

B.Sc. Semester - 2 (NEP-2020) Examination

MARCH/APRIL-2026 (As Per Syllabus Year June-2025)

MATH: Theory of Ordinary Differential Equations (Major-3)

Time: 2:00 Hours

Marks: 50

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate marks.

- Que.1(A) ANSWER ANY ONE: (05)
- (1) State and prove the necessary condition for a differential equation $Mdx + Ndy = 0$ to be an exact differential equation (where M & N are functions of x & y).
 - (2) Solve: $(\sin x + x \cos y + x)dy - (y \cos x + \sin y + y)dx = 0$.
- Que.1(B) ANSWER ANY ONE: (05)
- (1) Derive solution of Bernoulli's differential equation $\frac{dx}{dy} + Px = Qx^n$, where P & Q are functions of y .
 - (2) Define: Orthogonal Trajectories.
Find orthogonal trajectories to circles centered at the origin.
- Que.2(A) ANSWER ANY ONE: (05)
- (1) Write the general form of ordinary differential equations of first order and higher degree and discuss about the solution of the differential equations which are solvable for x .
 - (2) Solve: $x + y = \left(\frac{1+p}{1-p}\right)^2$.
- Que.2(B) ANSWER ANY ONE: (05)
- (1) State Clairaut's and Lagrange's forms of ordinary differential equations.
Describe the process of solving Lagrange's differential equations.
Explain how the Clairaut's differential equation is a particular case of Lagrange's differential equation?
 - (2) Solve: $y^2 = xyp + \left(\frac{yp}{x}\right)^3$.
- Que.3(A) ANSWER ANY ONE: (05)
- (1) Write the general form of the linear differential equation of n^{th} order and solve it.
 - (2) If a is a root of $f(D)$ of order 3, then prove that $\frac{1}{f(D)}e^{ax} = \frac{x^3}{f'''(a)}e^{ax}$.
- Que.3(B) ANSWER ANY ONE: (05)
- (1) Solve: $(D^2 - 1)y = x \sin 3x + \cos x$.
 - (2) Solve: $(D^2 - 2D + 1)y = xe^x \sin x$.
- Que.4(A) ANSWER ANY ONE: (05)
- (1) Give general form of homogeneous linear differential equation with variable coefficients. Explain a method of finding its Complementary Function (CF).
 - (2) Solve: $(x^3 D^3 + 3x^2 D^2 - 6xD + 6)y = \left(x^2 - \frac{1}{x^2}\right)^2$.
- Que.4(B) ANSWER ANY ONE: (05)
- (1) If m is the r times repeated root of $f(\theta)$, then prove that $\frac{1}{f(\theta)}x^m = \frac{x^m (\log x)^r}{r! F(m)}$; where $f(\theta) = (\theta - m)^r F(\theta)$.
 - (2) Solve: $(x^2 D^2 + 2xD - 20)y = (x + 1)^2$.
- Que.5(A) ANSWER ANY ONE: (05)
- (1) Solve: $(ax + hy + g)dx + (hx + by + f)dy = 0$.
 - (2) Define: Singular Solution of an ordinary differential equation.
Explain any of the methods to find singular solution by means of an example.
- Que.5(B) ANSWER ANY ONE: (05)
- (1) Define: Complementary Function (CF) and Particular Integral (PI).
 - (2) Solve: $(D^2 - 4)y = \cosh(2x - 1)$.
