Instructional School for Teachers (IST) on "Principles of Continuum Mechanics"

Period: June 03-15, 2024 (Two Weeks)

Venue: Department of Mathematics, J.C. Bose University of Science & Technology, YMCA, Faridabad-121006, Haryana.

Name of Organizers/ Conveners:

1. Prof. Neetu Gupta
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Speakers:

I. Prof. S. K. Tomar, Professor, Department of Mathematics, Panjab University, Chandigarh (Presently: Vice Chancellor, J. C. Bose University of Science and Technology, YMCA, Faridabad, Haryana).
II. Prof. Peeyush Chandra (Rtd), Department of Mathematics, IIT Kanpur.
III. Prof. Gopal Chandra Shit, Department of Mathematics, Jadavpur University, Kolkata.
IV. Dr. S. C. Martha, Associate Professor, Department of Mathematics, IIT Ropar.
V. Dr. Jitender Singh, Associate Professor, Department of Mathematics, Guru Nanak Dev University, Amritsar.
VI. Dr. Santanu Manna, Associate Professor, Department of Mathematics, IIT Indore

Tutors:

I. Dr. Dilbag Singh, Assistant Professor, Department of Mathematics, Panjab University, Chandigarh.
II. Dr. Jai Bhagwan, Assistant Professor, Department of Mathematics, Government College, Panipat, Haryana.
III. Dr. Manjeet Kumar, Assistant Professor, Department of Mathematics, Dr B R Ambedkar Government College, Dabwali, Haryana.
IV. Dr. Suraj Kumar, Assistant Professor, Department of Mathematics, Punjab Engineering College (Deemed to be University), Chandigarh.

Detailed Syllabus:

Name of the Speaker	**Number of Lectures**	**Syllabus**
Prof. S. K. Tomar	6	**Elasticity and Wave Propagation** Basic concepts of theory of elasticity: stress, strain and their properties, Hooke's law and its generalization, symmetry of

		stress tensor, equation of equilibrium and motion, compatibility conditions, Finite deformation; Waves in uniform elastic medium, Helmholtz decomposition of vector, body waves, boundary conditions, reflections/ refraction phenomena; Surface waves - Rayleigh, Love and stoneley.
Prof. Peeyush Chandra	6	**Fundamental Principles** Eulerian and Lagrangian coordinate systems, stress-strain tensors and their properties, Polar Decomposition theorem, governing differential equations of continuum mechanics, conservation laws for the mass, linear momentum, angular momentum, energy, first and second laws of thermodynamics for a continuum, equations of state, boundary conditions, fundamental restrictions on constitutive laws.
Prof. Gopal Chandra Shit	6	**Computational Fluid Dynamics (CFD)** Need of CFD as tool, role in R&D, CFD Applications. Concept of Finite Difference, Finite difference discretization, Convergence, Consistency, and Stability, Boundary conditions, CFD model formulation, Tridiagonal linear system of equations solver (TDMA/ Thomas Algorithm). Two time-level explicit scheme (Schmidt formula), Crank-Nicolson Implicit scheme and their von-Neumann stability analysis. Solution of one-dimensional wave equation using the Lax scheme, Lax-Wendroff Scheme and their von-Neumann stability analysis, CFL number. Second order wave equation using explicit method and its von-Neumann stability. Five point formula, Point-Gauss-Seidel and Line Gauss-Seidel method, Point and line Successive over/under relaxation method for Laplace and Poisson equations. Vorticity – Stream function formulation. MATALB program for Direct Numerical Solution of lid-driven cavity problem, Flow over a Backward-facing step problem. Graphical representation and validation of computational results. Basic concepts of the finite element methods for the solution of fluid dynamics problems.
Dr S. C. Martha	6	**Problems of Water Wave Mechanics** Sturm-Liouville problem, Boundary value problem for two-dimensional periodic water wave, eigenfunction solutions of linearized water wave boundary value problem, approximate solution of dispersion equation by Newton-Raphson method with MATLAB program. Least square method and its applications to water wave problems, energy balance equation using Green's identity. Boundary element method (BEM), numerical implementation through MATLAB code, BEM applications to water wave problems. Fredholm integral equations of second kind and its numerical solution and MATLAB applications, integral equation method for solving a problem on wave mechanics.
Dr Jitender Singh	6	**Some Hydrodynamical Problems**

		Hydrodynamics of Rayleigh-Benard convection and Couette-Taylor problem, the mathematics of Boundary layer flows such as the stretching sheet problem. Numerical methods for hydrodynamic and the flow problems: Shooting method, the method of matrix exponentials, homotopy perturbation technique
Dr Santanu Manna	6	**Some Non-Elasticity Problems** Mohr's circle diagram: principal stress & strain, Equations of deformation and equilibrium, combability etc. Concept of nonlocal elasticity: dynamic equation of motion, waves of dilatation and distortion, body wave & surface wave, concept of damping and meta-surface. Asymptotic analysis for elasticity problem, explicit models for surface waves, Bleustein-Gulyaev surface waves, comparison of asymptotic approach and analytical approach, hyperbolic-elliptic model of surface wave field.

Time Table*:

Day	**Date (June 2024)**	**L-1 (9:00-10:30)**	**10:30-11:00**	**L-2 (11:00-12:30)**	**12:30-2:00**	**L-3 (2:00-3:30)**	**3:30-4:00**	**Discussion/ Tutorial (4:00-5:00)**
Mon	3rd	SKT		PC		PC		SKT, DS, SK
Tue	4th	SKT		PC		PC		PC, DS, SK
Wed	5th	SKT		PC		PC		PC, DS, SK
Thu	6th	SKT		SCM		SCM		SKT, DS, SK
Fri	7th	SKT		SCM		SCM		SCM, DS, SK
Sat	8th	SKT	Tea/ Snacks	SCM	Lunch	SCM	Tea/ Snacks	SCM, DS, SK
Mon	10th	JS		GCS		GCS		JS, JB, MK
Tue	11th	JS		GCS		GCS		GCS, JB, MK
Wed	12th	JS		GCS		GCS		GCS, JB, MK
Thu	13th	JS		SM		SM		JS, JB, MK
Fri	14th	JS		SM		SM		SM, JB, MK
Sat	15th	JS		SM		SM		JS, JB, MK

*Holiday on Sunday (June 09, 2024)
SKT-Prof. S. K. Tomar
PC-Prof. Peeyush Chandra
GCS-Prof. Gopal Chandra Shit
SCM-Dr S. C. Martha
JS-Dr Jitender Singh
SM-Dr Santanu Manna
DS- Dr Dilbag Singh
SK- Dr Suraj Kumar
JB- Dr Jai Bhagwan
MK- Dr Manjeet Kumar