MERRIMACK COLLEGE
Department of Civil Engineering

GEN 2012: MECHANICS OF MATERIALS

Course Syllabus, Spring 2019

I. Course Information

Instructor:
Name: James Kaklamanos, Ph.D. ("Professor Kaklamanos")
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Phone: (978) 837-3401
Office hours: Mon. 6–7 p.m.; Wed. 11 a.m.–12 p.m. and 2–3 p.m.; or by appointment.

Teaching assistants:

Names:	Mr. Hisham Mohsen ("Hisham")	Ms. Tori Thistle ("Tori")
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Course details:
Name: GEN 2012: Mechanics of Materials (4 cr.); GEN 2012L: Mechanics of Materials Lab
Class meeting times and location: Mon., Wed., and Fri., 12:30–1:45 p.m.; Mendel 169
Lab meeting times and location: Lab Sections A and B: Mon. 2–3:50 p.m.; Mendel 140/141
Lab Sections C and D: Mon. 4–5:50 p.m.; Mendel 140/141
Prerequisites: Grades of C- or higher in GEN 2010 (Mechanics I: Statics) and MTH 1218 (Calculus II)
Course website: https://blackboard.merrimack.edu

Significance of this course: In GEN 2012, you will learn the fundamental mechanics of how objects behave when subjected to a system of forces. The subject matter in this course will provide the foundation for much of your future study in civil or mechanical engineering, as you will learn how and why materials fail. This course focuses on analytical methods to determine the internal stress and strain of deformable bodies (e.g. beams, columns, shafts, tubes, pressure vessels, etc.), as well as methods to determine the strength, stiffness, stability, and external deformations of load-carrying members.

Course description (catalog): The concept of stress and strain at a point. Stress-temperature relationships. Force and deformation analyses of bodies under axial, shearing, flexural, torsional and combined loadings. Euler Columns.

Course learning objectives:
Upon successful completion of this course, the student will be able to:
1. Differentiate between normal stress, normal strain, shear stress, and shear strain; and calculate stresses and strains in deformable bodies.
2. Develop, explain, and use a material's stress-strain curve and associated material properties.
3. Assess the response (i.e. internal stress/strain, deformations, axial force) of axially loaded members under various loading conditions (external forces, thermal loads, etc.).
4. Assess the response (i.e. internal stress/strain, deformations, torsion) of torsionally loaded members.
5. Construct shear and moment diagrams for beams under various loading conditions, and determine the distributions of bending stress and shear stress.
6. Assess the response of members subjected to combined loadings (axial force, shear force, bending moment, and/or torsional moment).
7. Apply stress transformation equations and Mohr's circle to determine the principal stresses, the maximum in-plane shear stress, and the state of stress on any plane through an element.
8. Calculate the Euler buckling load of slender columns.

9. Determine the deflections of beams subjected to different external loads and boundary conditions.
10. Conduct laboratory tests to evaluate the engineering behavior of materials; and analyze, evaluate, and communicate experimental data from these tests.

Topical outline:	*Number of sessions:*
1. Stress and strain	5 classes, 2 workshops, and 1 lab
2. Axial load	3 classes and 2 labs
3. Torsion	2 classes and 2 labs
4. Bending and shear	6 classes, 1 workshop, and 1 lab
5. Combined loadings and stress transformation	5 classes and 2 workshops
6. Buckling of columns	2 classes and 1 lab
7. Deflection of beams	4 classes and 1 lab

Additional class and lab sessions will be reserved for problem-solving workshops throughout the semester.

Required course materials:

- **Textbook:** *Mechanics of Materials (Ninth Edition)*, by Russell C. Hibbeler (2014). Prentice Hall: Upper Saddle River, New Jersey. ISBN: 978-0133254426.
- **Calculator:** Only the following calculator models will be allowed on examinations in this course:
    - Casio: All fx-115 and fx-991 models (Any Casio calculator must have "fx-115" or "fx-991" in its model name.)
    - Hewlett Packard: The HP 33s and HP 35s models, but no others
    - Texas Instruments: All TI-30X and TI-36X models (Any Texas Instruments calculator must have "TI-30X" or "TI-36X" in its model name.)

