University of South Carolina
College of Engineering and Computing
Department of Mechanical Engineering

EMCH 260 Solid Mechanics

1 Course Information

Course Description

Study of forces and deformation in solids; Basic concepts of stress and strain; Elastic relations between stress and strain; Stress and strain transformations; Applications to mechanical components under axial, torsional, bending and pressure loads.
Pre-requisites: EMCH 200 Statics or ENCP 200 or BMEN 212 with a minimum grade of C; MATH 241 Vector Calculus with a minimum grade of C;
Co-requisites or Pre-requisites: None.
Required for BSE in Mechanical Engineering
Contact hours - 3

2 Instructor Information

Ming Hu
Email: hu@sc.edu
Phone: 803-576-7206
Office Location: Horizon I Building Room 337, 541 Main St.
Office Hours: Monday and Wednesday, 1:00pm - 2:00pm
Other: Emails/Posts will be replied to within 48 hours.

3 Teaching Assistant/Grader

Mohammed Al-Fahdi
E-Mail: MALFAHDI@email.sc.edu

4 Textbook

Mechanics of Materials, 10th Ed. R. C. Hibbeler, Pearson Publisher, ISBN: 978-0-13-431965-0

5 Meeting Time/Location

Meeting Time
M/W/F | 10:50am - 11:40am

Meeting Location
Online Section COLUMBIA

6 Course Topics

1. Concepts of stress and strain
2. Material behavior, stress-strain relations, Hooke’s Law
3. Tension/compression of bars
4. Torsion of shafts
5. Bending of beams

6. Thin-walled pressure vessels
7. Combined loading
8. Stress and strain transformations, Mohr's circle, principal stresses and strains
9. Failure criteria; design of mechanical components
10. Buckling of columns

7 Course Outcomes

1. Students will illustrate the basic concepts of stress and strain at a point.
2. Students will implement the elastic relationship between stress and strain at a point.
3. Students will perform stress and strain transformations.
4. Students will calculate the stress and deformation of structures subjected to axial, torsional, bending and pressure loads according to basic theories.
5. Students will determine the required properties of mechanical components to meet design requirements.

8 Lecture Schedule

	JAN			FEB				MAR					APR			
M	11	~~18~~	25	1	8	~~15~~	22	1	8[8]	15	22	29	5	12	19	26
T	12	19	26	2	9	16	23	2	9	16	23	~~30~~	6	13	20	27
W	13	20	27	3[3]	10	17	24	3	10	17	24	31	7	14	~~21~~	28
Th	14	21	28	4	11	18	~~25~~	4	11	18	25	1	8	15	22	29
F	15	22	29	5	12	19	26	5	~~12~~	19	26	2	9	16	23	30
S	16	23	30	6	13	20	27	6	13	20	27	3	10	17	24	1
Su	17	24	31	7	14	21	28	7	14	21	28	4	11	18	25	2

Blue: Assignments due (3 times); Red: Mid-term exam (3 times); Purple: Quizzes (3 times)

Pink Date: Final Exam: 9:00 – 11:30, Wednesday, April 28th 2021

Classes | Total classes including lectures, review, Q&A, mid-term exams: **42**

Chapter 1 Stress (01/11 - 01/20)
1.1 General information about the course
1.2 Equilibrium of a deformable body and section method
1.3 Definition of stress at a point in material
1.4 Average normal and shear stress, allowable stress design
Chapter 2 Strain (01/22)
2.1 Deformation and strain
Chapter 3 Mechanical Properties of Materials (01/25 - 02/01)
3.1 Stress-strain diagram, ductile and brittle materials
3.2 Poisson's ratio
3.3 Shear stress-strain diagram, examples of stress-strain diagram analysis
3.4 More examples of stress-strain diagram analysis
Review Q&A & Quiz 1 (Assignment 1 due) (02/03)
Mid-term Exam 1 (02/05)
Chapter 4 Axial Load (02/08 - 02/12)

4.1 Saint-Venant’s principle, elastic deformation of an axially loaded member, statically indeterminate axially loaded members
4.2 More examples of statically indeterminate axially loaded members
4.3 Principle of superposition, force method of analysis for axially loaded member
Chapter 5 Torsion (02/17 - 02/24)
5.1 Torsion deformation of a circular shaft
5.2 Torsion formula and angle of twist
5.3 Statically indeterminate torque-loaded members
5.4 Shear strain and stress state produced by torsion
Review Q&A 2 (02/26)
Chapter 6 Bending (03/01 - 03/05)
6.1 Shear and bending moment diagrams
6.2 Graphical method for constructing shear and moment diagrams
6.3 Flexure formula
Review Q&A 3 & Quiz 2 (Assignment 2 due) (03/08)
Mid-term Exam 2 (03/10)
Chapter 8 Combined Loadings (03/15 - 03/19)
8.1 State and stress caused by combined loadings
8.2 Thin-walled pressure vessels
8.3 More example of combined loadings
Chapter 9 Stress Transformation (03/22 - 03/29)
9.1 General equations of plain-stress transformation, principal stresses, and maximum in-plane shear stress
9.2 Mohr’s circle
9.3 Absolute maximum shear stress
9.4 More examples of plane stress
Review Q&A 4 (03/31)
Chapter 10 Strain Transformation (04/02- 04/09)
10.1 General equations of plain-strain transformation and Mohr’s circle
10.2 Examples of plane strain
10.3 Generalized Hooke’s law and material property relationships
10.4 Examples of plane stress and plane strain for combined loadings
Review Q&A 5 & Quiz 3 (Assignment 3 due) (04/12)
Mid-term Exam 3 (04/14)
Chapter 13 Buckling of Columns (04/16)
13.1 Deflection of beams and shafts, critical load of columns
Preparing for final exam (04/19 - 04/26)
Review of the course Q&A Part I
Review of the course Q&A Part II

