ES120 Spring 2018 – Midterm 1 Review

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Disclaimer

The list provided below is by no means comprehensive and if you find anything missing that you would like to add please let me know. This review session has been created without prior knowledge of the problems in the exam and should not be treated in any way as hints to problems that will be asked in the exam. We will do our best to go over the topics of the course in detail however please do your own reading of chapters 1,2 and 3 as well as other topics not included in the book.

You may also find my notes useful from the previous year `http://fer.me/es120notes`

Topics Covered

1. Introduction – Concepts of Stress
   - Normal Stress – $\sigma = \frac{P}{A}$, where A is perpendicular to direction of force
   - Shearing Stress – $\tau_{ave} = \frac{P}{A}$, where A is parallel to the direction of force
   - Stresses under general loading conditions - Determining the different components of stress from FBD such as σ_{xx}, σ_{yy} and τ_{xy}.
   - Ultimate stress – $\sigma_U = \frac{P_u}{A}$
   - Factor of Safety – F.S.$= \frac{\text{ultimate load}}{\text{allowable load}} = \frac{\text{ultimate stress}}{\text{allowable stress}}$
2. Stress and Strain – Axial Loading
   - Strain – $\epsilon = \frac{\delta}{L}$
   - Elastic Stress-Strain Diagram – Linear Relationship
   - Plastic Stress-Strain Diagram – Ideal plasticity with yield stress σ_Y
   - True Stress and True Strain – Difference between True and Engineering is the cross-sectional area. True stress uses A of deformed specimen.
   - Hooke's Law – $\sigma = E\epsilon$
   - Modulus of Elasticity – E
   - Elastic vs. Plastic Behavior of Material – Necking, yield stress, rupture etc.
   - Fatigue – In cases of cyclic loading, rupture will occur at a stress much lower than the static breaking strength; this phenomenon is called fatigue.
   - Deformations of Members Under Axial Loading – $\delta = \frac{PL}{AE}$
   - Poisson's Ratio – Relates lateral and axial strains through $\nu = -\frac{\text{lateral strain}}{\text{axial strain}}$
   - Multiaxial loading – Loading through multiple axis and the relationship to strain
   - Generalized Hooke's Law – Generalized relationship between all stresses, strains and material parameters through equations of form $\epsilon_x = \frac{1}{E}\left(\sigma_x - \nu\sigma_y - \nu\sigma_z\right), \epsilon_y = \frac{1}{E}\left(\sigma_y - \nu\sigma_x - \nu\sigma_z\right), \epsilon_z = \frac{1}{E}\left(\sigma_z - \nu\sigma_y - \nu\sigma_x\right)$