

Homework Policy

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- 1) You are welcome to discuss class concepts and the homework problems with one another. However, all final answers, calculations, and explanations on the homework you turn in must be your own work.
- 2) You may not use copies of homework assignments or solutions (from previous years or the current year) or accept help from students who took the class in previous years. You may not share your graded homework with next year's class or help them with their assignments.
- 3) Late homework will be penalized by 10% of its full grade per day late. If you anticipate problems or delays they must be reported to Prof Nerurkar at no less than 24 hours before the due date / time.

SEAS Contract of Academic Integrity

I affirm that I will not plagiarize, use unauthorized materials, or give or receive illegitimate help on assignments, papers, or examinations. I will also uphold equity and honesty in the evaluation of my work and the work of others. I do so to sustain a community built around this Code of Honor.

I certify that my work on this assignment is original and in compliance with the class homework policy and the SEAS Code of Honor.

Signature _____ Date _____

To my knowledge, no member of this class has violated the homework policy, breached the SEAS Code of Honor, or acted unethically with respect to this class.

Signature _____ Date _____

Name (Print) _____

If you are unable to sign this coversheet, please meet with Professor Nerurkar as soon as possible to discuss the issue.

Homework 3

DUE BY UPLOAD TO GRADESCOPE NO LATER THAN 9/29 at 11:59PM (MONDAY!)

- (1 point) Explain in 5 sentences or less how the equations of motion (Eq. 6.5) were derived from $\mathbf{F} = m\mathbf{a}$. Use your own words, explain all key steps and properties used.
- (3 points) A tissue sample of cross sectional area 1 m^2 is subject to a uniaxial load of 1 N along the x_1 direction.
 - What is σ_{11} (include correct units)?
 - If the tissue is isotropic, linearly elastic, and has a Young's Modulus is 1 MPa , what is the strain ϵ_{11} ?
 - If the tissue is incompressible, what are the values of the principal components of strain and the associated principle directions of strain?
- (1 points) In class, we wrote out the constitutive law for an isotropic linear elastic solid (Eq. 5.4) in component form. How many separate equations are represented here? Write out each one and simplify (i.e. expand any summations and evaluate any symbols).
- (1 point) Give 5 examples of tissues that experience shear stress, and explain.
- (1 points) We performed a simplified stress analysis of a blood vessel in class. Explain why any four assumptions we made may be inaccurate and important to consider.
- (2 points) In the stress analysis of a blood vessel, we first derived a differential equation (Eq. 8.8), then wrote out the general solution (Eq. 8.9). Using the appropriate boundary conditions, prove the exact solution for radial and circumferential stresses (Eq. 8.10).
- (1 point) In class, I frequently say "mechanics is really partial differential equations." Explain this. What are the dependent and independent variables of the partial differential equations I'm referring to?
- BONUS (1 point): Hilma af Klint, whose paintings have appeared at the start of several lectures in this module, was a pioneer of abstract art in the late 1800s to early 1900s. While the rise of this art movement has traditionally been attributed men that were her contemporaries (e.g. Kandinsky, Mondrian etc), recently her central contributions have been increasingly appreciated. She even has an excellent exhibit at MoMA that ends next week! Af Klint was inspired by mathematics, physics, and nature. She studied anatomy and botany, and was fascinated by ideas of biological growth and form. She was also heavily influenced by the occult and spiritualism. Select one painting by Hilma af Klint that you are most drawn to. Include a picture of the painting and it's title in your response. Describe why you picked it, and relate it to biomechanics. The link to biomechanics can be literal or as abstract as some of the paintings themselves. Keep your answers brief (up to 5 sentences). Don't use AI, because where's the fun in that?