Spring 2020

MECH 237-002: Strength of Materials

Eduardo Castro

JOHN A. REIF, JR. DEPARTMENT OF
CIVIL AND ENVIRONMENTAL ENGINEERING

NJIT New Jersey Institute of Technology

MECH 237 - Strength of Materials		Spring 2020
Texts:	1. Beer, Johnson, DeWolf and Mazurek, Mechanics of Materials, Eighth Edition, McGraw-Hill, ISBN 978-1-260-11327-3 2. Hsu, C.T. Thomas, Strength of Materials Laboratory Manual, (PDF to be posted on the Canvas site).	
Lecture	**MECH 237-002/004,** Monday, 11:30-2:20 pm, KUPF-211 **MECH 237-010/012,** Thursday, 10:00-12:50 pm, KUPF-205 **MECH 237-106/108,** Thursday, 6:00-8:50 pm, CULM-LECT 2	
Instructor:	**Prof. Eduardo Castro, P.E., 262-Colton Hall, 973-596-6188, ecastro@njit.edu** **Office Hours:** Mon 1/27 2/10 2/24 3/9 3/30 4/13 4/27 3:00 – 6:00 pm Wed 1/22 2/5 2/19 3/4 3/25 4/8 4/22 4:00 – 5:30 pm Thu 1/23 2/6 2/20 3/5 3/26 4/9 4/23 4:00 – 5:30 pm	
Lab: **Colton Hall Rm. 423**	MECH 237-**002**, Mon., 8:30-9:30 am. MECH 237-**004**, Mon., 10:00-11:00 am. MECH 237-**010**, Thu., 1:00-2:00 pm. MECH 237-**012**, Tue., 8:30-9:20 am. MECH 237-**106**, Thu., 4:00-4:50 pm. MECH 237-**108**, Thu., 9:00-9:50 pm. • **Lab Instructor: Hasan Tariq, PhD Candidate, ht99@njit.edu**	
Tutoring: **Colton Hall Rm. 423**	The Lab Instructors will have tutoring hours in **423-Colton** and will be available to all students in all of the Strength of Materials sections. Lab Instructors are available for help with course material and lab questions.	

Prerequisites: MECH 234 or MECH 235 with a grade of C or better and MATH 112, PHYS111/111A. A working knowledge of statics with emphasis on force equilibrium and free body diagrams. Provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, and an understanding of the mechanical behavior of materials under various load conditions. Lab should be taken concurrently.

Mech 237 provides an understanding of the kinds of stress and deformation and how to determine them in a wide range of simple, practical structural problems, as well as an understanding of the mechanical behavior of materials under various load conditions. Lab must be taken concurrently.

Students must earn a grade of C or better in this course to register for CE332, CE341 or CE431

Course Policies:

- Attendance is mandatory
- Be prepared to participate with board work and/or class problem solving. Bring your calculator for class participation.

Exams and Grading Policies:

- There will be three exams during the semester. Dates to be announced in class.
- There will be a Final Exam in week 15 during Finals Week.
- Exams must have Free-Body-Diagrams. ALL work must be shown for full credit.
- There will be NO make-up exams unless there is documentation provided to the Dean of Students Office to validate your absence.
- We do NOT curve the grades.
- You must receive a passing grade in both the lab and the lecture to pass the course. Failure of either requires repeating both lecture and lab. In other words, failing the lab or the lecture means failing the course.

Homework Policies:

- All homework will be collected and graded. Presentation will account for 33% of the grade
- Late homework will be accepted up to one week after the class when it is due. However there will be a 30-point penalty for late homework.
- All homework MUST include a Free-Body-Diagram. All work must be shown for full credit.
- For more information on the format for homework and the type of paper, read the information following the course outlines.

The NJIT Honor Code will be upheld and any violations will be brought to the immediate attention of the Dean of Students.

*"Academic Integrity is the cornerstone of higher education and is central to the ideals of this course and the university. Cheating is strictly prohibited and devalues the degree that you are working on. As a member of the NJIT community, it is your responsibility to protect your educational investment by knowing and following the academic code of integrity policy that is found at:

https://www.njit.edu/policies/sites/policies/files/academic-integrity-code.pdf

Please note that it is my professional obligation and responsibility to report any academic misconduct to the Dean of Students Office. Any student found in violation of the code by cheating, plagiarizing or using any online software inappropriately will result in disciplinary action. This may include a failing grade of F, and/or suspension or dismissal from the university. If you have any questions about the code of Academic Integrity, please contact the Dean of Students Office at dos@njit.edu"

NJIT classes begin on Tuesday, January 21 and end on Tuesday, May 5, 2020.

