PARTIAL DIFFERENTIAL EQUATIONS

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PRE-REQUISITES : Exposure to Multivariable calculus is needed. In addition, exposure to Linear algebra would be ideal.
INTENDED AUDIENCE : Mathematics, Physics, Mechanical Engineering, Chemical Engineering

COURSE OUTLINE :
Partial Differential Equations (PDEs) appear as mathematical models for many a physical phenomena. Closed-form solutions to most of these PDEs cannot be found. One of the possible ways to understand the models is by studying the qualitative properties exhibited by their solutions. In this course, we study first order nonlinear PDEs, and the properties of the three important types of second order linear PDEs (Wave, Laplace, Heat) would be studied and compared.

ABOUT INSTRUCTOR :

Prof.Sivaji Ganesh did my M.Sc in Mathematics from University of Hyderabad, and Ph.D from Indian Institute of Science, Bangalore. He worked as a post-doctoral fellow at TIFR Bangalore, University of Joseph Fourier and University of Jean-Monnet before joining Indian Institute of Technology Bombay. His research interests lie in the asymptotic analysis of Partial differential equations.

COURSE PLAN :

Week 1: Introduction, First order partial differential equations, Method of characteristics

Week 2: Cauchy problem for Quasilinear first order partial differential equations

Week 3: Cauchy problem for fully nonlinear first order partial differential equations

Week 4: Classification of Second order partial differential equations and Canonical forms

Week 5: Wave equation: d'Alembert's formula, Solution of wave equation on bounded domains

Week 6: Wave equation: Solution by method of separation of variables, Wave equation in two and three space dimensions
Week 7: Wave equation: Parallelogram identity, Domain of dependence, Domain of influence, Causality principle
Week 8: Wave equation: Finite speed of propagation, Conservation of energy, Huygens principle, Propagation of confined disturbances
Week 9: Laplace equation: Boundary value problems, Fundamental solution, Construction of Greensfunction for Dirichlet problem posed on special domains.
Week 10: Laplace equation: Poisson's formula, Solution of Dirichlet problem on a rectangle by method of separation of variables
Week 11: Laplace equation: Mean value property, Maximum principles, Dirichlet principle
Week 12: Heat equation: Fundamental solution, Solution of initial-boundary value problem by separation of variables method, Maximum principle.