COMPUTATIONAL FLUID DYNAMICS

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PRE-REQUISITES : Basic knowledge of Mathematics and Fluid Mechanics

INTENDED AUDIENCE : Mechanical Engineering, Chemical Engineering, Civil Engineering, Aerospace Engineering, Mining Engineering, Atmospheric and Ocean Engineering, Physics

INDUSTRIES APPLICABLE TO : Oil Companies (IOCL, SHELL, BPCL and others), Automobile and Aviation companies (GE, AIRBUS, TATA Motors and others) , R&D sectors of different companies

COURSE OUTLINE :

CFD or computational fluid dynamics is a branch of continuum mechanics that deals with numerical simulation of fluid flow and heat transfer problems. The exact analytical solutions of various integral, differential or integro-differential equations, obtained from mathematical modeling of any continuum problem, are limited to only simple geometries. Thus for most situations of practical interest, analytical solutions cannot be obtained and a numerical approach should be applied. In the field of mechanics, the approach of obtaining approximate numerical solutions with the help of digital computers is known as Computational Mechanics whereas the same is termed as Computational Fluid Dynamics for thermo-fluidic problems. CFD, thus, deals with obtaining an approximate numerical solution of the governing equations based on the fundamental conservation laws of mass, momentum and energy.

ABOUT INSTRUCTOR :

Prof. Suman Chakraborty is currently a Professor in the MechanicalEngineering Department as well as an Institute Chair Professor of theIndian Institute of Technology Kharagpur, India, and the Head of th eSchool of Medical Science and Technology. He is also the AssociateDean for Sponsored Research and Industrial Consultancy. His cu rrentareas of research include microflu idics, nanofluidics, micro-nano scaletransport, with particular focus o n biomedical applications. He has beenawarded the Santi Swaroop Bhatnagar Prize in the year 2013, which isthe highest Scientific Award from the Government of India. He has beenelected as a Fellow of the American Physical Society, Fellow of the RoyalSociety of Chemistry, Fellow of ASME, Fellow of all the Indian NationalAcademies of Science and Engineering, recipient of the Indo-USResearch Fellowship, Scopus Young S cientist Award for high citation ofhis research in scientific/technical Journals, and Young Scientist/ YoungEngineer Awards from various National Academies of Science andEngineering. He has also been an Alexander von Humboldt Fellow, and avisiting Professor at th e Stanford University. He h as 380+ Journal publications.

COURSE PLAN :

Week 1: Introduction to Computational Fluid Dynamics, classification of partial differential equations their physical behavior
Week 2: Fundamentals of discretization
Week 3: Finite Volume approach and discretization of unsteady-state problems
Week 4: Important consequences of discretization of time-dependent diffusion type problems
Week 5: Discretization of time-dependent diffusion type problems (contd.); finite volume discretization of 2-D unsteady state diffusion type problems
Week 6: Solution of systems of linear algebraic equations (Part I)
Week 7: Solution of systems of linear algebraic equations (Part II)
Week 8: Solution of systems of linear algebraic equations (Part III)
Week 9: Solution of systems of linear algebraic equations (Part IV); A finite volume discretization of convection-diffusion equations (Part I)
Week 10: A finite volume discretization of convection-diffusion equations (Part II)
Week 11: A finite volume discretization of convection-diffusion equations (Part III),Discretization of Navier-Stokes equations (Part I)
Week 12: Discretization of Navier-Stokes equations (Part II)