MEC 539 Introduction to Finite Element Method

Fall 2024

Instructor: **Prof. Lifeng Wang**
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Lecture: Thur 6:30PM - 9:20PM at FREY HALL 217
Office Hours: Wed/Thur 10:00AM - 11:30AM
Credits: 3

Course Learning Objectives: This course will introduce the mathematical and physical formulation of finite element methods (FEM). An introduction to the theory of finite element methods and their application to structural analysis problems. Matrix operations, force and displacement methods. Derivation of matrices for bars, beams, shear panels, membranes, plates, and solids. Use of these elements to model actual structural problems. Weighted residual techniques and extension of the finite element method into other areas such as heat flow and fluid flow. A computer project consisting of the solution and evaluation of a structural problem is required. Physical problems will be taken from a variety of fields.

Pre-requisite knowledge:
Mechanics of Materials, Materials Science and Engineering, Strength of Materials.

Textbook: A first course in finite element method (6th Edition). Daryl L. Logan. ISBN 978-1305635111.

Suggested References:

- The finite element methods: Linear static and dynamic finite element analysis. T.J.R. Hughes. Dover Publications, 1987.
- Finite element procedures. K.J. Bathe. Prentice Hall, 1996.
- An Introduction to the Finite Element Method, J. N. Reddy, McGraw-Hill, 2005.
- A first course in finite elements, Jacob Fish and Ted Belytschko, Wiley, 2007.

Grading: Your grade in this course will be assessed by homework, class participation, in-class-exercises, and exams.
Homework: 20%

In-class Exercises: 20%
Exam 1: 20%
Exam 2: 20%
Final Project: 20%

Tentative Course Outline:

Week	Content	Reading
1	Introduction, Review of mathematics	Lecture notes
2	Introduction to the Stiffness (Displacement) Method, Principle of Minimum Potential Energy	Lecture notes, Ch. 2
3	Development of Truss Equations	Lecture notes, Ch. 3
4	Development of Truss Equations, Potential Energy Approach, Energy equivalent nodal forces	Lecture notes, Ch. 3
5	Development of Beam Equations, Symmetry, Boundary Conditions	Lecture notes, Ch. 4
6	Development of Beam Equations, Work-Equivalence Method	Lecture notes, Ch. 4
7	Development of Frame and Grid Equations	Lecture notes, Ch. 5
8	Exam 1 (in class)	
9	Development of the Plane Stress and Plane Strain Stiffness Equations	Lecture notes, Ch. 6, 8
10	Isoparametric Formulation, MATLAB Coding for Structural Analysis	Lecture notes, Ch. 10
11	Numerical Quadrature, Three-Dimensional Stress Analysis	Lecture notes, Ch. 10, 11
12	Heat Transfer, Thermal Stress, MATLAB Coding for Solid Materials	Lecture notes, Ch. 13
13	Exam 2 (in class)	
14	No lecture, Thanksgiving	
15	MATLAB Coding	Lecture notes, Handouts
16	Project Report	

Homework:

1. Homework will be assigned weekly and due every Thursday.
2. Late homework will not be accepted.
3. All homework assignments are individual, unless otherwise specified.
4. Homework problems should be neat, professional, and well organized.

Exams:

All exams are open book and closed notes. If you miss an exam due to unforeseen events, you will have to contact Office of Dean of Students to send me an official notification before I will give you a makeup exam. There will be no make-up exams for reasons that are within your control. Thus, this rules out reasons such as pre-arranged vacation, travel, conflict with other exams, or other engagements.
Make-up exam policy is consistent with university policy on:
1. Student Participation in University Sponsored Events
http://sb.cc.stonybrook.edu/bulletin/current/policiesandregulations/policies_expectations/participation_univsponsered_activities.php
2. University policy on Final Exams:
http://sb.cc.stonybrook.edu/bulletin/current/policiesandregulations/records_registration/final_examinations.php
3. New York State Education Law regarding Equivalent Opportunity and Religious Absences
http://sb.cc.stonybrook.edu/bulletin/current/policiesandregulations/policies_expectations/equivopportunity_religiousabsences.php

Student Accessibility Support Center Statement
If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential.
Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center. For procedures and information go to the following website: https://ehs.stonybrook.edu//programs/fire-safety/emergency-evacuation/evacuation-guide-disabilities and search Fire Safety and Evacuation and Disabilities.

Academic Integrity Statement
Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Professions, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at
http://www.stonybrook.edu/commcms/academic_integrity/index.html

Critical Incident Management
Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

Course Materials and Copyright Statement:

Course material accessed from Brightspace, SB Connect, SB Capture or a Stony Brook Course website is for the exclusive use of students who are currently enrolled in the course. Content from these systems cannot be reused or distributed without written permission of the instructor and/or the copyright holder. Duplication of materials protected by copyright, without permission of the copyright holder is a violation of the Federal copyright law, as well as a violation of Stony Brook's Academic Integrity and Student Conduct Codes.

Getting Technical Help:

DoIT provides technical assistance to all students. If you require assistance with hardware or using any supported applications, available support options include:

- Visit one of DoIT's Tech Stations
- Access self-help materials
- Submit a ticket online at service.stonybrook.edu
- Chat live with a student consultant
- Call 631-632-9800 for assistance (2-9800 from on campus)

If you need assistance with Brightspace, you can access resources from the Brightspace Resources link on Stony Brook Brightspace homepage (https://brightspace.stonybrook.edu) or contact the SUNY helpdesk via phone/ticket/live chat at: https://online.suny.edu/help/

Need a laptop? You can borrow a laptop from the Melville LIbrary SINC Site. Details can be found at: https://it.stonybrook.edu/services/student-laptop-loaner-program

We are using Brightspace, a digital learning environment, for this course. To learn more and for SUNY Online helpdesk information, visit: https://brightspace.stonybrook.edu If you would like, you can add a link to Brightspace in your Blackboard "My Courses" list to easily move between the LMS's during this transition. Information can be found: https://it.stonybrook.edu/help/kb/adding-brightspace-course-to-bb-course-list

Subject to Change Notice:

All material, assignments, and deadlines are subject to change with prior notice. It is your

responsibility to stay in touch with your instructor, review the course site regularly, or communicate with other students, to adjust as needed if assignments or due dates change.

Syllabus Disclaimer:

The instructor views the course syllabus as an educational understanding between the instructor and students. Every effort will be made to avoid changing the course schedule but the possibility exists that unforeseen events will make syllabus changes necessary. The instructor reserves the right to make changes to the syllabus as deemed necessary. Students will be notified in a timely manner of any syllabus changes via email or in the course site Announcements. Please remember to check your SBU email and the course site Announcements often.