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Reg. No. :

Name :



Fifth Semester B.Sc. Degree Examination, December 2022

First Degree Programme under CBCSS

Mathematics

Core Course

MM 1544 : DIFFERENTIAL EQUATIONS

(2018 Admission Onwards)

Time : 3 Hours

Max. Marks : 80

PART – A

All the first ten questions are compulsory. They carry 1 mark each.

1. Define order and degree of a ordinary differential equation.
2. Solve $\frac{dy}{dx} = 4y$ and $y(0) = 2$.
3. Show that the differential equation $(y^2 + \cos^2 x) \frac{dy}{dx} = y \sin 2x$ is exact.
4. Solve the differential equation $\frac{dy}{dx} = xy$.
5. Find the integrating factor of the differential equation $\frac{dy}{dx} + \frac{x}{1+y^2} = \frac{\tan^{-1} y}{1+y^2}$.
6. Write the general form of Euler – Cauchy equation.

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7. Find the complementary function of the differential equation $\frac{d^2y}{dx^2} + 4 = 8\cos x$.
 8. Solve the second order differential equation $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} = 4x$ to find $\frac{dy}{dx}$.
 9. Show that $y_1 = e^x$ and $y_2 = xe^x$ are Linearly independent functions.
 10. Define Basis of solutions of a differential equation $y'' + P(x)y' + Q(x)y = 0$.
- (10 × 1 = 10 Marks)

PART – B

Answer any **eight** questions. Each question carries **2** marks.

11. Solve the differential equation $\frac{dy}{dx} + 2xy = 4x$.
12. Solve $3e^x \tan y + (1 - e^x) \sec^2 y \frac{dy}{dx} = 0$.
13. Find the integral factor of the differential equation $\frac{dy}{dx} + y \tan x = \cos^3 x$.
14. Solve the differential equation $xy' + y = 0$.
15. Find the solution of the initial value problem $y' = 3x^2 e^{-y}$ and $y(0) = 2$.
16. Solve the differential equation $\frac{dy}{dx} = x + y + 1$.
17. Write a short note on a first-order linear and non-linear ordinary differential equations.
18. Write the general form of Bernoulli equation.
19. Solve the differential equation $y'' + y = 0$.
20. Solve $y'' - y = x$.
21. Find the solution of the second order ODE, $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = 0$.

22. Find a particular integral for $y'' - 3y' + 2y = e^x$.
23. Solve $x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + y = 0$.
24. Write a differential equation of the form $y'' + ay' + by = 0$ for which the functions e^{7x} and e^{4x} form a basis.
25. Find a real general solution of $x^2 y'' - 20y = 0$.
26. Solve the differential equation $(D^2 + 4D + 4)y = 0$.

(8 × 2 = 16 Marks)

PART – C

Answer any **six** questions. Each question carries 4 marks.

27. Solve $\cos(x + y)dx + (3y^2 + 2y + \cos(x + y))dy = 0$.
28. Solve the differential equation $\frac{dy}{dx} = -\frac{2}{y} - \frac{3y}{2x}$.
29. Solve the differential equation $(ax + hy + g)dx + (hx + by + f)dy = 0$.
30. Solve the differential equation $\frac{dy}{dx} = \frac{y}{x} + \tan\left(\frac{y}{x}\right)$.
31. Solve the Bernoulli's equation $\frac{dy}{dx} + \frac{y}{x} = 2x^3 y^4$.
32. Solve Differential equation $\frac{dy}{dx} + \frac{y}{x} = y^2 \log x$
33. Solve the second order ordinary differential equation $(D^2 + 4)y = \sin^2 x$.
34. Solve $x^2 \frac{d^2 y}{dx^2} + x \frac{dy}{dx} + \frac{2}{y^3} = 0$.
35. Solve the differential equation $4x^2 \frac{d^2 y}{dx^2} + 4x \frac{dy}{dx} + (x^2 - 1)y = 0$.

36. Solve $x^3 \frac{d^2y}{dx^2} - (x^3 + xy) \frac{dy}{dx} + (y^2 + xy) = 0$.
37. Solve the initial value problem $y'' + y = 0.001x^2$; $y(0) = 0, y'(0) = 1.5$.
38. Using the method of variation of parameters find the particular integral of $y'' + y = \sec x$.

(6 × 4 = 24 Marks)

PART – D

Answer any **two** questions. **Each** question carries **15** marks.

39. (a) Solve the equation $(x^2 - 3y^2)dx + 2xydy = 0$.
- (b) Solve the Bernoulli differential equation, $\frac{dy}{dx} + y = xy^3$.
40. (a) Solve the initial-value problem $(2x \cos y + 3x^2y)dx + (x^3 - x^2 \sin y - y)dy = 0$; $y(0) = 2$.
- (b) Solve the differential equation $\frac{dy}{dx} = \frac{2x - 5y + 3}{2x + 4y - 6}$.
41. Solve the initial-value problem $(y + \sqrt{x^2 + y^2})dx - xdy = 0, y(1) = 0$.
42. (a) Solve the initial-value problem $y'' - y' - 12y = 0, y(0) = 3, y'(0) = 5$.
- (b) Solve the differential equation, $y^2dx + (3x - 1)dy = 0$.
43. (a) Use the variation-of-parameters method to solve $\frac{d^2y}{dx^2} + y = \operatorname{cosec} x$ subject to the boundary conditions $y(0) = y(\pi/2) = 0$.
- (b) Find the general solution of the differential equation $y'' + 4y = 8 \cos 2x$.
44. (a) Solve the initial value $y'' + 3y' + 2.25y = -10e^{-1.5x}, y(0) = 1, y'(0) = 0$.
- (b) Find the solution of the Homogeneous Linear Equation $x^2y'' + 2xy' - 20y = x^4$.

(2 × 15 = 30 Marks)