NUMERICAL METHODS : FINITE DIFFERENCE APPROACH

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TYPE OF COURSE : Rerun | Core | PG
COURSE DURATION : 4 weeks (24 Jan' 22 - 18 Feb' 22)
EXAM DATE : 27 Mar 2022

PRE-REQUISITES : Numerical Methods Basic Knowledge

INTENDED AUDIENCE : UG students of technical universities/colleges

INDUSTRIES APPLICABLE TO : TCS, Intel, General Electric, General Motors, ABB, Nuclear Industries, etc

COURSE OUTLINE :

This course is an advanced course offered to UG/PG student of Engineering/Science background. It contains solution methods for different class of partial differential equations. The convergence and stability analysis of the solution methods is also included . It plays an important role for solving various engineering and sciences problems. Therefore, it has tremendous applications in diverse fields in engineering sciences.

ABOUT INSTRUCTOR :

Dr. Ameeya Kumar Nayak is Associate Professor in Department of Mathematics at IIT Roorkee and actively involved in teaching and research in the direction of numerical modeling of fluid flow problems for last ten years. His research interests are in the fundamental understanding of species transport in macro and micro-scale confinements with applications in biomedical devices and micro electro mechanical systems. He has authored and co-authored more than 32 peer-reviewed journal papers, which includes publications in Springer,ASME, American Chemical Society and Elsevier journals. He is also active in writing book chapter with reputed international publication house.

COURSE PLAN :

Week 1: Introduction to Numerical methods, Initial and Boundary value problems, Numerical solution of ODE, Picard's method, Taylor's series method, Euler's method, Modified Euler's method, Runge-Kutta method.

Week 2 : Introduction of PDE, Classification of PDE: parabolic, elliptic and hyperbolic. Boundary and initial conditions, Taylor series expansion, analysis of truncation error, Finite difference method: FD, BD & CD, Higher order approximation, Order of Approximation, Polynomial fitting, One-sided approximation.

Week 3 : Parabolic equation in 2D, Explicit & Crank-Nicolson method, Alternating direction Implicit method (ADI), Elliptic equations, Solution of Poisson equation with Example,Successive over Relaxation (SOR) method, Solution of Elliptic equation by using ADI method, Example.

Week 4 : Hyperbolic equations, solution using Explicit method, Stability analysis of Explicit and Implicit scheme, Example, Characteristics of PDE, Solution of Hyperbolic equation by using methods of Characteristics, Hyperbolic equation of first order, Lax-Wendroff's method, Wendroff's method, stability analysis of method, Example.