S.C.No.—M/22/18703301

M. Sc. EXAMINATION, 2022

(Third Semester)

(Batch 2018)

MATHEMATICS

18MTH-301

Partial Differential Equations

Time : 3 *Hours* *Maximum Marks* : 80

Note : Attempt *Five* questions in all. All questions carry equal marks.

1. (a) Define Genesis of first order partial differential equations.

(b) State classification of first order differential equations.

(c) Define complete integral, general integral and singular integral of PDE.

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(d) State the partial differential equation governed by vibration of an infinite string.

(e) Define wave equation, heat equation and Laplace equations.

(f) What do you mean by Boundary value problems ? Define.

(g) Define Neumann problem for a circle.

(h) State maximum principle.

2. (a) Show that the singular integral is also a solution of partial differential equation. Also show that $2z = (ax + y)^2 + b$ is a complete integral of $px + qy - q^2 = 0$.

(b) Find the general solution of :

$$y^2 p - xyq = x(z - 2y).$$

3. (a) Find the complete integral of partial differential equation $z^2\left(p^2 z^2 + q^2\right) = 1$ by Charpit's method.

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(b) Show that the equations :

$$f = xp - yq - x = 0;$$

$$g = x^2 p + q - xz = 0$$

are compatible and find a one-parameter family of common solutions.

4. (a) Reduce the equation $u_{xx} + x u_{yy} = 0$ in the region $x < 0$ into canonical form and solve if possible.

(b) Discuss the vibrations of semi-infinite string and solve the equation governing the motion of the string.

5. Discuss the vibrations of a string of finite length and solve the corresponding governed equation by method of separation of variables.

6. (a) Show that the solution of the Dirichlet problem, if it exists, is unique.

(b) State and prove the minimum principle.

7. (a) State and find the solution of the Neumann Problem for the Upper Half Plane.

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(b) What is the Dirichlet problem for a rectangle ? Find its solution.

8. (a) Discuss the conduction for inifinite rod case and obtain the solution of the governed partial differential equation.

(b) State and solve the Heat conduction equation by Duhamel's principle.

9. (a) Show that the surfaces :

$$x^2 + y^2 + z^2 = cx^3$$

can form an equipotential family of surfaces, and find the general form of the potential function.

(b) State and prove Kelvin's Inversion theorem.

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