New Jersey Institute of Technology
Department of Civil & Environmental Engineering

MECH 237 - Strength of Materials Summer 2017

Texts:

1. Beer, Johnson, DeWolf and Mazurek, Mechanics of Materials, Seventh Edition, McGraw-Hill, 2014.
   ISBN 978-0-07-339823-5
2. Hsu, C.T. Thomas, Strength of Materials Laboratory Manual, (to be emailed to you).
3. NCEES, Fundamentals of Engineering Supplied-Reference Handbook, Eighth Edition, 2nd. revision
   (or reproduce pages
   from: http://www.ncees.org/exams/study_materials/fe_handbook/)

Course Instructors: **MECH 237-141 and -142,** Tues/Thur, 6:00-9:00 p.m., Middle Summer Session, May 23 – July 13
Prof. G. Milano, P.E., 239-Colton Hall, 973-596-5830, milano@njit.edu

Lab Instructors: Either Lucas Martin, lm83@njit.edu or Hasan Tariq, 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.

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.*

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

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.

Course Policies:

- Attendance is mandatory
- There will be NO need for electronic devices during class time. Turn OFF your cell phone and put it away.
  Put away your laptop, tablet, or any other electronic device.
- Bring your textbook to each class meeting or pages from the relevant chapter.
- Take notes and pay attention. Ask questions.

- Be prepared to participate with board work and/or class problem solving. Bring your calculator.

Quizzes, Exams and Grading Policies:

- There will be nightly quizzes beginning with the second class meeting. These will be 50% of your grade.
- There will be a Final Exam on the last day of class. This will be 25% of your grade.
- Quizzes and exams must have Free-Body-Diagrams. ALL work must be shown for full 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 NJIT Health Service; a receipt from your mechanic for car failure; etc.
- We do NOT drop the lowest grade.
- We do NOT curve the grades.
- For more information on the grading scale, read the information following the course outlines.
- 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. Quiz problems may be taken from the homework problems or be very similar to the homework or those Sample Problems in the textbook.
- Homework may be collected on a random basis. Not all assigned problems will be collected. Only a select few will be collected randomly. Do your homework. Have it ready each week.
- NO late homework will be accepted.
- All homework MUST include a Free-Body-Diagram. All work must be shown for full credit.
- Homework NOT submitted will earn MINUS points deducted from your overall quiz grades. Have your homework ready each class meeting.
- 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.

WEEK	**TOPICS**	**ARTICLES**	**Homework Problems** (your instructor may modify)
1 - May 23 Ch. 1	Concept of Stress and Strain with a Review of Statics	p. 1-26 p. 27-50	1.3, 1.11, 1.26 1.29, 1.55
2 - May	Stress and Strain - Axial	p. 55-77	2.4, 2.7, 2.21, 2.24

25 Ch. 2	Loading		
3 - May 30 Ch. 2	Composites, Temperature Change, and Poisson's Ratio	p. 82-93 p. 94-104 p. 133-143	2.37, 2.47, 2.59 2.64, 2.65
4 – June 1 Ch. 3	Torsion Angle of Twist	p. 148-166 p. 167-184	3.3, 3.4, 3.11, 3.15 3.33, 3.34, 3.37, 3.41
5 - June 6 Ch. 3	Transmission Shafts	p. 185-193	3.64, 3.66, 3.74
6 – June 8 Ch. 4	Pure Bending Composite Materials	p. 237-257 p. 259-269	4.3, 4.4, 4.10, 4.22 4.33, 4.40
7 – June 13 Ch. 5	Analysis and Design of Beams for Bending: Shear and Moment Diagrams	p. 345-359	**Draw the V & M diagrams:** 5.7, 5.8, 5.9, 5.11
8 – June 15 Ch. 5	Section 5.2 Develop Equations Section 5.3 Design / Select the Beam	p. 360-370 p. 371-380 Review 407-413	**Write the equations for the following:** 5.40, 5.41, 5.42, 5.54 Design / select the beam for: 5.70, 5.73
9 – June 20 Ch. 7	Transformations of Stress and Strain, Section 7.2 Mohr's Circle	p. 477-491 p. 492-503	Solve by equations: 7.1, 7.2, 7.6 & 10, or 7.7 & 11 Draw Mohr's Circle: 7.35, 7.36, 7.37
10 – June 22 Ch. 7	Transformation of Plane Strain Strain Rosettes	p. 529-537 p. 538-552	7.128 & 132 7.147, 7.148
11 – June 27 Ch. 9	Deflection of Beams, Integration Method	p. 599-622	9.13, 9.15
12 – June 29 Ch. 9	Deflection of Beams, Superposition Method	p. 635-645	9.65, 9.78
13 – July 6 Ch. 10	Columns	p. 691-708	10.1, 10.2, 10.20, 10.121
14 – July 11	Column Buckling continued Review for the final exam		
15 – July 13	FINAL EXAM	.	.

