

## Exam 2 Equation Sheet

Law of Sines / Cosines  $\frac{\sin(\alpha)}{a} = \frac{\sin(\beta)}{b} = \frac{\sin(\gamma)}{c}$   $c^2 = a^2 + b^2 - 2ab \cos(\gamma)$

Force Equilibrium in Two and Three D.  $\sum F_x = 0$   $\sum F_y = 0$   $\sum F_z = 0$

Moment Equilibrium in Two and Three D.  $\sum M_x = 0$   $\sum M_y = 0$   $\sum M_z = 0$

Normal / Shear Stress  $\sigma = \frac{N}{A_n}$   $\tau = \frac{V}{A_n}$

Stress on an Oblique Plane  $\sigma = \frac{P}{A_o} \cos^2 \theta$   $\tau = \frac{P}{A_o} \cos \theta \sin \theta$

Normal Strain in Axial Loading  $\varepsilon = \frac{\delta}{L}$

Hooke's Law for Axial Loading  $\sigma = E\varepsilon$

Mechanical Deflection for Axial Loading  $\delta = \frac{PL}{AE}$

Thermal Deflection  $\delta_{th} = \alpha(\Delta T)L$

Unit vector  $\hat{e} = \frac{\bar{R}}{R} = \frac{R_x \hat{i} + R_y \hat{j} + R_z \hat{k}}{\sqrt{R_x^2 + R_y^2 + R_z^2}}$

Dot product of vectors  $\bar{A} \cdot \bar{B} = A_x B_x + A_y B_y + A_z B_z$

Moment of a force acting at P about point O  $\bar{M} = \bar{r}_{OP} \times \bar{F}$

$$\bar{M} = \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix} = (r_y F_z - r_z F_y) \hat{i} - (r_x F_z - r_z F_x) \hat{j} + (r_x F_y - r_y F_x) \hat{k}$$

Moment of a force acting at P about axis in direction  $\bar{e}$  passing through O.

$$M_{axis} = \bar{e} \cdot (\bar{r}_{OP} \times \bar{F})$$

$$\text{Factor of Safety} = \frac{\text{Failure Load}}{\text{Allowable Load}} = \frac{\text{Ultimate Stress}}{\text{Design Stress}} = \frac{\text{Strength}}{\text{Stress}}$$