  These are the same types of calculators that are permitted on the Fundamentals of Engineering (FE) exam that you will complete at the end of your college career (https://ncees.org/exams/calculator/).
- **Additional materials:** An engineer's scale (or ruler), compass, and protractor are required.

II. Policies

Philosophy: Canon 1 of the National Society for Professional Engineers (NSPE) Code of Ethics states that engineers shall "hold paramount the safety, health, and welfare of the public." Because the subject matter in this course is critical to your development as an engineering professional – and in the design and construction of engineering systems upon which the public rely – these course policies and assessment methods are intended to facilitate your learning, and to require mastery of this material in order to successfully complete this course.

Attendance:

- Attendance at all class meetings is strongly recommended and will be rewarded, but attendance at class meetings is not mandatory. When present in classes, you must arrive on time and behave in a professional manner (see the Professionalism section below); late arrivals and/or unprofessional behavior will result in a decreased course grade, as described in the Assessment section of the syllabus. If you miss a meeting for any reason, you will be expected to confer with a classmate to obtain notes, announcements, and/or assignments that you miss.
- Attendance at lab sessions, however, is mandatory. If you have more than two unexcused absences from lab sessions throughout the semester, you will receive an automatic F in the course. If a scheduling conflict arises for a given lab session (e.g., College-sponsored event, medical appointment, etc.), please email Hisham Mohsen at least one week in advance to make arrangements for attending another lab section. To be excused from lab because of an extended illness or other emergency, please visit the Hamel Health and Counseling Center and have them send me a note directly.

Professionalism:

Professional behavior is expected in all aspects of this course, as professionalism is an essential characteristic of your future as a practicing engineer. Unprofessional behavior may negatively detract from the classroom environment and the learning experience of other students in the course, and will not be tolerated. Examples of unprofessional behavior may include, but are not limited to:

- Arriving late or leaving the classroom while class is in session (except for emergencies).

- Using mobile technology or personal electronic devices (e.g., cell phones, tablets, laptops, etc.) during class or lab sessions. Unless otherwise noted, classes and labs operate in an "unplugged" environment in order to minimize distractions and optimize your engagement and interaction. (Turn your electronic devices off and place them out of sight before the beginning of the session, unless you receive my prior consent due to an extenuating circumstance.)
- Using derogatory, vulgar, hateful, or insulting language.
- Unsolicited talking or disruptions during any session.
- Sleeping during any session.

Consequences for unprofessional behavior are described in the Assessment section of the syllabus. Remember that professional behavior extends to electronic communication as well. I will not reply to any emails that are unprofessional and/or lack a subject, salutation, body, and signature.

Late assignments:

- Homework and lab assignments are due prior to the beginning of class on the due date; once class has begun, you will not be allowed to submit your work. Late submissions will not be accepted in this course, as they are usually not accepted in engineering practice. In the case of bids on contracts, late bids are rejected if even one minute late, resulting in the loss of employment opportunities for a firm and perhaps the subsequent loss of individual employment.
- The two formal laboratory reports (for Lab Experiments 4 and 5, as described in the Assessment section of the syllabus) are the only course assignments that will be accepted after the due date, although I hope you plan your time and efforts to avoid this. A late penalty will be applied to your laboratory report grade according to the following schedule: 0-24 hours late = reduction of one letter grade; 24-48 hours late = reduction of two letter grades; 48-72 hours late = reduction of three letter grades. Laboratory reports will receive zero credit if submitted more than 72 hours after the original due date.
- All assignments must be submitted in hard copy; email submissions are not acceptable. In addition, the two formal laboratory reports will also be submitted electronically on TurnItIn.com per the instructions of each assignment.

