MAE 243 – Mechanics of Materials
Fall 2020
COURSE SYLLABUS

Credits: 3 Hours
Prerequisites: MAE 241 and MATH 156 ("C" or better).
Textbook: Hibbeler, R. C., ***Mechanics of Materials***, Tenth Edition, Pearson Prentice Hall, USA, 2017, ISBN-10: 0-13-432605-9, ISBN-13: 978-0-13-432605-4.
Note: Students are required to get access to Mastering Engineering.
Students are required to have a webcam for this course.

Course Coordinator: **Dr. Sam Mukdadi**, E-mail: sam.mukdadi@mail.wvu.edu, Virtual Office Hours: W 10:00 – 11:00.

Section 001 (CRN: 80446), MWF 1:00 – 1:50, **Dr. Nithi Sivaneri**, E-mail: nithi.sivaneri@mail.wvu.edu, Virtual Office Hours: R 11:00 – 12:00.

Section 002 (CRN: 81495), TR 11:00 – 12:15, **Dr. Sam Mukdadi**, E-mail: sam.mukdadi@mail.wvu.edu, Virtual Office Hours: W 10:00 – 11:00.

Section 003 (CRN: 89123), MWF 9:00 – 9:50, **Dr. Terence Musho**, E-mail: terence.musho@mail.wvu.edu, Virtual Office Hours: M 2:00 – 3:00.

Course Objectives:
This course is intended to provide the students with both the theory and application of the fundamental principles of mechanics of materials. Understanding is based on the explanation of the physical behavior of materials under load and then modeling this behavior to develop the theory. The specific objectives consist of modeling of one-dimensional structural elements such as bars, shafts, beams, and columns with the aim of determining the stresses, strains, and deflections of these one-dimensional elements. The students are required to establish basic skills related to these structural elements by the end of the semester in order to **PASS** the course.

Expected Outcomes:
1) Students will be able to correctly draw a free-body-diagram and find the reactions and apply the method of cross-section to find the internal loads and forces.
2) Students will be able to correctly label stress strain curves and identify: proportional limit; yield stress; ultimate stress; fracture stress.
3) Students will be able to calculate the residual strain in a piece of uniform cross-section if given the loading and strain-stress curve.
4) Students will be able to identify the appropriate formulae to calculate the stress in a uniformly loaded specimen for the following conditions: uniaxial tension and compression; torsional loading; direct shear; and bending under statically determinate conditions.

5) Students will be able to determine internal load distributions and draw bending-moment diagrams and torque position diagrams for beams and shafts with step changes in cross-section.
6) Students will be able to determine displacement and strain in pieces with step changes in loading and/or radius given the loading and modulus or loading and a stress-strain curve. Students will be able to calculate these displacements for uniaxial tension and compression; torsion; and direct shear.
7) Students will be able to transform the state-of stress at a point in a material to determine principal stresses; maximum shear stress and the orientation of the stress element.
8) Students will be able to calculate the critical load for the buckling of a pin supported column and determine if the failure mode is compression or buckling.

This course supports ABET Outcome # 1:

"*An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics*."

Course Grading:

Homework (paper based & online)	10%
Quizzes	10%
Five (5) Tests (Common for all sections)	80%

Grades of four (4) best test scores will be considered (i.e., lowest test score will be dropped). Each test will consist of two problems; you would have to submit the solution for the first problem of a particular test before you are granted access to the second problem. Typically grades will be assigned according to the following scale: **A (90-100); B (80-89); C (70-79); D (60-69); F (less than 60).**

Quizzes and Homework:

Unannounced quizzes will be given at random class periods. Quizzes will cover the material taught in the previous and/or current lectures as well as the reading assignments given to the students. Assignments will be given on eCampus and Mastering Engineering.

Tests:

It is important that the students taking this course understand that all exams will be common among all the sections, will include all topics listed on the attached syllabus.

It is the responsibility of the student taking this course to ensure that he/she understands how to solve any of the book example problems following each topic and that he/she can solve all the problems listed as homework assignments.

