TEQIP Supported Short Term Training Programme

on

Advanced Mechanics of Continua

(23-27 December 2018)

Organized by

National Centre for Disaster Mitigation & Management

Malaviya National Institute of Technology Jaipur

Patron

Prof. Udaykumar R Yaragatti

(Director, MNIT Jaipur)

Course Chairperson

Prof. M. K. Shrimali

(Professor, Civil Department, MNIT Jaipur)

Coordinators

Prof. S.D. Bharti

(Professor, Civil Engg. Department, MNIT Jaipur)

Dr. Dinesh Kumar

(Associate Professor, Mechanical Engg. Department. MNIT Jaipur)

COORDINATOR FROM COLLABORATING INSTITUTION

Prof B. P. Nandawan

(Professor of Mechanical Engg. College of Technology & Engineering, Udaipur)

About the Institute

Malaviya National Institute of Technology Jaipur is an institution of National Importance under National Institutes of Technology, Science Education and Research Act 2007, under the aegis of Ministry of Human Resources, Government of India.

The Institute was established as Regional Engineering College in 1963, as a joint venture of Government of Rajasthan and Government of India. The Institutes runs programs leading to undergraduate (B. Tech.) Graduate (M. Tech.) and research degrees (Ph. D.), in all major disciplines engineering and technology.

The Institute operates from a well planned and developed, fully residential campus spread over 325 Acre of land. The campus has a premium location on the Jawahar Lal Nehru Marg in Jaipur, and it is well connected through Air, Rail and Road. The Air Port and Railway station (Gandhi Nagar, Jaipur) are within 10-15 minutes travel distance from the Institute campus.

About the department

National Centre for Disaster Mitigation and Management is an Academic Center of the Institute, approved by the Board of Governors (27th Meeting of the Board of Governors held on 7 October 2013). The Center works for disaster mitigation and management in India in general, and earthquake safety in particular. The activities of the Center include experimental and analytical Research & Development and training of both academics and students of other universities and institutions in India as well as practitioners. Presently the Center has 10 Adjunct Faculty Members with Ph. D. degrees in relevant disciplines such as earthquake engineering, management and instrumentation.

Overview of the course

In continuum mechanics we study physics and mathematical descriptions of deforming continuous media at macroscale i.e. at continuum scale. In such study we do not consider the behavior of matter at smaller scales such as molecular, atomic, or subatomic scales. With the assumption of thermodynamic equilibrium in the deforming continua the study of continuum mechanics provides thermodynamic framework consisting of conservation and balance laws and associated constitutive theories for solid continua as well as fluent continua that describe the physics of evolution of these continua when they are disturbed. In engineering terms the mathematical model for thermoelastic solids, thermoviscoelastic solids with and without memory, both compressible and incompressible, Newtonian and generalized Newtonian compressible and incompressible fluids (liquids and gases), polymeric fluids, and the associated constitutive theories are within the scope of study in continuum mechanics course proposed here. Thus, this course addresses mechanics of continua without any specific bias to solids, liquids, or gases. It would include higher level presentations of concepts and principles with sufficient clarity and details for specific applications

Objectives of the course

The objectives of this course are:

- To study the fundamentals of continuum mechanics applicable to all deforming continua, both solids and fluids, compressible as well as incompressible under thermodynamic equilibrium.

- To develop mathematical framework, referred to as thermodynamic framework, and associated constitutive theories for solid and fluent continua with thorough understanding for deriving mathematical descriptions of desired physics.
- To present and derive the basic concepts and principles applicable to all continua without any bias to specific nature (solids and fluids) of the continua.

Who can attend?

The course material is designed for students, researchers, postdoctoral fellows in engineering, applied mathematics, applied and theoretical mechanics, and physical sciences in general. The material in the course consists of core concepts and principles of the mechanics of continuous media, hence should be of benefit to practitioners, students, and researchers in mechanical engineering, civil engineering, geological sciences, chemical engineering, aerospace engineering, and mathematical physics.

Benefits of attending the course

Successful completion of the course should result in strengthening the core knowledge in the following areas:

- Clear understanding of various notations, their use, and benefits in derivation of the mathematical descriptions of deforming continua.
- Fundamentals of kinematics of deformation, its measures, rates, stress measures for finite deformation, finite strain and strain rates, contravariant and covariant bases and their use in the thermodynamic framework.
- Conservation and balance laws and constitutive theories for all solid and fluent continua in Lagrangian and Eulerian descriptions, their derivation and applications.
- Complete mathematical descriptions of deforming continua, thermodynamic relations, and applications of the complete mathematical models in the study of deformation of solid and fluid continua.