Academic integrity policy and class honor code:

- Canon 6 of the NSPE Code of Ethics states that "Engineers shall act in such a manner as to uphold and enhance the honor, integrity, and dignity of the engineering profession." This means that acts of academic dishonesty are unprofessional, unacceptable, and will not be tolerated whatsoever.
- It is unacceptable to copy the work of another student, whether on exams or assignments.
- You are prohibited from looking at prior students' work or solutions to assignments or exams that have not been made directly available by the instructor.
- Now or in the future, you are not allowed to distribute any instructor-provided course materials to others, as this may violate both copyright policy and academic integrity policy.
- No audio/video recording or photography of any kind is allowed in class without my prior written permission.
- Collaboration is allowed on homework and lab assignments, but all assignments must be written up independently by each student. If you consult with any of your classmates or anyone else, you must indicate their names at the end of the relevant problem(s).
- Students must carefully review the Merrimack College Academic Integrity Code (AIC) posted on Blackboard and available at https://www.merrimack.edu/live/files/279-academic-integrity-code. You will be required to sign an Academic Integrity Pledge during the first week of class, after you have reviewed the Academic Integrity Code and course policies. Please consult http://libguides.merrimack.edu/c.php?g=343001 for a complete discussion of academic integrity at Merrimack College.
- Violations of the academic integrity policy and/or class honor code will be grounds for academic disciplinary action, including, but not limited to: zero credit for the assessment in question, a failing grade for the course, suspension from the College, or expulsion from the College. If you withdraw from any course in which you have been accused of an academic integrity violation for which the penalty is an F for the course, the Provost will record the grade of WF on your transcript.

Communication: Course announcements will be made in class and via email. Students are expected to be reachable through their Merrimack email address, and are responsible for receiving all course announcements, both inside and outside of class.

Americans with Disabilities (ADA) policy: Merrimack College provides reasonable accommodations for students with documented disabilities. Students who have, or think they may have, a disability are invited to contact the Accessibility Services Office via the online request form, email (accessibilityservices@merrimack.edu), phone (978-837-5278), or by visiting the third floor of McQuade Library. Students are encouraged to contact the office as soon as possible to ensure adequate time to meet and create a plan; accommodations cannot be made retroactively. Additional information about the office and the process for requesting accommodations can be found at http://www.merrimack.edu/accessibility.

General comments: I look forward to working with you throughout the semester, and I encourage you to ask questions and be engaged in the course. Throughout the semester, please inform me of any personal circumstances or issues that I should know about. Please do not hesitate to drop by office hours, call me, or send me an email if you ever have any questions or concerns.

III. Assessment

Grading: To earn a grade in the C range, you will need to successfully memorize the basic material and correctly apply it to problems similar to those we have covered. To earn a grade in the B range, you will also need to show evidence of understanding the material well enough to explain the intuition behind the problems. To earn a grade in the A range, you will also need to be able to correctly apply the material to new problems and explain the intuition behind the underlying theory. Grades of D and F represent below-average and failing performance, respectively. Throughout the semester, students are responsible for being aware of their current course averages. The weights for your final course grade are as follows:

65% Exams *
- Midterm Examination 1, Midterm Examination 2, Midterm Examination 3, and Final Examination
- Your examination average will be computed as follows: your score on each of the three midterm examinations will be written down twice, and your score on the final examination will be written down three times. The lowest of these numbers will be crossed out, and the remaining eight numbers will be averaged to determine your examination average for the course.

35% Assignments
- 15% Homework assignments (13)
- 20% Laboratory assignments (7) *

* In order to pass this course, you must demonstrate mastery of the material presented in class and lab. This means that (1) your weighted exam average must be greater than 60%, and (2) your laboratory assignment average (prior to any late penalties applied to the lab reports) must be greater than 60%, regardless of your grades on other assignments. In addition, your final weighted course average (encompassing all exams and assignments) must be greater than 60%.

Letter grades will be computed from your final numerical course average using the following scale:
A: 93 and above, A−: 90–92, B+: 87–89, B: 83–86, B−: 80–82, C+: 77–79, C: 73–76, C−: 70–72,
D+: 67–69, D: 63–66, D−: 60–62, F: 0–59. Numerical averages will be rounded to the nearest whole number. Per departmental policies, you are required to obtain a grade of C- or higher in GEN 2012 to enroll in any subsequent course for which GEN 2012 is a prerequisite.

