6-1 4jw & 1 LHP. There are 2 rows of zeros!

The rows are as follows:

```
s^5: 1 2 1
s^4: 2 4 2
s^3: 8 8 0 (Row of Zeros)
s^2: 2 2 0
s^1: 4 0 0 (Row of Zeros)
s^0: 2 0 0
```

Let's analyze the even polynomial at s^4: 2s^4+4s^2+2 Clearly, there are 4 roots, and the table shows no sign changes. Therefore there are 4 roots on the jw axis.

Looking above the s^4 row, we see no sign changes. There are a total of 5 poles, so the fifth must be in the LHP.

6-2 4jw, 1 LHP, 1 RHP. There is a row of zeros.

6-3 3 RHP, 2 LHP. We have a single zero. Try the reverse polynomial, -s^5+2s^4-3s^3+3s^2-s+1

```
s^5: -1     -3  -1
s^4:  2      3   1
s^3: -1.5  -.5   0
s^2: 2.3     1   0
S^1: .1429   0   0
S^0: .1429   0   0
```

There are 3 sign changes, so there are 3RHP poles. There must be a total of 5 poles, so the other 2 are in the LHP.

6-4 2jw & 2 LHP. There is a row of zeros.

6-14 4jw, 1RHP, 2LHP. There is a row of zeros.

6-18

We find the Closed loop transfer function is

```
               K(s+6)
T(s) = ------------------------
       s^3 + 4s^2 +(K+3)s + 6K
```

We can form the Routh table with the following rows:

```
        1       K+3
        4       6K
        3-.5K
        6K
```

We want the first row to be all positive (no sign changes), so K>0 and K<6.

6-19

We find the Closed loop transfer function (CLTF) as

```
                 K(s+1)
T(S) = ---------------------------
        s^4+9s^3+26s^2+(K+24)s+K
```

And the routh table becomes:

```
s^4     1                      26          K
s^3     9                      24+K        0
s^2     210-K                  9K          0
s^1     (-K^2+105K+5040)
        ----------------       0           0
              210-K
s^0     9K
```

We want the first row to be all positive, so

210-K>0, or K<210

(-K^2+105K+5040)/(210-K)>0, or K<140.8

9K>0, or K>0

so 0<K<140.8

6-34

The closed loop transfer function is

```
                    K
T(S) = -----------------------------
       s^4 + 8s^3 + 17s^2 + 10s + K
```

and the Routh table is

s^4	1	17	K
s^3	8	10	
s^2	126/8	K	
s^1	-32/63 K + 10		
s^0	K		

and for first row positivity, K>0 and
-32/63 K +10 >0, or K<19.69

a) 0<K<19.69
b) A row of all zeros creates marginal stability, so K=19.69 for marginal stability.
c) Using Matlab with K=19.69, we find the poles are at +/- 1.118j, -4.5, -3.5