INTEGRAL TRANSFORMS AND THEIR APPLICATIONS

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INTENDED AUDIENCE: Any interested learners
PRE-REQUISITES : Ordinary Differential Equations (ODEs) , Complex variables (optional)
INDUSTRIES APPLICABLE TO : Industries in areas of Signal Processing and Communications,Data Science,Computational Fluid Dynamics,Software Development

COURSE OUTLINE :
The course is designed as an introduction to the theory and applications of integral transforms to problems in Linear Differential Equations, to Boundary and Initial Value Problems in Partial Differential Equations and Continuum Mechanics. Many new applications in Applied mathematics, Physics, Chemistry, Biology and Engineering are included. This course will serve as a reference for advanced study and research in this subject as well as for its applications in the fields of Signal Processing, Informatics and Communications, Neuroscience, Fluid Mechanics, Quantum Mechanics, Computer Assisted Tomography (CAT). The course is open to all MTech, PhD students, some final year advanced undergraduate and honors students.

ABOUT INSTRUCTOR :

Prof. Sarthok Sircar currently working as an Assistant Professor in the Department of Mathematics at Indraprastha Institute for Information Technology, Delhi. His prior academic appointments include Lectureship in the Division of Mathematical Sciences, University of Adelaide, Australia; Research Associate in Division of Applied Mathematics, University of Colorado, Boulder; Research Fellow in Biomathematics in the University of Utah; Visiting Scholar in the Center for Nanophase Material Science at Oak Ridge National Laboratory, and Research Scientist in Corning Inc. at Ithaca, NY. His main mathematical interests are in the development and analysis of nonlinear hyperbolic and elliptic partial differential equations, with applications which lie at the interface of applied mathematics and biology.I am particularly interested in solving problems involving soft matter and fluid flow using asymptotic and perturbation methods, numerical approximation and statistical mechanics

COURSE PLAN :

Week 1: Basic concepts of integral transforms. Fourier transforms: Introduction, Basic properties, Applications to solutions of Ordinary Differential Equations (ODE), Partial Differential Equations
Week 2: Applications of Fourier Transforms to solutions of ODEs, PDEs and Integral Equations, Evaluation of definite integrals. theorems, Watson's Lemma, solutions to ODE, PDE including Initial Value Problems Laplace transforms: Introduction, Existence criteria
Week 3: Laplace (IVP) and Boundary Value Problems (BVP). transforms: Convolution, differentiation, integration, inverse transform, Tauberian
Week 4: Applications of joint Fourier-Laplace transform, Definite integrals, Summation
Week 5: Hankel Transforms: Introduction, properties and applications to PDE, Mellin transforms: Introduction, Properties, Applications; Generalized Mellin transforms.
Week 6: Hilbert Transforms
Week 7: Stieltjes Transform
Week 8: Z - Transforms
Week 9: Radon transform
Week 10: Fractional Calculus and its application
Week 11: Integral transforms in fractional equation
Week 12: Wavelet Transform: Discussion on continuous and discrete, Haar, Shannon and Daubechie Wavelets