MERRIMACK COLLEGE
Department of Civil Engineering

GEN 2012: MECHANICS II (Mechanics of Materials)

Course Syllabus, Spring 2016

I. Course Information

Course instructor:
Name: James Kaklamanos, Ph.D. ("Professor Kaklamanos" or "Dr. K.")
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Office hours: Tues. 5–6:30 p.m., Thurs. 5–6:30 p.m., or by appointment.

Teaching assistants (labs):

Names:	Cristopher Algarra	Angel Escalona
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Office hours:	Wed. 12–2 p.m.	Tues. 9–11 a.m.

Course details:
Name: GEN 2012: Mechanics II (4 cr.); GEN 2012L: Mechanics II Lab
Class meeting times and location: Class Section A: Tues. and Thurs., 11 a.m.–12:15 p.m.; Sullivan 105
Class Section B: Tues. and Thurs., 12:30–1:45 p.m.; Sullivan 105
Lab meeting times and location: Lab Sections A and C: Mon. 1–3:20 p.m.; Mendel 140/141
Lab Sections B and D: Mon. 3:30–5:50 p.m.; Mendel 140/141
Prerequisites: 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, 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 objectives:
Upon completion of this course, the student will be able to:
1. Differentiate between normal stress, normal strain, shear stress, shear strain, and bearing stress.
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 deflection of beams subjected to a variety of external loads and boundary conditions.
10. Conduct laboratory tests to measure the strength of materials, and analyze, evaluate, and communicate experimental data from these tests.

Topical outline:
1. Stress and strain
2. Axial load
3. Torsion
4. Bending and shear
5. Combined loadings and stress transformation
6. Buckling of columns
7. Deflection of beams

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:** You are welcome to use any calculator you wish on out-of-class assignments, but on examinations, only the following calculator models will be allowed:
    - Casio: fx-115 (all models with fx-115 in their name)
    - Hewlett Packard: HP 33s or HP 35s (but no others)
    - Texas Instruments: TI-30X or TI-36X (all models with TI-30X or TI-36X in their 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-policy/).
- **Additional materials:** An engineer's scale (or ruler), compass, and protractor are necessary.

II. Policies

Attendance:
- Attendance at all class meetings is strongly recommended and rewarded, but attendance at class meetings is not mandatory. When present in class, 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 class 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 an unexcused absence from lab, then your grade on that lab assignment will be reduced by 30 percent. To be excused from lab for any planned College-sponsored event, a note must be submitted from the advisor or coach prior to the event. 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 at 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. (Turn your cell phone off and place it out of sight before the beginning of the session, unless you receive my prior consent due to an extenuating circumstance.)
- Using derogatory, vulgar, or insulting language.
- Unsolicited talking in class.
- Sleeping in class.

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. Consequences for unprofessional behavior are described in the Assessment section of the syllabus.

Late assignments:
Homework/lab submissions 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. All assignments should be submitted in hard-copy form unless otherwise stated.

Class honor code:
- Canon 6 of the National Society for Professional Engineers (NSPE) Code of Ethics states that "Engineers shall conduct themselves honorably, responsibly, ethically, and lawfully so as to enhance the honor, reputation, and usefulness of the profession." This means that acts of academic dishonesty are unprofessional, unacceptable, and will not be tolerated.
- It is unacceptable to copy the work of another student, whether on exams or assignments; such behavior will be grounds for academic disciplinary action, including, but not limited to: zero credit for the assignment in question, a failing grade for the course, suspension from the College, or dismissal from the College. It is also unacceptable to look at prior students' work or solutions to homework/exam problems that have not been made directly available by the instructor.
- Collaboration is allowed on homework/lab assignments, but all assignments must be written up independently by each student (unless you are submitting a laboratory assignment as a group). 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) distributed in class and available at <http://www.merrimack.edu/about/offices_services/office-of-the-provost/academic-integrity-code.php>. 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.

Americans with Disabilities (ADA) Policy: If you have a disability that may have some impact on your work in this class and for which you may require accommodations, please see me and the Disability Services Office so that such accommodations may be arranged.

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. Please do not hesitate to drop by office hours, call me, or send me an email if you ever have any questions or concerns. Also, please inform me of any personal circumstances or issues that I should know about. When in doubt, it is always better to keep me informed throughout the semester rather than waiting until the end.

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 those problems. The weights for your final course grade are as follows:

60% Exams *
- 18% Midterm Examination 1
- 18% Midterm Examination 2
- 24% Final Examination

30% Assignments
- 15% Homework assignments
- 15% Laboratory assignments *

10% Quizzes

* 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 must be greater than 60%, regardless of your grades on other assignments. In addition, your final weighted course average (encompassing all exams, assignments, and quizzes) must be greater than 60%.

