AAE 654- Fracture Mechanics

Spring 2017 Syllabus

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Lecture
Tuesdays and Thursdays, Time: TBD, 75 Minute Lectures in Pro-Ed classrooms in Wang Hall

Office Hours
Based on class Poll, Usually 90 Minutes on Thursdays and 90 Minutes on Fridays
In addition: for distance students special weekend appointments and phone appointments available on request by calling or by email

Goals
The objective of this course is to provide students with an introduction to the mechanics of fracture of brittle and ductile materials. Lectures will focus on the basics of linear-elastic fracture mechanics (LEFM) and elastic-plastic fracture mechanics (EPFM) including the J-Integral. Time dependent fracture including creep and fatigue crack growth will be covered. Methods to experimental determine fracture properties (ASTM standards) will be introduced.

Course Outcomes
At the end of course the students will have fundamental understanding of the following:
Introduction to the mechanics of fracture of brittle and ductile materials. Linear elastic fracture mechanics; elastic-plastic fracture; fracture testing; numerical methods; composite materials; creep and fatigue fracture.

Textbook

Homework
Homeworks will have roughly a frequency of one per week. Your homeworks will be graded and solutions will be posted on the Blackboard Learn website. Homeworks will be returned in class for in-class students and through emails to Pro-Ed students. Homework solutions will be scanned and posted on Blackboard Learn for all students. The home work submission deadline
time is beginning of the lecture on the day homework is due. For distance students the submission is at the end of the day (11:59 PM) on which homework is due by email to instructor and copied to both TA and grader. ALL SUBMISSIONS MUST BE IN PDF FORMAT. Homework must be legible and professional (neat, orderly, final solutions circled or boxed). Illegible homework solutions will be marked as incorrect.

**Exams**
Three exams will be given during the semester. Exam dates/time/format are to be determined. Exams will consist primarily of numerical problems but may also include short answer problems as appropriate for the course material.

**Grading**
Homework/Projects (assignments to be determined): 30% Exams (3 equally weighted): 70%
Course grades will be “curved” if necessary – this decision will not be made until the end of the semester once all exams and homework assignments are graded.

**Policies**
The *University Regulations Handbook* reads: "Students are expected to be present for every meeting of the classes in which they are enrolled." Regular attendance will not be taken, but if you must miss a class, you are responsible for the lecture material, assignments and / or announcements made.

Late homework will generally not be accepted except in the case of illness or serious emergency. Contact the instructor before the due date (if possible) to arrange an acceptable due date.
Illnesses and emergencies should be documented with an appropriate authority (such as a doctor etc.)

**Grading Corrections**
Any disputes over grading should be brought to the instructor.

**Campus Emergencies**
In the event of a major campus emergency, course requirements, deadlines, and grading percentages are subject to changes that may be necessitated by a revised semester calendar or other circumstances beyond the instructor’s control. Information about these changes will be available from the Blackboard Vista web page, via my e-mail (tomar(at)purdue.edu) or my office phone (765-494-3423).

**PLEASE NOTE THAT** Purdue’s home page ([www.purdue.edu](http://www.purdue.edu)) is the official source of emergency information.

**Honor Code:**
Collaboration with other students on assessments and homework is acceptable - even encouraged - because learning from peers is a valuable addition to the educational experience.
However, each student is responsible for completing his/her own work. All submitted assignments must be demonstrably independent from that of other students.

**EMERGENCY PREPAREDNESS – A MESSAGE FROM PURDUE**

To report an emergency, **call 911**. To obtain updates regarding an ongoing emergency, sign up for Purdue Alert text messages, view [www.purdue.edu/ea](http://www.purdue.edu/ea).

There are nearly 300 **Emergency Telephones** outdoors across campus and in parking garages that connect directly to the PUPD. If you feel threatened or need help, push the button and you will be connected immediately.

If we hear a **fire alarm** during class we will immediately suspend class, evacuate the building, and proceed outdoors. **Do not use the elevator.**

If we are notified during class of a **Shelter in Place requirement for a tornado warning**, we will suspend class and shelter in [the basement].

