

# Fracture Mechanics – Fall 2021

MME 4333 CRN 17979, MME 5390 CRN 15898, MASE 6390 CRN 15816

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Lecture M, W, 10:30 - 11:50 Quinn Hall Room 206

Office Hours T, 1:30 – 2:30 pm Microsoft Teams  
Or by appointment

## COURSE DESCRIPTION

This course is a 3-credit elective course on the deformation behavior of materials and fracture mechanics. The initial portion of the course will reintroduce important aspects from the mechanics of materials curriculum including methods to analyze elastic beam bending, torsion and combined loading in idealized laboratory experiments and engineering applications. Plastic flow of materials will be briefly reviewed including micro- and macroscopic yielding including yield criteria for multiple material systems. The course will then progress to fundamental concepts in the fracture of materials including the statistical nature of fracture, stress concentrations, Linear Elastic Fracture Mechanics (LEFM), Elastic-Plastic Fracture Mechanics (EPFM), cyclic stress/fatigue, and fatigue crack propagation. Finally, we will review laboratory methods to assess the fracture toughness and fatigue crack propagation behavior of materials.

## COURSE OUTLINE

### MECHANICS OF MATERIALS

- Center of Gravity, Centroid and Moment of Inertia
- Stress and Strain Transformations
- Bending, Torsion, Combined Loading

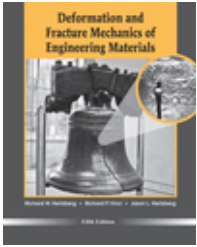
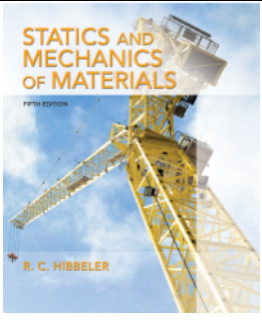
### YIELD AND PLASTIC DEFORMATION

- Yield Criteria for Metals and Ceramics
- Plastic Instability and Necking
- Micro- and Macroscopic Deformation Characteristics

### FRACTURE

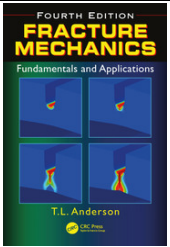
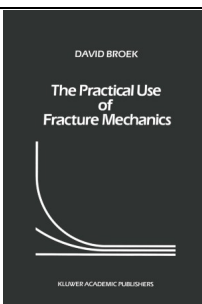
- Theoretical Strengths of Materials
- Defects and Stochastic Effects on Fracture
- Linear Elastic Fracture Mechanics (LEFM, Griffith)
- Elastic-Plastic Fracture Mechanics (EPFM, Orowan-Irwin)
- Elastic-Plastic Analysis with the J-Integral
- Stress Analysis of Cracks
- Fracture Toughness Measurements
- Fatigue/Cyclic Loading

## REFERENCES:

	<p>PRIMARY (recommended)</p> <p>Deformation and Fracture Mechanics of Engineering Materials, 5th Edition</p> <p>Richard W. Hertzberg, Richard P. Vinci, Jason L. Hertzberg  <a href="#">Hertzberg</a></p>
	<p>SECONDARY</p> <p>Statics and Mechanics of Materials or Mechanics of Materials</p> <p>R.C. Hibbeler</p> <p>This will be used as a reference during the Mechanics of Materials review to start the semester. Alternatively, this general content should be in most any mechanics of materials book.</p>

## OTHER REFERENCES

These are not required by are included for your own information.

	<p>Advanced Topics:</p> <p>Fracture Mechanics</p> <p>Ted Anderson  <a href="#">Anderson</a></p>
	<p>The Practical Use of Fracture Mechanics</p> <p>David Broek  <a href="#">Broek</a></p>

## **GRADING** (subject to Revision)

Quizzes	10%
Exam 1 Mechanics of Materials	20%
Exam 2 Deformation and LEFM	25%
Exam 3 Fracture	25%
Report/Presentation	20%

Because this class is offered to undergraduate, fast-track and doctoral students, there will be some differentiation in the exams and final report. Graduate students will see advanced problems on the midterm exams and differentiation on the report/presentation.

## **Report/Presentation**

Students will be required to submit a written report and make a final presentation to the class. Elements of this assignment include a literature review with a detailed technical review of the underlying fracture mechanics. Fast track and graduate students should include additional elements including analytical and computational modeling to supplement experimental observations. By the end of September, students will be expected to provide an abstract outlining their goals for the semester. Students will meet periodically with the instructor to review and discuss progress. Topics should reflect your respective program of study. Graduate students in the MASE program should identify topics that align nicely with their proposed dissertation topics.

## **TECHNOLOGY REQUIREMENTS**

The course will be delivered in person in a traditional lecture setting. Dr. Schuster may be required to be on travel for official University business and will likely teach using Zoom. Office hours will be conducted through individual meetings on teams. You can send a message during office hours and I will contact you in the order of the waiting list.

## **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 excuse absences. Therefore, if I find that, due to non-performance in the course, you are at risk of failing, I will drop you from the course. I will provide 24 hours advance notice via email.

OR

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.

## **DEADLINES, LATE WORK, AND ABSENCE POLICY**

See the weekly announcements email or in class due date and time for your quizzes and other coursework. Homework will be assigned and you are encouraged to work through the solutions, but it will not be collected and graded.

Make-up work will be given *only* in the case of a *documented* emergency. Note that make-up work may be in a different format than the original work, may require more intensive preparation, and may be 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 make-up work, no further extensions or exceptions will be granted.

Give yourself plenty of time to submit your coursework to avoid technical issues near deadlines.

## **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](mailto: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](#).

## **CLASS RECORDINGS**

The use of recordings will enable you to have access to class lectures, group discussions, and so on in the event you miss a synchronous or in-person class meeting due to illness or other extenuating circumstance. Our use of such technology is governed by the Federal Educational Rights and Privacy Act (FERPA) and UTEP's acceptable-use policy. A recording of class sessions will be kept and stored by UTEP, in accordance with FERPA and UTEP policies. Your instructor will not share the recordings of your class activities outside of course participants, which include your fellow students, teaching assistants, or graduate assistants, and any guest faculty or community-based learning partners with whom we may engage during a class session. **You may not share recordings outside of this course.** Doing so may result in disciplinary action.

## **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.

## **COVID-19 PRECAUTIONS**

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](mailto: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.

Students who are considered high risk according to CDC guidelines and/or those who live with individuals who are considered high risk may contact [Center for Accommodations and Support Services](#) (CASS) to discuss temporary accommodations for on-campus courses and activities.