Variational Methods in Structural Mechanics (171034L11) January 21-25, 2019

Overview

Structural analysis is at the core of a broad range of technological innovations leading to design and Manufacture of products and system within a wide range of sectors spanning automotive engineering, construction, transportation, biomedical devices and implants and aerospace engineering. Advanced structural analysis methods heavily rely upon approximate methods that, in turn, require formulations using variational approached as opposed to Newtonian free-body-diagrams. The short course is an introduction to this methodology covering fundamental principles leading to methods such as finite element analysis and applicable to a host of problems is statics, stress analysis and dynamics of industrial components. The contents of the short course are in line with the broader industrial and training visions within the SKILL DEVELOPMENT and MAKE IN INDIA initiatives of the Government of India.

Specific topics covered will enable the participants to take up modern computational approaches in stress and structural vibration analysis further. It will also enable them to follow modern trends in computational solid mechanics as frequently demanded within scientific publications as well as engineering practice.

Objectives

The primary objectives of the course are as follows:

To introduce variational formulations in stress analysis under static loading.

To introduce variational formulations in structural dynamics

To use the variational framework established for approximate solutions of stress analysis and vibration problems.

To establish connections between variational approaches and modern computational methods such as Finite Element Analysis.

To apply energy and variational methods to the mechanics of thin plates.

Modules	**Lectures** : Introduction to Variational Methods in Structural Mechanics. The variational operator and its properties. The Principle of Minimum Total Potential Energy (PMTPE). Application of variational approach to derive equations of equilibrium. Kinematic vs natural boundary conditions. Illustration to simple structural models including rods in tension & compression, shaft, strings. Application of PMTPE to beam bending problems. Derivation of equations of equilibrium. Development of variational approaches for approximate methods such as Rayleigh-Ritz and Finite Element analysis. Hamilton's Principle as the starting point for dynamics of mechanical systems. Illustration for simple discrete systems. Derivation of equations for motion of continua using Hamiton's Principle. Examples from the dynamics of rods, shafts and strings. Application of Hamilton's Principle to the dynamics of beam bending. Kinematic and dynamics boundary conditions. Rayleigh Ritz procedure via energy approaches. Examples and illustrations. Introduction to Finite Element formulations via variational route. Application of variational and energy approaches to the mechanics of thin plates. **Tutorials :** Problem solving session in the use of PMTPE for simple structural problems. Tutorial on the use of PMTPE in seeking approximate solutions. Tutorial on derivation of governing differential equations using Hamilton's principle. Tutorial on Rayleigh Ritz procedure. Tutorial on static analysis of thin plates using FEM **Number of participants for the course will be limited to Fifty.** The **last date** to apply for the course is **December 31, 2018 (Monday)**
You Should Attend If...	• Executives, engineers and researchers from manufacturing, service and government organizations including R&D laboratories and industry. • Student students at all levels (B.Tech/M.Sc./M.Tech/Ph.D). • Post-doctoral fellows and Faculty from reputed academic and technical institutions who are engaged in teaching and research related to composite materials and mechanics fields.
Fees	**Participants from abroad : USD 500** **Industry participants : INR 10,000** **Faculty/Research staff from other Institutions: INR 4,000** **PhD scholars/Students from other Institutions: INR 2,500** **Faculty/PhD scholars/Students from NITK : INR 1,500** The above fee includes all instructional materials and working lunch. The outstation participants will be provided with limited accommodation (shared) on payment basis.
Steps for Registration	(i) Prospective participants have to register first on GIAN Portal (http://www.gian.iitkgp.ac.in/GREGN/index) by paying Rs. 500 /- (One time non-refundable GIAN Portal registration fee). (ii) Select the course from the list of courses available in the portal. Register for the course selected.

	(iii) Mode of payment: **DD** for registration fee in favour of the **Director NITK Surathkal**, payable at Surathkal/Mangalore through any Nationalized Bank. **DD must reach to** *Dr. P. Jeyaraj, Associate Professor, Mechanical Engineering, National Institute of Technology Karnataka, Surathkal, PO Srinivasnagar 575025, Mangalore, Karnataka* by post ***on or before 31st December 2018.***

The Faculty

Prof. Atul Bhaskar

Atul Bhaskar graduated from IIT Kanpur in Mechanical Engineering. Following this, he obtained his master's degree in Applied Mechanics (IIT Delhi) and a PhD (University of Cambridge). Before joining Southampton in 1999, he taught at IISc Bangalore and IIT Delhi. He has also worked in the industry in the mechanical design and aerospace sectors prior to joining the academia. His current research interests are in the areas of computational and theoretical solid mechanics applied to structures & materials where he has published extensively in the leading journals and international journals, in addition to being awarded several patents. His previous and current research has been supported by EPSRC, BBSRC, EU, industry, Royal Academy of Engineering, Leverhulme Trust, etc. He has been a recipient of several awards and honours such as the George Stevenson Prize and Medal of the IMechE and the Leverhulme Senior Research Fellowship of the Royal Academy of Engineering. He leads a team of over ten researchers working on problems in the aerospace, automotive, marine and biomedical sectors, with current research funding over £2M.

Course Co-coordinator

Dr. P. Jeyaraj

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GIAN web link : http://www.gian.iitkgp.ac.in/GREGN

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DD must reach to *Dr. P. Jeyaraj, Associate Professor, Mechanical Engineering, National Institute of Technology Karnataka, Surathkal, PO Srinivasnagar 575025, Mangalore, Karnataka* by post ***on or before 10th January 2019.***