Exams: There will be four (4) exams: (1) Midterm Examination 1, during class on Wed., Feb. 20; (2) Midterm Examination 2, during class on Fri., Mar. 22; (3) Midterm Examination 3, during class on Wed., Apr. 24; and (4) a cumulative Final Examination, on Mon., May 6, from 8–11 a.m. (the date and time established by the Registrar). The format and coverage of each exam will be discussed in class, with sufficient notice. Exams will assess your understanding of concepts covered in class, lab, homework, and the assigned reading. No make-ups will be allowed for exams except in the case of a medical emergency with appropriate documentation.

Homework:
- Homework assignments will assess material covered in class and the assigned reading, and will require calculations and written responses. Homework problems provide you with practice using the methods covered in class and are essential for you to become proficient with these methods. Homework also provides an opportunity to assign more

complex and/or thought-provoking problems than those that may be assigned during a timed exam. Remember that the primary purpose of homework is to facilitate learning, not just to produce a solution as the end result.
- Homework assignment due dates are specified in the course schedule in this syllabus (generally, but not always, on Wednesdays); submissions must be made prior to the start of class. Your assignments will generally be structured as follows: (a) composing an outline or study guide of the assigned reading sections from the textbook, (b) completing preliminary and/or fundamental problems (whose solutions are given in the back of the textbook, allowing you to check your work in detail), and (c) completing end-of-the-chapter problems. Homework assignments must follow the prescribed format in the "Guidelines for Homework Submissions" section at the end of this syllabus.
- Homework solutions will not be posted; the burden is on you to make sure you find out how to solve the problems by getting help before they are due, or asking about them after they have been handed in.
- Your grades on homework assignments will be primarily based on whether all problems have been completed accurately, and that an honest attempt has been made. In order to receive full credit on a problem, the following conditions must be met: (a) all parts of the problem must be completed, (b) at least three-fourths of the problem must be solved correctly, and (c) your work must follow the prescribed format guidelines. Note that instructor feedback will be more detailed on exams than on homework assignments.
- All homework assignments will be weighted equally when determining your final homework average, and your two lowest homework grades will be dropped. Each assignment will be worth 10 points.

Labs:
- Hands-on laboratory learning will be an integral component of this course. There will be seven (7) laboratory experiments throughout the semester. The assignments for Laboratory Experiments 1, 2, 3, 6, and 7 will be submitted in the general lab assignment format (data presentation and analysis [calculations, tables, and figures], and answers to specified questions), and will each be worth 10 points. The assignments for Laboratory Experiments 4 and 5 will be formal laboratory reports, and will each be worth 20 points. Your laboratory average will be computed by summing your total earned points divided by the total number of possible points.
- Laboratory assignments will be completed in groups of three students, but smaller groups (i.e. individually or in pairs) are permissible. For groups composed of multiple students, all students will receive the same assignment grade. (Homework assignments, on the contrary, are completed and submitted individually by each student.)
- Laboratory assignments will be due prior to class on selected Mondays and Fridays throughout the semester; see the course schedule in this syllabus for the exact due dates. Note that it will be virtually impossible to pass the course if you miss more than one or two lab assignments.

Reading: In the course schedule provided in this syllabus, reading assignments from the textbooks are listed for each class session. Reading assignments are to be done before the class for which they are listed, so that you may take an active role in the class and ask any questions to clarify the reading. Class sessions are intended to highlight or clarify concepts in the assigned reading, not to cover every concept for which you are responsible. If I do not cover a concept that needs clarification, please bring it up during class. Homework assignments and exam questions will be drawn heavily from the reading. As mentioned above, the first problem on every homework assignment will be to submit an outline or study guide of the assigned reading sections from the textbook. For each textbook chapter, make sure to also read the chapter objectives and review.

Professionalism: Professional or unprofessional behavior will result in adjustments to your final course average: professional behavior throughout the term will result in a numerical increase, and unprofessional behavior will result in a numerical decrease.
- Students who exhibit exemplary attendance, punctuality, and participation will be rewarded. At the end of the semester, students who have no more than one unexcused absence, no more than one unexcused late arrival, do not engage in any unprofessional behavior (including usage of personal electronics), and who actively participate in class and lab throughout the semester, will receive one bonus point added to their final course average.
- Usage of personal electronics during any session, arriving to any session late (on more than two occasions), and/or engaging in other disruptive, disrespectful, or unprofessional behavior (examples of which are given in the course policies above) will result in automatic reductions of a student's final course average. On each instance that you engage in unprofessional behavior, I will immediately deduct one or more points off your final course average, no questions asked. Continued unprofessional and/or disruptive behavior may result in dismissal from the class, with readmission only allowed after a follow-up conversation with the instructor.

