

## Final Exam Equation Sheet

Law of Sines  $\frac{\sin(\alpha)}{a} = \frac{\sin(\beta)}{b} = \frac{\sin(\gamma)}{c}$

Law of Cosines  $c^2 = a^2 + b^2 - 2ab \cos(\gamma)$

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

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

Normal Stress  $\sigma = \frac{P}{A}$

Shear Stress  $\tau = \frac{V}{A}$

Bearing Stress  $\sigma = \frac{P}{td}$

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

$$\sigma = \frac{P}{A_o} \cos^2 \theta$$

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

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

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

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

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

Poisson's Ratio 
$$\nu = -\frac{\epsilon_y}{\epsilon_x}$$

Shear of Block: 
$$\gamma = \frac{\delta}{h} \quad \tau = G\gamma$$

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.

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

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

Centroids of Areas. 
$$\bar{x} = \frac{1}{A} \int x dA \quad \bar{y} = \frac{1}{A} \int y dA$$

Centroids of Composite Bodies. 
$$A = \sum_i A_i \quad \bar{x} = \frac{1}{A} \sum_i \bar{x}_i A_i \quad \bar{y} = \frac{1}{A} \sum_i \bar{y}_i A_i$$

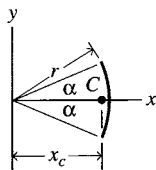
TABLE 5-1 Centroid Locations For A Few Common Line Segments And Areas

Circular arc

$$L = 2r\alpha$$

$$x_C = \frac{r \sin \alpha}{\alpha}$$

$$y_C = 0$$

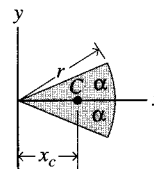


Circular sector

$$A = r^2\alpha$$

$$x_C = \frac{2r \sin \alpha}{3\alpha}$$

$$y_C = 0$$

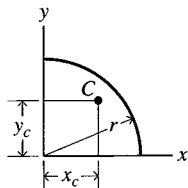


Quarter circular arc

$$L = \frac{\pi r}{2}$$

$$x_C = \frac{2r}{\pi}$$

$$y_C = \frac{2r}{\pi}$$

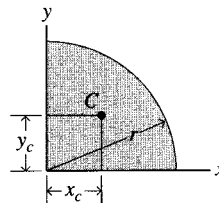


Quadrant of a circle

$$A = \frac{\pi r^2}{4}$$

$$x_C = \frac{4r}{3\pi}$$

$$y_C = \frac{4r}{3\pi}$$

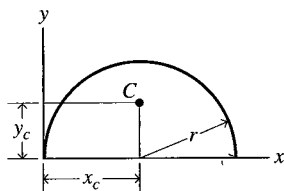


Semicircular arc

$$L = \pi r$$

$$x_C = r$$

$$y_C = \frac{2r}{\pi}$$

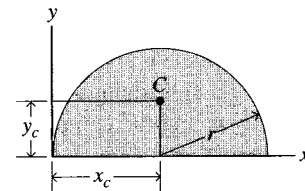


Semicircular area

$$A = \frac{\pi r^2}{2}$$

$$x_C = r$$

$$y_C = \frac{4r}{3\pi}$$

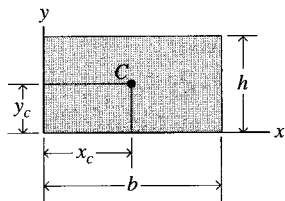


Rectangular area

$$A = bh$$

$$x_C = \frac{b}{2}$$

$$y_C = \frac{h}{2}$$



Quadrant of an ellipse

$$A = \frac{\pi ab}{4}$$

$$x_C = \frac{4a}{3\pi}$$

$$y_C = \frac{4b}{3\pi}$$