Review of the course Q&A Part III
Final Examination (04/28)

9	Grading Policy

Assignments: **15%**
Quizzes: **9%**
Mid-term Exams: **36%**
Final Exam: **40%**

All mid-term exams and final exam have extra bonus points (10% for mid-term exams and 20% for final exam). But the maximum points you will get for each mid-term and final exam is capped to 100.

- **Additional net points toward final grade (max. 15%):**
  Extra exercises: in addition to assignments, we will give 4 extra exercises throughout the semester. The extra exercises are optional. However, for **each** submission of the first 3 extra exercises, you'll earn **maximum 3** points toward your final grade (in 100-point scale). For the last (big) extra exercise, you'll earn **maximum 6** points toward your final grade (in 100-point scale). For example, if you get 80 for one of the first 3 extra exercises submission, you'll earn 80/100x3=2.4 point toward your final grade (net value!). If you get 80 for the last (big) extra exercise submission, you'll earn 80/100x6=4.8 point toward your final grade (net value!). The maximum total points you can earn through all extra exercises are capped to **15 points**. No group work is allowed for both assignments and extra exercises.

Estimated schedule for 4 extra exercises:

#1. Ch.1-3 (max. 3 net points)
#2. Ch.4-6 (max. 3 net points)
#3. Ch.8-10 (max. 3 net points)
#4. All chapters (max. 6 net points)

Universities Standard Grade Rule Applies
Guidance for letter grade assignment of the final grades (100-point scale):
≥90 A
≥85 B+
≥80 B
≥75 C+
≥70 C
≥65 D+
≥60 D
<60 F

10	Attendance Policy

Attendance is expected at all class sessions. In accordance with USC's Attendance Policy, if you miss 15% of the scheduled class you will be asked to drop the course.

11	Miscellaneous Policies

Software Requirements
This course will not require any special software.

Technology
Course delivery will be conducted through Blackboard Ultra/Microsoft Teams.

Fair Policy
All readings/materials comply with copyright/fair use policies.

Online Learning Outcomes
All Learning Outcomes are equivalent of those of a face-to-face (F2F) version of the course.

Interactions
S2I: Blackboard announcements will be used with a combination of emails/teams forfurther interaction.

S2S: This is not required.

S2C: All course material is posted on Blackboard.

Technical Support
Students facing issues with Blackboard or Microsoft Teams cansubmit requests on https://scprod.service-now.com/sp or call 803-777-1800. Also,departmental support is available on helpme@cec.sc.edu.

Accommodating Disability
Reasonable accommodations are available for students with a documented disability. If you have a disability and may need accommodations to fully participate in this class, contact the Student Disability Resource Center: 777-6142 email sasds@mailbox.sc.edu, or stop by 1705 College Street, Close-Hipp, Suite 102, Columbia, SC 29208.

All accommodations must be approved through the Student Disability Resource Center.

Diversity
In order to learn, we must be open to the views of people different than ourselves. In this time we share together over the semester, please honor the uniqueness of your fellow classmates and appreciate the opportunity we have to learn from one another. Please respect each others' opinions and refrain from personal attacks or demeaning comments of any kind. Finally, remember to keep confidential all issues of a personal or professional nature that are discussed in class.

Academic Integrity
University policies and procedures regarding academic integrity are defined in policy STAF 6.25, Academic Responsibility - The Honor Code (see http://www.sc.edu/policies/ppm/staf625.pdf). Prohibited behaviors include plagiarism,

cheating, falsification, and complicity. All potential Honor Code violations will be reported to the Office of Academic Integrity, which has the authority to implement non-academic penalties as described in STAF 6.25. Academic penalties for Honor Code violations in this course range from a zero on the assignment to failure of the course.

12	Relationship of Course Outcomes to Student Outcomes

SO/CO Table	CO 1	CO 2	CO 3	CO 4	CO 5
SO 1 - Complex Problems	1	2	2	2	2
SO 2 - Design	0	0	1	0	1
SO 3 - Communication	0	0	0	0	0
SO 4 - Judgement	0	0	0	0	0
SO 5 - Teams	0	0	0	0	0
SO 6 - Experiments	0	0	0	0	0
SO 7 - Knowledge	2	1	1	2	1

SO 1 - Complex Problems
an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics

SO 2 - Design
an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors

SO 3 - Communication
an ability to communicate effectively with a range of audiences

SO 4 - Judgement
an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts

SO 5 - Teams
an ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives

SO 6 - Experiments
an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

SO 7 - Knowledge
an ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

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