2025/FYUG/EVEN/SEM/
MATDSM–251/252/221

FYUG Even Semester Exam., 2025

MATHEMATICS

(4th Semester)

Course No. : MATDSM–251/252

(Differential Equations)

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* of the following questions : 2×2=4

(a) Write one solution for $\frac{dy}{dx} = 3x^2$.

(b) Form a differential equation by eliminating the arbitrary constant from $y = e^{ax}$.

(c) Determine whether the equation

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

is exact.

2. Answer *either* [(*a*) and (*b*)] or [(*c*) and (*d*)] : 10

(*a*) Solve the homogeneous differential equation

$$\frac{dy}{dx}=\frac{x+y}{x-y}$$

5

(*b*) Solve the first-order linear differential equation

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

5

(*c*) Form a differential equation by eliminating two arbitrary constants from the equation

$$y=Ae^{2x}+Be^{-2x}$$

5

(*d*) Solve the differential equation

$$(2x-y+1)\,dx=(y-x+1)\,dy$$

5

UNIT—II

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

(*a*) Find the complementary function of the equation $y''+4y=0$.

(*b*) Find the particular integral (PI) of $y''-y=e^x$.

(*c*) Write the general form of Clairaut's equation.

4. Answer *either* [(*a*) and (*b*)] or [(*c*) and (*d*)] : 10

(*a*) Find the general solution of $y''+3y'+2y=e^{-2x}$. 5

(*b*) Reduce the order and solve the equation

$$xy''+2y'=x^2$$

2+3=5

(*c*) Solve the Clairaut's equation

$$y=xp+e^{-p}$$

5

(*d*) Find the singular solution of the differential equation

$$y=xp+\frac{1}{p}$$

5

UNIT—III

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

(*a*) Write the characteristic equation of the Cauchy-Euler equation

$$x^2y''-3xy'+2y=0$$

(*b*) What substitution should be used to reduce the equation

$$x^2y''-4xy'+6y=0$$

into a constant coefficient equation? Write the transformed equation.

(c) Using the method of variation of parameters, write the formula for the particular integral of $y'' + 2y' + y = e^x$.

6. Answer *either* [(a) and (b)] *or* [(c) and (d)] : 10

(a) Solve the following differential equation by using variation of parameter : 5

$$y'' - y = e^x$$

(b) Solve the following Cauchy-Euler equation using substitution : 5

$$x^2 y'' + 5xy' + 6y = 0$$

(c) Find the general solution of the following differential equation using appropriate method : 5

$$y'' + \frac{2}{x} y' - \frac{3}{x^2} y = 0$$

(d) Solve the Cauchy-Euler equation 5

$$x^2 y'' - xy' + y = 0$$

UNIT—IV

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

(a) Solve the simultaneous equations

$$\frac{dx}{1} = \frac{dy}{2} = \frac{dz}{3}$$

(b) Find the general solution of $\frac{dx}{x} = \frac{dy}{y}$.

(c) Check if the equation

$$(2x + 3y)\,dx + (3x + 4y)\,dy = 0$$

is a total differential equation.

8. Answer *either* [(a) and (b)] *or* [(c) and (d)] : 10

(a) Solve the simultaneous differential equations

$$\frac{dx}{2x + y} = \frac{dy}{x + 3y}$$ 5

(b) Solve the total differential equation

$$Pdx + Qdy + Rdz = 0$$

given that $P = y + z$, $Q = x + z$ and $R = x + y$. 5

(c) Find the general solution of the given system of equations : 5

$$\frac{dx}{dt} = x + 2y, \quad \frac{dy}{dt} = 3x + 4y$$

(d) Verify whether the equation is a total differential equation and solve if it is : 5

$$(3x^2 + 2y)\,dx + (2x + 4y^3)\,dy = 0$$

UNIT—V

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

(a) Find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ if $z = 2x^2 + 3xy + y^2$.

(b) Find the order and degree of the PDE

$$\frac{\partial^2 z}{\partial x^2} + \left(\frac{\partial z}{\partial x}\right)^2 = 0$$

(c) Form the first-order partial differential equation by eliminating the arbitrary function from $z = f(x^2 + y^2)$.

10. Answer *either* [(a) and (b)] *or* [(c) and (d)] : 10

(a) Solve the following first order PDE using Lagrange's method : 5

$$(x-y)\frac{\partial z}{\partial x} + (x+y)\frac{\partial z}{\partial y} = 1$$

(b) Find the characteristic equations and solve the PDE : 2+3=5

$$(y+z)p + (x+z)q = x+y$$

(c) Form a PDE by eliminating arbitrary constants from the equation 5

$$z = ax + by + a^2 + b^2$$

(d) Solve the following PDE by using appropriate method : 5

$$p + q = \frac{z}{x+y}$$

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