Students may miss one (and only one) test due to an emergency case (for example, sudden illness). If the excuse is accepted, the final score will be calculated based on the remaining 4 mid-term tests.

Class Rules:

1) Professional attitude in class is expected from all students.
2) No use of cell phones allowed during exams or in class without permission.
3) No credit for late homework.
4) No hats will be allowed during exams.
5) ID check maybe done for exam submission and attendance policy.
6) You may need to show your face and workspace via web camera during exam. Your IP address will be logged. During exams your computer will be pinged to log conductivity issues.

Academic Integrity:

High level of academic integrity and honor is expected from each student. Each student is expected to do his/her own work on homework, quizzes, and exams. You may discuss the problems with other students on homework but not copy solutions. You should make sure of your ability to solve the problems on your own.

Statement on Social Justice:

WVU is committed to social justice. The instructor of this course concurs with WVU's commitment and expects to maintain a positive learning environment, based upon open communication, mutual respect and nondiscrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color, or national origin. Any suggestions are encouraged as to how to further such a positive and open environment and to anticipate needing any type of accommodation in order to participate in this class. Please advise us and make appropriate arrangements with Disability Services (293-6700).

Days of Special Concern:

WVU recognizes the diversity of its students and the needs of those who wish to be absent from class to participate in Days of Special Concern, which are listed in the Schedule of Courses. Students should notify their instructors by the end of the second week of classes or prior to the first Day of Special Concern, whichever is earlier, regarding Day of Special Concern observances that will affect their attendance. Further, students must abide by the attendance policy of their instructors as stated on their syllabi. Faculty will make reasonable accommodation for tests or field trips that a student misses as a result of observing a Day of Special Concern

Statement on Academic Integrity:

The integrity of the classes offered by any academic institution solidifies the foundation of its mission and cannot be sacrificed to expediency, ignorance, or blatant fraud. Therefore, instructors will enforce rigorous standards of academic integrity in all aspects and assignments of their courses. For the detailed policy of West Virginia University regarding the definitions of acts considered to fall under academic dishonesty and possible ensuing sanctions, please see the West Virginia University Academic Standards Policy (http://catalog.wvu.edu/undergraduate/coursecreditstermsclassification). Should you

have any questions about possibly improper research citations or references, or any other activity that may be interpreted as an attempt at academic dishonesty, please see your instructor before the assignment is due to discuss the matter. In addition, the MAE Policy of Academic Integrity will be used to address instances of academic dishonesty according to the following table:

MAE Policy of Zero Tolerance for Academic Dishonesty:

Case	Violation	Penalty
1	Cheating on an assignment	Zero in the assignment + Letter reduction in final grade
2	Cheating on a quiz	Failure in the Course + UF recommendation
3	Cheating on an exam	Failure in the Course + UF recommendation
4	Cheating on the final	Failure in the Course + UF + Suspension recommendation
5	Other (doc. alteration, tampering with records, etc.)	F, Rec: UF, Probation, Suspension, Dismissal
6	Disrespect, harassing of any kind to instructor or TA	Police report, UF, Suspension or Dismissal
7	Physical contact, or threat of any kind	Police report + Expulsion
FORBIDDEN: The use of smart devices (smart-phones, pads, or wearable devices) in exams.		

Inclusivity Statement:

The West Virginia University community is committed to creating and fostering a positive learning and working environment based on open communication, mutual respect, and inclusion.

