Appendix 3 Summary
Mechanics of Materials

axial strain:

$$\varepsilon_{axial} = \frac{\Delta L}{L}$$

Hooke's Law:

$$\sigma_{axial} = E\varepsilon_{axial}$$

axial stress:

$$\sigma_{axial} = F/A$$

axial strain:

$$\varepsilon_{axial} = \frac{\sigma_{axial}}{E} = \frac{F/A}{E}$$

transverse strain:

$$\varepsilon_{transverse} = \frac{\Delta D}{D}$$

Poisson's ratio:

$$\nu = -\frac{\varepsilon_{transverse}}{\varepsilon_{axial}}$$

principal stresses:

$$\sigma_{max} = \left(\frac{\sigma_x + \sigma_y}{2}\right) + \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\sigma_{min} = \left(\frac{\sigma_x + \sigma_y}{2}\right) - \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\tan(2\theta_p) = \frac{2\tau_{xy}}{\sigma_x - \sigma_y}$$

maximum shear stress:

$$\tau_{max} = \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2} = \frac{\sigma_{max} - \sigma_{min}}{2}$$

Mohr's Circle:

$$\sigma_{max} = \sigma_{avg} + \tau_{max}$$

$$\sigma_{min} = \sigma_{avg} - \tau_{max}$$

$$\sigma_{avg} = \frac{\sigma_x + \sigma_y}{2}$$

$$\tan(2\theta_s) = -\frac{\sigma_x - \sigma_y}{2\tau_{xy}}$$