Mechanical Design

by Richard G. Budynas and J. Keith Nisbett

CRN: 24242
Class Time: 1:30 – 2:50 pm MW. Undergraduate Learning Center 216

Prerequisite: Mechanicals of Materials

Professor: Methaq Abed, Ph.D., P.E.
Department: Mechanical Engineering
Office: A104
Email: msabed@utep.edu

Office Hours: Monday & Tuesday 12:00-1:15 pm, and students are welcome to set up an appointment to meet through Ms Teams for another day and time if needed.

COURSE DESCRIPTION:

This three-credit-hour class is intended to provide the students with intensive learning about the analysis and design concepts for beams and rods in three dimensions. Besides, to learn how to calculate the deflections of the essential elements in the structure at the critical locations. New concepts about the consideration of the buckling in the design process will be discussed, as well as determining the final design factor for the component. The use of software to compare the analysis results for a project may be needed.

COURSE OBJECTIVES:

At the end of this course, students will be able to:

- Understand the economics, tolerances, safety, and probability of failure.
- Study the mechanical properties of materials, including the cold work, hardness, effects of temperatures, and creep. Identify the material as brittle or ductile.
- Study in-depth the analysis of structural and mechanical components under statics loads in 2D and 3D.
- Understand how to use Mohr's circle to calculate the principal stresses in 2D and 3D.
• Analyze any given type of structure or machine and identify the principal stresses at the critical sections.
• Use the superposition method and tables to calculate the deflection for determinate and indeterminate structures.
• Learn and apply the principles of buckling into mechanical elements that are subjected to compression loads.
• Understand the cracks propagation and failure criterion.
• Calculate the fatigue and include the essential factors.

TOPICS

1. Introduction (Chapter 1)
2. Materials (Chapter 2)
3. Load and stress analysis (Chapter 3)
4. Deflection and stiffness (Chapter 4)
5. Failures resulting from static loading (Chapter 5)
6. Failures resulting from variable loading (Chapter 6)

LEARNING MODULES

This course is designed using a modular format—that is, each week is "packaged" as a single module so that all the materials, lecture notes, submission areas, discussion posts are in one area for a given week.

GRADES

Your grade for this course will be assessed based on your performance in:

Mid-term exams (50%)
Project (20%)
Quizzes (10 %)
Homework (20%)

Anticipated Exams Dates:

Test #1 Feb. 8th
Test #2: March. 6th
Test #3: April. 7th
Test #4: May 1st

Note: Any of the tests might be given on another day in the same week.

Your final grade will be calculated based on the points you have accumulated as follows:

A  $\geq 88$
B  $\geq 78$ but $<88$
C  $\geq 68$ but $<78$
D  $\geq 58$ but $<68$
F  $<58$

**Exams:** There will be four exams. *No makeup exam will be given under any circumstances.* If you miss two exams, the instructor has the right to drop you or assign you an "F" grade for the class. The exams' grades will be calculated based on the average of the three highest tests' grades. *It means that the lowest test grade will be dropped.* Students may work on the projects in groups by week #10.

**Homework:** All homework assignments will be through McGraw Hill connect. Therefore, all students are required to register for the course through McGraw Hill connect during the first week of class. If a student fails to register to the course after 10 days of starting the class, the instructor has the right to drop him/her from class. No homework outside the McGraw Hill Connect will be accepted.

*Register to the course through McGraw Hill connect through Blackboard by following the steps below:*

- Log in to your course through Blackboard
- Access Homework folder and click on H.W.#1 to get the link to register for the course through McGraw Hill connect.

**Quizzes:** The quizzes will be given in class/ Maybe through McGraw-Hill Connect if there are no F2F classes.

**TECHNOLOGY REQUIREMENTS**

Course content is delivered via the Internet through the Blackboard learning management system. Ensure your UTEP email account is working and that you have access to the Web and a stable web browser. Google Chrome and Mozilla Firefox are the best browsers for Blackboard; other browsers may cause complications. When having technical difficulties, update your browser, clear your cache, or try switching to another browser.

You will need to have access to a computer/laptop, a scanner, a webcam, and a microphone. You will need to download or update the following software: Microsoft Office, Adobe Acrobat Reader, Windows Media Player, QuickTime, and Java. Check that your computer hardware and software are up-to-date and able to access all parts of the course.
If you do not have a word-processing software, you can download Word and other Microsoft Office programs (including Excel, PowerPoint, Outlook and more) for free via UTEP's Microsoft Office Portal. Click the following link for more information about Microsoft Office 365 and follow the instructions.

IMPORTANT: If you encounter technical difficulties beyond your scope of troubleshooting, please contact the UTEP Help Desk as they are trained specifically in assisting with the technological needs of students. Please do not contact me for this type of assistance. The Help Desk is much better equipped than I am to assist you!

