SYLLABUS

AE529 VISCOELASTICITY THEORY
Fall 2024

Instructor: Ioannis Chasiotis (chasioti@illinois.edu)
Class: Mondays, Wednesdays 9:00-10:20 A.M. (106B6 Engineering Hall)
Office hours: By appointment

TOPICS

1. **Rheological Models:** Differential formulation, creep, relaxation and recovery, standard linear solid, generalized rheological models, representation of properties through differential equations, creep compliance, relaxation modulus, retardation and relaxation spectra.
2. **Hereditary Integrals:** Integral forms for stress and strain, application to mechanical analogues, representation of properties through integral equations.
3. **Laplace transform analysis of linear viscoelastic materials:** Application to mechanical models and complex loading, relaxation modulus and creep compliance interconversion.
4. **Special strain histories related to material characterization:** Ramp history and approximation in material tests, time harmonic deformation: Complex moduli and complex compliances - Fourier transform energy dissipation per cycle, damping, impact.
5. **Problems in stress analysis for linearly viscoelastic homogeneous solids:** Correspondence principle, elementary solutions: Torsion and flexure, infinite cylinder under axial load, line load on half space, two dimensional stress fields independent of material properties, contact problems, 1D wave propagation in a viscoelastic solid, viscoelastic Poisson's ratio.
6. **Effect of temperature on polymer behavior:** Time-temperature superposition (thermorheologically simple behavior, thermorheologically complex behavior and physical sources), the glass transition and free volume and the Doolittle and the WLF equation.
7. **Non-linear viscoelasticity:** Leaderman strain-nonlinear behavior, Seth strain behavior, Schapery's approximations, power law behavior, Quasi-linear viscoelasticity (QLV), free volume generalization of linear viscoelastic to nonlinear behavior and consequences for time-dependent compressibility, thermal behavior, etc.

Grading

Homeworks	40%[1]
Midterm	30%[2]
Final Exam	30%

[1] All homeworks contribute equally to the average homework score irrespective of the points assigned to each assignment.
[2] There are no make up midterm or final exams.

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Academic Integrity

Violations of academic integrity are unacceptable. 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 will result in a sanction proportionate to the severity of the infraction, with possible sanctions described in 1-404 of the Student Code (https://studentcode.illinois.edu/article1/part4/1-404/). Every student is expected to review and abide by the Academic Integrity Policy as defined in the Student Code: https://studentcode.illinois.edu/article1/part4/1-401/. As a student it is your responsibility to refrain from infractions of academic integrity and from conduct that aids others in such infractions. A short guide to academic integrity issues may be found at https://provost.illinois.edu/policies/policies/academic-integrity/students-quick-reference-guide-to-academic-integrity/. Ignorance of these policies 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 if you are ever in doubt about what constitutes plagiarism, cheating, or any other breach of academic integrity.

Preparation for Emergencies

Emergencies can happen anywhere and at any time, so it's important that we take a minute to prepare for a situation in which our safety could depend on our ability to react quickly. Take a moment to learn the different ways to leave this building. If there's ever a fire alarm or something like that, you'll know how to get out and you'll be able to help others get out. Next, figure out the best place to go in case of severe weather – we'll need to go to a low-level in the middle of the building, away from windows. And finally, if there's ever someone trying to hurt us, our best option is to run out of the building. If we cannot do that safely, we want to hide somewhere we cannot be seen, and we have to lock or barricade the door if possible and be as quiet as we can. We will not leave that safe area until we get an Illini-Alert confirming that it's safe to do so. If we can't run or hide, we'll fight back with whatever we can get our hands on. If you want to better prepare yourself for any of these situations, visit ***police.illinois.edu/safe***. Remember you can sign up for emergency text messages at ***emergency.illinois.edu***. Watch the short video: ***http://police.illinois.edu/emergency-preparedness/run-hide-fight***

Emergency Response Recommendations

Emergency response recommendations can be found at the following website:
http://police.illinois.edu/emergency-preparedness

For more information, review this website and the campus building floor plans.
http://police.illinois.edu/emergency-preparedness/building-emergency-action-plans