ADVANCED COMPUTATIONAL TECHNIQUES

PROF.SOMNATH BHATTACHARYYA
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PRE-REQUISITES : Basic UG course in Mathematics/ Undergraduate Calculus

INTENDED AUDIENCE : UG or PG of any Engineering course, Mathematics,Physics and Postgraduate student of Mathematics/Mechanical/Aerospace/Chemical Engineering

COURSE OUTLINE :

There are several basic online courses on numerical methods available, however a course which can provide a foundation for the advanced numerical modeling and scientific computing is infrequent. This course is designed as an introductory course on advanced topics on numerical methods for engineering and science students. It is intended to teach the implementation of numerical methods rather than just provide theoretical foundations of the methods. Scientific computing is an integral part of several disciplines including computational mathematics. The completion of this course will equipped the students in handling advanced computational tools. All the methods will be illustrated by working out several examples. Pre-requisite for this course is the basic knowledge of undergraduate calculus and elementary numerical methods.

ABOUT INSTRUCTOR :

Prof. Somnath Bhattacharyya is a senior professor in the Dept. Mathematics, IIT Kharagpur. His specialization is Applied Mathematics. He is teaching courses on Integral Transform Techniques, Partial Differential Equations, Numerical solutions of PDEs and other related courses on a regular basis for the B.Tech students at IIT Khargpur for the past 28 years. His research works involve numerical solutions of PDEs and he has published more than 160 research papers in reputed international journals. He has undertaken several sponsored research projects and guided 19 PhD students. Prof. Bhattcahrayya has organized and delivered lectures in several Conferences, AICTE sponsored short term courses, NPTEL courses and GIAN courses on topics related to Applied Mathematics. He has received several fellowships for research collaboration in USA, UK and Germany.

COURSE PLAN :

Week 1: Overview on Elementary Numerical Methods, Hermit Interpolation, Cubic Splines, Numerical quadrature, Gauss Quadrature.

Week 2: Least square approximation, Linear system of equations, LU-decomposition, Tri-diagonal system, Iterative Methods, SOR, Conjugate gradient method, Eigen value computation, Power method.

Week 3: Initial value problems, Predictor-corrector methods, Stability, Truncation error, Runge-Kutta method, Linear boundary value problem, Finite Difference Method.

Week 4: Non-linear BVP, Iterative methods, Advection-diffusion equations, Implicit Scheme, Crank-Nicolson Scheme, von-Neumann stability analysis, Linear hyperbolic PDE, Upwind scheme, Lax scheme, Non-linear Burgers equations, Iterative scheme.