Exams and Quizzes:
- Three (3) exams will be administered throughout the semester: (1) Midterm Examination 1, on Mon., Feb. 29, from 1–3 p.m.; (2) Midterm Examination 2, on Mon., Apr. 11, from 1–3 p.m.; and (3) a cumulative Final Examination, on Tues., May 10, from 8–11 a.m. for Class Section A, and Thurs., May 12, from 11:30 a.m.–2:30 p.m. for Class Section B. The two midterm examinations will each be administered during lab at a single time for all students, and the final examinations for each class section will be administered at 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.
- Three (3) quizzes will be administered throughout the semester, at the start of class on Thurs., Feb. 4; Thurs., Mar. 10; and Thurs., Apr. 28. These quizzes will be approximately 5-10 minutes in length, and will assess key concepts from class, lab, homework, and the assigned reading. Make-up quizzes will only be allowed if you have a medical emergency with appropriate documentation. Your highest quiz grade will be weighted twice as heavily as your other two quiz grades in the computation of your final quiz average.

Homework:
- Homework assignments will assess material covered in class and in the textbook. Some assignments will require written responses in addition to calculations. 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.
- Assignments will generally be due prior to the beginning of class on Tuesdays; see the course schedule in this syllabus for exact due dates. Your submissions 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. However, a portion of lab on Mondays will be dedicated as a problem session, where you will have the opportunity to ask questions about the homework assignment. These problem sessions will provide a chance to discuss additional examples beyond those provided in class and in the textbook. You are expected to attempt all

homework problems prior to Monday's lab session, so that you may contribute to group discussions about these problems.
- Your grades on homework assignments will be primarily based on whether all problems have been completed 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 and quizzes than on homework assignments.
- Unless otherwise noted, all homework assignments will be weighted equally when determining your final homework average, and your two lowest homework grades will be dropped.

Labs:
- Hands-on laboratory learning will be an integral component of this course. Laboratory assignments will consist of data presentation and analysis (calculations, tables, and figures), and answers to specified questions. Some lab assignments will consist of more formal written reports (approximately two throughout the semester); specific requirements will be announced for each lab assignment.
- Laboratory assignments may be completed individually, or in groups of two or three. For groups composed of multiple students, all students will receive the same grade.
- Laboratory assignments will be due prior to class on selected Thursdays throughout the semester; see the course schedule in this syllabus for exact due dates.
- All laboratory assignments will be weighted equally when determining your final laboratory average, with the following exception: assignments involving more formal written reports will be weighted slightly more heavily. The exact weighting will be announced at the time of the assignment.

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 <u>before</u> 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 <u>adjustments to your final course average</u>: professional behavior throughout the term will result in a numerical increase, and unprofessional behavior will result in a numerical decrease.
- To earn "bonus points" added to your final course average, you must attend and participate fully in all class and lab sessions, and engage in professional behavior during class, lab, and in all course communications (see course policies above). Students who exhibit exemplary attendance, punctuality, and participation will be rewarded. At the end of the semester, students who have no unexcused absences, 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 <u>two</u> bonus points added to their final course average. Students who are professional throughout the semester, but have either one unexcused absence or two unexcused late arrivals, will receive <u>one</u> bonus point added to their final course average.
- Usage of personal electronics during class or lab, arriving to class or lab late (on three or more 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 interrupt class, instruct you to stop, and will immediately deduct one or more points off your final course average. Continued unprofessional behavior may result in dismissal from the class.

IV. Class and Laboratory Schedule (Tentative)

Session No.	Session Title	Date	Textbook Reading	Assignment Due
Module 1: *Stress and Strain*				
Class 1	Course Introduction; Overview of Mechanics of Materials	Thu. Jan. 21	1.1	
Lab 1	Review of Statics	Mon. Jan. 25	1.2	
Class 2	Normal and Shear Stresses	Tue. Jan. 26	1.3–1.5	HW 1
Class 3	Allowable Stress; Strain	Thu. Jan. 28	1.6; 2.1–2.2	
Lab 2	Lab Experiment 1: Stress and Strain	Mon. Feb. 1		
Class 4	Stress-Strain Behavior	Tue. Feb. 2	3.1–3.3	HW 2
Class 5	Hooke's Law and Poisson's Ratio, **Quiz 1**	Thu. Feb. 4	3.4–3.8	Quiz 1
Module 2: *Axial Load*				
Lab 3	Lab Experiment 2: Axial Tension	Mon. Feb. 8		
Class 6	Deformation of Axially Loaded Members	Tue. Feb. 9	4.1–4.2	HW 3
Class 7	Statically Indeterminate Axially Loaded Members	Thu. Feb. 11	4.3–4.4	Lab 1
Lab 4	Lab Experiment 3: Axial Compression	Tue. Feb. 16 (Mon. schedule)		
Class 8	Thermal Effects	Thu. Feb. 18	4.6	Lab 2
Module 3: *Torsion*				
Lab 5	Lab Experiment 4: Torsion	Mon. Feb. 22	5.1–5.2	
Class 9	Torsional Deformation	Tue. Feb. 23	5.1–5.2	HW 4
Class 10	Angle of Twist	Thu. Feb. 25	5.4	Lab 3
Lab 6	**Midterm Examination 1**	Mon. Feb. 29, 1–3 p.m.		Midterm 1
Module 4: *Bending and Shear*				
Class 11	Shear and Moment Diagrams	Tue. Mar. 1	6.1–6.2	HW 5
Class 12	Shear and Moment Diagrams	Thu. Mar. 3	6.1–6.2	Lab 4
Lab 7	Shear and Moment Diagrams Workshop	Mon. Mar. 7		
Class 13	Bending Stresses in Beams	Tue. Mar. 8	6.3–6.4	HW 6

