ME 538: Introduction to Finite Element Methods and Analysis

Fall 2020

Instructor and Class Information

Instructor: Dr. Harold Park, Professor of Mechanical Engineering
Office: 730 Commonwealth, ENA 212 (this building is directly above CVS).
Email: parkhs@bu.edu
Phone: (617) 353-4208
Office Hours: Thursdays from 11-12
Class Hours: MW 10:10-11:55
Classroom: Lectures will be held in FLR 123, Ansys labs will be held in EMB 125 (to get here, go in the 5 St. Mary's entrance and walk all the way down the long hallway)
Prerequisites: ME305, Linear Algebra, Ordinary Differential Equations
Course Website: Blackboard (`http://learn.bu.edu`)

TA Information

TBD

Course Summary

This class serves as an introduction to the linear finite element method, and its application to static and dynamic problems with an emphasis on solid mechanics. The first half of the course will use the stiffness approach to developing the finite element equations as applied to bars and beams. The second half of the course will focus on developing the finite element method as one that is applicable as a general numerical method for solving ordinary and partial differential equations that arise in solid mechanics. Lab sessions will focus on applying the commercial code Ansys to various problems in solid mechanics.

Textbook (Recommended)

A first course in the finite element method by Daryl L. Logan, sixth edition, Cengage 2017

Reference Books

- *Concepts and applications of finite element analysis* by R.D. Cook, D.S. Malkus, M.E. Plesha and R.J. Witt, fourth edition, Wiley 2002

Class Policies

- **COVID-related course attendance:** According to BU, the Learning from anywhere (LfA) capacity of FLR 123 is 19 students. Because the number of students who plan to attend class in-person is less

than this number, those students will be able to attend lectures in-person on both Mondays and Wednesdays. Arrangements for in-person attendance for the ANSYS labs will be announced later in the semester.

- Homework (i.e. labs, written homeworks, and matlab projects) not turned in by the end of class (i.e. 12 PM) on the due date will be considered to be late. **No credit for late homeworks, labs or programming assignments will be given.**
- There will be some written homework assignments. Homework problems should be well-organized while demonstrating a clear flow of thought and worked-out steps. Homework problems will be graded on a 10/7/0 scale. A score of 10 indicates that you worked through the entire problem and came to a correct or mostly correct solution. A score of 7 indicates that you made a solid attempt and a 0 will be given for a minimal attempt or lack thereof.
- There will be ANSYS and Matlab-based programming assignments throughout the semester. There will not be a midterm or a final exam.
- Making up of missed examinations will be permitted only when proof of medical or personal emergency is furnished.
- All complaints related to grading of homework assignments, quizzes, and examinations must be reported to the instructor immediately after the grades are announced.

COVID-19 and BU Community Health Expectations

Masks are required and face coverings must be worn over the mouth and nose at all times when in public spaces on campus, including classrooms. Students should be prepared to show proof that they are compliant with health attestations and testing in order to attend class. All students are expected to follow all university guidelines with respect to daily symptom checks, testing, social distancing, and mask wearing when they leave their dorm or home. For a detailed description of official BU policies regarding COVID, please visit: `http://www.bu.edu/dos/policies/lifebook/covid-19-policies-for-students/`

Academic Misconduct

BU takes academic integrity very seriously. Academic misconduct is conduct by which a student misrepresents his or her academic accomplishments, or impedes other students opportunities of being judged fairly for their academic work. Knowingly allowing others to represent your work as their own is as serious an offense as submitting anothers work as your own. More information on BU's Academic Conduct Code, with examples, may be found at `http://www.bu.edu/academics/policies/academic-conduct-code`

Accommodations for Students with Documented Disabilities

If you are a student with a disability or believe you might have a disability that requires accommodations, requests for accommodations must be made in a timely fashion to Disability & Access Services, 25 Buick St, Suite 300, Boston, MA 02215; 617-353-3658 (Voice/TTY). Students seeking academic accommodations must submit appropriate medical documentation and comply with the established policies and procedures `http://www.bu.edu/disability/accommodations/`

Absence for Religious Reasons

According to Chapter 151C of the General Laws, Commonwealth of Massachusetts, any student in an educational or vocational training institution, other than a religious or denominational educational or vocational training institution, who is unable, because of his or her religious beliefs, to attend classes or to participate in any examination, study, or work requirements on a particular day, shall be excused from any such examination or study or work requirement, and shall be provided with an opportunity to make up such examination, study, or work requirement that may have been missed because of such absence on any particular day. More details can be found here: `https://www.bu.edu/academics/policies/absence-for-religious-reasons/`

Approximate List of Topics to be Covered

Stiffness (displacement) method for bars and beams, matrix methods, governing differential equation for solids (strong form), weak form, discretization of weak form using the finite element approximation, shape functions, numerical quadrature, isoparametric elements, dynamic analysis, heat transfer, fluid mechanics, mass transfer, multi-dimensional finite elements.

Grading

- Written homeworks: 10%
- Matlab homeworks: 35%
- Ansys Labs: 35%
- Final Matlab homework: 20%