TEQIP-III Short Term Course
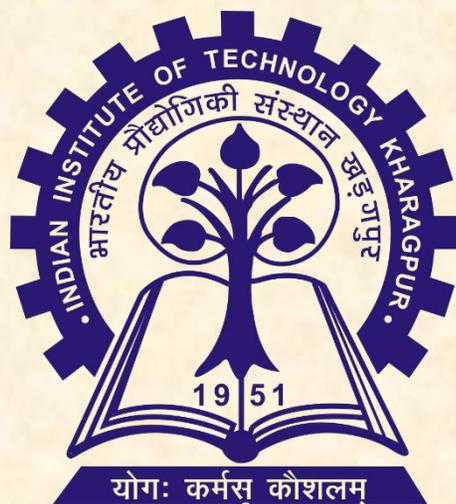
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Mathematical Tools for Boundary Value Problems and Applications

(MARCH 9 - 13, 2020)

At
Indian Institute of Technology Kharagpur
Kharagpur, India – 721302

Organized by
Department of Mathematics
Indian Institute of Technology Kharagpur
Kharagpur, India – 721302

About the Institute

The Indian Institute of Technology Kharagpur was established by the government of India in 1951. The first of the IITs to be established, it is recognized as an Institute of National Importance by the government of India. The institute was established to train scientists and engineers after India attained independence in 1947. It shares its organizational structure and undergraduate admission process with sister IITs. IIT Kharagpur has the largest campus (2,100 acres), the most departments, and the highest student enrolment. Currently IIT Kharagpur has about 550 faculty, 1700 employees and 9000 students in the campus.

About the Department

The Department, since its inception in 1951, has been actively engaged in teaching and research in various branches of mathematical Sciences. The department offers core courses at under graduate level and several courses at postgraduate level. The courses are also designed to prepare students for further graduate work at the Ph.D. level. The Department offers 2-Year M.Sc. programme in Mathematics, 5-Year M.Sc. programme in Mathematics and Computing and M.Tech. programme in Computer Science and Data Processing. Department also enrolls candidates for Ph.D. program. There is a wide spread interaction between mathematics department and various engineering departments in the field of teaching and research.

Course Overview

The BVP has widespread applications in several practical contexts such as, fluid flow, boundary layer analysis, transport phenomena, quantum mechanics, population balance models will be made. This course is intended to provide methods to solve linear and nonlinear boundary value problems involving ordinary as well as partial differential equations. Mathematical tools based on integral transformation, Fourier series solution and Greens function for obtaining analytic solutions for BVPs. A BVP can be equivalently converted to a Fredholm integral equation. Several techniques for solving the integral equations will be illustrated.
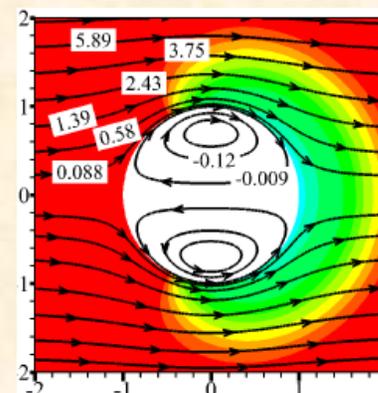
Numerical solutions based on the shooting methods will be introduced. Finite difference methods for linear BVP of second-order and higher orders will be discussed. Iterative techniques to solve nonlinear BVP are included in this course. Algorithms for block tri-diagonal system to handle higher order and system of BVPs will be discussed. Computation of elliptic type of PDEs arises in diffusion dominated process will be described. All the methods will be illustrated by working out several examples. The techniques will be introduced intelligibly along with implementation to sufficient number of problems so that any pre-requisite other than the familiarity of differential equations and basic mathematics are not to be imposed.