EXCUSED ABSENCES AND/OR COURSE DROP POLICY
According to UTEP Curriculum and Classroom Policies, "When, in the judgment of the instructor, a student has been absent to such a degree as to impair his or her status relative to credit for the course, the instructor may drop the student from the class with a grade of "W" before the course drop deadline and with a grade of "F" after the course drop deadline." See academic regulations in the UTEP Undergraduate Catalog for a list of excused absences. Therefore, if I find that, due to non-performance in the course, you are at risk of failing, I will not drop you from the course. However, if you feel that you are unable to complete the course successfully, please let me know and then contact the Registrar's Office to initiate the drop process. If you do not, you are at risk of receiving an "F" for the course.

MAKEUP WORK
Makeup work will be given only in the case of a documented emergency. Note that makeup work may be in a different format than the original work, may require more intensive preparation, and maybe graded with penalty points. If you miss an assignment and the reason is not considered excusable, you will receive a zero. It is therefore important to reach out to me—in advance if at all possible—and explain with proper documentation why you missed a given course requirement. Once a deadline has been established for makeup work, no further extensions or exceptions will be granted.

ALTERNATIVE MEANS OF SUBMITTING WORK IN CASE OF TECHNICAL ISSUES
I strongly suggest that you submit your work with plenty of time to spare in the event that you have a technical issue with the course website, network, and/or your computer. I also suggest you save all your work (answers to discussion points, quizzes, exams, and essays) in a separate Word document as a backup. This way, you will have evidence that you completed the work and will not lose credit. If you are experiencing difficulties submitting your work through the course website, please contact the UTEP Help Desk. You can email me your backup document as a last resort.

INCOMPLETE GRADE POLICY
Incomplete grades may be requested only in exceptional circumstances after you have completed at least half of the course requirements. Talk to me immediately if you believe an incomplete is warranted. If granted, we will establish a contract of work to be completed with deadlines.

ACCOMMODATIONS POLICY
The University is committed to providing reasonable accommodations and auxiliary services to students, staff, faculty, job applicants, applicants for admissions, and other beneficiaries of University
programs, services and activities with documented disabilities in order to provide them with equal opportunities to participate in programs, services, and activities in compliance with sections 503 and 504 of the Rehabilitation Act of 1973, as amended, and the Americans with Disabilities Act (ADA) of 1990 and the Americans with Disabilities Act Amendments Act (ADAAA) of 2008. Reasonable accommodations will be made unless it is determined that doing so would cause undue hardship on the University. Students requesting an accommodation based on a disability must register with the UTEP Center for Accommodations and Support Services (CASS). Contact the Center for Accommodations and Support Services at 915-747-5148, or email them at cass@utep.edu, or apply for accommodations online via the CASS portal.

SCHOLASTIC INTEGRITY
Academic dishonesty is prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as ones' own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the Office of Student Conduct and Conflict Resolution (OSCCR) for possible disciplinary action. To learn more, please visit HOOP: Student Conduct and Discipline.

COPYRIGHT STATEMENT FOR COURSE MATERIALS
All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.

Course Resources: Where you can go for assistance
UTEP provides a variety of student services and support:
Technology Resources
- Help Desk: Students experiencing technological challenges (email, Blackboard, software, etc.) can submit a ticket to the UTEP Helpdesk for assistance. Contact the Helpdesk via phone, email, chat, website, or in person if on campus.

Academic Resources
- UTEP Library: Access a wide range of resources, including online, full-text access to thousands of journals and eBooks, plus reference service and librarian assistance for enrolled students.
- University Writing Center (UWC): Submit papers here for assistance with writing style and formatting, ask a tutor for help and explore other writing resources.
- Math Tutoring Center (MaRCS): Ask a tutor for help and explore other available math resources.
- History Tutoring Center (HTC): Receive assistance with writing history papers, get help from a
tutor and explore other history resources.

- **RefWorks**: A bibliographic citation tool; check out the RefWorks tutorial and Fact Sheet and Quick-Start Guide.

Individual Resources

- **Military Student Success Center**: Assists personnel in any branch of service to reach their educational goals.
- **Center for Accommodations and Support Services**: Assists students with ADA-related accommodations for coursework, housing, and internships.
- **Counseling and Psychological Services**: Provides a variety of counseling services including individual, couples, and group sessions as well as career and disability assessments.

**ACES & Tutoring Center**

Please note there are tutoring services available in the ACES center. Tutoring is free to you; the department pays them. If tutors are not used, the department may stop funding them. Check the schedule of the tutors and make use of the services. For more details, visit the

**ME Advising Blackboard -> cc mech acadav: MECH Academic Advising -> Tutoring & Resources**

At the link, you can find tutor schedules, the location of the ACES center, and the list of tutors available. For more information, send an email to METrutors@utep.edu.

