2025/FYUG/ODD/SEM/
MTMSEC–101T/065

FYUG Odd Semester Exam., 2025

MATHEMATICS

(1st Semester)

Course No. : MTMSEC–101T

Mathematical Skill Development with Software)

Full Marks : 50
Pass Marks : 20

Time : 2 hours

The figures in the margin indicate full marks for the questions

UNIT—I

1. Answer any *three* of the following questions : $1\times3=3$

(a) What is a flowchart?

(b) What symbol is used to represent input/output operation in a flowchart?

(c) What does the 'if-then' statement represent in programming?

(d) Define iterative algorithm.

2. Answer any *one* of the following questions :

(a) Construct a flowchart to show the procedure for obtaining the average of two numbers.

(b) Write the algorithm to determine the greater of two numbers.

3. Answer any *one* of the following questions :

(a) Write an algorithm and flowchart for solving quadratic equation $ax^2 + bx + c = 0$.

(b) (i) Draw flowchart to find the product of first 5 natural numbers.

(ii) Write an algorithm to print the numbers below 100 that are divisible by 7.

UNIT—II

4. Answer any *three* of the following questions : 1

(a) Define polynomial function.

(b) Let A and B be two finite sets of orders m and n respectively. Find the number of relations from A to B.

(c) Draw the graph of sine function on $[-\pi, \pi]$.

(d) If $f(x) = 2x + 3$, $g(x) = x^2$, then find $(f \circ g)(x)$.

5. Answer any *one* of the following questions : 2

(a) Let R be the set of all real numbers. Show that the function

$$f : \mathbb{R} \to \mathbb{R} : f(x) = \cos x \ \forall x \in \mathbb{R}$$

is neither injective nor surjective.

(b) Let A and B be two non-empty sets. Let f be an injective function from A to B. Then prove that f^{-1} is also injective.

6. Answer any *one* of the following questions : 5

(a) (i) Show that the relation 'congruence modulo m' on the set of integers defined by $a \equiv b \pmod{m}$ is an equivalence relation, $m > 0$. 3

(ii) Consider a relation $R = \{(1, 1), (1, 2)\}$ on $A = \{1, 2, 3\}$. Add minimum of elements in R so that the enlarged relation becomes equivalence relation. 2

(b) (i) Prove that the product of any function with the identity function is the function itself. 4

(ii) Let Q be the set of all ratio[nal] numbers. Show that the functi[on] $f : Q \to Q : f(x) = 3x + 5$ for $x \in Q$ [is] surjective.

UNIT—III

7. Answer any *three* of the following questions :

(a) Define Eucledian algorithm.

(b) What is congruence relation betwe[en] two integers?

(c) If $ac|bc$, $c \neq 0$, then prove that $a|b$, usin[g] division algorithm.

(d) What is the well ordering property [of] positive integers?

8. Answer any *one* of the following questions :

(a) Using Eucledian algorithm, find th[e] GCD of 7468 and 2464.

(b) Prove that the fraction $\frac{21n+4}{14n+3}$ i[s] irreducible for any natural number n.

9. Answer any *one* of the following questions :

(a) (i) Show that $10^n + 3 \cdot 4^{n+2} + 5$ is divisible by 9

(ii) If p is prime and $p|ab$, then prove that $p|a$ or $p|b$, where $a, b \in \mathbb{Z}$. 2

(b) (i) Show that g.c.d. of $a+b$ and $a-b$ is either 1 or 2 if $(a, b) = 1$. 3

(ii) If $a \equiv b (\bmod m)$, $c \equiv d (\bmod m)$, then prove that $a + c \equiv b + d (\bmod m)$. 2

UNIT—IV

[1]0. Answer any *three* of the following questions as directed : 1×3=3

(a) Define conjugate of a matrix.

(b) If A is symmetric matrix, then show that kA is also symmetric matrix.

(c) Every invertible matrix possesses a ______.

(Fill in the blank)

(d) Give an example of a unitary matrix.

[1]1. Answer any *one* of the following questions : 2

(a) If A and B are Hermitian matrices, show that $(AB + BA)$ is Hermitian matrix and $(AB - BA)$ is skew-Hermitian matrix.

(b) If A is an $n \times n$ matrix, prove that $|adjA| = |A|^{n-1}$.

(Turn Over)

12. Answer any *one* of the following questions

(a) Find the adjoint of the matrix

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 1 & 2 & -3 \\ 2 & -1 & 3 \end{bmatrix}$$

and verify that $A(adjA) = (adjA)A = |A|I_3$

(b) Find the inverse of the matrix

$$A = \begin{bmatrix} 0 & 1 & 2 \\ 1 & 2 & 3 \\ 3 & 1 & 1 \end{bmatrix}$$

and verify that $AA^{-1} = A^{-1}A = I_3$.

UNIT—V

13. Answer any *three* of the following questions :

(a) Find the order and degree of the differential equation

$$y = \frac{dy}{dx} + \left[1 + \left(\frac{d^2y}{dx^2}\right)\right]^{\frac{1}{2}}$$

(b) Find the differential equation from the relation $y = A\cos x + B\sin x$, where A and B are arbitrary constants.

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(c) Define homogeneous first-order linear differential equation.

(d) Write general form of first-order linear differential equation.

14. Answer any *one* of the following questions : 2

(a) Solve :

$$x\sqrt{1+y^2}\,dx + y\sqrt{1+x^2}\,dy = 0$$

(b) Form differential equation from the relation $y = e^x(A\cos x + B\sin x)$.

15. Answer any *one* of the following questions : 5

(a) Solve :

$$(x^3 + 3xy^2)dx + (y^3 + 3x^2y)dy = 0$$

(b) Reduce the equation

$$\frac{dy}{dx} + x\sin 2y = x^3\cos^2 y$$

into linear differential equation and hence solve the equation. 2+3=5

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