UNIVERSITY OF CALIFORNIA, DAVIS
Dept. of Mechanical and Aeronautical Engineering

MAE - 275

Homework Assignment 1

Due: Tues. April 14

1.) Beginning with the following integral equation from the handwritten notes (Eqn. 11 on p. 8):

$$\overline{M}_0 + \overline{M}_{T_0} + \overline{M}_{IR_0} = \iiint_{sys} \bar{r}^2 \dot{\overline{\Omega}} dm - \iiint_{sys} (\bar{r} \cdot \dot{\overline{\Omega}}) \bar{r} dm + \iiint_{sys} \; (\overline{\Omega} \cdot \bar{r}) \;\; (\bar{r} \text{ x } \overline{\Omega})] dm$$

obtain the z component of the moment equation as given below:

$$N = \dot{R} I_z - \dot{P} I_{xz} + PQ(I_y - I_x) + QRI_{xz}$$

2.) Using the assumption of small disturbances and identifying each dependent variable as an equilibrium value plus a perturbation value, e.g.,

$$U = U_0 + u$$
$$Z = Z_0 + dZ$$
etc

where the d(-) notation is used for perturbation forces and the lower case notation is used for perturbation velocities, linearize the nonlinear z-force equation given by

$$Z = Z_T - Z_g = m(\dot{W} + PV - QU - g \cos \Theta_0 \cos \Phi)$$

to obtain

$$dZ = m[\dot{w} + V_0 p + P_0 v - U_0 q - Q_0 u + (g \cos \Theta_0 \sin \Phi_0)\phi + (g \sin \Theta_0 \cos \Phi_0)\theta]$$