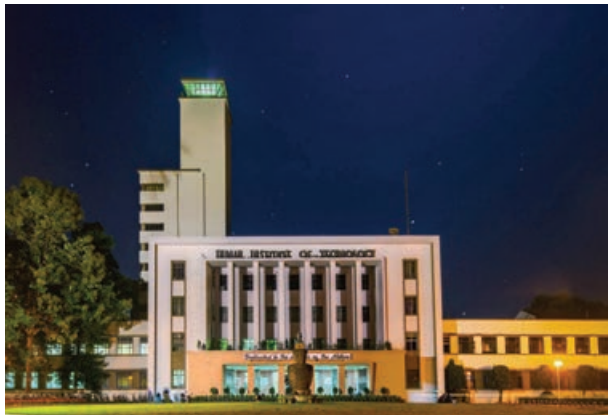
About IIT Kharagpur



Kharagpur - a dusty town tucked away in the eastern corner of India, famous until 1950 as home to the longest railway platform in the world - became the nursery where the seed of the IIT system was planted in 1951. IIT Kharagpur started its journey in the old Hijli Detention Camp in Eastern India, where some of the country's great freedom fighters toiled and sacrificed their lives for India's independence. Spurred by the success of IIT Kharagpur, four younger IITs sprouted around the country in the two following decades, and from these five came thousands of IITians, the brand ambassadors of modern India. It was the success of this one institution at Kharagpur that wrote India's technological odyssey.

The Institute takes pride in its relentless effort to provide the best platform for both education as well as research in the areas of science and technology, infrastructure designs, entrepreneurship, law, management, and medical science and technology. IITKGP is not just the place to study technology, it is the place where students are taught to dream about the future of technology and beam across disciplines, making differences enough to change the world.

Program Features/ Structure

Classroom lectures – **60%**

Numerical/ Problem solving, Case study and Activity – **30%**

Lab visits - **10%**

Program Schedule and Venue

1 week, 10 – 14 August 2020 (9:30 AM – 6 PM)

IIT Kharagpur – Department of Mathematics

Program Fee

Nil for AICTE-QIP sponsored participants

For others - INR 15,000/- (Fifteen thousand) **+ GST** @18% per participant

Who will benefit (Eligibility)

Faculty members from different AICTE approved universities and working professionals. Mathematics, Civil Engineering, Mechanical Engineering and Related department

Last day of Registration

30

June 2020

Accommodation

Accommodation will be provided to the AICTE-QIP sponsored participants at the campus Guesthouse. For other participants, the same will be provided on chargeable basis as per rule.

How to Apply

Use the link: **https://erp.iitkgp.ac.in/CEP/courses.htm** to apply ONLINE.

Signup → Login → Profile Fillup → Choose a Program → Apply Now

Payment if applicable is to be done **ONLINE** after getting short listed for the program.

Contact Us

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AICTE QIP

QUALITY IMPROVEMENT PROGRAMME

Indian Institute of Technology Kharagpur

2020

Mathematical Modeling of Flow and Transport Processes in Fluid Mechanics and Numerical Simulations

1 Week

10 – 14 August 2020

Introduction / Overview

This course will give a mathematical approach towards fluid mechanics. The theoretical aspect of the course will be made as much self-explanatory as possible to serve a much wider audience and later on it will complimented with several numerical simulations to give them a feel of the subject. We will first start with the basic concepts of fluid mechanics such as kinematics of fluids in motion: Lagrangian and Eularian description, stream lines, velocity potential, vorticity, equation of continuity, balance laws, Euler's equations of motion, Bernouli's equation, potential flows. Afterwards we will start with stream function, complex potential for a flow, sources and sinks, irrotational flows, image systems, use of conformal transformations, Kutta-Joukowski condition, aerofoils, stress analysis in fluid motion, relations between stress and rate of strain, Navier-Stokes equations of motion of a viscous fluid, some exact solutions of Navier-Stokes equations, laminar flows, boundary layer theory, Prandtl's boundary layer theory. After the theoretical part, we will perform some numerical simulations for different types of fluid flow for both steady and unsteady cases in COMSOL Multiphysics. The coordinator and the co-ordinator have tried their best to design the course in such a way so that it is beneficial for students and early level researchers and faculties.

Program Objectives

The objective of this course is to give an overview of the basic physical concept and modelling techniques in fluid mechanics. We will also perform numerical simulations to show the application of the theory. The entire course structure is made in such a way that it will be beneficial for both mathematicians as well as engineers who are seeking to have a good grip on the topics from fluid mechanics.

What you will learn

Program Content

Kinematics of fluids motion: Lagrangian and Eulerian descriptions of motion, material, local and convective derivatives, velocity and acceleration of a fluid flow, equation of continuity, streamlines, path lines, streak lines, vortex lines.

Rotational and irrotational motions, Euler's equation of motion, Lamb's hydro-dynamical equations.

Bernoulli's equation, Steady motion for conservative field.

Motion in two dimension, complex potentials, sources, sinks, images, doublets, images with respect to circle and other curves, Milne-Thompson and Blasius Theorems, use of conformal mappings, aerofoils, Kutta-Joukowski's Theorem.

Flow and Circulation, Kelvin minimum energy theorem, Kelvin circulation theorem, kinetic energy of infinite liquid, cyclic and acyclic motion, motion of a cylinder, motion past a cylinder.

Newton's law of viscosity, Newtonian and non-Newtonian fluids, body and surface surfaces, stress and strain analysis in fluid, principal stress, Cauchy Stress tensor and stress vector, symmetric nature of stress tensor, the constitutive equation for a compressible Newtonian viscous fluid.

Navier-Stokes equation, energy equation, dissipation of energy, Laminar flows, Couette and Poiseuille flows, exact solution of Navier-Stokes equation.

Prandtl's boundary layer theory, limitations of Navier-Stokes equations, displacement, momentum and energy thickness, drag and lift, thermal boundary layer, forced and free convection, plane free jet and circular jet, thermal-energy integral equation.

Numerical simulations with COMSOL Multiphysics and Lab Visit

About the Faculty

Dr. Hari Shankar Mahato

Hari Shankar Mahato is an assistant professor in the Department of Mathematics at Indian Institute of Technology Kharagpur. He has done his PhD from University of Bremen in Germany and have Postdoc experiences from University of Erlangen and TU Dortmund (both in Germany) and from University of Georgia in the US. His research expertise are multiscale modeling of heteregenous media, flow in porous medium, partial differential equations and applied analyisis. He has written several papers on these topics and is actively further working on them.

Co-Coordinator

Dr. Mohammad Saud Afzal

Mohammad Saud Afzal is an assistant professor in Department of Civil engineering, Indian Institute of Technology, Kharagpur. He is young and dynamic researcher in the field of Hydraulics and water resources. His research area focuses on Computational Fluid Dynamics, Hydraulics of sediment transport, Coastal Engineering and machine learning and artificial intelligence in Hydraulics. He is an alumnus of IIT Kanpur, Tu Delft and Norwegian university of science and Technology (NTNU). He is famous for his numerical analysis technique in the field of hydraulics and sediment transport. He is very famous for his work on Three-dimensional streaming in sea bed boundary layer.

Other faculty for the course

Dr. Rajaram Lakkaraju

Rajaram Lakkaraju is an assistant professor in the Department o Mechanical Engineering at the Indian Institute of Technology Kharagpur. His research primarily focuses on understanding commonly observed phenomena, such as boiling and churning motion of water in a tea pot, solidification and melting of ice, rising bubbles/falling particles in a beverage bottle, bursting bubbles at sea-air interfaces, and meandering of plumes from a lighted incense stick.