

Int. M.Sc. (DS) (NEP) Sem.-5 Examination

DSC-C-DTSC-351T

Differential Equations

Time : 2-00 Hours]

November-2025

[Max. Marks : 50

Instructions: All questions are compulsory. Use of non-programmable scientific calculator is allowed.

Q.1 (a) Find the Orthogonal trajectories of the curve $y^2 = x^2 + c$, where c is a parameter. (05)

(b) Solve Bernoulli's equation: $\frac{dy}{dx} + xy = xy^3$ (05)

OR

(a) Form the differential equation of the family of circles of radius r whose center lies on the x -axis. (05)

(b) A tank initially contains 100 liters of pure water. Brine with 0.5 kg/liters salt flows in at 5 liters/minute, with outflow at the same rate. Find the amount of salt present after 10 minutes. (05)

Q.2 (a) Form the partial differential equation by eliminating the arbitrary function from the equation $z = f\left(\frac{y}{x}\right)$. (05)

(b) Find the complete solution of the PDE: $p - q = \log(x + y)$ (05)

OR

(a) Cars are moving at constant speed of $c = 40$ km/h. The initial traffic density is given by: $u(x, 0) = 100 - 2x$ (cars/km) for $0 \leq x \leq 50$. Find the traffic density $u(x, t)$ after 2 hours. (05)

(b) Using Lagrange's method, solve $(y + z)p + (x + z)q = x + y$ (05)

Q.3 (a) Find the complete solution for the homogeneous linear partial differential equation with constant coefficients: (05)

$$25r - 40s + 16t = 0$$

(b) Using method of separation of variables, solve $x \frac{\partial u}{\partial x} - 2y \frac{\partial u}{\partial y} = 0$ (05)

OR

(a) Using Charpit's method solve $px + qy = pq$ (05)

(b) Classify the following partial differential equations as parabolic, hyperbolic and elliptic. (05)

I. $\frac{\partial^2 u}{\partial t^2} + 4 \frac{\partial^2 u}{\partial x \partial t} + 4 \frac{\partial^2 u}{\partial x^2} = 0$

II. $2 \frac{\partial^2 u}{\partial t^2} + 4 \frac{\partial^2 u}{\partial x \partial t} + 3 \frac{\partial^2 u}{\partial x^2} = 0$

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- Q.4** (a) Use the second-order Runge-Kutta method to find an approximate value of y given that $y' = x - y^2$ and $y(0) = 1$ at $x = 0.2$ taking $h = 0.1$. (05)
- (b) Evaluate $\int_{-1}^1 \frac{dx}{1+x^2}$ by one-point and two-point Gaussian formulae. (05)

OR

- (a) Using the fourth order Runge-Kutta method, find y at $x = 0.1$ for differential equation $\frac{dy}{dx} = 3e^x + 2y$, $y(0) = 0$ by taking $h = 0.1$ (05)
- (b) A river is 80 meters wide. The depth ' d ' in meters at a distance x meters from one bank is given by the following table. Calculate the area of cross section of the river using Simpson's 1/3 rule. (05)

x	0	10	20	30	40	50	60	70	80
y	0	4	7	9	12	15	14	8	7

- Q.5** Attempt any **FIVE** out of **SEVEN**: (10)

- (1) Find the order and degree of differential equation: $5 \frac{d^2y}{dx^2} = \left[1 + \left(\frac{dy}{dx} \right)^2 \right]^{1/2}$
- (2) Find the complementary function for $(D^2 + 25)(D^2 - 2D + 1) = x$
- (3) Check whether the differential equation $(x^3 + 3xy^2)dx + (3x^2y + y^3)dy = 0$ is exact or not.
- (4) Solve $\frac{\partial^2 z}{\partial x \partial y} = \cos x \cos y$
- (5) Write (only) the solution of one-dimensional wave equations.
- (6) Write (only) the formula for Simpson's 1/3 rule.
- (7) Find Particular integral of the PDE: $(D^2 + 10DD' + 25D'^2)z = e^{3x+2y}$
