THE PENNSYLVANIA STATE UNIVERSITY
MONT ALTO CAMPUS
Spring 2024

EMCH 213 – Strength of Materials

Course Title: EMCH 213 "Strength of Materials"
Section: 001
Credits: 3
Class Meeting: MWF 11:15 – 12:05 PM, Room 313 Sci-Tech Building
Text and Material: No required text, recommended text "Mechanics of Materials" 8th - 10th Edition by R.C. Hibbeler

Instructor: Dr. Jacob Moore, Associate Professor of Engineering
E-mail: jmoore@psu.edu
Phone: (717) 749-6209
Office Location: 7 Bookstore Building
Office Hours: Mondays 9 AM - 10 AM, Tuesdays 10 AM – 12PM, and Wednesdays 9 AM - 10 AM or by appointment.

Course Goals:
Strength of Materials provides students with the tools and guidance to allow them to master the use of deformation and stress equations to solve real engineering problems. Students should leave this class with the ability to analyze and calculate the stresses at any point in a structural component, determine the deformation of long thin members subjected to stretch, pressure, twist, and bending, consider the possibility of buckling for a compressive member and utilize these to consider if a given loading is "safe" for a particular material.

Course Learning Objectives:
Upon successfully completing this course students will be able to…

- Determine normal stress and axial deformation in statically determinate and indeterminate axially loaded members.
- Determine shear stress and angular deformation in statically determinate and indeterminate circular shafts supporting torsional loads.
- Calculate internal shear force and bending moments in transversely loaded beams and develop shear and moment diagrams.
- Determine normal stress and shear stress in transversely loaded beams.
- Determine beam deflections using integration for statically determinate and indeterminate transversely loaded beams.

- Identify a 2-D state of stress and apply both transformation equations and Mohr's circle to determine principal stress, maximum in-plane shear stress, and stress on an inclined plane.
- Identify if buckling may be an issue and calculate Euler buckling load for a slender column for a variety of boundary conditions.
- Calculate and/or apply a factor of safety to any of the stress calculations.
- Sketch and explain both true and engineering stress/strain curves.
- Identify ALL features (such as elastic modulus, yield stress, ultimate stress, linear elastic region, and plastic region) on a stress/strain curve as well as distinguish between ferrous and non-ferrous curves.
- Distinguish between ductile and brittle materials' behavior and response to loads.
- Apply generalized Hooke's Law to determine stress and/or strain
- Explain physical meaning and application of Poisson ratio.
- Identify the resultant internal loads on an identified section and calculate the total stress state at a point for an object experiencing a combination of internal loads.

Course Policies:

Attendance:

- Students are expected to attend all classes except in cases of illness or other extenuating circumstances.
- Students experiencing any symptoms of COVID 19, or those who were exposed to someone testing positive or presumed positive should not attend class and should alert the instructor. If possible, these students will be encouraged to continue to participate remotely.
- Class will begin promptly at the designated time, and you are expected to be ready to go at that point.
- Each <u>unexcused</u> absence will result in losing one point from your attendance grade, up to a maximum of 5 points.
- Students should contact the instructor before class for any pre-scheduled absences. In the case of an illness or another unexpected reason for absence, the student should contact the instructor as soon as possible.
- It is the responsibility of the student to determine what activities and assignments were missed in the case of any missed classes or significant tardiness. This can be done by contacting the instructor. Not all assignments may be made up in the case of non-university sanctioned excuses for absence.

Assignments:

- All assignments will be graded according to the mastery grading system. For details on this system, see the section on “Mastery Assignment Grading”.
- All assignments and dues dates will be documented on Canvas (https://psu.instructure.com).
- Homework is to be formatted according homework formatting guidelines. Submissions that do not follow the formatting guidelines may lose points or may be handed back for the student to redo.

- All assignments are due at the beginning of class on the listed due date. Assignments should be dropped off with the instructor in class. Late assignments will not be accepted without prior consent of the instructor.
- Students are encouraged to work in groups; however, students are expected to complete and submit their own original work.

