FYUG Odd Semester Exam., 2025

MATHEMATICS

(3rd Semester)

Course No. : MTMDSM–201T

(Classical Algebra and Trigonometry)

Full Marks : 70
Pass Marks : 28

Time : 3 hours

The figures in the margin indicate full marks for the questions

UNIT—I

1. Answer any *two* from the following : 2×2=4

(a) Write Jacobi's theorem for the determinant of a matrix.

(b) Define adjoint of a square matrix.

(c) Find the rank of the identity matrix I_3.

2. Answer any *one* from the following : 10

(a) *(i)* Find the adjoint and inverse of

$$\begin{bmatrix} 2 & 1 \\ 5 & 3 \end{bmatrix}$$ 3+2=5

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(ii) Solve the system of equations using matrix inverse method : 5

$x+y+z=6,\ x-y+z=2,\ 2x+y+3z=14$

(b) (i) Solve using Gaussian elimination : 5

$x+y+z=1,\ 2x+3y+5z=2,\ 4x+5z=4$

(ii) Find the inverse of

$$\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 4 \\ 5 & 6 & 0 \end{bmatrix}$$ 5

UNIT—II

3. Answer any *two* from the following : 2×2=4

(a) If α and β are the roots of $x^2-5x+6=0$, then find $\alpha+\beta$ and $\alpha\beta$.

(b) Write the sum and product of roots for a cubic equation $ax^3+bx^2+cx+d=0$.

(c) If one root of the quadratic equation $x^2-4x+3=0$ is 1, then find the other root.

4. Answer any *one* from the following : 10

(a) (i) Solve $x^3-3x+2=0$ using Cardan's method. 5

(ii) If α, β and γ are the roots of $ax^3+bx^2+cx+d=0$, then find $\alpha^2+\beta^2+\gamma^2$. 5

(b) (i) Form the equation whose roots are twice those of $x^2-5x+6=0$. 5

(ii) Solve $x^3-4x^2-7x+10=0$. 5

UNIT—III

5. Answer any *two* from the following : 2×2=4

(a) If $a=4$ and $b=9$, then verify AM ≥ GM.

(b) State Cauchy-Schwarz inequality for two sequences (a_i) and (b_i).

(c) If $a=1$ and $b=4$, then find HM.

6. Answer any *one* from the following : 10

(a) (i) Verify Cauchy-Schwarz inequality for vectors (1, 2, 3) and (2, 1, 4). 5

(ii) Prove that AM ≥ GM ≥ HM for any two positive numbers. 5

(b) (i) If a, b and c are positive, then prove that

$(a+b+c)^2 \le 3(a^2+b^2+c^2)$ 5

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(ii) Prove Minkowski's inequality for two vectors in $\mathbb{R}^2$. 5

UNIT—IV

7. Answer any *two* from the following : 2×2=4

(a) Expand $(\cos\theta + i\sin\theta)^4$.

(b) Express $\sin 3\theta$ in terms of $\sin\theta$.

(c) Find the cube roots of unity.

8. Answer any *one* from the following : 10

(a) (i) Show that the sum of nth root of unity is zero. 5

(ii) Find the value of $(1+i)^6$ using De Moivre's theorem. 5

(b) (i) Find $\cos 5\theta$ in terms of powers of $\cos\theta$. 5

(ii) Prove that

$$(\cos\theta + i\sin\theta)^n = \cos n\theta + i\sin n\theta$$

for positive integer n. 5

UNIT—V

9. Answer any *two* from the following : 2×2=4

(a) Write the Maclaurin series expansion of e^x.

(b) Express $\tanh x$ in terms of $\sinh x$ and $\cosh x$.

(c) Write the Gregory's series expansion for $\tan^{-1} x$.

10. Answer any *one* from the following : 10

(a) (i) Prove that

$$\cosh(x+y) = \cosh x \cosh y + \sinh x \sinh y$$ 5

(ii) Show that

$$\frac{\pi}{4} = 1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \ldots$$ 5

(b) (i) Prove that

$$\cosh 2x = \cosh^2 x + \sinh^2 x$$ 5

(ii) Derive the Maclaurin series for $\sin x$. 5

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