AE 522: Dynamic Response of Materials  
Spring 2024

Instructor: Prof. John Lambros, 306B Talbot Lab, lambros@illinois.edu

Class Hours: Monday and Wednesday 10 am-11:50 am, 410B1 Engineering Hall

Office Hours: To be determined

Textbook and Website: There is no required textbook. Copies of the slides presented during the lectures can be found on the course Canvas site (https://canvas.illinois.edu/courses/43744). You are encouraged to download and/or print them prior to the lectures. The slides contain primarily the theoretical part of the course. Examples will be solved in class on the board.

Recommended Textbooks:

References:

Prerequisites:
TAM 451 or TAM 551 (or equivalent). A knowledge of 3D linear elasticity with use of indicial notation and tensor analysis is required. Some knowledge of plasticity is helpful though not required.

Homework: Handed out approximately every other week for about the first half of the course.
Midterm exam: An in-class exam will be scheduled, tentatively around 2/3 of the way through semester. The exam will cover everything up to and including Chapter 9 (probably).
Lab report: I will try to arrange a demo of a Hopkinson bar lab experiment some time during the second half of the semester. Each student will then be provided with a set of experimental data and write a lab report using these data.

Grading:  
Homework 35%
Exam 40%
Lab Report 25%
Course Outline

1. Introduction: Definition, applications and uses.

2. Uniaxial stress waves: Equation of motion, x-t diagrams, Reflection at boundaries, Impedance mismatch.

3. Uniaxial strain waves: Transverse stress, Method of characteristics.

4. Bulk waves (2D/3D): Longitudinal and shear waves, Rayleigh, Stoneley waves Plane waves in 2D, Reflection and refraction.

5. Wave guides: Dispersion, Phase and group velocities, Vibrating beams, Love waves, Plate problems, 3D bar problems (Pochhammer-Chree).


7. Inelastic waves: Elastic-plastic wave propagation, Hugoniot elastic limit, Wave propagation in rate dependent solids,


9. Dynamic testing techniques: Split Hopkinson Bars, Plate impact technique, Recovery and pressure-shear tests, Other methods (Taylor test, Expanding ring etc.).

10. Strain rate dependence: Metals, Polymers, Glasses/Ceramics, Empirical relations, Physically based relations.


12. Waves in anisotropic media: Bulk waves in anisotropic solids, The Christofel equation, Material symmetry, Slowness and energy flow surfaces, Interaction with a boundary (Snell’s law), Rayleigh waves, Reflection and refraction, Strain rate effects in composite materials,


Run > Hide > Fight

Emergencies can happen anywhere and at any time. It is important that we take a minute to prepare for a situation in which our safety or even our lives could depend on our ability to react quickly. When we’re faced with almost any kind of emergency – like severe weather or if someone is trying to hurt you – we have three options: Run, hide or fight.

Run
Leaving the area quickly is the best option if it is safe to do so.

- Take time now to learn the different ways to leave your building.
- Leave personal items behind.
- Assist those who need help, but consider whether doing so puts yourself at risk.
- Alert authorities of the emergency when it is safe to do so.

Hide
When you can’t or don’t want to run, take shelter indoors.

- Take time now to learn different ways to seek shelter in your building.
- If severe weather is imminent, go to the nearest indoor storm refuge area.
- If someone is trying to hurt you and you can’t evacuate, get to a place where you can’t be seen, lock or barricade your area if possible, silence your phone, don’t make any noise and don’t come out until you receive an Illini-Alert indicating it is safe to do so.

Fight
As a last resort, you may need to fight to increase your chances of survival.

- Think about what kind of common items are in your area which you can use to defend yourself.
- Team up with others to fight if the situation allows.
- Mentally prepare yourself – you may be in a fight for your life.

Please be aware of people with disabilities who may need additional assistance in emergency situations.

Other resources

- police.illinois.edu/safe for more information on how to prepare for emergencies, including how to run, hide or fight and building floor plans that can show you safe areas.

- emergency.illinois.edu to sign up for Illini-Alert text messages.

- Follow the University of Illinois Police Department on Twitter and Facebook to get regular updates about campus safety.