank of the following matrix :

$$A = \begin{bmatrix} 1 & 3 & 4 \\ 2 & 6 & 8 \end{bmatrix}$$

24. Define orthogonality of a square matrix.

Unit—III

25. Find the roots of  $x^3 = 1$ .

26. The sum of two roots of

$$x^3 + a_1x^2 + a_2x + a_3 = 0$$

is zero. Show that  $a_1a_2 - a_3 = 0$ .

24J/309

( Continued )

( 17 )

Unit—IV

27. Find all possible values of  $(-1)^{1/4}$ .

28. If

$$\sin \alpha + \sin \beta + \sin \gamma = \cos \alpha + \cos \beta + \cos \gamma = 0$$

then prove that

(i)  $\cos 3\alpha + \cos 3\beta + \cos 3\gamma = 3 \cos(\alpha + \beta + \gamma)$

(ii)  $\sin 3\alpha + \sin 3\beta + \sin 3\gamma = 3 \sin(\alpha + \beta + \gamma)$

Unit—V

29. If  $n$  is positive integer, then prove that

$$(1+i)^n + (1-i)^n = 2^{\left(\frac{n}{2}+1\right)} \cos \frac{n\pi}{4}$$

30. Separate real and imaginary parts of  $\tan(x+iy)$ .

SECTION—C

Answer five questions, taking one from each Unit :

5×5=25

Unit—I

31. Find  $A^{-1}$  if the matrix

$$A = \begin{bmatrix} 4 & 3 & 8 \\ 6 & 2 & 5 \\ 1 & 5 & 9 \end{bmatrix}$$

24J/309

( Turn Over )

32. If

$$A = \begin{pmatrix} \alpha & \beta \\ \gamma & \delta \end{pmatrix}$$

then show that  $\text{adj}(\text{adj } A) = A$ .

Unit—II

33. Solve :

$$x + 2y + 3z = 11$$

$$x + 2y + 3z = -3$$

$$x + 2y + 3z = -1$$

34. If  $A$  and  $B$  are invertible square matrices of the same order, then prove that  $AB$  is invertible and  $(AB)^{-1} = B^{-1}A^{-1}$ .

Unit—III

35. If  $\alpha, \beta, \gamma$  are roots of  $x^3 + px^2 + qx + r = 0$ , then find the equation whose roots are  $\beta + \gamma - 2\alpha, \gamma + \alpha - 2\beta, \alpha + \beta - 2\gamma$ .

36. (a) Solve  $2x^3 - x^2 - 18x + 9 = 0$  if two roots are equal in magnitude but opposite on sign. 3

(b) Prove that  $(x+1)^4 = \alpha(x^4 + 1)$  is reciprocal if  $\alpha \neq 1$ . 2

Unit—IV

37. (a) If

$$x + \frac{1}{x} = 2 \cos \frac{\pi}{7}$$

then show that  $x^7 + \frac{1}{x^7} = -2$ . 2

(b) Show that

$$\frac{\pi}{8} = \frac{1}{1 \times 3} + \frac{1}{5 \times 7} + \dots$$

3

38. If  $x + iy = \sin(a + ib)$ , then show that

$$\frac{x^2}{\cosh^2 b} + \frac{y^2}{\sinh^2 b} = 1$$

Unit—V

39. Find the sum of

$$1 - \frac{1}{3 \cdot 2^2} + \frac{1}{5 \cdot 2^4} - \dots$$

40. Prove that

$$\pi = 2\sqrt{3} \left[ 1 - \frac{1}{3^2} + \frac{1}{5 \times 3^2} - \frac{1}{7 \times 3^3} + \dots \right]$$

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