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May 2026

B.Sc.(Maths/MAC) 4th SEMESTER

Partial Differential Equation (BMH-403A)

Time: 3 Hours

Max. Marks:75

Instructions: *1. It is compulsory to answer all the questions (1.5 marks each) of Part -A in short.*
2Answer any four questions from Part -B in detail.
3. Different sub-parts of a question are to be attempted adjacent to each other.

PART-A

Que.1(a)Define 2-Dimensional wave equation.

(b)Form the partial differential equation of the set of all right circular cones whose axes coincide with z-axis.

(c)Write Charpit's auxiliary equations.

(d)Check whether the given system of equations : $p = 6x+3y$, $q = 3x - 4y$ are compatible or not.

(e)Define general integral or general solution.

(f) Find the complementary function of $(D^2 - 2DD')z = 0$, where $D = \frac{\partial}{\partial x}$, $D' = \frac{\partial}{\partial y}$.

(g)Write one dimensional heat equation.

(h)Classify the equation : $\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial y^2} = 0$.

(i)Find the real characteristics of the equation: $\frac{\partial^2 z}{\partial x^2} + 4\frac{\partial^2 z}{\partial y^2} + 4\frac{\partial^2 z}{\partial x \partial y} = 0$.

(j)Write down the steps for reducing a parabolic equation to its canonical form.

(1.5*10 = 15)

PART-B

Que.2(a)Find the complete integral of $p_3x_3(p_1 + p_2) + x_1 + x_2 = 0$ using Jacobi's method. (8)

(b) Using Lagrange's method, solve $z(xy + z^2)(px - qy) = x^4$. (7)

Que.3(a)Solve $(D^2 - 2DD' + D'^2)z = 12xy$, where $D = \frac{\partial}{\partial x}$, $D' = \frac{\partial}{\partial y}$ (8)

(b) Solve the non-homogeneous PDE $(D^2 - D'^2 + D + 3D' - 2)z = e^{x-y}$, where $D = \frac{\partial}{\partial x}$, $D' = \frac{\partial}{\partial y}$. (7)

Que.4 Reduce the partial differential equation: $x^2r - 2xys + y^2t - xp + 3yq - \frac{8y}{x} = 0$ to canonical form. (15)

Que.5Find the steady state temperature distribution in a rectangular plate of sides 'a' and 'b' insulated at the lateral surface and satisfying the boundary conditions $u(0,y) = u(a,y) = 0, 0 \leq y \leq b$ and $u(x, b) = 0, u(x, 0) = f(x), 0 \leq x \leq a.$ (15)

Que.6(a) Determine the real characteristics of the equation $y^2 \frac{\partial^2 z}{\partial x^2} - x^2 \frac{\partial^2 z}{\partial y^2} = 0.$ (8)

(b)Solve : $r + t - (rt - s^2) = 1$,where r, t and s have their usual meanings. (7)

Que.7(a)Solve $x^2r - y^2t + px - qy = \log x.$ (8)

(b)Find the solution of two dimensional heat equation by using the method of separation of variable. (7)