**COVID-19 PRECAUTION STATEMENT**

Please stay home if you have been diagnosed with COVID-19 or are experiencing COVID-19 symptoms. If you are feeling unwell, please let me know as soon as possible so that we can work on appropriate accommodations. If you have tested positive for COVID-19, you are encouraged to report your results to covidaction@utep.edu, so that the Dean of Students Office can provide you with support and help with communication with your professors. The Student Health Center is equipped to provide COVID-19 testing.

The Center for Disease Control and Prevention recommends that people in areas of substantial or high COVID-19 transmission wear face masks when indoors in groups of people. The best way that Miners can take care of Miners is to get the vaccine. If you still need the vaccine, it is widely available in the El Paso area, and will be available at no charge on campus during the first week of classes. For more information about the current rates, testing, and vaccinations, please visit epstrong.org.
Weekly Calendar (Subject to Change)

This calendar provides an overview of the course. More details and a weekly checklist are available in the weekly modules in Blackboard. The due date for major writing assignments is ALWAYS Sunday at 11:59 pm (MST). No late work will be accepted.

KEY:

<table>
<thead>
<tr>
<th>Weeks</th>
<th>Topics</th>
<th>Readings Due</th>
<th>Assignments Due</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>Week 1</td>
<td>*Class introduction</td>
<td>Review syllabus, Bb Lect. 1-3</td>
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<td>Jan.16th Martin Luther King Jr. Day.</td>
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<td>1/16-1/22</td>
<td>*Syllabus, *Review of Statics</td>
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<td>University Closed</td>
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<td></td>
<td><em>Load Analysis and Stress Analysis</em></td>
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<td>1/23-1/29</td>
<td>Reviewing Internal forces</td>
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<td>Week 3</td>
<td><em>Load Analysis by Using Singularity Meth.</em></td>
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<td>1/30-2/05</td>
<td>*Chapter -3- part-1</td>
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<td>H.W.#1 due 2/05</td>
<td>Quiz#1 due Wednesday</td>
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<td></td>
<td>*Stresses and Mohr's Circle</td>
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<tr>
<td>2/06-2/12</td>
<td>*Chapter -3- part-2</td>
<td>Test #1</td>
<td>H.W.#2 due 2/13</td>
<td>Test #1 due 2/08</td>
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<td>Week 5</td>
<td>Mohr’s Circle, Normal and Shear Stresses in Beams</td>
<td>*Chapter -3- part-2</td>
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<td>2/13-2/19</td>
<td>*Chapter -3- part-2</td>
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<td>Week 6</td>
<td>Normal and Shear Stresses in Beams and 2 Plane Pending</td>
<td>*Chapter -3- part-2</td>
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<td>2/20-2/26</td>
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<td>Week 7</td>
<td>*3D Structural Analysis and Stress Calculation</td>
<td>*Chapter -3- part-2</td>
<td>Quiz#2 due on Wednesday</td>
<td>H.W.#3 due 3/05</td>
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<td>2/27-3/05</td>
<td>Torsional Stress*</td>
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<td>Week</td>
<td>Date</td>
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<td>8</td>
<td>3/06-3/12</td>
<td>Test#2 Torsional Stress*</td>
<td>Test#2 on Monday, March 6th.</td>
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<td>3/13-3/19</td>
<td>Spring Break</td>
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<td>9</td>
<td>3/20-3/26</td>
<td>* Deflections Calculations by Superposition Method and Using Tables</td>
<td>*Chapter -4- part-1</td>
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<td>10</td>
<td>3/27-4/02</td>
<td>* Buckling for Compression Members</td>
<td>*Chapter -4- part-2 H.W. #4 due 4/02</td>
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<td>*Quiz#3 Due on Wednesday</td>
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<td>11</td>
<td>4/03-4/09</td>
<td>* Failure Resulting from Statics Loadings * Failure Criterion</td>
<td>*Chapter-5- part -1 *Chapter-5- part -2</td>
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<td>12</td>
<td>4/10-4/16</td>
<td>* Failure Criterion * Introduction to Fracture Mechanism *</td>
<td>*Chapter-5- part -2 H.W. #5 Due to 04/16</td>
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<td>13</td>
<td>04/07-04/23</td>
<td>* Introduction to Fracture Mechanism</td>
<td>Test#3 Test #3 Due on Monday 04/07</td>
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<td>14</td>
<td>04/24-04/30</td>
<td>Fatigue Failure Resulting from Variable Loads *Stress-Life Method and S-N Diagrams</td>
<td>Chapter-6-part-1 Fatigue H.W. #7 05/01 (for Practice only, not counting for credits)</td>
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<td>15</td>
<td>5/01-5/05</td>
<td>*Stress-Life Method and S-N Diagrams *Fatigue Stress</td>
<td>Chapter-6-part-2 Fatigue Test#4 Optional Project due on May, 3rd. Turn it in as a hard copy</td>
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The above schedule, policies, and assignments in this course are subject to change in the event of extenuating circumstances or by mutual agreement between the instructor and the students.