

## **Partial Differential Equations (PDEs)-MATH-21205**

**Books:** 1. Introduction to Partial Differential Equations By Sankara Rao  
2. Ordinary and Partial Differential Equations By Sundrapandia

### **Outlines of Course upto Mid-Term**

#### **A. Already discussed/done in regular classes**

- i) Basic introduction of definition of PDEs including
  - Order, Degree and Linear/Nonlinear
  - General form of nth-order PDE, 1<sup>st</sup> and 2<sup>nd</sup> order PDE
  - Solution of PDE with examples
- ii) Boundary and initial conditions, Classification of BCs
- iii) Arising of 1<sup>st</sup>-order PDE from different geometries having common symmetry of axes
- iv) General form of linear 1<sup>st</sup> order PDE and its solution technique with examples from notes and book + unsolved exercise from book
- v) Compatible condition of two PDEs and their solution with examples from book + unsolved exercise from book
- vi) Solution method (Charpit's method) for nonlinear 1<sup>st</sup> order PDE with examples from book + unsolved exercise from book

#### **B. Currently ongoing course outlines through whatsapp groups/online discussion**

- i) Classification of 2<sup>nd</sup> order PDE
  - Using discriminant  $B^2 - AC$ , Classify 2<sup>nd</sup> order PDE into
    - Hyperbolic if  $B^2 - AC > 0$
    - Parabolic if  $B^2 - AC = 0$
    - Elliptic if  $B^2 - AC < 0$
- ii) Reduction of 2<sup>nd</sup> order PDE into Canonical form
  - Reduce 2<sup>nd</sup> order PDE into canonical form using coordinates transformation  $\xi = \xi(x, y)$  and  $\eta = \eta(x, y)$
  - Derivation of canonical form of hyperbolic PDE with examples
  - Derivation of canonical form of parabolic PDE with examples
  - Derivation of canonical form of elliptic PDE with examples
  - Reduction of one-dimensional wave equation  $u_{xx} = \frac{1}{c^2} u_{tt}$  with Cauchy's data in canonical form and find the general solution + Exercise of all above

- iii) Mathematical Modelling (of physical problems into PDEs)
- Basics important step of mathematical modelling, and we will study the following three physical problems
    - The continuity equation-formulation of this problem will give the 1<sup>st</sup> order PDE
    - Wave Phenomena (Vibrating String) plus example
    - Build a model that describes the temperature distribution in a metal (rod)