मौलाना आज़ाद राष्ट्रीय प्रौद्योगिकी संस्थान भोपाल

Maulana Azad National Institute of Technology Bhopal

Short Term Executive Training Program for Professionals and Scientists

on

Finite Element Methods: Theory and Applications

Hybrid Mode

August 12–16, 2024

Organized by

Department of Mechanical Engineering

MANIT Bhopal 462 003

CHIEF PATRON

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Director, MANIT Bhopal

PATRON

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Department of Mechanical Engineering

MAULANA AZAD NATIONAL INSTITUTE OF TECHNOLOGY BHOPAL

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OVERVIEW OF THE COURSE

The Finite Element Method (FEM) is a numerical and computer-based technique of solving a variety of practical engineering problems that arise in different fields like solid mechanics, fluid mechanics, biomechanics, heat transfer, structural health monitoring, ship buildings, aerospace, aeronauticals *etc*. It is recognized by developers and users as one of the most powerful numerical analysis tools ever devised to analyze complex problems of engineering. The underlying theory of the method is now well established, with many books and courses providing adequate explanations of the theory. However, most people using the method via commercial software or in-house codes do not often understand the method as applied to engineering problems, especially in generating input data and interpreting the results.

COURSE OBJECTIVE

- ❖ The major problem facing the engineering analyst contemplating the use of the technique lies in acquiring appropriate knowledge to provide assurance that the finite element model produced gives a reasonably reliable representation of the 'real life' problems being analyzed.
- ❖ The main challenge for the engineering analyst is obtaining the necessary knowledge to ensure that the finite element model accurately represents real-life problems.
- ❖ The present course is designed to bridge the gap between the theoretical finite element knowledge and its industrial applications by providing sufficient insights into the relationship between the physical data (e.g., loads, boundary conditions, constitutive behavior, etc) and the finite element model. The lecturer will address the issues of element selection, mesh design, convergence and response characteristics.
- ❖ This course aims to bridge the gap between theoretical finite element knowledge and practical industrial applications. It provides deep insights into the relationship between physical data—such as loads, boundary conditions, and constitutive behavior—and the finite element model. The course will cover critical topics including element selection, mesh design, convergence, and response
- ❖ This course is intended to provide graduate students, engineers, and researchers working in aerospace, automotive, civil, mechanical engineering, and information technology industries as well as numerical analysts and materials scientists with the theory and applications of linear finite element analysis of problems from heat transfer, fluid mechanics, and solid and structural mechanics.
- ❖ This course aims to equip graduate students, engineers, and researchers in aerospace, automotive, civil, and mechanical engineering, as well as in

information technology, with a thorough understanding of the theory and applications of linear finite element analysis. It covers practical problems in heat transfer, fluid mechanics, and solid and structural mechanics, making it valuable for numerical analysts and materials scientists as well.

PROFILE AND NUMBER OF PARTICIPANTS

The course is aimed at students, analysts and researchers who are involved with the analysis of differential equations arising in engineering and applied science, and who are using or plan to use commercially available finite element packages to analyze problems in the aeronautical, automobile, mechanical, civil and other engineering industries. The course will also enable participants to be able to write their own in-house code in FEM. Participants are assumed to have knowledge of the basic principles of engineering (i.e., undergraduate degree in engineering). Some knowledge of the finite element method is an advantage, but not essential. ***The maximum number of participants for the course shall be limited to 50.***

This course targets students, analysts, and researchers engaged in analyzing differential equations in engineering and applied science. It is ideal for those using or planning to use commercial finite element packages for problems in the aeronautical, automotive, mechanical, civil, and other engineering sectors. Additionally, the course will equip participants with the skills to develop their own in-house FEM code.

Participants should have a foundational understanding of engineering principles, typically at the level of an undergraduate engineering degree. While some prior knowledge of the finite element method is helpful, it is not mandatory. To maintain an effective learning environment, the course is limited to a maximum of 50 participants.

