

Fall 2009

ENG BE 420 Introduction to Solid Biomechanics

Dimitrije Stamenović
Mon. & Wed., 2 – 4 pm

This is an introductory course whose main goal is to acquaint students with fundamentals of mechanics of solids using the unifying mathematical framework of vectors and tensors. In addition to the classical linear (Hookean) theory, elements of nonlinear theory will be also considered since it provides a more accurate description of biological soft tissues and cells. Illustrative examples from tissue and cell biomechanics will be given.

- **Prerequisites:** MA 226, EK 102 or MA 142 or MA 242, and EK 301 or equivalent.
- **Textbook:** Hjelmstad, K. D. *Fundamentals of Structural Mechanics*, 2nd edition, Springer, New York, 2005.
- **Class notes:** Available on the Course Info web site.
- **Additional Texts:**
 1. Atkin, R. J., and Fox, N. *An Introduction to the Theory of Elasticity*, Longman: London, UK, 1980
 2. Fung, Y. C. *A First Course in Continuum Mechanics*, 3rd edition, Prentice Hall, Englewood Cliffs, NJ, 1994.
 3. Hjelmstad, K. D. *Fundamentals of Structural Mechanics*, Prentice Hall, Upper Saddle River, NJ, 1997.
 4. Humphrey, J. D., and Delange, S. L. *An Introduction to Biomechanics*, Springer, New York, 2004.
 5. Ward, J. P. *Solid Mechanics – An Introduction*, Kluwer, Dordrecht, Netherlands, 1992.
- **Lecture Topics:**
 1. Introduction (continuum, stress, examples) – Notes: Ch. 1
 2. Basic concepts of mechanics of solids (Newton's laws, equilibrium, free-body diagram, trusses, beams, examples) – Notes: Ch. 2
 3. Vectors and tensors (algebra and calculus) – Notes: Ch. 3
 4. Kinematics of deformation (deformation, stretch, strain, volume dilatation, shear, examples) – Notes: Ch. 4
 5. Traction, stress, and stress analysis (traction forces, body forces, stress, balance equations, examples) – Notes: Ch. 5

6. Constitutive equations (isotropy, strain energy, Hooke's law, nonlinear equations, examples) – Notes: Ch. 6
7. Simple beam theory (beam deflections, examples) – Notes: Ch. 7
8. Linear viscoelasticity – if time permits – Notes: Ch. 8.

- **Course Grade:**

1. Weekly quizzes (Wed., 20 min., total 50 pt.)
2. Weekly homeworks (given on Mon. due next Wed., total 50 pt.)
3. 3 projects (total 60 pt.)
4. 2 midterm exams (2 hr., 50 pt. each; the midterm with the lower score will be dropped)
5. Comprehensive final exam (3 hr., 100 pt.)

A student must earn at least 155 points (50%) in order to get a passing grade (D).

Grading scale:

- 0-50% = F
- 50-60% = D
- 60-65% = C–
- 65-70% = C
- 70-75% = C+
- 75-80% = B–
- 80-85% = B
- 85-90% = B+
- 90-95% = A–
- 95-100% = A

Students who on quizzes, homeworks, projects and two midterms do better than 90% (>279 pts.) will be **exempted from the final exam** with the final grade of an A or an A-, according to the above scale.

- **Incompletes & Withdrawals:** Incompletes (I) will be given to students making good academic progress (C or better) who have a compelling reason for being unable to complete the course schedule. Students may withdraw from the course prior to the University's deadline for doing so. Students who take the final exam will not be allowed an incomplete. Students who observe special religious holidays which may conflict with quizzes/exams, please let me know in advance in order to reschedule quizzes/exams.
- **Office Hours:** Tuesday 11 am -12 pm, Friday 1:30-2:30 pm.
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- **E-mail:** dimitrij@bu.edu