Reg. No.															

Question Paper Code	13682

B.E. / B.Tech. - DEGREE EXAMINATIONS, APRIL / MAY 2025

Second Semester

Mechanical Engineering

(Common to Mechanical and Automation Engineering)

24BSMA203 - DIFFERENTIAL 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. What is the order of the differential equation given by $\frac{dy}{dx} + 4y = \sin x$? *1 K1 CO1*
   (a) 0.5 (b) 1 (c) 2 (d) 0
2. The nature of roots for differential equation $(D^2 + 9)y = 0$ is *1 K1 CO1*
   (a) Complex conjugates (b) Real and distinct
   (c) Real and equal (d) None of the above
3. How many prior values are required to predict the next value in Milne's method? *1 K1 CO2*
   (a) One (b) Two (c) Three (d) Four
4. Modified Euler's formula is *1 K1 CO2*
   (a) $y_{n+1} = y_0 + \frac{h}{2}\left[f(x_n, y_{n)}) + f(x_{n+1}, y_{n+1})\right]$
   (b) $y_{n+1} = y_n + \frac{h}{2}\left[f(x_n, y_{n)}) + f(x_{n-1}, y_{n-1})\right]$
   (c) $y_{n+1} = y_0 + \frac{h}{2}\left[f(x_n, y_{n)}) + f(x_{n-1}, y_{n-1})\right]$
   (d) $y_{n+1} = y_n + \frac{h}{2}\left[f(x_n, y_{n)}) + f(x_{n+1}, y_{n+1})\right]$
5. A solution of a partial differential equation which contains as many arbitrary constants as the number of independent variables is called the *1 K1 CO3*
   (a)singular solution (b) general solution
   (c) complete solution (d) particular solution
6. Eliminate the arbitrary constants a and b from the equation $z = ax + by + ab$. *1 K1 CO3*
   (a) $z = px + qy + pq$ (b) $z = px + qy + p^2$
   (c) $z = qx + py + q^2$ (d) $z = qx + py + pq$
7. Find the complementary function of $\left(D^2 + DD' - 2D'^2\right)z = 0$ *1 K2 CO4*
   (a) $z = \varphi_1(y + x) + 2\varphi_2(y + 2x)$
   (b) $z = \varphi_1(y + x) - 2\varphi_2(y + 2x)$
   (c) $z = \varphi_1(y + x) + \varphi_2(y - 2x)$
   (d) $z = \varphi_1(y + x) - 2\varphi_2(y - 2x)$
8. Find the particular integral of the non-homogeneous linear partial differential equation $(D - D' - 1)(D - D' - 3)z = e^{2x-y}$ is *1 K2 CO4*
   (a) $\frac{x}{2}e^{2x-y}$ (b) $-\frac{1}{3}e^{2x-y}$ (c) $-\frac{1}{2}e^{2x-y}$ (d) $\frac{1}{2}e^{2x-y}$
9. How many boundary conditions are required to solve the two- dimensional heat equation in the steady state condition *1 K1 CO5*
   (a) 3 (b) 2 (c) 4 (d) 1

10. The Bender – Schmidt recurrence equation is *1 K1 CO6*

a) $u_{i,j+1} = \frac{1}{2}[u_{i+1,j} + u_{i-1,j}]$

b) $u_{i+1,j+1} = \frac{1}{2}[u_{i+1,j-1} + u_{i-1,j}]$

c) $u_{i,j} = \frac{1}{2}[u_{i+1,j+1} + u_{i-1,j}]$

d) $u_{i,j} = \frac{1}{2}[u_{i+1,j+1} + u_{i-1,j-1}]$

PART - B (12 × 2 = 24 Marks)