Course contents

The course contents would include:

- Einstein, index, and matrix notations, and basic operations using these notations, change of frame, transformations, concept and representation of tensors, tensor operations, tensor calculus, covariant and contravariant bases and transformations, transformation of tensors, invariants of tensors, Hamilton-Cayley theorem.
- Kinematics of motion, deformation and their measures, Lagrangian and Eulerian descriptions, different measures of strains, invariants of strain tensors, physical meaning of strain tensors, polar decomposition, definition and measures of stresses: Cauchy stress tensor, first and second Piola-Kirchhoff stress tensors, rate of deformation, strain rate measures, spin tensors, convected time derivatives of stress and strain tensors.
- Conservation and balance laws in Lagrangian and Eulerian descriptions for finite deformation, finite strain, and finite strain rates.
- General considerations in the derivations of constitutive theories, ordered rate constitutive theories for thermoelastic solids and thermoviscoelastic solids with and without memory for compressible and incompressible cases, ordered rate constitutive theories for thermofluids and thermoviscoelastic fluids both

compressible and incompressible, Maxwell, Oldroyd-B, and Giesekus constitutive models, ordered rate theories for hypoelastic solids, complete mathematical models with thermodynamic relations, principle of virtual work.

Course instructor cum resource person

Prof. Karan Surana, Deane E. Ackers University Distinguished Professor of Mechanical Engineering University of Kansas, Lawrence, KS 66045 USA.

Education: B.E. (Mech. Engg. 1965) BITS Pilani, M.S. and Ph.D. (University of Wisconsin, Madison, 1967 & 1970)
Industrial Experience: 15 Years. SDRC, Cincinnati (1970-1973), EMRC, Detroit (1973-1978); and McDonnell-Douglas, St. Louis (1978-1984).
Teaching Experience: 34 Years (Since 1984)
Research Interest: Computational Mathematics, Computational Mechanics, and Continuum Mechanics.
Prof Karan Surana is author of over 350 research reports, conference papers, and journal articles. He has served as advisor and chairman of 50 M.S. students and 22 Ph.D. students. He has also delivered many plenary and keynote lectures in various national and international conferences and congresses on computational mathematics, computational mechanics, and continuum mechanics. He has served on international advisory committees of many conferences and has co-organized mini-symposia on k-version of the finite element method, computational methods, and constitutive theories at U.S. National Congresses of Computational Mechanics organized by the U.S. Association of Computational Mechanics (USACM). He is a member of International Association of Computational Mechanics (IACM) and USACM, and a fellow and life member of ASME. He is author of recently published textbooks, Advanced Mechanics of Continua, CRC/Taylor & Francis, and The Finite Element Method for Boundary Value Problems: Mathematics and Computations, CRC/Taylor & Francis.

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REGISTRATION FORM

TEQIP Supported Short Term Training Programme (STTP)

Advanced Mechanics of Continua

(23-27 December 2018)

(To be sent through post/email along with DD or E-transfer details.)

Name: .....

Designation: .....

Affiliation: .....

Correspondence: .. ..
Address .....
.....

Mobil No.: .....

E-.mail: .....

Registration Category:

(Please Tick)

☐ Participants from Industry **(Rs. 5000/-)**

☐ Faculty Members **(Rs. 4000/-)**

☐ Students & Scholars **(Rs. 1500/-)**

Registration Fee Details: **Demand Draft/E-Transfer Details:**

(through DD or E-transfer)* Name of Bank....., Branch:.....

DD No./E-transfer No.: ....., Date:.....

(Note: The registration fee includes: attendance in all lectures, working lunches on course days and registration kit)

Accommodation: Required/Not Required (Tick)

(Note: On campus accommodation, if available, would be arranged in the Institute Guest House on chargeable basis. Approximate guest house charges for a twin shared room is Rs 800.00)

Date: **Signature of Participant**

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* **Payment Details:** Demand Draft to be drawn in favour of **"Registrar, MNIT Jaipur"** payable at Jaipur & E-transfer to be made in: A/c No. **: 36875887782,** IFSC**: SBIN0015921,** Bank**: SBI, MNIT Campus Jaipur.**