

# MEC 539 Introduction to Finite Element Method

Fall 2021

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**Lecture:** Thur 3:00PM - 5:44PM at HUMANITIES 3018  
**Office Hours:** Wed/Thur 10:00AM - 11:30AM Online  
Zoom session: <https://stonybrook.zoom.us/j/3170781664>

**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: 15%

Exam 1: 25%

Exam 2: 25%

Lab/project report: 15%

Your final grade will depend on the overall performance of your classmates.

**Tentative Course Outline:**

<b>Week</b>	<b>Content</b>	<b>Reading</b>
<b>1</b>	Introduction, Review of mathematics	Lecture notes
<b>2</b>	Introduction to the Stiffness (Displacement) Method, Principle of Minimum Potential Energy	Lecture notes, Ch. 2
<b>3</b>	Development of Truss Equations	Lecture notes, Ch. 3
<b>4</b>	Development of Truss Equations, Potential Energy Approach, Energy equivalent nodal forces	Lecture notes, Ch. 3
<b>5</b>	Development of Beam Equations, Symmetry, Boundary Conditions	Lecture notes, Ch. 4
<b>6</b>	Development of Beam Equations, Work-Equivalence Method	Lecture notes, Ch. 4
<b>7</b>	Development of Frame and Grid Equations	Lecture notes, Ch. 5
<b>8</b>	Exam 1 (in class)	
<b>9</b>	Development of the Plane Stress and Plane Strain Stiffness Equations	Lecture notes, Ch. 6, 8
<b>10</b>	Isoparametric Formulation, MATLAB Coding for Structural Analysis	Lecture notes, Ch. 10
<b>11</b>	Numerical Quadrature, Three-Dimensional Stress Analysis	Lecture notes, Ch. 10, 11
<b>12</b>	Heat Transfer, MATLAB Coding for Solid Materials	Lecture notes, Ch. 13
<b>13</b>	Exam 2 (in class)	
<b>14</b>	No lecture, Thanksgiving	
<b>15</b>	MATLAB Coding	Lecture notes, Handouts
<b>16</b>	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\\_univ-sponsored\\_activities.php](http://sb.cc.stonybrook.edu/bulletin/current/policiesandregulations/policies_expectations/participation_univ-sponsored_activities.php)
2. University policy on Final Exams:  
[http://sb.cc.stonybrook.edu/bulletin/current/policiesandregulations/records\\_registration/final\\_examinations.php](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/equivalent\\_opportunity\\_religiousabsences.php](http://sb.cc.stonybrook.edu/bulletin/current/policiesandregulations/policies_expectations/equivalent_opportunity_religiousabsences.php)

**Academic Policies:**

**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 are required to report any suspected instances of academic dishonesty to the Academic Judiciary. For more comprehensive information on academic integrity, including categories of academic dishonesty, please refer to the academic judiciary website at  
<http://www.stonybrook.edu/uaa/academicjudiciary/>

**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 Judicial Affairs any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn.

**University Student Conduct Code** can be found at (check for most current version)  
<http://studentaffairs.stonybrook.edu/ucs/docs/universitystudentconductcode.pdf>

**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, ECC (Educational Communications Center) Building, Room 128, (631)632-6748.

They will determine with you what accommodations, if any, are necessary and appropriate. All information and documentation is confidential.

<https://www.stonybrook.edu/commcms/studentaffairs/sasc/facstaff/syllabus.php>

Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and Student Accessibility Support Center. For procedures and information go to the following website: <https://ehs.stonybrook.edu/programs/fire-safety/emergency-evacuation/evacuation-guide-people-physical-disabilities>

- To access mental health services, call Counseling and Psychological Services at 631-632-6720; Counselors are available to speak with 24/7.
- For updated information on the Academic Success and Tutoring Center please check [www.stonybrook.edu/tutoring](http://www.stonybrook.edu/tutoring) for the most up-to-date information.
- For IT Support: Students can visit the Keep Learning website at <https://sites.google.com/stonybrook.edu/keeplearning> for information on the tools you need for alternative and online learning. Need help? Report technical issues at <https://it.stonybrook.edu/services/itsm> or call 631-632-2358.
- For information on Library services and resources please visit the [Continuity of Library Operations](#) guide.

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### **Getting Technical Help:**

#### **Getting Help with Bb Learning Management System (LMS)**

Students that need help with Bb can contact the TLT Student Help Desk by calling (631) 632-9602, emailing [helpme@stonybrook.edu](mailto:helpme@stonybrook.edu); more information is available via Stony Brook IT: <http://it.stonybrook.edu/services/blackboard#section-6706>

Frequently asked questions about the Bb LMS along with tutorials are available here: <http://it.stonybrook.edu/services/blackboard/navigate-manage>

### **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.