Tests:

- Tests will be conducted during the class periods indicated on the schedule unless otherwise noted in class. Because of this the tests will be limited to the regular 50-minute time period. Time starts at the beginning of class regardless of when the student shows up.
- Tests will be open note and you will have access to the electronic textbook; however, students are highly encouraged to make crib sheets of common formulas so that information can be found quickly. You will not have time to do a lot of learning or searching during the test.
- The tests will consist of two main sections:
    - The basics section will cover the fundamentals of the topics covered in class and consist of a combination of multiple choice and open response style questions. Students will be expected to answer all the questions in this section.
    - The challenge section will cover more complex topics and may string various topics together. This section will consist entirely of open response style questions and students will be expected to choose and solve a subset of the questions.

General Conduct:

- Students are expected to act professionally during all class related activities and meetings. Inappropriate behavior or language during any class activities will not be tolerated.

Mastery Assignment Grading:

The purpose of having assignments in this class is to help students learn the material and mastery the skills covered in the course. Students are expected to show mastery of the material through complete and correct solutions to the homework assignments, though it is understood that this may not happen the first time students attempt to solve a problem. To match this expectation, the following process will be used to grade all homework assignments unless otherwise noted.

1. Students will be given a weekly assignment with a number of homework problems on the material covered in class. Students must complete all problems to the best of their abilities, completely document all of their work, and turn in their work by the assigned due date.
2. Within one week, the instructor will grade and return the assignment. Each problem will have one of three marks on it, indicating whether or not the instructor feels the problem was mastered.
    - **M (Mastered):** Indicating that the student completely and correctly answered the problem.

- **NM (Not Mastered):** Indicating that the student did not completely and correctly answer the problem. This will be accompanied by comments from the instructor indicating any mistakes or missing information that the instructor has identified.
- **X (Not Attempted):** Indicating that the instructor felt that the student did not make a reasonable attempt at answering the problem.

3. All problems that were marked NM (Not Mastered) can be redone and resubmitted within one week of being returned. Problems may not be resubmitted more than one week after being returned (due dates will be printed on the assignments). All problems resubmitted will be regraded and just as the original assignment was. The new marks for each problem will replace the previous marks the student received. Resubmissions should be written on a separate sheet and must be stapled to the front of the original assignment and any previous resubmissions. The whole problem must be written out again unless the instructor has marked a "continue from here" point in the previous submission.
4. Problems can be resubmitted as many times as needed so long as the problem is marked NM.
5. The last day of classes will be the last day to resubmit any assignment. After this date, no more resubmissions will be accepted.
6. Each student's course homework grade will be the average of all homework grades at the end of the semester.

Services for Students with Disabilities

In order to receive consideration for reasonable accommodations, you must contact the Disability Coordinator, Kendra Wolgast, located on the first floor of the General Studies Building in the Student Success Center. Appointments can be made at https://psu.mywconline.com/. She can also be reached at 749-6045 or kmw24@psu.edu. Students must complete an introductory meeting and provide documentation: http://equity.psu.edu/sdr/guidelines. If the documentation supports your request for reasonable accommodations, the disability services office will provide you with an accommodation letter. Please share this letter with your instructors and discuss the accommodations with them as early in your courses as possible. You must follow this process for every semester that you request accommodations.

Counseling and Psychological Services:

Many students at Penn State face personal challenges or have psychological needs that may interfere with their academic progress, social development, or emotional wellbeing. The university offers a variety of confidential services to help you through difficult times, including individual and group counseling, and crisis intervention. Mantra Health Telepsychiatry services offer evaluations and limited medication prescriptions. Penn State students receive limited sessions free of charge. These services are provided by staff who welcome all students and embrace a philosophy respectful of clients' cultural and religious backgrounds, and sensitive to differences in race, ability, gender identity and sexual orientation.

To schedule an appointment contact:
Counseling Services

Darlene Pasi, M.S., LPC
104 Conklin Hall
Drp16@psu.edu
Phone: 717-749-6125

Penn State Crisis Line (24 hours/7 days/week): 877-229-6400
Crisis Text Line (24 hours/7 days/week): Text LIONS to 741741

Academic Support Center:
The Academic Support Center provides academic and skill building support for all students. If you are having difficulty in any of your classes, or with academic skills, contact the Academic Support Center.
E-mail: kmw24@psu.edu
Call: (717) 749-6046
Schedule a Tutoring Appointment: http://www.psu.mywconline.com
Stop by: 1st floor of the General Studies Building

Academic Integrity:
Academic integrity is the pursuit of scholarly activity in an open, honest and responsible manner. Academic integrity is a basic guiding principle for all academic activity at The Pennsylvania State University, and all members of the University community are expected to act in accordance with this principle. Consistent with this expectation, the University's Code of Conduct states that all students should act with personal integrity, respect other students' dignity, rights and property, and help create and maintain an environment in which all can succeed through the fruits of their efforts.

