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Candidate's Seat No :_____

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

DSC-C-AIML-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 $y = x^2 + c$. where c is a parameter. **(05)**

(b) Solve Bernoulli's equation: $\frac{dy}{dx} + \frac{2y}{x} = x^2y^2$ **(05)**

OR

(a) Form the differential equation representing the family of the curves $y = A\sin(x + B)$, where A and B are constants. **(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 $z = f(x^2 - y^2)$. **(05)**

(b) Find the complete solution of the PDE: $p^2 - q^2 = x - y$ **(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 $0 \le x \le 50$. Find the traffic density $u(x, t)$ after 2 hours. **(05)**

(b) Using Lagrange's method, solve $yzp - xzq = xy$ **(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: $5\frac{d^2y}{dx^2} = \left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2}$

(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) Write (only) the solution of one-dimensional wave equations.

(5) Solve $\frac{\partial^2 z}{\partial x \partial y} = \cos x \cos y$

(6) Find Particular integral of the PDE: $(D^2 + 10DD' + 25D'^2)z = e^{3x+2y}$

(7) Write (only) the formula for Simpson's 1/3 rule.

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