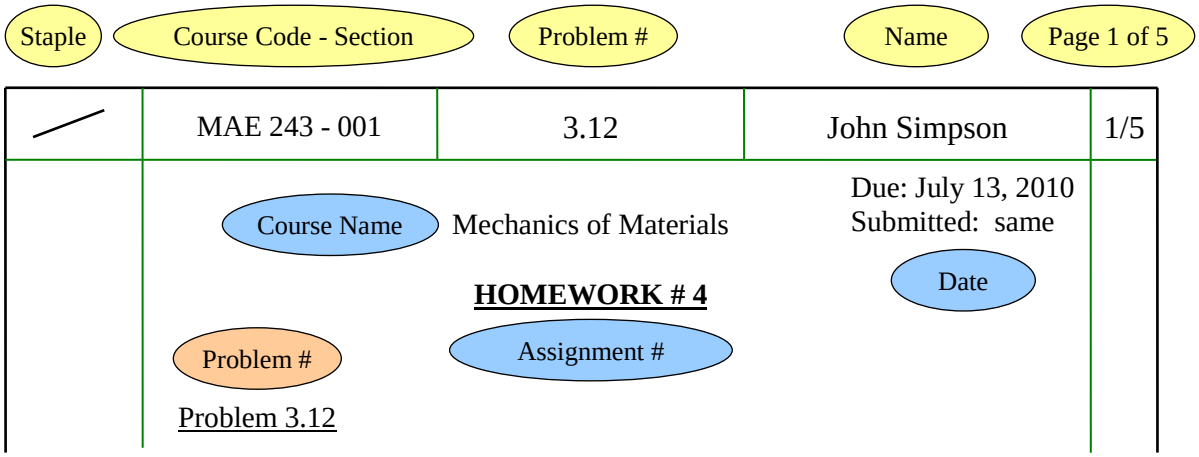
If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with the Office of Accessibility Services (293-6700). For more information on West Virginia University's Diversity, Equity, and Inclusion initiatives; please see http://diversity.wvu.edu.

PAPER-BASED HOMEWORK PREPARATION INSTRUCTIONS

As an engineer and a professional, your work will be often read and scrutinized by others. In some instants your work could be a legal document or a piece of evidence in a court of law. It is your responsibility to present your work in a legible, methodical, and logical manner. **If paper-based homework is assigned**, a specific format is required in this course. The intent of the required format is to get you in the habit of presenting your work in a professional manner that earns you professional respect and credibility.

1) ACCURACY is essential in any engineering work. Clear work, neatly and systematically arranged, will assist in reducing errors to a minimum.
2) CLEARNESS AND NEATNESS are indication of clear thinking and mastery of the subject; they are essential if the work is to be understood and used by others.
3) SYSTEMATIC PRESENTATION reduces errors and increases the informational and engineering value of the work performed.

All work must be done on "Engineering Paper" or typed (and figures drawn) neatly using a computer. Work will be done on only one side of the paper (engineers do not write on the back of the paper). The course name, date, and assignment number are to be written only on the first page. Begin each homework problem in an assignment on a new sheet of paper, and present the solutions in the same order that the problems were assigned. Fill in the blank areas at the top of each sheet as follows:



You must follow the following requirements for each problem:

1) Sketch the problem with given dimensions and symbols.
2) Write a summary statement of the problem or what is required.
3) Draw Free Body Diagrams (FBD).
4) Equations and solutions: It is not sufficient to write numbers in equation form: the basic equation must be first written, where the physical condition or reference must be indicated.
5) The answer must be presented to completely define the problem requirement. It must be set apart from the calculations and emphasized by surrounding it in a box.
6) The solution must be done from top to bottom (never from left to right or right to left). If during the solution a value is needed to be replaced in a previous equation to solve for other unknown, a reference should be placed:

$(\rightarrow +)\ \sum F_x = 0;$ $\quad N_A\left(\frac{4}{5}\right) - N_B\left(\frac{5}{13}\right) = 0$ (3)

$N_A = 39.70$ lb

Replacing N_A into Eq. (3); $\quad 39.70\left(\frac{4}{5}\right) - N_B\left(\frac{5}{13}\right) = 0$

$N_B = 82.58$ lb

7) Homework must be scanned an uploaded online within a single PDF. No homework will be accepted over email. PDFs must not exceed 15 Mb.

It should be understood by all students that adherence to the attached homework solution format is not optional; it is mandatory. Failure to adhere to the attached format will result in penalty at 50% of the homework grade. Homework submitted in any other form other than that specified above will not be graded.

