A–1009

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MAT-504

Mathematics (MSCMAT/MAMT)

Advanced Differential Equation-I

Examination February, 2026

Time : 2:00 Hrs. Max. Marks : 70

Note* :–** This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. ***Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

Section–A

Long Answer Type Questions 2×19=38

***Note* :–** Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *Two* (02) questions only.

1. Solve :

$$(D^2 - D - 2)y = \sin 2x$$

2. Solve $\frac{d^2y}{dx^2} + 4y = \tan 2x$ by using variation of parameter method.

3. Show that the system :

$$\frac{dx}{dt} = -y + x(1 - x^2 - y^2)$$
$$\frac{dy}{dt} = x + y(1 - x^2 - y^2)$$

has a periodic solution.

4. Show that $P_n(x)$ is the coefficient of z^n in the expansion of $(1 - 2xz + z^2)^{-1/2}$ in ascending power of z.

5. If the polynomials of degree m, prove that $f(x)$ may be expressed in form :

$$f(x) = \sum_{r=0}^{m} C_r L_r(x)$$

where $C_r = \int_0^\infty e^{-x} L_r(x) f(x) dx$.

Section–B

Short Answer Type Questions 4×8=32

***Note* :–** Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *Four* (04) questions only.

1. Find the unique solution of $y'' = 1$ satisfying $y(0) = 1$ and $y'(0) = 2$.

2. Solve $xdx + ydy + \dfrac{xdy - ydx}{x^2 + y^2} = 0.$

3. Solve :

$$(D^2 + 4)y = 0$$

4. Discuss the various types of critical points.

5. Find the orthogonal trajectories of the family of parabolas $y^2 = 4a(x + a)$, where a being a parameter.

6. A body of mass 0.2 kg is hung from a spring of constant $80 \dfrac{N}{m}$. The body is subjected to a resistive force given by bv, where v is the velocity in m/s. Calculate the value of the undamped frequency and the value of t if the damped frequency is $\sqrt{\dfrac{3}{2}}$ of the undamped frequency.

7. Show that $J_n(x)$ is even and odd function for even n and for odd n respectively.

8. Write a short note on Singular points and Homogeneous equations.

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