If we are notified during class of a **Shelter in Place requirement for a hazardous materials release, or a civil disturbance**, including a shooting or other use of weapons, we will suspend class and shelter in the classroom, shutting the door and turning off the lights.


**Wang Hall Emergency Procedures**

A comprehensive listing of all Armstrong Hall emergency procedures and other information is available in the Building Emergency Plan (BEP). Click the link below to access the ARMS BEP.


The two most common emergency situations encountered at Purdue at fire alarms and severe weather alerts. The evacuation/shelter-in-place locations for these two types of emergencies are below (as described in the BEP):

**Fire Alarm:** The evacuation location for the ENE spaces in WANG is the grassy area to the north of the rear parking lot (shown in the photo below). Use the nearest stairwell to exit the building. **Do not use the elevator.**
Severe Weather Shelter-In-Place: The severe weather shelter-in-place location for WANG is any space on the first floor that is away from windows and other glass. Ideally, the first floor stairwell, restrooms, and janitor area are to be used. An alternate shelter-in-place location is the tunnel underneath the Northwestern Parking Garage. This location should only be used if it is safe to briefly travel outdoors.

An ENE emergency response plan for WANG will be developed in the coming months.
## AAE 654- Fracture Mechanics

### Spring 2017 Course Schedule

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<thead>
<tr>
<th>Week</th>
<th>Book Section</th>
<th>Topics</th>
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</thead>
<tbody>
<tr>
<td>Week #1</td>
<td>1.1-1.4</td>
<td>Syllabus and history Review of basic fracture mechanics</td>
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<tr>
<td></td>
<td></td>
<td>Review of basic fracture mechanics</td>
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<tr>
<td>Week #2</td>
<td>2.1-2.3</td>
<td>Atomic view of fracture Griffith energy criterion</td>
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<tr>
<td>Week #3</td>
<td>2.4-2.5</td>
<td>Energy release rate R and driving force curves</td>
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<tr>
<td>Week #4</td>
<td>2.6-2.9</td>
<td>Stress analysis Crack tip plasticity</td>
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<tr>
<td>Week #5</td>
<td>2.10-2.11, 3.1</td>
<td>Mixed mode fracture Crack tip opening displacement</td>
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<tr>
<td>Week #6</td>
<td>3.2-3.3</td>
<td>J Integral J – CTOD relationships</td>
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<tr>
<td>Week #7</td>
<td>3.4</td>
<td>EXAM 1 (Chapters 1,2) Crack growth resistance curves</td>
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<tr>
<td>Week #8</td>
<td>3.5, 4.1</td>
<td>J controlled fracture Dynamic fracture</td>
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<tr>
<td>Week #9</td>
<td>4.1-4.2</td>
<td>Rapid crack propagation/arrest Creep crack growth</td>
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<td>Week #10</td>
<td>5.1-5.4</td>
<td>Ductile/brittle failure Intergranular fracture</td>
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<td>Week #11</td>
<td>6.1-6.2</td>
<td>Failure in polymers Fracture in ceramics</td>
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<td>Week #12</td>
<td>7.1-7.3</td>
<td>EXAM 2 (Chapters 3,4) Experimental Fracture testing methods</td>
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<tr>
<td>Week #13</td>
<td>7.4-7.6</td>
<td>Elastic-plastic testing methods Dynamic testing</td>
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<tr>
<td>Week #14</td>
<td>8.1-8.3</td>
<td>Fracture testing of polymers Testing of composites and ceramics</td>
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<tr>
<td>Week #15</td>
<td>11.1-11.4</td>
<td>Stress corrosion cracking Hydrogen embrittlement</td>
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<tr>
<td>Week #16</td>
<td>Finals Week</td>
<td>EXAM 3 (Topics from Ch. 4,5,6,7,8,11)</td>
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**Note:**

1. The schedule here is a 16 weeks semester schedule. Extra vacation days such as spring break will be inserted based on adoption of this schedule to a particular semester.
2. Course schedule may change over the course of the semester; changes will be communicated in class and/or electronically.