ME 2580 Dynamics - Equation Sheet #5

Linear and Angular Momentum
(G = mass center; O = fixed point)

$$\underset{\sim}{L} = m\underset{\sim}{v}_G$$
$$\underset{\sim}{H}_G = I_G\underset{\sim}{\omega}$$
$$\underset{\sim}{H}_O = I_G\underset{\sim}{\omega} + (\underset{\sim}{r}_G \times m\underset{\sim}{v}_G)$$

Principles of Impulse and Momentum
(G = mass center; O = fixed point)

$$(m\underset{\sim}{v}_G)_1 + \int_{t_1}^{t_2} \sum_i \underset{\sim}{F}_i dt = (m\underset{\sim}{v}_G)_2$$

$$(I_G\underset{\sim}{\omega})_1 + \int_{t_1}^{t_2} \sum_i (\underset{\sim}{r}_i \times \underset{\sim}{F}_i) dt = (I_G\underset{\sim}{\omega})_2$$

$$\left(I_O\underset{\sim}{\omega}\right)_1 + \int_{t_1}^{t_2} \sum_i (\underset{\sim}{r}_i \times \underset{\sim}{F}_i) dt = \left(I_O\underset{\sim}{\omega}\right)_2 \quad \text{(fixed axis rotation)}$$

$$(\underset{\sim}{H}_O)_1 + \int_{t_1}^{t_2} \sum_i (\underset{\sim}{r}_i \times \underset{\sim}{F}_i) dt = (\underset{\sim}{H}_O)_2 \quad \text{(O is a fixed point)}$$

Conservation of Linear Momentum

$$\sum_i (m_i \underset{\sim}{v}_{G_i})_1 = \sum_i (m_i \underset{\sim}{v}_{G_i})_2$$

Impact of Two Bodies *A* and *B*
(Contact Point, C; *n* = impact normal)

$$e = \frac{(v_{CB})_{n2} - (v_{CA})_{n2}}{(v_{CA})_{n1} - (v_{CB})_{n1}}$$

Conservation of Angular Momentum
(O = fixed point)

$$\sum_i (\underset{\sim}{H}_{O_i})_1 = \sum_i (\underset{\sim}{H}_{O_i})_2$$