WEEK	DATE	CLASS	TOPICS	ARTICLES
1 Ch. 1	Mon 1/27 Thu 1/23	Face to Face	Concept of Stress and Strain with a Review of Statics	p. 1-26
2 Ch. 1 Ch. 2	Mon 2/3 Thu 1/30	Online	 Concept of Stresses, continued Stress and Strain - Axial Loading	 p. 27-47 p. 57-79
3 Ch. 2	Mon 2/10 Thu 2/6	Face to Face	Composites, Temperature Change, and Poisson's Ratio	p. 80-95 p. 96-116
4 Ch. 3	Mon 2/17 Thu 2/13	Online	Torsion Torsional Stresses in Shafts	p. 148-167
5	Mon 2/24 Thu 2/20	Face to Face	Exam #1	
6 Ch. 3	Mon 3/2 Thu 2/27	Online	Torsion Torsional Stresses in Shafts	p. 168-193
7 Ch. 4	Mon 3/9 Thu 3/5	Face to Face	Pure Bending	p. 237-258
8 Ch. 5	Mon 3/23 Thu 3/12	Online	Analysis and Design of Beams for Bending: Shear and Moment Diagrams	p. 347-361
9	Mon 3/30 Thu 3/26	Face to Face	Exam #2	
10 Ch. 5	Mon 4/6 Thu 4/2	Online	Analysis and Design of Beams for Bending: Shear and Moment Diagrams	p. 362-370 p. 373-381 p. 408-410
11 Ch. 7	Mon 4/13 Thu 4/9	Face to Face	Mohr's Circle for Plane Stress Plane Strain, Strain Rosettes	p. 477-502 p. 538-550
12 Ch. 10	Mon 4/20 Thu 4/16	Online	Column Buckling under Axial Load	p. 691-708
13 Ch. 6	Mon 4/27 Thu 4/23	Face to Face	Shearing Stresses: Beams and Thin- Walled Members	p. 417-426
14	Mon 5/4 Thu 4/30	Face to Face	Exam #3	
15			FINAL EXAM	.

Laboratory Schedule

Week	DATE	Lab Topic	Due
1		No Lab this week	
2		No Lab this week	READ about Reports in Lab Manual
3	Mon 2/10 Tue 2/4 Thu 2/6	Room **423-Colton Hall**: Introduction, Safety, Procedures for Lab, Instructions on how to prepare your Lab Reports, Grading Policies	
4		No Lab this week	
5	Mon 2/24 Tue 2/18 Thu 2/20	**Experiment 1**: 413-Colton Hall Tension Test of Metals, Automated Testing of Steel and other metal	Formal report due week 7
6		No Lab this week	
7	Mon 3/9	**Experiment 2**: 413-Colton Hall Torsion Test of Metallic Materials	Formal report due week 9
8	Tue 3/10 Thu 3/12	**Experiment 2**: 413-Colton Hall Torsion Test of Metallic Materials	Formal report due week 10
9	Mon 3/30 Tue 3/24 Thu 3/26	**Experiment 3**: 413-Colton Hall Stresses, Strains and Deflection of Steel Beams in Pure Bending	Formal report due week 11
10		No Lab this week	.
11	Mon 4/13 Tue 4/7 Thu 4/9	**Experiment 4**: 413 Colton Hall Strain Measurements Using Strain Rosettes in Aluminum Beams	Formal report due week 13
12		No Lab this week	.
13	Mon 4/27 Tue 4/21 Thu 4/23	**Experiment 5** : 413-Colton Hall Compression Test of Steel Columns, Column Buckling	Informal report due week 14
14		No Lab this week	.

The **Honor Code** will be upheld and any violations will be brought to the immediate attention of the Dean of Students.
Remember to cite your references when writing your lab reports. Each person will contribute to and be responsible for each lab report submitted.

Laboratory Safety

Your safety and the safety of those around you are of prime importance. Efforts have been made to reduce the hazard in the lab as much as possible. If you should see anything that you consider to be a safety hazard report this condition to your lab instructor. Take your experiments seriously. Forces into the thousands of pounds will be used throughout the course and if these forces are released in an uncontrolled manner injuries are possible. Horseplay will not be tolerated and will constitute grounds for dismissal from the course.

Grading Policies for LAB

Your lab grade will represent 10% of your course grade. The lab grade will be averaged into your lecture grade to determine your final grade. You must receive a passing grade in both the lab and the lecture to pass the course. Failure of either requires repeating both lecture and lab. In other words, failing the lab or the lecture means failing the course. **Three unexcused absences will result in automatic failure of the lab and course.**

All reports should be word processed. Graphs are to be computer generated.

The results of the experiment are the results you must work with. Do not "cook" the results to produce the "expected" results. Draw your conclusions based on these results. If they are not as expected (you should have an idea of the expected results), account for the discrepancies.

Reports are also graded on your presentation. Is the material presented in a logical way? Can all of the required results be found with ease? Are the results discussed intelligently, in a good technical language? Be advised that your discussion and conclusions will probably carry more weight than production of the right answers.

All labs are due at the meeting after they were conducted. Due dates are listed on the syllabus. After the due date reports will be accepted **maximum one week late** for 75% credit.