Laboratory Schedule		
Class	**Lab Topic**	**Due**
1 Tues. May 23	Room 423-Colton Hall: Introduction, Safety Procedures for Lab, Instructions on how to prepare your Lab Reports, Grading Policies	READ about Reports in Lab Manual
2 Thurs. May 25	Experiment 1: **Pre-Lab Presentation** in 423-Colton Hall Tension Test of Metals, Automated Testing of Steel and other metal (refer to Ch. 1 and 2 in text)	.
3 Tues. May 30	Experiment 1: **Experiment** in room 413-Colton Hall Tension Test of Metals, Automated Testing of Steel and other metal	Formal report due week 6
4 Thurs. June 1	Meet with Lab Instructor for assistance with Analysis of Data and using Spreadsheets for the Labs and how to prepare your Lab Report	.
5 Tues. June 6	Experiment 2: **Pre-Lab Presentation** in 423-Colton Hall Torsion Test of Metallic Materials (refer to Ch. 3 in text)	.
6 Thurs. June 8	Experiment 2: **Experiment** in room 413-Colton Hall Torsion Test of Metallic Materials	Formal report due week 8
7 Tues. June 13	Meet with Lab Instructor for help to complete lab reports and begin to study for the next experiment	.
8 Thurs. June 15	Experiment 3: **Pre-Lab Presentation** in 423-Colton Hall Stresses, Strains and Deflection of Steel Beams in Pure Bending (refer to Ch. 4 and 5 in text)	.
9 Tues. June 20	Experiment 3: **Experiment** in 413-Colton Hall Stresses, Strains and Deflection of Steel Beams in Pure Bending	Formal report due week11
10 Thur. June 22	Experiment 4: **Pre-Lab Presentation** in 423-Colton Hall Strain Measurements Using Strain Rosettes in Aluminum Beams (refer to Ch. 7 in text)	.
11 Tues. June 27	Experiment 4: **Experiment** in 413-Colton Hall Strain Measurements Using Strain Rosettes in Aluminum Beams	Informal report due week 13
12	Experiment 5 : **Pre-Lab Presentation** in 423-	.

Thur. June 29	Colton Hall Compression Test of Steel Columns, Column Buckling (refer to Ch. 10 in text)	
13 Thurs. July 6	Experiment 5 : **Experiment,** in 413-Colton Hall Compression Test of Steel Columns, Column Buckling	Informal report due week 14
14 Tues. July 11	Experiment 5 reports are due 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.		

Prepared by Milano, 8/25/14, 1/8/15, 1/16, 1/17

GRADES:	RANGE	GRADE
Weekly Quizzes / Exams 50%	88 -100	A
Final Exam 25%	82-87	B+
Homework 10%	76-81	B
Laboratory 15%	70-75	C+
	65-69	C
	60-64	D
	59 and below	F

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

QUIZZES AND FINAL (Attendance at exams is mandatory. Excused absences will require appropriate documentation.)

