INTRODUCTION TO CFD

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IIT Kharagpur

TYPE OF COURSE : New | Elective | UG/PG
COURSE DURATION : 12 weeks (20 Jul' 20 - 9 Oct' 20)
EXAM DATE : 17 Oct 2020

PRE-REQUISITES : Basic course on Fluid Mechanics and Numerical Methods

INTENDED AUDIENCE : Aerospace Engineering/ Mechanical Engineering/ Applied Mechanics Applied Mathematics and allied disciplines

INDUSTRIES APPLICABLE TO : This introductory course on computational fluid dynamics (CFD) could be appropriate for new recruits in aerospace research laboratories like NAL, DRDL, ADA, ADE, HAL and private industry. Additionally, large number of industries in Mechanical engineering domain dealing with thermal and fluid mechanics applications would find it useful.

COURSE OUTLINE :

This course is introductory in nature and expected to impart firsthand knowledge of CFD. It is mainly aimed for senior undergraduate students/first year post graduate students in Aerospace, Mechanical, Applied Mechanics, Applied Mathematics and allied streams.

ABOUT INSTRUCTOR :

Prof. Arnab Roy currently working as Professor at the Department of Aerospace Engineering, IIT Kharagpur. He have taught various courses covering Aerodynamics, introductory and advanced courses in CFD, Wind Tunnel Design and Testing as well as a few courses in Aerospace Propulsion at IIT Kharagpur.

COURSE PLAN :

Week 1**:** Governing conservations equations of fluid flow and classification of system of partial differential equations (PDEs)

Week 2**:** Methods for approximate solution of PDEs: brief overview of finite difference, finite volume and finite element approaches

Week 3**:** Taylor table approach for constructing finite difference schemes of arbitrary orders of accuracy, implementation of schemes near boundaries

Week 4**:** Numerical solution of steady state heat conduction (Elliptic PDE) using various explicit and implicit schemes, implementation of boundary conditions, mesh dependence and convergence of solution

Week 5**:** Numerical solution of unsteady heat conduction (Parabolic PDE) using various schemes, implementing initial and boundary conditions, stability analysis, multi-dimensional implementation

Week 6**:** Numerical solution of linear wave equation (Hyperbolic PDE) using various schemes, artificial viscosity, diffusion and dispersion error, stability analysis

Week 7**:** Numerical solution of one dimensional convection-diffusion equation

Week 8**:** Numerical solution of two dimensional incompressible Navier Stokes equations

Week 9**:** Numerical solution of one dimensional Euler equation for shock tube problem

Week 10**:** Basics of interface capturing methods for application in multiphase flow

Week 11**:** Basics of turbulence modeling

Week 12**:** Structured and unstructured grid generation