IV. Class and Laboratory Schedule

Notes:

- Class and lab schedules are tentative and may be adjusted due to inclement weather and other circumstances.
- Due to the Martin Luther King Jr. Day holiday, a Monday class schedule will be followed on Wed., Jan. 23.
- Due to the Presidents' Day holiday, a Monday class schedule will be followed on Tues., Feb. 19.
- Activities are currently scheduled on 9 of the 13 laboratory blocks throughout the semester.

Session No.	Session Title	Date	Textbook Reading	Assignment Due
Module 1: *Stress and Strain*				
Class 0A	Review of Statics	Wed. Jan. 16	1.2	
Class 0B	Review of Statics	Fri. Jan. 18	1.2	
Class 1	Course Introduction; Overview of Mechanics of Materials	Wed. Jan. 23 (Mon. schedule)	1.1	
Class 2	Normal and Shear Stresses	Fri. Jan. 25	1.3–1.5	HW 1
Class 3	Allowable Stress; Strain	Mon. Jan. 28	1.6; 2.1–2.2	
Lab 0	Lab 0: Laboratory Introduction	Mon. Jan. 28		
Class 4	Stress-Strain Behavior	Wed. Jan. 30	3.1–3.3	HW 2
Class 5	Hooke's Law and Poisson's Ratio	Fri. Feb. 1	3.4–3.8	
Module 2: *Axial Load*				
Class 6	Deformation of Axially Loaded Members	Mon. Feb. 4	4.1–4.2	
Lab 1	Lab 1: Stress and Strain	Mon. Feb. 4		
Class 7	Statically Indeterminate Axially Loaded Members	Wed. Feb. 6	4.3–4.4	HW 3
Class 7A	Problem Session	Fri. Feb. 8		
Class 8	Thermal Effects	Mon. Feb. 11	4.6	
Lab 2	Lab 2: Axial Tension	Mon. Feb. 11		
Module 3: *Torsion*				
Class 9	Torsional Deformation	Wed. Feb. 13	5.1–5.2	HW 4
Class 10	Angle of Twist	Fri. Feb. 15	5.4	Lab 1
Module 4: *Bending and Shear*				
Class 11	Shear and Moment Diagrams	Tue. Feb. 19 (Mon. schedule)	6.1–6.2	
Lab 3	Lab 3: Axial Compression	Tue. Feb. 19 (Mon. schedule)		

