Spring 2021

MECH 237-104: Strength of Materials

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CIVIL AND ENVIRONMENTAL ENGINEERING
NJIT New Jersey Institute of Technology

MECH 237 - Strength of Materials

Spring 2021

Synchronous / Online / Hybrid

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).
3. NCEES, Fundamentals of Engineering Supplied-Reference Handbook, Eighth Edition, 2nd. revision (or you can reproduce pages from: http://www.ncees.org/exams/study_materials/fe_handbook/)

Lecture & Instructors:

MECH 237-006 and -008, Online, Tues., 11:00-1:50
MECH 237-102 and -104, Online, Tues., 6:00-8:50 p.m.

- **Prof. Milano, P.E., milano@njit.edu**

Lab:

MECH 237-**006**, **Wed., 7:30-8:30 a.m.** and **-008**, **Thur., 7:30-8:30 a.m.**
MECH 237-**102**, **Tue., 5:00-6:00 p.m.** and -**104**, **Tue., 4:00-5:00p.m.**

- **Celina Samir Semaan, PhD Candidate, css39@njit.edu**

Homework:

- **Di Zhang, PhD Candidate, dz72@njit.edu**

Tutoring: Available by email or WebEx. For a WebEx session, make your request at least 24 hours in advance. Contact any of us for extra help.

Prerequisite: *Mech235, Math 112, or equivalents, and 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.*

All students must have proper prerequisites for Mech 237, Strength of Materials; Mech 235 Statics and Math 112 Calculus II. Students without these prerequisites will be dropped from the course.

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: http://www5.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"*

Course Policies:

- Attendance is mandatory
- Remote learning will be synchronous with WebEx. The link is in Canvas.
- Hybrid means that some learning will be from pre-recorded lectures available in the Media Gallery in Canvas. These will supplement the online lecture.
- Please turn your cell phone OFF and put it away during the class time.
  Pay attention and participate with the problem solving
- Have your textbook available during class meeting or pages from the relevant chapter.
  Take notes. Ask questions.
- Be prepared to participate with class problem solving with your calculator. Practice.
- Excused absences will require appropriate documentation from the Dean of Students.

Quizzes, Exams and Grading Policies:

- Weekly quizzes at the end of each class period and will be administered using Respondus Lockdown Browser. These quizzes will comprise 50% of your grade.
- The Final Exam will be in week 15 during Finals Week. This will be 25% of your grade.
- Quizzes / exams must have Free-Body-Diagrams. ALL work must be shown for full credit. Your worksheets must be uploaded to Canvas. **No upload, no credit.**
- There will be NO make-up quizzes or exams unless there is documentation provided to the Dean of Students Office to validate your absence. Such circumstances may include sickness documented by a doctor or Health Service; a receipt from your mechanic for car failure; etc.
- We do NOT drop the lowest grade.
- 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, so, do all of your work, please.

Homework Policies:

- Follow the syllabus and do the homework problems suggested. Your instructor has the discretion to modify assignments and collection policy. NO credit for homework copied from another source.
- Homework will be uploaded to a Homework Module in Canvas.
- NO late homework will be accepted. NO credit for homework copied from another source.
- 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.

Homework Format

1. Homework sets are due each week as shown in syllabus schedule.
2. The homework should be done on quadrille 8½ x 11 engineering pad. Use 5-square per inch National Computation pad paper ONLY (sold at the NJIT Bookstore or any office supply store). The proper form consists of doing the problems on one side of the pad paper.
3. 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.
4. All problems must have a F.B.D. or some figure to describe the problem.
5. Homework must be legible when scanned and uploaded to Canvas. Put the problem number in the UPPER RIGHT corner.
6. NO LATE Homework will be accepted. NO credit for work copied from a solution source.

Our classes begin on Tuesday, January 21 and end on Tuesday, April 28, 2020.

WEEK	**TOPICS**	**ARTICLES**	**Homework Problems** (your instructor may modify)
1 Ch. 1	Concept of Stress and Strain with a Review of Statics	p. 1-26	1.3, 1.10, 1.12, 1.25, 1.26
2 Ch. 1 Ch. 2	Concept of Stresses, continued Stress and Strain - Axial Loading	p. 27-47 p. 57-79	1.29, 1.31, 1.40, 1.67 2.2, 2.6, 2.8, 2.17, 2.23
3 Ch. 2	Composites, Temperature Change, and Poisson's Ratio	p. 80-95 p. 96-116	2.38, 2.39, 2.47, 2.58 2.61, 2.64
4 Ch. 3	Torsion Torsional Stresses in Shafts	p. 148-167	3.3, 3.4, 3.9, 3.17
5 Ch. 3	Torsion, Transmission Shafts and Gear Trains, Horsepower	p. 168-193	3.41, 3.48, 3.57, 3.64, 3.76
6 Ch. 4	Pure Bending	p. 237-258	4.1, 4.9, 4.12, 4.18, 4.20, 4.22*
7 Ch. 5	Analysis and Design of Beams for Bending: Shear and Moment Diagrams	p. 347-361	**Draw the V & M diagrams:** 5.4, 5.9, 5.10, 5.12, 5.15, 5.20
8 Ch. 5	Section 5.2 Develop Equations Section 5.3 Design / Select the Beam Review and Summary	p. 362-370 p. 373-381 p. 408-410	**Write the equations for these:** 5.42, 5.43, 5.47, 5.49 **Design** / **select** the beam for: 5.67, 5.75
9 Ch. 6 Ch. 7	Shearing Stresses: Beams and Thin- Walled Members Transformations of Plane Stress	p. 417-426 p. 477-491	 **Solve by equations:** 7.1, 7.2, 7.6 & 10, 7.7 & 11
10 Ch. 7	Mohr's Circle for Plane Stress Plane Strain, Strain Rosettes	p. 492-502 p. 538-550	**Draw Mohr's Circle**: 7.31, 7.33, 7.38, 7.50 7.128 &132, 7.147, 7.148
11 Ch. 9	Deflection of Beams, Integration Method	p. 599-622	9.10, 9.11, 9.13, 9.16
12 Ch. 9	Deflection of Beams, Superposition Method	p. 635-648	9.73, 9.78 refer to table in FE Handbook
13 Ch. 10	Column Buckling under Axial Load	p. 691-708	10.10, 10.13, 10.19, 10.26
14	Column Buckling continued	p. 722-728	
15	FINAL EXAM	.	.