You should keep a copy of the work you turn-in.

EXAMS and FINAL (Attendance at exams is mandatory. Excused absences will require appropriate documentation.)

1. Exam problems may include theory as well as numerical problems.

2. All exams including final exam are closed book. All necessary formulas will be provided with the exam.
3. All problem solutions must be done on paper provided. The format of the solution must include assumptions and the solution and answer clearly shown.
4. The solution must illustrate the understanding of the material. Correct numerical solutions alone are insufficient for any credit.
5. All answers must be accompanied by the appropriate and correct units.
6. Exams and the final are to be taken with a fully charged calculator. Calculators may not be borrowed during exams.
7. The dates of the exams are shown on the schedule above. Dates may be changed at the instructor's discretion with a minimum of 2 weeks notice.
8. The grade of "I" (incomplete) will not be given for unsatisfactory academic performance.
9. No mid-term warning notice will be given. Maintain your own records of grades.
10. Students cannot leave the classroom during exams.
11. Cell phones (and other electronic devices) must be OFF and put away during exams.

HOMEWORK

1. Homework sets are due at the start of the following class.
2. Homework must be submitted in sets, arranged in order by problem number.
3. The homework must be written on quadrille 8½ x 11 engineering pad. Use 5-square per inch National Computation pad paper ONLY (sold at the NJIT Bookstore). The proper form consists of doing the problems on one side of 8-1/2 x11 pad paper. Also acceptable; engineering paper from office supply stores.
4. On the top of each page, in the space provided, PRINT your name, course and **section**, and problem number. Write on ONLY the front side of the paper.
5. All problems must show the figure and data provided with the problem
6. All problems must have a free body diagram.
7. Sets must be stapled together in the upper left hand corner.
8. LATE Homework will be accepted up to one week after it is due. However there will be a penalty of 30 points on the grade.

Students are expected to properly maintain their registration status. If your name does not appear on the final grade sheet, it is not possible to assign you a grade and it will be necessary for you to repeat the course.

GRADING	GRADE RANGE	GRADE
3-Exams …….55%	100 - 90	A
Final Exam ……. 25%	89 - 85	B+
Laboratory ……. 10%	84 - 80	B
Homework ……. 10%	79 - 75	C+
	74 - 67	C
	66 - 60	D*
	59 and below	F

Students must earn a grade of C or better in this course to register for CE332, CE341 or CE431.

Students will be consulted for any substantial changes to the course outline. Changes will be discussed and announced in advance.

Outcomes Course Matrix MECH 237 Strength of Materials

Strategies, Actions and Assignments	ABET Student Outcomes (1-7)	Program Educational Objectives	Assessment Measures
Student Learning Outcome 1: Identify and calculate the state of stresses and strains in engineering components as a result of different loading conditions.			
Introduce the concept of determining stresses and strains from the member forces.	1	1	Weekly homework and quizzes.
Provide the principles of normal and shearing stresses and how to determine the principal stresses.	1	1, 2	Weekly homework and quizzes.
Student Learning Outcome 2: Analyze structural members under axial loads, bending, shear, and torsion.			
Provide the basic concepts and effects of axial loads, bending, shear, and torsion on structural components.	1	1	Weekly homework, quizzes and lab experiments.
Introduce the methods used to solve determinate and indeterminate problems. Compare analytical work with results from MD Solids software program.	1	1, 6	Weekly homework, quizzes and review of assigned problems.
Student Learning Outcome 3: Identify the behavior of various engineering materials, their performance under loads, and design needs.			
Introduce a state of the art analysis with Instron testing apparatus.	1, 7	1, 2, 6	Homework and lab experiments.

CEE Mission, Program Educational Objectives and Student Outcomes

The mission of the Department of Civil and Environmental Engineering is:

- to educate a diverse student body to be employed in the engineering profession
- to encourage research and scholarship among our faculty and students
- to promote service to the engineering profession and society

Our program educational objectives are reflected in the achievements of our recent alumni:

1 – Engineering Practice: Alumni will successfully engage in the practice of civil engineering within industry, government, and private practice, working toward sustainable solutions in a wide array of technical specialties including construction, environmental, geotechnical, structural, transportation, and water resources.

2 – Professional Growth: Alumni will advance their skills through professional growth and development activities such as graduate study in engineering, research and development, professional registration and continuing education; some graduates will transition into other professional fields such as business and law through further education.

3 – Service: Alumni will perform service to society and the engineering profession through membership and participation in professional societies, government, educational institutions, civic organizations, charitable giving and other humanitarian endeavors.

Our Student Outcomes are what students are expected to know and be able to do by the time of their graduation:

1. an ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science and mathematics
2. 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
3. an ability to communicate effectively with a range of audiences
4. 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
5. 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
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data and use engineering judgment to draw conclusions
7. an ability to acquire and apply new knowledge as needed, using appropriate learning strategies

Revised: 2/13/18, 5/18/18