**PROBLEM 1: H&H 2.15, ADEQUACY OF SUPPORT FOR A CUBE-AND-RODS PROBLEM**

**GIVEN**
See H&H, but note that rod 6 is parallel to the x-axis, not (as it appears in the figure), aligned with rod 5.

**REQUIRED**
Show that cube is adequately supported with rod 4 acting in line $e_4 = j$.

(Note that the rigid bars that H&H use as restraints act the same way as the rollers we talked about in class: they prevent translation of the point to which they are attached, and only against translation parallel to the axis of the rod. They don’t restrain rotation about that point at all, nor translation in any direction that lies in the plane perpendicular to the axis of the rod. Also, H&H use the notation $r_{nw}$ to indicate the $w$-component of the vector from the arbitrary point $Q$ to restraint $n$. We used $p_{nw}$ in lecture, but they refer to the same thing.)

**PROBLEM 2: KINEMATIC MODES OF A CUBE-AND-RODS PROBLEM**

**GIVEN**
A unit cube has one vertex (point $Q$) at the origin. It is supported in some unspecified way, but it is known that it is inadequately supported. Two solutions to the equations of kinematics are:

$$\Delta_1 = [1/2 -1/2 0 0 0 1]^T$$
$$\Delta_2 = [-1 0 1 0 1 0]^T$$

where

$$\Delta = [\Delta U_{Qx} \; \Delta U_{Qy} \; \Delta U_{Qz} \; \Delta \theta_{Qx} \; \Delta \theta_{Qy} \; \Delta \theta_{Qz}]^T$$

$\Delta U_{Qw}$ refers to an incremental translation of the point $Q$ in the $+w$ direction, and $\Delta \theta_{Qw}$ refers to a positive incremental rotation of the point $Q$ about the $w$ axis.

**REQUIRED**
Draw the cube and its modes of displacement.
**Problem 3: H&H 2.36, Horizontal Plate Stability Problem**

**Given**

See H&H. *NB: part (b) of the problem is slightly modified.* See “required,” below.

Assume that the triangular plate has unit length along the x- and z-axes; that the line of action of $P_1$ is through $[0, 0.75, 1]$; that of $P_2$ passes through $[0, 0.75, 0]$; and that of $P_3$ passes through $[1, 0.75, 0]$.

**Required**

Part (a): Is the plate adequately supported?

Part (b): If the plate is not adequately supported, will either of these additional bars (6a or 6b) added at point $A (\xi_6 = k)$ complete the support?

\[
\begin{align*}
6a: & \quad \xi_6 = 1 \\
6b: & \quad \xi_6 = k
\end{align*}
\]

Hint: In MS Excel, the function MDETERM(A) calculates the determinant of a square array $A$.

**Problem 4: H&H 3.1, The Screw Press**

As stated in H&H.

**Problem 5: H&H 3.15, Hinged Rod and Springs**

**Given**

See H&H.

**Required**

Equilibrium position of the bars (in terms of $\theta$) as a function of $P$. 