Academic integrity includes a commitment by all members of the University community not to engage in or tolerate acts of falsification, misrepresentation or deception. Such acts of dishonesty violate the fundamental ethical principles of the University community and compromise the worth of work completed by others.

Students charged with a breach of academic integrity will receive due process and, if the charge is found valid, academic sanctions may range, depending on the severity of the offense, from F for the assignment to F for the course. The University's statement on academic integrity, from which the above statement is drawn, is available at https://undergrad.psu.edu/aappm/G-9-academic-integrity.html

Reporting Educational Equity Concerns:
Consistent with University Policy AD29, students who believe they have experienced or observed a hate crime, an act of intolerance, discrimination, or harassment that occurs at Penn State are urged to report these incidents as outlined on the University's Report Bias webpage (http://equity.psu.edu/reportbias/)

Grading Policy:

Your grade will depend on your homework assignments as well as the four course exams (The three section exams and the final). Grades will be distributed as follows:

- Attendance 5%
- Labs 10% (2 labs)
- Homework Assignments 15%
- Midterm Exams 45% (3 tests, 15% each)
- Final Exam 25%

Final letter grade will be assigned as follows:

93 - 100	A
90 – 92.99	A-
87 – 89.99	B+
83 – 86.99	B
80 – 82.99	B-
77 – 79.99	C+
70 – 74.99	C
60 – 69.99	D
below 60	F

Tentative Schedule:

Week of	Topic	Book Section (Hibbeler 10th)	Assignments Due
1/8	M- Preliminaries and course introduction W- Average Normal Stresses F – Average Shear Stresses	1.1 – 1.2 1.3 – 1.4 1.5	
1/15	M – No Class, MLK Day W – Safety Factors and Component Design F – Snow Day	1.6 – 1.7	
1/22	M – Normal and Shear Strain W – The Tensile Test and Stress Strain Relationships F – Toughness and Strain Hardening	2.1 – 2.2 3.1 – 3.3 3.4	M - HW1
1/29	M – Tensile Testing Lab W – Tensile Testing Lab F – **Exam 1**		M - HW2
2/5	M – Deformation of Axial Loaded Members W – Solving Statically Indeterminate Problems F – Pressure Vessels	4.1 – 4.2 4.4 – 4.5 8.1	W – Tensile Testing Lab
2/12	M – Thermal Stresses and Strains W - Stress Concentrations F – Shear and Moment Diagrams	4.6 4.7 6.1 – 6.3	M – HW3
2/19	M – Bending W – Area Moments of Inertia F – Transverse Shear	6.3 – 6.4 7.1 - 7.4	M – HW4
2/26	M – Review for Exam W – **Exam 2** F – Torsional Stress and Angle of Twist	 5.1 – 5.4	M – HW 5
3/4	Spring Break – No Classes		
3/11	M – Torsion and Angular Displacement Diagrams W – Other Torsion Topics F – Combined Loading	5.4 5.5, 5.8 8.2	 F – HW6
3/18	M – Combined Loading cont. W – Plane Stress Transformations F – Principal Stress Calculations	8.2 9.1 – 9.2 9.3	 W – HW7
3/25	M – Mohr's Circle W – Strain Transformations F – Principal Strains and Mohr's Circle for Strain	9.4 10.1 – 10.2 10.3 – 10.4	 W – HW8
4/1	M – Strain Gauges and Rosettes W – Generalized Hooke's Law F – Review for Exam	10.5 10.6	 F – HW9
4/8	M – **Exam 3** W – Beam Deflection via Integration F – Beam Deflection via Superposition	 12.1-12.2 12.5	
4/15	M – Statically Indeterminate Beams W – Diving Board Design Lab F – Diving Board Design Lab	12.6, 12.7, 12.9	 W – HW10
4/22	M – Impact Loading W – Buckling F - Course wrap up	14.1 – 14.4 13.1 – 13.3	M – Diving Board Lab F –HW11 (no regrade)
4/29 – 5/2	**Finals Week – Final Exam**		