## MAE 243 – Mechanics of Materials

**Fall 2018**

# 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**

**Course Coordinator**: **Dr. Sam Mukdadi**, Office: 927 ESB, 304-293-3110, E-mail: [sam.mukdadi@mix.wvu.edu](mailto:sam.mukdadi@mix.wvu.edu), Office Hours: MWF 11:00 - 12:00.

Section 001 (CRN: 80537), MWF 2:00 – 2:50, G39 ESB, **Dr. Nithi Sivaneri**, Office: 951 ESB, (304) 293-3191 E-mail: [nithi.sivaneri@mail.wvu.edu](mailto:nithi.sivaneri@mail.wvu.edu), Office Hours: MWR 11:00 - 12:00

Section 002 (CRN: 81923), TR 11:00 – 12:15, G102 ESB, **Dr. Sam Mukdadi**, Office: 927 ESB, 304-293-3110, E-mail: [sam.mukdadi@mix.wvu.edu](mailto:sam.mukdadi@mix.wvu.edu), Office Hours: MWF 11:00 - 12:00.

Section 003 (CRN: 83235), MWF 9:00 – 9:50, G39 ESB, **Dr. Nithi Sivaneri**, Office: 951 ESB, (304) 293-3191 E-mail: [nithi.sivaneri@mail.wvu.edu](mailto:nithi.sivaneri@mail.wvu.edu), Office Hours: MWR 11:00 - 12:00

**Course Goals:**

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 students are required to establish basic skills by the end of the semester in order to **PASS** the course. The exam materials emphasize the understanding of the following goals:

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.

**Expected Outcomes:**

Key Course for ABET Outcome *e*:

“Graduates will have an ability to identify, formulate, and solve engineering problems.”

**Final Exam:**

It is important that the students taking this course understand that the final exam will be:

1. Comprehensive, i.e., it will include all topics listed on the attached syllabus, and
2. Common final, i.e., all sections will have the same problems on the final.

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.

**Course Grading:**

Homework (paper based & online) 15%

Quizzes 10%

2 Tests (Common for all sections) 45%

Final Exam (Common for all sections) 30%

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).**

**Class Attendance:**

**Class attendance is not required;** but students cannot reasonably expect to master the course material without regular attendance at class. Students are responsible for all material covered and in class regardless of their attendance. No make-up quizzes will be given for missed classes.

**Quizzes:**

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.

**Policy on Missed Mid-term Exams:**

Students may miss one (and only one) test due to an emergency case (for example, sudden illness). If the excuse is accepted, the final exam score will adjust to make for the missed test.

**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

**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:

3.12

Problem 3.12

MAE 243 - 001

John Simpson

1/5

Due: July 13, 2010

Submitted: same

Mechanics of Materials

**HOMEWORK # 4**

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:

(→ +) ;  (3)



Replacing *NA* into Eq. (3); 



1. Homework must be stapled at the top left corner. Loose sheets will not be accepted.

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**

Tuesday, August 21 Last Day to Register, Add New Courses, Make Section Changes, Change Pass/Fail, and Audit

Monday, September 3 Labor Day Recess

Thursday, October 4 Mid-Check Grades Due by noon

Friday, October 12 Fall Break Recess

Tuesday, October 23 Last Day to Drop a Class

Tuesday, November 6 General Election Recess

November 19-23 Thanksgiving Recess

Wednesday, December 5 Last Day to Withdraw from the University

Thursday, December 6 Last Day of Classes

**Common Test Dates**

Wednesday, September 19 **Test 1**, 7:00 – 9:00 PM, Room TBA, Ch. 1 - 4

Wednesday, October 17 **Test 2**, 7:00 – 9:00 PM, Room TBA, Ch. 5 – 7

Thursday, December 13 **Final**, 8:00 – 10:00 PM, Room TBA, **Comprehensive**

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| --- | --- | --- | --- |
| **Week** | **Day** | **Topic** | **Section** |
| 1 | W, 8/15 | Introduction | 1.1 & 1.2 |
| F, 8/17 | Normal Stress | 1.3 & 1.4 |
| 2 | M, 8/20 | Shear Stress | 1.5 |
| W, 8/22 | Allowable Stress and Design | 1.6 & 1.7 |
| F, 8/24 | Strain | 2.1 & 2.2 |
| 3 | M, 8/27 | Mechanical Properties of Materials | 3.1 – 3.3 |
| W, 8/29 | Hooke’s Law and Strain Energy | 3.4 & 3.5 |
| F, 8/31 | Poisson’s Ratio and Shear Stress-Strain Diagram | 3.6 & 3.7 |
| 4 | **M, 9/3** | **Labor Day Recess - No Class** |  |
| W, 9/5 | Additional Examples from Chapter 3 |  |
| F, 9/7 | Axial Loading - Deformation | 4.1 & 4.2 |
| 5 | M, 9/10 | Statically Indeterminate Axially-Loaded Members | 4.3 – 4.5 |
| W, 9/12 | Thermal Stress | 4.6 |
| F, 9/14 | Additional Examples from Chapter 4 |  |
| 6 | M, 9/17 | Torsion of Circular Shafts | 5.1 – 5.3 |
| W, 9/19 | Angle of Twist | 5.4 |
| F, 9/21 | Statically Indeterminate Shafts (SIS) | 5.5 |
| 7 | M, 9/24 | SIS and Additional Examples from Chapter 5 |  |
| W, 9/26 | Shear and Moment Diagrams – Analytical Method | 6.1 |
| F, 9/28 | Shear and Moment Diagrams – Graphical Method | 6.2 |
| 8 | M, 10/1 | Bending Strain and Stress in Beams | 6.3 & 6.4 |
| W, 10/3 | Additional Examples from Chapter 6 |  |
| F, 10/5 | Additional Examples from Chapter 6 |  |
| 9 | M, 10/8 | Shear Stresses in Beams | 7.1 & 7.2 |
| W, 10/10 | Additional Examples from Chapter 7 |  |
| F, 10/12 | **Fall Break Recess - No Class** |  |
| 10 | M, 10/15 | Thin-Walled Pressure Vessels | 8.1 |
| W, 10/17 | Combined Loading | 8.2 |
| F, 10/19 | Additional Examples from Chapter 8 |  |
| 11 | M, 10/22 | Plane-Stress Transformation | 9.1 & 9.2 |
| W, 10/24 | Principle Stresses | 9.3 |
| F, 10/26 | Mohr’s Circle | 9.4 & 9.5 |
| 12 | M, 10/29 | Additional Examples from Chapter 9 |  |
| W, 10/31 | Additional Examples from Chapter 9 |  |
| F, 11/2 | Generalized Hooke’s Law | 10.6 |
| 13 | M, 11/5 | Additional Examples from Chapter 10 |  |
| W, 11/7 | Additional Examples from Chapter 10 |  |
| F, 11/9 | Beam Design | 11.1 – 11.3 |
| 14 | M, 11/12 | Additional Examples from Chapter 11 |  |
| W, 11/14 | Deflection of Beams | 12.1 & 12.2 |
| F, 11/16 | Additional Examples from Chapter 12 |  |
| 15 | 11/19 –11/23 | **Thanksgiving Recess** |  |
| 16 | M, 11/26 | Additional Examples from Chapter 12 |  |
| W, 11/28 | Buckling of Columns | 13.1 – 13.3 |
| F, 11/30 | Additional Examples from Chapter 13 |  |
| 17 | M, 12/3 | Review |  |
| W, 12/5 | Review |  |