1. Quiz problems will include theory as well as numerical problems. Questions on the laboratory may also be asked.
2. All quizzes and final exam are closed book and may include multiple choice problems.
3. All problem solutions must be done on paper provided. Work will be done on one side only. 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 units.

7. Quizzes and final are to be taken with a fully charged calculator. Calculators may not be borrowed during the quizzes.
8. The dates of the quizzes will be announced.
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 the classroom during quizzes or exam.
12. Cell phones must be OFF and laptop computers / notebooks / tablets not necessary in class.

HOMEWORK

1. Homework sets are due as announced by your instructor in advance.
2. Homework must be submitted in sets, arranged in order as in course outline.
3. The homework must be written on quadrille 8½ x 11 engineering pad. Sets must be stapled together in the upper left hand corner. DO NOT HAND IN CLASS NOTES. Put the problem number in the UPPER RIGHT corner.
4. NO LATE Homework will be accepted.

HOMEWORK INSTRUCTIONS

The following are to be observed when handing in homework for grading. Failure to do so may result in significant deductions in the homework grade:

1. 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.
2. On the top of each page, in the space provided, PRINT your name, course and section, and problem number,
3. The problems must be presented in numerical order as assigned. One problem per page. Write on one side of the sheet only. Lettering and numbers are to be neat, clear and legible.
4. Draw neat, clear F.B.D's as required. Use a straight edge or other drawing instruments as needed.
5. Box in the final answer.

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

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.

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? 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.

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 for 75% credit. After the reports have been returned to the class late papers will be accepted for only 50% credit. Papers more than two weeks late will not be accepted.

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

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.

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

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

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

(a) an ability to apply knowledge of math, science, and engineering
(b) an ability to design and conduct experiments, as well as interpret data
(c) an ability to design a system, component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
(d) an ability to function on multi-disciplinary teams
(e) an ability to identify, formulate, and solve engineering problems
(f) an understanding of ethical and professional responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
(i) a recognition of need for, and an ability to engage in life-long learning
(j) a knowledge of contemporary issues
(k) an ability to use techniques, skills and modern engineering tools necessary for engineering practice

Rev. 4/4/12, 1/16/14

Course Objectives Matrix – MECH 237 Strength of Materials
Revised 1/16/13, 1/16/14

Strategies and Actions	**Student Learning Objectives**	**Student Outcomes (a – k)**	**Program Educational Objectives**	**Assessment Methods/Metrics**
Course Objective 1: Develop the understanding on 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.	Learn the technique of calculating stresses and strains in a given structural member.	a, e, h, k	1	Weekly homework and quizzes.
Provide the principles of normal and shearing stresses	Learn techniques and equations used to calculate principal	a, e, h, k	1, 2	Weekly homework and quizzes.

and how to determine the principal stresses.	stresses, which will be used for design and failure analysis.			
Course Objective 2: Provide the principles and equations, and necessary tools to 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.	Learn the techniques and equations used to determine axial stresses, bending and shearing stresses under different loading conditions.	a, b, e, h, k	1	Weekly homework, quizzes and review of analysis problems.
Introduce the methods used to solve determinate and indeterminate problems	Learn the techniques and approaches used for determining reactions, member forces, and corresponding stresses and strains in determinate and indeterminate structures.	a, e, h, k	1	Weekly homework, quizzes and review of assigned problems.
Course Objective 3: Introduce the behavior of various engineering materials, its performance under loads, and design considerations.				
Introduce a state of the art analysis and design software (STAAD/Pro).	Learn how to use the latest technology in solving structural analysis and design problems.	c, e, k	1, 2	Homework and projects that are solved using STAAD/Pro.
Discuss the pitfalls with “black box” use of computers.	Learn how to use modern technology in solving structural analysis and design problems.	c, e, k	1, 2	Certain homework and projects are solved both manually and by STAAD/Pro.
Place assignments and course syllabus on the internet. Use e-mail for communication.	Learn how to use information technology.	k	1, 2	None.