COURSE CONTENTS

1. **Basic Concepts in FEM: One-Dimensional Problems**
   - **Solution of Differential Equations and Essential Boundary Conditions**
   - **Rayleigh-Ritz Method**
   - **Galerkin Method**

2. **Introduction to Two and Three Dimensional FEM**

- **Triangular Elements, Quadrilateral Elements**
- **Subparametric, isoparametric, and superparametric formulations**
- **Tetrahedral element**
- **3D brick element**

3. **Industrial Applications**
   - **FEM analysis of turbine blades**
   - **Examples of ship analysis by FEM**
   - **Examples of Composite Dynamics by FEM**
   - **FEM analysis of Penstock**
   - **FEM analysis of Laser assisted bending process**

4. **Hands-on-Experiences**
   - **Sketching and Modelling using ANSYS Spaceclaim**
   - **Best Practices for Meshing (Structural Problem and CFD Problem)**
   - **Different Mesh Techniques for Local and Global mesh settings.**
   - **Analysis of Globe Valve, Connections, Joints, Remote Connections, and Contacts**
   - **Multi Body dynamic and Heat Transfer FEM Analysis**
   - **Laminar and turbulent fluid flow and Heat Transfer through elbow and T-junction**
   - **External Flow and Fluid Structure Interaction-1-way FSI**

BENEFITS OF ATTENDING THE COURSE

- ❖ Persons who have attended the course and followed the material should benefit in strengthening their background in the following areas:
- ❖ A strong understanding of the formulative steps involved in the finite element model development of the equations of engineering and applied science, including certain solid mechanics and heat transfer problems.

- Generation of finite element data (e.g., selection of elements and mesh, computation of nodal forces), imposition of boundary conditions, post-computation of stresses and strains, etc), exploitation of problem symmetries, and interpretation and evaluation of the results.

ABOUT THE INSTITUTE

As a one of the premier teaching, research and consulting organizatios, Maulana Azad National Institute of Technology Bhopal needs little introduction. It has established itself a world-class teaching and research institute. The institute also carries out expansion work on large scale in form of consulting, training programme and sponsored research for the industry. The alumni of the institute hold top technical and management positions in reputed Indian and Multinational companies. This is how MANIT has an ideal setting conductive to learning engineering and technology. The more detailed can be assessed here https://www.manit.ac.in/.

ABOUT THE DEPARTMENT

The department of mechanical engineering, being one of the largest and oldest departments of the institute, caters to its students with class tutorial and state-of-the-art laboratories. The department is continuously striving to achieve excellence in education, academic and industry-oriented research as well as consultancy work with service to the society. Currently, the department offers One Undergraduate (UG) in Mechanical Engineering and Four Postgraduate (PG) programs namely Industrial Design, Thermal Engineering, Robotics & Automation and Industrial Engineering & Management. The department is actively engaged in high quality research in Design, Materials, Thermal, Manufacturing and Industrial Engineering. We aim to provide out students with a perfect blend of intellectual and practical experiences, that helps them to serve our society and address a variety of needs. Innovative teaching methods, industrial collaborations, and state-of- the-art infrastructural facilities are some of the strengths of the department.

ELIGIBILITY

The course is open to Scientists/Industry Professionals/Faculty members/Research Scholars.

IMPORTANT DATES

The last date for the receipt of duly sponsored application: By email: scanned copy: **August 10, 2024 (till 5.00 PM)**

Intimation of selection: **August 10, 2024 (Mid night)**

Program dates: **August 12-16, 2024**

SELECTION CRITERIA

Number of seats: 50

Selection will be based on **First cum first served basis**. Participants from Research Institutions/Labs/Industry Professionals will get preference.

REGISTRATION FEE

For participants from academic institutions/Research labs/students/research scholar/industry: Rs. 500

Link for registration: https://forms.gle/rUKaPgVjkBRVETDP9

MODE OF PAYMENT REGISTRATION FEES

Details of Money-Transfer by net-banking:

- Account Name: Director MANIT Bhopal;
- Bank Name: State Bank of India Bank;
- Address: MANIT (MACT) Bhopal
- Account No. 10020150107
- IFSC Code: SBIN0001608

In net banking money transfer please clearly mention narration in remark column as "FEMTA-2024" otherwise it will be difficult to trace the money transfer and receipt may not be issued.

EMINIENT SPEAKERS

- **Prof. K K Shukla, Director MANIT Bhopal**
- **Dr. B P Patel, Professor, IIT Delhi**

INTERNAL SPEAKERS

- **Dr. Vinod Yadav, Assistant Professor, MANIT Bhopal**

- Dr. Narendra Gajbhiye, Assistant Professor, MANIT Bhopal

INDUSTRY EXPERTS

Following experts from ARK Solutions, New Delhi

- **Dr. Tushar Sharma**
- **Mr. Sourabh Katiyar**
- **Mr. Ravindra Bucherla**
- **Mr. Rohit Sangwan**

ADDRESS FOR CORRESPONDENCE

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https://sites.google.com/view/femta2024/home