Laboratory Schedule (remember that our weeks begin on Tuesday)

Week beginning:	Lab Topic	Due
1 Jan. 19	No lab classes this first week.	
2 Jan. 26	**Introduction** to the LAB Sessions: **ONLINE via WebEx** Information about the lab sessions, expectations, formation of lab groups, expectations for lab reports, submission of lab reports, grading, etc.	READ about Reports in Lab Manual posted on Canvas
3 Feb. 2	Experiment 1: **Pre-Lab Presentation, 423-Colton / Online** Tension Test of Metals, Automated Testing of Steel and other metal (refer to Ch. 1 and 2 in text)	Converged
4 Feb. 9	Experiment 1: **Experiment in 413-Colton Hall /** Converged Class Tension Test of Metals, Testing of Steel and other metal	Formal report due week 6
5 Feb. 16	ONLINE with Lab Instructor for assistance with Analysis of Data and using Spreadsheets for the Labs and how to prepare your Lab Report	.
6 Feb. 23	Experiment 2: **Pre-Lab Presentation, 423-Colton / Online** Torsion Test of Metallic Materials (refer to Ch. 3 in text)	Converged
7 Mar. 2	Experiment 2: **Experiment in 413-Colton Hall** / Converged Class Torsion Test of Metallic Materials	Formal report due week 9
8 Mar. 9	ONLINE with Lab Instructor for assistance with Analysis of Data and using Spreadsheets for the Labs and how to prepare your Lab Report	.
	Spring Break – March 13 through March 21	
9 Mar. 23	Experiment 3: **Pre-Lab Presentation, 423-Colton / Online** Stresses, Strains and Deflection of Steel Beams in Pure Bending (refer to Ch. 4 and 5 in text)	Converged
10 Mar. 30	Experiment 3: **Experiment in 413-Colton Hall /** Converged Class Stresses, Strains and Deflection of Steel Beams in Pure Bending	Report due week 12
11 Apr. 6	Experiment 4: Pre-Lab Presentation, 423-Colton / Online Strain Measurements Using Strain Rosettes in Aluminum Beams (refer to Ch. 7 in text) and **Experiment**	Report due week 13
12 Apr. 13	Experiment 5: Pre-lab Presentation, 423-Colton / Online Column Buckling (refer to Ch. 10 in text)	Converged.
13 Apr. 20	Experiment 5: **Experiment in 413-Colton Hall** / Converged	Report due week 14
14 Apr. 27		

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 15% 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, so, do all of your work, please.**Three unexcused absences will result in an automatic failure of the lab and course.**

All reports should be word processed. Graphs are to be computer generated. All lab group members should have copies of the report. Continually share your portion with your lab partners. Coordinate.

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? Can all the questions that enter the readers mind be satisfied? Be advised that your discussion and conclusions will probably carry more weight than production of the right answers.

Due dates for lab reports are listed on the syllabus. Reports must be uploaded to the appropriate module on Canvas. After the due date, reports will be accepted for 75% credit. Reports more than one week late will not be accepted.

You should keep a copy of the work you submit. If a report is "lost" it is a favor to the instructor, and insurance for you, to be able to submit a copy of the report. That is why all members of the lab group should have the finalized copy of the report.

Quizzes, Exams, andFinal Exam (Attendance at exams is mandatory. Excused absences will require appropriate documentation.)

1. Quiz/exam problems will include theory as well as numerical problems. Questions on the laboratory may also be asked.
2. All quizzes, exams and final exam are closed book. Only the FE Handbook may be used as a resource BUT no additional notes may be written in the handbook. Resources will be provided with the exam / quiz on Canvas.
3. All problem solutions must be done on paper provided. The format of the solution must include assumptions and the solution or answer clearly shown.
4. The solution must illustrate the understanding of the material. Correct numerical solutions alone are insufficient for any credit.
5. If a problem starts with incorrect assumptions and formulations, it will receive no credit.
6. All answers must be accompanied by the appropriate and correct units.
7. Quizzes, exams and the final are to be taken with a fully charged calculator. Calculators may not be borrowed during the quizzes.
8. The dates of the quizzes/exams will be announced in advanced.
9. The grade of "I" (incomplete) will not be given for unsatisfactory academic performance.
10. No mid-term warning notice will be given. Maintain your own records of grades.
11. Students cannot leave their work area during quizzes or exam.
12. Cell phones (and other electronic devices) must be OFF and put away during exams.

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
Quizzes / Exams ….. 50%	100 - 88	A
Final Exam ……. 25%	87 - 82	B+
Laboratory ……. 15%	81 - 76	B
Homework ……. 10%	75 - 70	C+
	69 - 65	C
*NOTE: There is no grade of D for	64 - 60	D
CE students.	59 and below	F

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

Prepared by Milano, 8/25/14, 1/8/15, 1/16, 1/17, 8/17, 1/18, 8/18, 1/19, 8/19, 1/20, 1/21

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