2026/FYUG/EVEN/SEM/
MTMDSM 251/252T/294

FYUG Even Semester Exam., 2026

MATHEMATICS

(4th Semester)

Paper Code : MTMDSM 251/252T

(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) Define degree and order of a differential equation.

(b) Solve the differential equation

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

(c) Solve $\frac{dy}{dx} = xy$.

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

(a) Solve the differential equation

$$\frac{dy}{dx} = \frac{2x+2y-5}{2x+2y+7}$$ 5

(b) Is the differential equation $(x^2+y^2+x)\,dx+2xydy=0$ exact? Hence solve. 1+4=5

(c) Solve : $y+px=p^2x^4$, $p=\frac{dy}{dx}$. 4

(d) Prove that a differential equation of the form $Mdx+Ndy=0$ is exact if and only if $\frac{\partial M}{\partial y}=\frac{\partial N}{\partial x}$. 6

UNIT—II

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

(a) Solve $\frac{d^2y}{dx^2}-8y=2$.

(b) Find the PI of $y''-y'=x^2+1$.

(c) Find the CF of the differential equation $(D^2-5D+6)y=e^{4x}$.

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

(a) Solve $(D^3+1)y=\cos 2x$. 5

(b) Solve $(D^2-D-2)y=\sin 2x$. 5

(c) Write Clairauts form and obtain its solution. 1+4=5

(d) Solve the equation

$$\frac{d^2y}{dx^2}=a+bx+cx^2$$

given that $\frac{dy}{dx}=0$ when $x=0$ and $y=d$, when $x=0$. 5

UNIT—III

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

(a) Define Cauchy-Euler equation. What is the substitution to convert Cauchy-Euler equation to differential equation with constant coefficient?

(b) Write the formula of method of variation of parameters.

(c) Solve $(x^2D^2+1)y=e^x$.

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

(a) Solve : 5

$$x^2\frac{d^2y}{dx^2}+4x\frac{dy}{dx}+2y=x\log x$$

(b) Using method of variation of parameters, solve

$$\frac{d^2y}{dx^2}-6\frac{dy}{dx}+9y=\frac{e^{3x}}{x^2}$$ 5

(c) Solve $(x^2D+xD+1)y=(\log x)^3+2$. 5

(d) Solve $y''-y'+y=xe^x$ by the method of variation of parameters. 5

UNIT—IV

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

(a) What is geometrical interpretation of

$$\frac{dx}{P}=\frac{dy}{Q}=\frac{dz}{R}?$$

(b) Solve :

$$\frac{dx}{x}=\frac{dy}{y}=\frac{dz}{z}$$

(c) Solve :

$$\frac{dx}{y^2}=\frac{dy}{x^2}=\frac{dz}{x^2y^2z^2}$$

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

(a) Solve : 5

$$\frac{dx}{x^2-y^2-z^2}=\frac{dy}{2xy}=\frac{dz}{2xz}$$

(b) Solve : 5

$$(2xy+z^2)\,dx+(x^2+2yz)\,dy+(y^2+2xz)\,dz=0$$

(c) *(i)* Solve : 4

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

(ii) Test the integrability of

$$(2x^3y+1)\,dx+x^4dy+x^2\tan z\,dz=0$$ 1

(d) Test the condition of integrability of

$$yz\log z\,dx-zx\log z\,dy+xy\,dz=0$$

Hence solve. 5

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UNIT—V

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

(a) Define degree and order of a PDE.

(b) Find the degree and order of

$$\frac{\partial^3 z}{\partial x^3} + \sqrt{\frac{\partial^4 z}{\partial x^4} + \frac{\partial z}{\partial y}} = 0$$

(c) Form the first-order partial differential equation by eliminating arbitrary constants a and b from $z = ax^2 + by^2$.

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

(a) Form PDE by eliminating arbitrary function from the following : 2+3=5

(i) $z = f(x+y)$

(ii) $z = f\left(\frac{y}{x}\right)$

(b) Solve the following by Lagrange's method : 2½×2=5

(i) $yzp + zxq = xy$

(ii) $p\tan x + q\tan y = \tan z$

(Continued)

(c) Form PDE by eliminating arbitrary constants from the following : 2½×2=5

(i) $z = a\cos x + b\sin y$

(ii) $z = ae^x + be^y$

(d) Solve $(x+y)p + (y+z)q = x+z$. 5

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