ME323 Mechanics of Materials

Exam 1 - Equation sheet

$$\sigma_{\text{avg}} = \frac{F_N}{A}\ , \quad \tau_{\text{avg}} = \frac{V}{A}$$

$$\sigma = \frac{P}{2A}(1 + cos2\theta)$$

$$\tau = \frac{P}{2A} sin2\theta$$

Generalized Hooke's law:

$$\varepsilon_x = \frac{1}{E}\left[\sigma_x - \nu\left(\sigma_y + \sigma_z\right)\right] + \alpha\Delta T$$

$$\varepsilon_y = \frac{1}{E}\left[\sigma_y - \nu\left(\sigma_x + \sigma_z\right)\right] + \alpha\Delta T$$

$$\varepsilon_z = \frac{1}{E}\left[\sigma_z - \nu\left(\sigma_x + \sigma_y\right)\right] + \alpha\Delta T$$

$$\gamma_{xy} = \frac{1}{G}\tau_{xy}\ , \qquad \gamma_{xz} = \frac{1}{G}\tau_{xz}\ , \qquad \gamma_{yz} = \frac{1}{G}\tau_{yz}$$

$$G = \frac{E}{2(1+v)}$$

$$\sigma_x = \frac{E}{(1+\nu)(1-2\nu)}\left[(1-\nu)\varepsilon_x + \nu\left(\varepsilon_y + \varepsilon_z\right) - (1+\nu)\alpha\Delta T\right]$$

$$\sigma_y = \frac{E}{(1+\nu)(1-2\nu)}\left[(1-\nu)\varepsilon_y + \nu\left(\varepsilon_x + \varepsilon_z\right) - (1+\nu)\alpha\Delta T\right]$$

$$\sigma_z = \frac{E}{(1+\nu)(1-2\nu)}\left[(1-\nu)\varepsilon_z + \nu\left(\varepsilon_x + \varepsilon_y\right) - (1+\nu)\alpha\Delta T\right]$$

Axial deformations:

$$e_{AB} = u_B - u_A$$

$$\text{Varying properties:} \quad e = \int_0^L \frac{F}{AE}dx + \int_0^L \alpha\Delta T dx$$

$$\text{Constant properties:} \quad e = \frac{FL}{AE} + \alpha\Delta TL$$

$$\text{Planar truss:} \quad e = u\cos(\theta) + v\sin(\theta)$$