

# TAM 451: Intermediate Solid Mechanics -- Fall 2024

**MW 10-11:50am**  
**2045 LuMEB**

**Instructor:** Prof. Varda Hagh

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**Course Description:** Analysis of stress and strain (definitions, transformation of axes, equilibrium equations, and symmetry of the stress tensor); linear materials, Hooke's law; strain energy, potential energy, energy principles and methods; two-dimensional problems in elasticity (torsion, axisymmetric problems); the finite-element method for two- and three-dimensional boundary-value problems in linear elasticity; plasticity (introduction, yield criteria, elastic-plastic behavior, and limit-load calculations); linear-elastic fracture mechanics (introduction, Griffith's approach, stress intensity factor, and energy release rate). Course Information: 4 undergraduate hours. 4 graduate hours. Prerequisite: TAM 251.

**Textbook:** Suggested, but not required: A. F. Bower, *Applied Mechanics of Solids*, Taylor & Francis, 2009; website: <http://solidmechanics.org>

**Office hours:**

Prof Hagh: Mondays 4-5 pm, LuMEB 3042

TA Sri Sridhar: Tuesdays and Thursdays 5-6 pm, LuMEB 0024

**Course webpage:** You can access general information about the course, download this document, homework, lecture notes, etc. and check your grades at the TAM 451 Illinois Canvas web site.

**Grading:** Your semester score will be based on homework (20%), two quizzes (each 25%), and a final exam (30%). Note HW must be submitted on Canvas by the posted due date. Your lowest homework grade will be dropped from your final grade. Your semester grade will be determined on the basis of your semester score as follows (>90%, A; 80-89%, B; 70-79%, C; etc.).

**Course Expectations:**

**Classes.** During class time, the instructor will introduce and discuss new concepts, present and solve example problems. While solving example problems, the instructor will solicit input from students, such that students are actively involved in these portions of the lectures. The idea is that students will first gain knowledge of a new concept, see how to apply the concept to a problem, and then apply the concept with guidance from the instructor. In this way, you will build a knowledge base that will enable you to succeed on homework, exams, and later in approaching similar problems later in your careers.

**Student Expectations.**

- Attend all class sessions, arrive on time, complete homework assignments to augment learning.
- Participate in class by asking and answering questions, and actively participating in solving example problems presented in lectures.
- Refrain from using cellphones, tablets, and laptops for reasons unrelated to the course.
- Show respect for your peers and instructor.

### **Instructor Expectations.**

- Arrive on time to class prepared with an agenda for the day.
- Support student learning by communicating expectations to students, clearly explaining concepts and example problems, and being available to students through email and office hours.
- Show respect for students by grading fairly and consistently and accepting feedback from students with an open mind.

### **Accommodations for Disabilities.**

To obtain disability-related academic adjustments and/or auxiliary aids, students with disabilities must contact the course instructor as soon as possible. To ensure that disability-related concerns are properly addressed from the beginning, students with disabilities who require assistance to participate in this class should contact Disability Resources and Educational Services (DRES) and see the instructor as soon as possible. If you need accommodations for any sort of disability, please speak to me after class, or make an appointment to see me, or see me during my office hours. DRES provides students with academic accommodations, access, and support services. To contact DRES you may visit 1207 S. Oak St., Champaign, call 333-4603 (V/TDD), or e-mail a message to [disability@uiuc.edu](mailto:disability@uiuc.edu). <http://www.disability.illinois.edu/>.

### **Student Code & Academic Integrity.**

The University of Illinois at Urbana-Champaign *Student Code* should also be considered as a part of this syllabus. Students should pay particular attention to Article 1, Part 4: Academic Integrity. Read the Code at the following URL: <http://studentcode.illinois.edu/>. Academic dishonesty may result in a failing grade. Every student is expected to review and abide by the Academic Integrity Policy: <http://studentcode.illinois.edu/>. Ignorance is not an excuse for any academic dishonesty. It is your responsibility to read this policy to avoid any misunderstanding. Do not hesitate to ask the instructor(s) if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity. *All students are responsible to refrain from infractions of academic integrity, conduct that may lead to suspicion of such infractions, and conduct that aids others in such infractions. "I did not know" is not an excuse. The following are academic integrity infractions:*

- Cheating - using or attempting to use unauthorized materials
- Plagiarism - representing the words, work, or ideas of another as your own
- Fabrication - falsification or invention of any information, including citations
- Facilitating infractions of academic integrity - helping or attempting to help another commit infraction
- Bribes, Favors, and Threats - actions intended to affect a grade or evaluation
- Academic Interference - tampering, altering or destroying educational material or depriving someone else of access to that material

(source <http://www.provost.illinois.edu/academicintegrity/students.html> )

***Violators will be caught*** – we check. You can easily fail course or worse! All infractions are documented in campus-wide FAIR database.

### **Family Educational Rights and Privacy Act (FERPA).**

Any student who has suppressed their directory information pursuant to *Family Educational Rights and Privacy Act* (FERPA) should self-identify to the instructor to ensure protection of the privacy of their attendance in this course. See <http://registrar.illinois.edu/ferpa> for more information on FERPA.

### **Note**

This syllabus is subject to change based on student progress and feedback throughout the semester.

## TAM 451 Syllabus – Fall 2024

*Note this schedule reflects the topics to be discussed and the general flow of the class, however the dates are approximate and may shift as we progress through the semester.*

<b>Date</b>	<b>Topic</b>
M 8/26	Introduction
W 8/28	Index notation
M 9/2	<i>No lecture: Labor Day Holiday</i>
W 9/4	Definition of continuum
M 9/9	Definition of stress, equilibrium
W 9/11	Definition of stress, equilibrium
<b>Friday 9/13</b>	<b>HW 1 due at 5:00 pm</b>
M 9/16	Measures of strain
W 9/18	Measures of strain
M 9/23	Material behavior; axisymmetric plane strain
W 9/25	Material behavior; axisymmetric plane strain
<b>Friday 9/27</b>	<b>HW2 due at 5:00 pm</b>
M 9/30	Plane strain boundary value problems
W 10/2	Plane strain boundary value problems
M 10/7	Plane stress boundary value problems
W 10/9	Airy stress function, Energy Methods
<b>Friday 10/11</b>	<b>HW3 due at 5:00 pm</b>
M 10/14	Quiz #1 Review
<i>W 10/16</i>	<i>Quiz #1</i>
M 10/21	Energy Methods, Finite element method
W 10/23	Finite element method
M 10/28	Finite element method
W 10/30	Plastic material behavior
<b>Friday 11/1</b>	<b>HW4 due at 5:00 pm</b>
M 11/4	Plastic material behavior
W 11/6	Flow theory in plasticity
M 11/11	Elastic-plastic boundary value problems
W 11/13	Linear elastic fracture mechanics

**Friday 11/15 HW5 due at 5:00 pm**

M 11/18 Quiz #2 Review  
*W 11/20 Quiz #2*

M 11/25 *Fall Break*  
W 11/27 *Fall Break*

M 12/2 Linear elastic fracture mechanics  
W 12/4 Linear elastic fracture mechanics

M 12/9 Problem solving workshop  
W 12/11 Final Exam Review

*Th 12/19 8:00 am: Final Exam*