**Course Objectives**
By the end of this course the students will be able to
- understand the mathematical background of the Finite Element Method (FEM),
- write finite element codes to solve 1D and 2D structural mechanics and field problems.
- solve problems using a third-party Finite Element Analysis (FEA) software.

**Tentative Course Outline**
- **Ch 1. Introduction**: Variational formulations, Ritz method, method of weighted residuals, weak formulation of a differential equation, model problems
- **Ch 2. 1D FEM Formulation**: Shape functions, iso-parametric formulation, numerical integration, elemental system, assembly process, boundary conditions
- **Ch 3. Computer Implementation of 1D FEM**: MATLAB coding for 1D problems
- **Ch 4. Trusses, Beams and Frames**: Solution of structural mechanics problems using 1D elements
- **Ch 5. 2D FEM Formulation and 2D Field Problems**: Triangular and quadrilateral elements, Jacobian transformation, extension of 1D MATLAB code to 2D, solution of heat transfer and potential flow problems.
- **Ch 6. 2D Elasticity**: Solution of Plane stress and plane strain problems

**Instructor and Assistant**
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**Course Schedule**
- **Tuesday**: 12:40 - 13:30  
  G-202
- **Thursday**: 15:40 - 17:30  
  G-202

**Prerequisites**
Passing grades from ME 206, ME 305 and ME 311.

**Course Web Site**
http://www.me.metu.edu.tr/courses/me413/section2

**Reference Books**
There is no officially selected course textbook. There are many FEM related books at the METU library and the following list may help you to start with.
- *An Introduction to the Finite Element Method*, by Reddy (TA 347 F5 R4)
- *A First Course in the Finite Element Method*, by Logan (TA 347 F5 L64)
- *The Finite Element Method for Engineers*, by Huebner et al. (TA 347 F5 F83)
- *Introduction to the FEM : Theory, Programming and Applications*, by Thompson (TA 347 F5 T47)
- *A First Course in Finite Elements*, by Fish & Belytschko, (QC 20.7 F56 F57)
- *The Finite Element Method*, by Zienkiewicz & Taylor (TA 646 Z541)
- *Introduction to Finite Elements in Engineering*, by Chandrupatla & Belegundu (TA 347 F5 C463)
- *The Finite Element Method : Linear Static and Dynamic FEA*, by Hughes (TA 347 F5 H84)
- *The Finite Element Method : Basic Concepts and Applications*, by Pepper et al. (TA 347 F5 P46)

Most FEM books focus on structural mechanics, with some having small sections or chapters for other fields. It is not easy to find FEM books directly focusing on fluid mechanics and/or heat transfer. If these are your fields of interest, the following is a list of such books. But most of these are too advanced for our introductory course and they fit better to ME 582.
• The Finite Element Method in Heat Transfer Analysis, by Lewis et al. (TJ 260 F556)
• Applied CFD Techniques: An Introduction Based on FEM, by Löhner (TA 357 L592)
• Finite Element Methods for Flow Problems, by Donea & Huerta (TA 347 F5 D681)
• The Finite Element Method for Fluid Dynamics, by Zienkiewicz et al. (TA 640.2 Z5)
• Finite Element Technique for Fluid Flow, by Conor & Brebbia (TA 347 F5 C66)

Homework, Term Project, Exams
Study sets will be distributed regularly. Exams will include problems that are similar to the ones in the study sets. Selected study set problems will be collected and graded as homework.

In the second half of the semester a term project will be assigned. It may include several parts with multiple due dates.

There will be 2 midterm exams of closed books and notes type. There won’t be a final exam and no re-sit exam will be offered.

Grading
Homework, term project and midterm exams will contribute to your final grade. Their percentages will be determined at the end of the semester.

Attendance Policy
Students who do not attend more than 10 lectures without a valid excuse will get NA. You should report your excuse about a missed lecture at most in 1 week time, otherwise it will be ignored.

MATLAB and COMSOL
MATLAB will be used for coding and COMSOL will be used as the third-party FEA tool.

Communication
An email list with the address me413@metu.edu.tr will be used for communication purposes. All of us will be a member of the list. An email sent to the list will reach all of us. You are encouraged to discuss the problems in the study sets and the project assignment on this list.

You can visit me during the office hours or send me an email about anything related with the course or personal issues that affect your course performance. When you send me an email make sure that the email’s subject starts with "ME 413". If you have classes during the office hours we can talk to arrange some other time for your visits.

Academic Honesty
You are expected to read the code of ethics available at the Department’s web site and behave accordingly. Academic dishonesty of any form will be punished to all extents.