Aero 321 **Name: Benjamin Tollison**

1. A small satellite has six thrusters, each capable of applying F units of force (if used). The thrust directions and thruster locations (in a centroidal body-fixed coordinate system) are provided in the table.

   Write a relationship between the thrust on-off selector vector and the net force and moment produced:

2. Solve

$$\begin{cases} \frac{\partial}{\partial t}u = \frac{\partial^2}{\partial x^2}u \\ u(0,t) = u(\pi,t) = 0 \\ u(x,0) = 2\sin 3x \end{cases}$$

3. Find all eigenvalues and eigenfunctions for the equation: $\varphi'' + \lambda\varphi = 0$ with $\varphi(0) = 0$ and $\varphi'(\pi) = 0$.

4. Solve

$$\begin{cases} \frac{\partial^2}{\partial t^2}u = \frac{\partial^2}{\partial x^2}u \\ u(0,t) = u(\pi,t) = 0 \\ u(x,0) = f(x), \frac{\partial}{\partial t}u(x,0) = 0, \end{cases}$$

where $f(x)$ is the "hat function": it's 0 and 0 and π and 1 and $\pi/2$ and linear in between.

5. This is another perspective on the SOV method. Consider the problem

$$\begin{cases} \frac{\partial}{\partial t}u = \frac{\partial^2}{\partial x^2}u \\ u(0,t) = u(\pi,t) = 0 \\ u(x,0) = g(x) \end{cases}.$$

For each fixed x, assume that the solution can be written as $\sum_{k=1}^{\infty} B_k \sin(kx)$. Note that the B_k depend on t so a better way to write it is $\sum_{k=1}^{\infty} B_k(t)\sin(kx)$. Starting from this point, find the SOV solution. (Note: I had a typo that said $B_k(x)$ before; it should be $B_k(t)$ SORRY!!)