Numerical methods of Ordinary and Partial Differential Equations - Video course

COURSE OUTLINE

Ordinary Differential Equations: Initial Value Problems (IVP) and existence theorem. Truncation error, deriving finite difference equations. Single step methods for I order IVP- Taylor series method, Euler method, Picard's method of successive approximation, Runge Kutta Methods. Stability of single step methods.

Multi step methods for I order IVP - Predictor-Corrector method, Euler PC method, Milne and Adams Moulton PC method. System of first order ODE, higher order IVPs. Stability of multi step methods, root condition. Linear Boundary Value Problems (BVP), finite difference methods, shooting methods, stability, error and convergence analysis. Non linear BVP, higher order BVP. (24 Lectures)

Partial Differential Equations: Classification of PDEs, Finite difference approximations to partial derivatives. Solution of one dimensional heat conduction equation by Explicit and Implicit schemes (Schmidt and Crank Nicolson methods), stability and convergence criteria.

Laplace equation using standard five point formula and diagonal five point formula, Iterative methods for solving the linear systems. Hyperbolic equation, explicit / implicit schemes, method of characteristics. Solution of wave equation. Solution of I order Hyperbolic equation. Von Neumann stability. (16 Lectures)

COURSE DETAIL

Module No.	Topic/s	Lectures
1	Initial Value Problems (IVP) and existence theorem. Truncation error, deriving finite difference equations.	1
2	Single step methods for I order IVP- Taylor series method, Euler method, Picard's method of successive approximation	4
3	Runge Kutta Methods. Stability of single step methods.	4
4	Multi step methods for I order IVP - Predictor-Corrector method, Euler PC method, Milne and Adams Moulton PC method.	5
5	Stability of multi step methods, root condition.	2
6	System of first order ODE, higher order IVPs.	1
7	Linear Boundary Value Problems (BVP), finite difference methods, shooting methods, stability, error	4

NP-TEL

NPTEL

http://nptel.iitm.ac.in

Mathematics

Pre-requisites:

- First course on Ordinary Differential Equations.
- First course on Numerical Methods.

Additional Reading:

ELEMENTARY NUMERICAL ANALYSIS An Algorithmic Approach (Mc-GrawHill) S. D. Conte, Carl de Boor(only for ODE Part)

Coordinators:

Dr. G.P. Raja Sekhar
Department of MathematicsIIT Kharagpur

	and convergence analysis.	
8	Non linear BVP, higher order BVP.	2
9	Classification of PDEs, Finite difference approximations to partial derivatives.	2
10	Solution of one dimensional heat conduction equation by Explicit and Implicit schemes (Schmidt and Crank Nicolson methods), stability and convergence criteria.	4
11	Laplace equation using standard five point formula and diagonal five point formula, Iterative methods for solving the linear systems.	3
12	Hyperbolic equation, explicit / implicit schemes, method of characteristics. Solution of wave equation.	3
13	Solution of I order Hyperbolic equation. Von Neumann stability.	3
14	In hand for some topics to be revised	2

References:

- Numerical Solution of Partial Differential Equations: Finite Difference Methods (Oxford Applied Mathematics & Computing Science Series), G. D. Smith
- Numerical Solution of Ordinary Differential Equations(Wiley), Kendall E. Atkinson, Weimin Han, David E. Stewart
- Numerical Methods for Scientific and Engineering Computation(New Age International) M K Jain, S R K Iyengar, R K Jain. (only for ODE part).