The Institut für Statik at the TU-Braunschweig is organizing an intensive postgraduate course on nonlinear computational mechanics. The course is part of the Mercator-fellow program offered to Doctoral and Master Students at Engineering Departments.

The course lecturer Adnan Ibrahimbegovic is Professor (Classe Exceptionnelle) at one of the elite engineering schools in Paris, Ecole Normale Supérieure Cachan. He has obtained his engineering education in Sarajevo (winner of 1986 Fulbright Fellowship), PhD at the University of California at Berkeley, USA and Habilitation at the University of Pierre and Marie Curie in Paris, France. He has held professorships and research positions at four different universities (including UC Berkeley, USA; EPFL in Switzerland; UTC, France and currently ENS-Cachan, France). He is the past Chairman of ENS-Cachan Civil Engineering Department, Master Program MaiSE and Head of Civil Engineering Division of LMT-Cachan, the largest French laboratory in mechanics. He has received a number of international distinctions, including IACM Fellow Award, Humboldt Research Award for Germany, Research Award for Slovenia, International Fellow NSERC Award for Canada, ‘Claude Levy-Strauss’ Chair for Univ. Sao Paulo, Brazil, ‘Asgard’ Chair for NTNU, Norway, ‘Hôte Académique’ Award for EPFL, Switzerland. He has produced over 440 publications, including 145 papers in scientific journals and 6 textbooks and monographs.

Time schedule
Thursdays 13:30-15:00, 15:30-17:00
(short schedule possible for outside participants)

Course Contents
1. Introduction: Variational formulations in nonlinear solid mechanics
2. FEM technology for 2D/3D BVP in elasticity
3. Thermodynamics foundation of inelastic constitutive behavior at small strains
4. Advanced constitutive models
5. Multi-scale problems: applications to concrete, steel, graphene …
6. Nonlinear solid mechanics problems at large displacements
7. Constitutive models at large strains
8. Instability of structures and materials
9. Advanced aspects of multi-scale problems, probability and size-effect
10. Multi-physics, coupled and interaction problems

Course materials
The course material will consist of copies of transparencies from the lectures, recent papers and lecture notes. Also, a copy of the course textbook will be offered for purchase to participants at the author discount rate.
Course objectives

The main objective of this course is to provide engineers who use computer codes, graduate students, and researchers with an extensive review of FE based numerical models and solution algorithms for nonlinear mechanics. It presents the current state-of-the-art in finite element modeling of nonlinear problems in solid and structural mechanics, and their coupling with thermal fields. It will illustrate the difficulties (and their solutions), which appear in a number of applications from mechanical, aerospace or civil engineering and material science. All the sources of nonlinear behavior are present in a systematic manner, related to kinematics, equilibrium, constitutive equations, or boundary and coupling conditions. Special attention is paid to dealing with a class of problems with nonlinear constitutive behavior of materials, large deformations and rotations of structures and instability problems with either material (localization) or geometric (buckling) nonlinearities, which are needed to fully grasp any weakness of a particular structural design near the ultimate limit state. In addition, multi-physics models will be addressed, with a special emphasis on thermal coupling and fluid-structure interaction.

The course will also provide insight into the practical aspects of the Finite Element Method, related to making the choice of a particular element type, the constitutive model, or integration scheme among those available in advanced computer codes. Our second objective is thus to provide the participants with a solid basis for using the FEM based models and software in trying to achieve the optimal design, and/or to carry out a refined analysis of nonlinear behavior of structures or multibody systems. The course finally provides a basis to account for any pertinent multi-physics and multi-scale effects, which are likely to achieve a significant breakthrough in a number of industrial applications.

Participants

The course is suitable for all engineers and researchers who would like to improve their skills with using a refined modeling approach in nonlinear mechanics. In particular, those who are developing their own tools (with an illustration of the research code CO-FEAP), and those who seek to make a more efficient use of existing codes will find the course very helpful. Moreover, all those who would like to reinforce their understanding of the theoretical basis of problems in nonlinear mechanics and an illustration of current research in Computational Mechanics will be well served through the course notes and the course books. This course (in a somewhat reduced format) has already been held several times since 2000 in France, Germany, Italy, Austria, Finland, Luxembourg, Norway and Brazil, and has proved very successful. Among the previous participants, those with background in engineering or applied mathematics, as well as those with previous knowledge of basic FEM procedures for linear problems, found the course most profitable. The participants are assumed to have a background in continuum and structural mechanics. Some background in the finite element method is also desirable.

Students enrolled at the TU Braunschweig for one of those Ph.D. programs are asked to sign up for the course by sending an e-mail to statik@tu-bs.de

Guest students from other universities are welcome, until the course is fully booked. They are asked to sign up for the course by sending an e-mail to statik@tu-bs.de

Requirements and credits (ECTS)

Attending lectures and successful completion of home exercises will give 6 credit points.

Further information

The lectures will be given at the TU Braunschweig, Institut für Statik, located at Beethovenstraße 51, 38106 Braunschweig (Phone: 0531-391-3668; Email: statik@tu-bs.de).

The lecture room is on the 1st floor (left)