JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

Mechanical Engineering 530.606
Mechanics of Solids and Materials II
Spring, 2019 (3 credits)

Instructor
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Office hours: Malone 117, Wednesdays 3 – 4 PM, or by appointment.

Teaching Assistant
Zheliang Wang
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Class Meetings
Monday, Wednesday, 1:30–2:45 PM, Shriver Hall 001

Textbooks
No required textbooks but references [1]–[8] are useful. References [1]–[3] are freely available through www.library.jhu.edu or at www.solidmechanics.org and are sufficient for most of the course. The progression of topics roughly follows the content of [1].

[1] M. H. Sadd, *Elasticity: theory, applications, and numerics*. Academic Press, 2009.

[2] M. E. Gurtin, E. Fried, and L. Anand, *The mechanics and thermodynamics of continua*. Cambridge University Press, 2010.

[3] A. F. Bower, *Applied mechanics of solids*. CRC press, 2009.

[4] R. J. Atkin and N. Fox, *An introduction to the theory of elasticity*. Courier Corporation, 2013.

[5] C. Truesdell and R. Toupin, "The classical field theories," in *Principles of classical mechanics and field theory/Prinzipien der Klassischen Mechanik und Feldtheorie*, Springer, 1960, pp. 226–858.

[6] N. Muskhelishvili, *Some basic problems of the mathematical theory of elasticity*. Springer, 2013.

[7] A. E. H. Love, *A treatise on the mathematical theory of elasticity*. Cambridge university press, 2013.

[8] Y. Fung, P. Tong, and X. Chen, *Classical and computational solid mechanics*, vol. 2. World Scientific Publishing Company, 2017.

Online Resources

Use Blackboard for digital copy of schedule and some reading assignments.

Course Description and Learning Objectives

This course provides an overview of the area of the mechanics of solids and materials, with the intent of providing the foundation for graduate students interested in research that involves these disciplines. The course is based on the principles of continuum mechanics, and covers the fundamental concepts of elasticity, plasticity, and fracture as applied to materials. One objective is to get graduate students to the point that they can understand significant fractions of research seminars and papers in this area. This mathematically rigorous course emphasizes the setup and solution of boundary value problems in mechanics, and attempts to integrate the primary behaviors with deformation and failure mechanisms in materials. Special topics covered may include (depending on the interests of the student body) wave propagation, viscoelasticity, geomechanics or biomechanics.

Tentative Course Schedule (Subject to change)

Date	Topic	Remark
1/28	Vector and tensor mathematics	
1/30	Tensor calculus, kinematics	HW 1 given
2/4	Strain, linearized kinematics	
2/6	Linearized kinematics, strain compatibility	HW 1 due, 2 given
2/11	Stress, linear elasticity	
2/13	Isotropic linear elasticity, introduction to BVPs	HW 2 due, 3 given
2/18	BVPs: fundamental concepts, direct methods	
2/20	**Snow day, no class**	
2/25	BVPs: plane problems, Airy's stress function	HW 3 due, 4 given
2/27	BVPs: Airy's stress functions; cartesian coordinates	
3/4	BVPs: Airy's stress in polar; stress concentrations	HW 4 due, 5 given
3/6	BVPs: Airy's stress in polar; wedges, cracks, Flamant	
3/11	BVPs: torsion, warping function, rigidity	
3/13	Midterm exam	
3/18-24	Spring Break	
3/25	BVPs: torsion, membrane analogy, Fourier series	HW 5 due
3/27	Introduction to plasticity	HW 6 given
4/1	Plasticity: hardening rules, elastoplastic beam bending	
4/3	Plasticity: Drucker's postulate, elastoplastic sphere	HW 6 due
4/8	Thermoelasticity	HW 7 given
4/10	Elastodynamics	
4/15	Elastodynamics: waves in strings, infinite media	
4/17	Elastodynamics: waves in infinite media	HW 7 due, 8 given
4/22	Elastodynamics: reflections in bars, half spaces, x-t	
4/24	BVPs: Complex variables	HW 8 due, 9 given

4/29	BVPs: Complex variables	
5/1	BVPs: Complex variables	HW 9 due

Grading
Homework (50%), Midterm (25%), Final (25%). Grades will not be curved for individuals. Grading scheme: A+ (97.5-100%), A (92.5-97.49%), A- (89.5-92.49%), B+ (87.5-89.49%), B (82.5-87.49), B- (79.5-82.49%).

Collaboration Policy
You are encouraged to discuss solution strategies to homework problems with other students, but you must find the solutions and write down answers to all questions on your own.

Ethics
The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Report any violations you witness to the instructor.

You can find more information about university misconduct policies on the web at these sites:

- For undergraduates: http://e-catalog.jhu.edu/undergrad-students/student-life-policies/
- For graduate students: http://e-catalog.jhu.edu/grad-students/graduate-specific-policies/

Students with Disabilities
Any student with a disability who may need accommodations in this class must obtain an accommodation letter from Student Disability Services, 385 Garland, (410) 516-4720, studentdisabilityservices@jhu.edu .