Session No.	Session Title	Date	Textbook Reading	Assignment Due
Class 14	Bending Stresses in Beams, **Quiz 2**	Thu. Mar. 10	6.3–6.4	Quiz 2
Lab 8	Lab Experiment 5: Bending Strength of Beams	Mon. Mar. 14		
Class 15	Shear Stresses in Beams	Tue. Mar. 15	7.1–7.2	HW 7
Class 16	Shear Stresses in Beams	Tue. Mar. 29	7.1–7.2	
Module 5: *Combined Loadings and Stress Transformation*				
Class 17	Combined Loadings	Thu. Mar. 31	8.2	HW 8
Lab 9	Combined Loadings Workshop	Mon. Apr. 4		
Class 18	Plane-Stress Transformation	Tue. Apr. 5	9.1–9.2	HW 9
Class 19	Principal Stresses and Maximum Shear Stress	Thu. Apr. 7	9.3	Lab 5
Lab 10	**Midterm Examination 2**	Mon. Apr. 11, 1–3 p.m.		Midterm 2
Class 20	Mohr's Circle	Tue. Apr. 12	9.4	HW 10
Class 21	Mohr's Circle; Generalized Hooke's Law	Thu. Apr. 14	9.4, 10.6	
Lab 11	Mohr's Circle Workshop	Mon. Apr. 18		
Module 6: *Buckling of Columns*				
Class 22	Critical Load; Ideal Columns	Tue. Apr. 19	13.1–13.2	HW 11
Class 23	Columns With Various Types of Supports	Thu. Apr. 21	13.3	
Lab 12	Lab Experiment 6: Buckling of Columns	Mon. Apr. 25		
Module 7: *Deflection of Beams*				
Class 24	The Elastic Curve; Deflections by Method of Integration	Tue. Apr. 26	12.1–12.2	HW 12
Class 25	Deflections by Method of Superposition, **Quiz 3**	Thu. Apr. 28	12.5	Quiz 3
Lab 13	Lab Experiment 7: Deflection of Beams	Mon. May 2		
Class 26	Stresses in Thin-Walled Pressure Vessels	Tue. May 3	8.1	HW 13
Class 27	Course Conclusion	Thu. May 5		Labs 6–7
—	**Final Examination** Class Section A: Tue. May 10, 8–11 a.m. Class Section B: Thu. May 12, 11:30 a.m.–2 p.m.	Tue. May 10, Thu. May 12		Final Exam

V. Guidelines for Homework Submissions

Format:

1. 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 encouraged, but not required.
2. On the first page of a homework assignment, please include your name, date, course number (GEN 2012), class section (A or B), 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.
3. Use straightedges, protractors, and/or compasses for all diagrams, sketches and graphs; write legibly and unambiguously in a sequential format down the page.
4. Leave an appreciable space (at least 1 inch) between problems or start each problem on a new page.
5. Acknowledge collaboration with fellow students.

Problem-solving procedure:

1. Restate the problem in your own words, including the information that is given and what is to be found. The reader should not have to refer to the textbook or problem assignment.
2. Include a sketch of the system, using straightedges where appropriate.
3. State the fundamental equations and/or principles necessary to solve the problem, as well as any assumptions.
4. Solve the problem (algebraically and/or numerically) to obtain your answer. Provide written explanations to help explain your thought process.
5. Highlight your final answer with a box. Include units and remember the number of significant figures that are appropriate.
6. If necessary, discuss your results and the assumptions used. Check your answer for reasonableness and confirm the consistency of your units.

General comments:

1. 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.
2. 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.
3. 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?