Objectives

Computation and simulation are increasingly important in all aspects of science and engineering. At the same time writing efficient computer programs to take full advantage of current computers is becoming increasingly difficult. The objective of this course is to introduce the participants the advanced computing techniques, sophisticated computer programming methodology and hands-on experience on using high-end computer server and computing software. Starting

from mathematical models (derivation, analysis, and classification; various examples), their numerical treatment will be discussed. The main objectives are:

- *Fundamentals of the advanced numerical techniques*
- *Exposure to modeling several industrial problems*
- *Computer simulation*
- *Hands-on experience on computer simulation in high-end servers*

Course contents

- **Boundary Value Problems (BVP): Eigen Values, Eigen Functions; Fourier series solution; Green's function; BVP reduction to Integral equations** *of Fredhom type*

- **Methods of solutions. Integral Transform Techniques for BVPs: Fourier and Laplace Transforms.**

- **Numerical Treatment of Integral equations of Fredholm type**
- **Numerical Techniques for BVP: Shooting Method; Finite Difference Method; Block tri-diagonal system of equations**

- **Numerical Methods for Non-linear BVPs; Elliptic type of Partial Differential Equations; Multigrid Methods; Finite Volume Methods. Applications to modeling fluid flow, boundary layer, heat transfer and transport problems**.

Training Method

The training methods consist of lecture sessions, hands-on-exercises, discussions on cases and real-life problems.

Course Coordinator

Prof. N. Gnaneshwar & Prof. S. Bhattacharyya
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Resource Persons

Faculty members from IIT Kharagpur and other reputed Institutes/ Universities of India.

Eligibility

Category A: Faculty members of TEQIP-III *approved Engineering colleges/ Institutes/ Universities with M.Sc./PhD in Mathematics/ Physics and B.Tech/M.Tech/PhD in Aerospace/ Mechanical/ Chemical/ Metallurgical/ Computer Engineering.*
Category B: Industry/ Institute Sponsored Participants with above mentioned academic background.

Registration

Number of participants for the course will be limited to forty.

The course is free for Category A.

The course fee for Sponsored Candidates (Category B) is Rs. 5,000/- for students and Rs. 10,000/- for others. Payment should be made through bank draft drawn in favor of "CEP-STC, IIT Kharagpur" payable at Kharagpur. Registration fee includes study materials only.

Accommodation

The Category A participants will be provided free AC accommodation in the Technology Guest House.
TA as per the rule will be paid to Category A.
Accommodation on payment basis for Category B may be arranged.

Course Schedule & Venue

9:30 am to 6:15 pm with 2 hour lunch break on each day. B R Seth Seminar Hall, Department of Mathematics,IIT Kharagpur, Kharagpur, India.

Important Dates

Last date for receipt of application: February 2nd, 2020
Start of Course: March 9, 2020
End of Course: March 13, 2020

How to reach

Situated about 120 km west of Kolkata, Kharagpur can be reached in about 2 hours by train from the Howrah railway station of Kolkata or 3 hours by car from Kolkata Airport. Kharagpur is also connected by direct train services to most major cities of the country. The Institute is about 10 minutes drive (5 km) from the Kharagpur railway station. Private taxi, auto rickshaw or cycle rickshaw can be hired to reach the Institute.

How to Apply

Procedure for applying in IIT Kharagpur online Course Registration portal Use the link:

https://erp.iitkgp.ernet.in/CEP/courses.htm

Step to be followed:
1. Sign-Up
2. Verify your email-id (link will be send to your e-mail)
3. Login
4. Edit Profile(Fill up all the mandatory fields, upload photo and signature)
5. Click on 'APPLY NOW' button.
6. Upload your pdf format id-card.

An e-mail will be communicated from the Continuing Education Program, IIT Kharagpur to the shortlisted applicants stating the payment details.
** *This is one time sign up process in apply to IIT Kharagpur online Course Registration portal*. You can apply to other courses using the same credential.

Details of "**How to Pay"** is available at
https://erp.iitkgp.ac.in/CEP/courses.htm

upon the candidate getting shortlisted.

Step to be followed for payment:

1. Click on the button "Pay Fees". You will be redirected to IIT Kharagpur Payment Gateway page.

2. Check the details shown and click on Proceed. You will be redirected to State Bank of India MOPS facility (SBIMOPS).

3. Choose the mode of payment and proceed as per instructions.
4. After successful payment through SBI MOPS click on "Click here to return to IIT Kharagpur e-Transaction

For any queries please send E-mail to:
    gnanesh8@gmail.com