FREE-BODY DIAGRAM

In homework, quizzes, tests, and exams it is imperative that a proper free-body diagram is drawn even if it is not explicitly stated in the problem statement. The steps in drawing a proper free-body diagram area as follows:

1) Isolate the part/component of the structure/system of interest.
2) Set up a reference system and its origin.
3) Include the applied loads.
4) Remove the constraints and replace them with the equivalent reactions.
5) Include all necessary dimensions.

IMPORTANT DATES

August 26	First Day of Classes
September 1	Last day to Register, Add/Drop Courses
September 7	Labor Day Recess (University Closed)
October 13	Mid Semester Reports Due by Noon
November 3	General Election Day (University Closed)
November 20	Last Day to Drop a Class and Last Day to Withdraw from the University
November 25 – 29	Thanksgiving Recess
December 4	Last day of classes

Common Test Dates

Thursday, September 10	**Test 1**, 7:00 – 7:45 PM, Ch. 1 – 2
Thursday, October 8	**Test 2**, 7:00 – 7:45 PM, Ch. 3 – 5
Thursday, October 29	**Test 3**, 7:00 – 7:45 PM, Ch. 6 – 7
Thursday, November 19	**Test 4**, 7:00 – 7:45 PM, Ch. 8 – 10
Thursday, December 10	**Test 5**, 8:00 – 8:45 PM, Ch. 11 – 13

Week	Day	Topic	Section
1	W, 8/26	Introduction	1.1 & 1.2
	F, 8/28	Normal Stress	1.3 & 1.4
2	M, 8/31	Shear Stress	1.5
	W, 9/2	Allowable Stress and Design	1.6 & 1.7
	F, 9/4	Strain	2.1 & 2.2
3	**M, 9/7**	**Labor Day Recess - No Class**	
	W, 9/9	Mechanical Properties of Materials	3.1 – 3.3
	F, 9/11	Hooke's Law and Strain Energy	3.4 & 3.5
4	M, 9/14	Poisson's Ratio and Shear Stress-Strain Diagram	3.6 & 3.7
	W, 9/16	Additional Examples from Chapter 3	
	F, 9/18	Axial Loading - Deformation	4.1 & 4.2
5	M, 9/21	Statically Indeterminate Axially-Loaded Members	4.3 – 4.5
	W, 9/23	Thermal Stress	4.6
	F, 9/25	Additional Examples from Chapter 4	
6	M, 9/28	Torsion of Circular Shafts	5.1 – 5.3
	W, 9/30	Angle of Twist	5.4
	F, 10/2	Statically Indeterminate Shafts (SIS)	5.5
7	M, 10/5	SIS and Additional Examples from Chapter 5	
	W, 10/7	Shear and Moment Diagrams – Analytical Method	6.1
	F, 10/9	Shear and Moment Diagrams – Graphical Method	6.2
8	M, 10/12	Bending Strain and Stress in Beams	6.3 & 6.4
	W, 10/14	Additional Examples from Chapter 6	
	F, 10/16	Additional Examples from Chapter 6	
9	M, 10/19	Shear Stresses in Beams	7.1 & 7.2
	W, 10/21	Additional Examples from Chapter 7	
	F, 10/23	Thin-Walled Pressure Vessels	8.1
10	M, 10/26	Combined Loading	8.2
	W, 10/28	Additional Examples from Chapter 8	
	F, 10/30	Plane-Stress Transformation	9.1 & 9.2
11	M, 11/2	Principle Stresses	9.3
	W, 11/4	Mohr's Circle	9.4 & 9.5
	F, 11/6	Additional Examples from Chapter 9	
12	M, 11/9	Additional Examples from Chapter 9	
	W, 11/11	Generalized Hooke's Law	10.6
	F, 11/13	Additional Examples from Chapter 10	
13	M, 11/16	Beam Design	11.1 – 11.3
	W, 11/18	Additional Examples from Chapter 11	
	F, 11/20	Deflection of Beams	12.1 & 12.2
14	M, 11/23	Additional Examples from Chapter 12	
	11/25 – 29	**Thanksgiving Recess**	
15	M, 11/30	Buckling of Columns	13.1 – 13.3
	W, 12/2	Additional Examples from Chapter 13	
	F, 12/4	Review	