Reg. No.																

Question Paper Code	14234

B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025

Second Semester

Mechanical Engineering

24BSMA203 - DIFFERNTIAL EQUATIONS AND ITS APPLICATIONS

Regulations - 2024

Duration: 3 Hours — Max. Marks: 100

PART - A (MCQ) (10 × 1 = 10 Marks)

Answer ALL Questions

		Marks	K – Level	CO
1.	Find the particular integral of $(D^2 - 4)y = e^{2x}$ is (a) $\frac{1}{4}xe^{2x}$ (b) $-\frac{1}{4}xe^{2x}$ (c) $\frac{1}{2}e^{2x}$ (d) xe^{2x}	1	K2	CO1
2.	Find the complete solution of $(D^2 + 2D + 1)y = 0$ is (a) $y(x) = (c_1 + c_2x)e^x$ (b) $y(x) = (c_1 + c_2x)e^{-x}$ (c) $y(x) = (c_1 + c_2)e^x$ (d) $y(x) = (c_1 + c_2)e^{-x}$	1	K2	CO1
3.	Modified Euler's formula is $y_{n+1} = y_0 + \frac{h}{2}[f(x_n, y_{n)} + f(x_{n+1}, y_{n+1})]$ $y_{n+1} = y_n + \frac{h}{2}[f(x_n, y_{n)} + f(x_{n-1}, y_{n-1})]$ $y_{n+1} = y_0 + \frac{h}{2}[f(x_n, y_{n)} + f(x_{n-1}, y_{n-1})]$ $y_{n+1} = y_n + \frac{h}{2}[f(x_n, y_{n)} + f(x_{n+1}, y_{n+1})]$	1	K1	CO2
4.	How many prior values are required to predict the next value in Milne's method? (a) One (b) Two (c) Three (d) Four	1	K1	CO2
5.	The complete solution of the first order partial differential equation $pq = 1$ is (a) $z = ax + \frac{1}{a}y + c$ (b) $z = ax + ay + c$ (c) $z = bx + by + c$ (d) $z = ax + by + ab$	1	K2	CO3
6.	Find the general solution of the Lagrange's linear equation $px + qy = z$ is (a)$f\left(\frac{x}{y}, \frac{y}{z}\right) = 0$ (b) $f\left(\frac{x}{y}, yz\right) = 0$ (c)$f\left(xy, \frac{y}{z}\right) = 0$ (d) $f(xy, yz) = 0$	1	K2	CO3
7.	The particular integral of the homogeneous linear partial differential equation $\left(D^2 + DD' - 6D'^2\right)z = \cos(3x + 2y)$ is (a) $\frac{1}{9}\cos(3x + 2y)$ (b) $-\frac{1}{9}\cos(3x + 2y)$ (c) $\frac{1}{6}\cos(3x + 2y)$ (d) $-\frac{1}{6}\cos(3x + 2y)$	1	K3	CO4
8.	The general solution of the non-homogeneous linear partial differential equation $(D^2 - DD' + D' - 1)z = 0$ is (a) $z = e^{-x}\varphi_1(y + x) + e^x\varphi_2(y)$ (b) $z = e^x\varphi_1(y + x) + e^{-x}\varphi_2(y)$ (c)$z = e^x\varphi_1(y - x) + e^{-x}\varphi_2(y)$ (d) $z = e^{-x}\varphi_1(y - x) + e^x\varphi_2(y)$	1	K2	CO4
9.	What is nature of one - dimensional heat equation? (a)Elliptic (b) Parabolic (c) Hyperbolic (d) None of the above	1	K1	CO5
10.	Bender – Schmidt method is valid only for (a) $0 \geq \lambda \geq \frac{1}{2}$ (b) $-1 \leq \lambda \leq 1$ (c) $0 \leq \lambda \leq \frac{1}{2}$ (d) $-\infty \leq \lambda \leq \infty$	1	K1	CO6

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11.	Find the particular integral of $(D^2 - 2D + 5)y = e^x \sin 2x$.	2	K2	CO1
12.	Reduce the equation $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = 0$ to homogeneous differential equation with constant coefficients.	2	K2	CO1

13. Using modified Euler's method find y at $x = 0.1$, if $\frac{dy}{dx} = 1 - y,\ y(0) = 0$. *2 K2 CO2*

14. State Milne's Predictor corrector formula. *2 K1 CO2*

15. Find the complete integral of $z = px + qy + p^2q^2$. *2 K2 CO3*

16. Solve $\sqrt{p} + \sqrt{q} = 1$. *2 K2 CO3*

17. Find the complementary integral of $(D^2 + 2DD' + D'^2 - 2D + 2D')z = 0$. *2 K2 CO4*

18. Solve the particular integral of $(D^2 - 2DD' + D'^2)z = \cos(x - 3y)$. *2 K3 CO4*

19. Write all the possible solutions of one-dimensional wave equation. *2 K1 CO5*

20. A rod of length 20cm whose one end is kept at $30°$ and the other end is kept at $70°$ is maintained so until steady state prevails. Find the steady state temperature. *2 K2 CO5*

21. Write down the Crank – Nicolson formula to solve $u_t = u_{xx}$. *2 K2 CO6*

22. Write the diagonal five – point formula to solve the Laplace equation. *2 K1 CO6*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23. a) Solve $(D^2 + a^2)y = \tan ax$ by the method of variation of parameters. *11 K3 CO1*

OR

b) Solve $(x^2D^2 - 2xD - 4)y = 32(\log x)^2$. *11 K3 CO1*

24. a) Using the Runge-Kutta method of fourth order solve $\frac{dy}{dx} = x + y^2$ given that y =1 when x=0 at x=0.1, 0.2. *11 K3 CO2*

OR

b) Using Milne's Method solve $y(2)$ if $y(x)$ is the solution of $\frac{dy}{dx} = \frac{1}{2}(x + y),\quad y(0) = 2, y(0.5) = 2.636,\ y(1) = 3.595,\ y(1.5) = 4.968$. *11 K3 CO2*

25. a) Solve $(mz - ny)p + (nx - lz)q = ly - mx$. *11 K3 CO3*

OR

b) Solve $z = px + qy + \sqrt{1 + p^2 + q^2}$. *11 K3 CO3*

26. a) Solve $r + 2s + t + 2p + 2q + z = e^{2x+y}$. *11 K3 CO4*

OR

b) Solve $\left[D^3 - 7DD'^2 - 6D'^3\right]z = \sin(x + 2y) + e^{2x+y}$. *11 K3 CO4*

27. a) A string is stretched and fastened to two points $x = 0$ and $x = l$ apart. Motion is started by displacing the string into the form $y(x, 0) = k(lx - x^2)$ from which it is released at time $t = 0$. Find thedisplacement at any point on the string at a distance x from one endat time t. *11 K3 CO5*

OR

b) A rod 20cm long has its ends A and B kept at 30^0C and 90^0C respectively, until steady state conditions prevail. The temperature at each end is reduced to 0^0C suddenly and kept so. Solve the resulting temperature function $u(x, t)$. *11 K3 CO5*

28. a) Solve the Poisson equation $u_{xx} + u_{yy} = 8xy,\ 0 < x < 1,\quad 0 < y < 1$, given that $u(x, 0) = 0, u(0, y) = 0, u(1, y) = 100, u(x, 1) = 100$ and $h = \frac{1}{3}$. *11 K3 CO6*

OR

b) Solve $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$, $u(0, t) = 0, u(4, t) = 0$, and $u(x, 0) = 4(4 - x)$, choosing $h = k = 1$ using Bender-Schmidt formula. *11 K3 CO6*