Session No.	Session Title	Date	Textbook Reading	Assignment Due
Class 11A	**Midterm Examination 1**	Wed. Feb. 20		Midterm 1
Class 12	Shear and Moment Diagrams	Fri. Feb. 22	6.1–6.2	HW 5
Class 13	Bending Stresses in Beams	Mon. Feb. 25	6.3–6.4	Lab 2
Lab 4A	Lab 4: Torsion, Part I	Mon. Feb. 25		
Class 14	Bending Stresses in Beams	Wed. Feb. 27	6.3–6.4	HW 6
Class 14A	Shear and Moment Diagrams Workshop	Fri. Mar. 1		
Class 15	Shear Stresses in Beams	Mon. Mar. 4	7.1–7.2	
Lab 4B	Lab 4: Torsion, Part II	Mon. Mar. 4		
Class 16	Shear Stresses in Beams	Wed. Mar. 6	7.1–7.2	HW 7
Class 16A	Problem Session	Fri. Mar. 8		Lab 3
Module 5: *Combined Loadings and Stress Transformation*				
Class 17	Combined Loadings	Mon. Mar. 18	8.2	
Lab 5	Lab 5: Bending Strength of Beams	Mon. Mar. 18		
Class 17A	Combined Loadings Workshop	Wed. Mar. 20		HW 8
Class 17B	**Midterm Examination 2**	Fri. Mar. 22		Midterm 2
Class 17C	Problem Session	Mon. Mar. 25		
Class 18	Plane-Stress Transformation	Wed. Mar. 27	9.1–9.2	HW 9
Class 19	Principal Stresses and Maximum Shear Stress	Fri. Mar. 29	9.3	Lab 4 Report
Class 20	Mohr's Circle	Mon. Apr. 1	9.4	
Class 21	Mohr's Circle; Generalized Hooke's Law	Wed. Apr. 3	9.4, 10.6	HW 10
Class 21A	Mohr's Circle Workshop	Fri. Apr. 5		
Module 6: *Buckling of Columns*				
Class 22	Critical Load; Buckling of Ideal Columns	Mon. Apr. 8	13.1–13.2	
Lab 6	Lab 6: Buckling of Columns	Mon. Apr. 8		
Class 23	Buckling of Other Columns	Wed. Apr. 10	13.3	HW 11
Class 23A	Problem Session	Fri. Apr. 12		
Module 7: *Deflection of Beams*				
Class 24	The Elastic Curve; Deflections by Method of Integration	Mon. Apr. 15	12.1–12.2	Lab 5 Report
Lab 7	Lab 7: Deflection of Beams	Mon. Apr. 15		

Session No.	Session Title	Date	Textbook Reading	Assignment Due
Class 25	Deflections by Method of Superposition	Wed. Apr. 17	12.5	HW 12
Class 25A	**Midterm Examination 3**	Wed. Apr. 24		Midterm 3
Class 26	Stresses in Thin-Walled Pressure Vessels	Fri. Apr. 26	8.1	Lab 6
Class 26A	Review Session	Mon. Apr. 29		HW 13
Class 27	Course Conclusion	Wed. May 1		Lab 7
—	**Final Examination**	Mon. May 6, 8–11 a.m.		Final Exam

V. Guidelines for Homework Submissions

Format:

- Homework assignments should be neat, clear, and accurate. All work is to be done on 8½×11 paper and stapled together. The use of engineering paper is required for all portions of assignments, except on problems that involve typed or written responses (such as reading outlines or study guides).
- On the first page of a homework assignment, please include your name, date, course number (GEN 2012), assignment number and name, and the total number of pages (e.g., "Page 1 of *n*"). On successive pages, include your name (or initials) and page number in the upper right corner.
- Use straightedges, protractors, and/or compasses for all diagrams, sketches and graphs; write legibly and unambiguously in a sequential format down the page.
- Show all your work in an organized manner, and present the problems in the order they were assigned. Use proper units throughout the solution, carry calculations to at least 3 or 4 significant figures, and show leading zeroes for numbers less than one (i.e. 0.3 instead of .3).
- Leave an appreciable space (at least 1 inch) between problems or start each problem on a new page.
- Acknowledge collaboration with fellow students.

Problem-solving procedure:

- **Given**: Restate the problem in your own words, including all information that is given. The reader should not have to refer to the textbook or problem assignment.
- **Find**: In your own words, state what the problem requires you to find.
- **Sketch**: Include a sketch of the system, using straightedges where appropriate.
- **Solution**: Solve the problem (algebraically and/or numerically) to obtain your answer. Provide written explanations to help explain your thought process. State the fundamental equations and/or principles necessary to solve the problem, as well as any assumptions.
- **Answer**: Enclose your final answer with a box. Include units and remember the number of significant figures that are appropriate. If necessary, discuss your results and the assumptions used. Check your answer for reasonableness and confirm the consistency of your units.

General comments:

- Neatness and legibility is a requirement for an assignment to be graded. Homework that does not follow these guidelines or that is illegible may be returned with a grade of zero.
- Organization and neatness will be considered in grading, along with procedures and final answer. Show enough equations, sources of information, assumptions and intermediate steps so that your work can be followed both by a grader and by you when you later use the homework for review.
- Your homework submissions should reflect the diligence and thoroughness required in engineering. Consider your homework a professional submittal to your boss. What will happen if he/she cannot read or understand it?