

HW6.

1. D.

2. B.

3. A.

4. A.

5. A.

6. D.

7. B.

8. A.

9. C.

10. D.

$$a_3 = 1 \quad a_1 = 8$$

$$a_2 = 2 \quad a_0 = 4$$

$$\frac{a_3 a_0 - a_2 a_1}{-a_2}$$

2.

$$s^3 + 15s^2 + 2s + 40 = 0$$

s^3	$a_3 = 1$	$a_2 = 15$	$a_1 = 2$	$a_0 = 40$
s^2				
s				
s^0				

Since b_1 is negative it is unstable.

3. a. $s^2 + 5s + 2 = 0$

s^2	1	2
s	5	0
1	b_1	0

$$\frac{0}{5}(1) + 2 = b_1 = 2 \rightarrow \text{Stable}$$

b. $s^3 + 4s^2 + 8s + 4 = 0$

s^3	1	8	0
s^2	4	4	0
s	b_1	b_2	0
s^0	c_1		

$$b_1 = -\left(\frac{4}{4}\right)(1) + 8 = 7$$

$$b_2 = 0(8) + 0 = 0$$

$$c_1 = -\left(\frac{0}{7}\right)(4) + 4 = 4$$

Since first row is +, The system is stable

c. $s^3 + 2s^2 - 6s + 20 = 0$

Since there is a negative coefficient
it is unstable,

d. $s^4 + s^3 + 3s^2 + 2s + k = 0$

s^4	1	3	k	0
s^3	1	2	0	0
s^2	b_1	b_2	0	0
s	c_1	c_2	0	0
1	d_1	0	0	0

$$b_1 = -\left(\frac{-2}{1}\right)(1) + 3 = 1$$

$$b_2 = -\left(\frac{-0}{2}\right)(3) + k = k$$

$$c_1 = -\left(\frac{-k}{1}\right)(1) + 2 = -k + 2$$

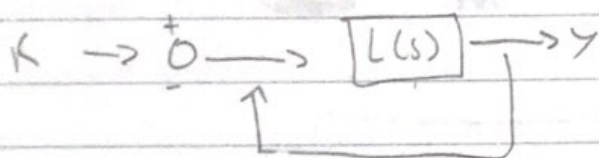
$$c_2 = -\left(\frac{-0}{k}\right)(2) + 0 = 0$$

$$d_1 = -\left(\frac{-0}{-k+2}\right)(1) + k = k$$

if $0 < k < 2$ Then it is stable.

3. $s^5 + s^4 + 2s^3 + s + 6 = 0 \rightarrow$ unstable b/c no s^2 term.

4. $L(s) = \frac{k(s+10)}{[s(s+3)(s^2+4s+8)]}$



$$T(s) = \frac{k(s+10)}{s(s+3)(s^2+4s+8) + k(s+10)}$$

denominator: $s(s^3 + 4s^2 + 8s + 3s^2 + 12s + 24) + ks + 10k$
 $s(s^3 + 7s^2 + 24s + 24) + ks + 10k$
 $s^4 + 7s^3 + 20s^2 + (24+k)s + 10k$

s^4	1	20	10k	0
s^3	7	24+k	0	0
s^2	b_1	b_2	0	0
s^1	c_1	c_2	0	0
s^0	d_1	0	0	0

$$b_1 = \frac{-(24+k)(1) + 20}{7} = \frac{20 - (24+k)}{7} = \frac{116+k}{7} \rightarrow 0 < k < 116$$

$$b_2 = \left(\frac{-0}{24+k}\right)(20) + 10k = 10k \rightarrow k > 0$$

$$c_1 = \frac{-10k}{\frac{116+k}{7}}(7) + (24+k) = \frac{-490k}{116+k} + 24+k = \frac{-490k + (24+k)(116+k)}{116+k}$$

$$c_2 = 0$$

$$d_1 = b_2 = 10k \rightarrow k > 0$$

$$\frac{-490k + (24+k)(116-k)}{116-k} = \frac{-490k + 2784 + 92k - k^2}{116-k}$$

$$2784 - 398k - k^2 > 0 \rightarrow \cancel{k^2 + 398k - 2784 = 0}$$

$$\frac{398 \pm \sqrt{398^2 - 4(2784)(-1)}}{2(-1)} = -4.04, \quad \overset{6.87}{\cancel{2784}}$$

$$0 < k < 6.876 \quad \leftarrow \text{for stability}$$