Answer ALL Questions

11.	Solve $(D^2 + 5D + 4)y = 0$.	*2*	*K3*	*CO1*
12.	Transform $(x+2)^2 \frac{d^2y}{dx^2} - (x+2)\frac{dy}{dx} + y = 3x + y$ in to differential equation with constant coefficients.	*2*	*K2*	*CO1*
13.	Given $y' = x + y,\ y(0) = 1$. Find $y(0.2)$ by Euler's method.	*2*	*K2*	*CO2*
14.	Write the Runge-Kutta algorithm of 4th order to solve $\frac{dy}{dx} = f(x,y)$ with $y(x_0) = y_0$.	*2*	*K1*	*CO2*
15.	Solve $p + q = pq$.	*2*	*K3*	*CO3*
16.	Find the complete integral of $pq = xy$.	*2*	*K2*	*CO3*
17.	Solve the particular integral of $(D^2 - 2DD' + D'^2)z = e^{x-y}$.	*2*	*K3*	*CO4*
18.	Find the complementary integral of $(D^4 - D'^4)z = 0$.	*2*	*K2*	*CO4*
19.	Classify the nature of the equation $\frac{\partial^2 u}{\partial x^2} + 2\frac{\partial^2 u}{\partial x \partial y} + \frac{\partial^2 u}{\partial y^2} = 0$.	*2*	*K2*	*CO5*
20.	Write all the possible solutions of one-dimensional wave equation.	*2*	*K1*	*CO5*
21.	State Schmidt's explicit formula for solving heat flow equation.	*2*	*K1*	*CO6*
22.	Write down the Crank – Nicolson formula to solve $u_t = u_{xx}$.	*2*	*K2*	*CO6*

PART - C (6 × 11 = 66 Marks)

Answer ALL Questions

23.	a)	Solve $(D^2 + 4D + 3)y = e^{-x}\sin x + xe^{3x}$.	*11*	*K3*	*CO1*
		OR			
	b)	Solve $(D^2 + 4)y = \sec 2x$ by the method of variation of parameters.	*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)	Given $\frac{dy}{dx} = xy + y^2$ with $y(0) = 1, y(0.1) = 1.1169$ and $y(0.2) = 1.2773$, solve $y(0.4)$ by Milne's method.	*11*	*K3*	*CO2*
25.	a)	Solve $z = px + qy + \sqrt{1 + p^2 + q^2}$.	*11*	*K3*	*CO3*
		OR			
	b)	Solve $x(y^2 - z^2)p + y(z^2 - x^2)q = z(x^2 - y^2)$.	*11*	*K3*	*CO3*
26.	a)	Solve $[D^3 - 7DD'^2 - 6D'^3]z = \sin(x + 2y) + e^{2x+y}$.	*11*	*K3*	*CO4*
		OR			
	b)	Solve $r + 2s + t + 2p + 2q + z = e^{2x+y}$.	*11*	*K3*	*CO4*

27. a) A tightly stretched string with fixed end points $x = 0$ and $x = l$ is initially at rest in its equilibrium position. If it is set vibrating by giving each point a velocity $kx(l - x)$, Find the displacement of the string at any distance $'x'$ from one end at any time 't'. *11* *K3* *CO5*

OR

b) An infinitely long plate in the form of an area is enclosed between the lines $x = 0$ and $x = l$. The temperature is zero along the edges $x = 0$, $x = l$ and at $y = \infty$. The edge $y = 0$ is kept at temperature kx. Solve the steady state temperature distribution in the plate. *11* *K3* *CO5*

28. a) Solve $\frac{\partial^2 u}{\partial x^2} = 2\frac{\partial u}{\partial t}$, $u(0,t) = 0, u(4,t) = 0$, and $u(x,0) = x(4 - x)$, choosing $h = k = 1$ and using Bender-Schmidt formula find the values up to t= 5 . *11* *K3* *CO6*

OR

b) Using Crank–Nicolson's implicit scheme, solve $16\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$, $0 \le x \le 1$, $t > 0$, given that $u(x,0) = 0$, $u(0,t) = 0, u(1,t) = 100t$ Compute u for one-time step with $h = \frac{1}{4}$. *11* *K3* *CO6*