Pg 45

5) a) $\frac{22}{z^2 - 1.4z - 0.45}$; $a = 1 \quad b = -1.4 \quad c = -0.45$

poles $= (1.4 \pm \sqrt{1.96 + 5.6})/2$

$= (1.4 \pm 2.75)/2$

$= 2.075$ or -0.675

i) Order = 2

ii) poles = $2.075 \; \& \; -0.675$

iii) pole $> 1 \Rightarrow$ not stable.

b) $\frac{13}{z^4 - z^3 + 0.35z^2 - 0.05z - 0.024}$ ⇒ Solved using matlab

i) order = 4 ; Poles = -0.1687 ; 0.6687

$0.2500 - 0.3877i$

$0.2500 + 0.3877$

$\Rightarrow r = \sqrt{a^2 + b^2} = 0.46$

$\theta =$

Code:

```
syms x
solve( x^4 - x^3 + .35*x^2 - 0.05*x - 0.024
```

3.9) a) & b) a) $\frac{0.94}{z - 0.51}$

i) System stable pole = 0.51 ⇒ $0.51 < 1 \Rightarrow$ stable

ii) Final value $= \lim_{k \to \infty} f(k) = \lim_{z \to 1} (z-1) F(z)$

$F(z) = G(z) U(z) \Rightarrow \frac{0.94}{z - 0.51} \times \frac{z}{z - 1}$

$\Rightarrow$ Final $= \lim_{z=1} (z-1) \times \frac{0.94}{z - 0.51} \times \frac{z}{z-1}$

$\Rightarrow \frac{0.94}{0.49} = 1.918367347$

$K_S = \frac{1-|F(a)|}{} = \frac{-4}{\ln(a)} = \frac{-4}{\ln(0.51)} = 5.94$

$= \approx 6.$

b) $\frac{7}{z^4 - 1.31z^3 + 1.21z^2 - 0.287z - 0.0178}$

poles = $0.4849 \pm 0.8153i$ & 0.3909 & -0.0506.

5-3 ?

6.3 a) $\frac{4}{(z-1.5)(z-0.5)}$

9.2) a) $C(z) = \frac{Y(z)}{U(z)} = \frac{0.47}{z-0.43}$ $K_p = 2$ $K_I = 1$.

$$f_p(z) = \frac{\frac{(K_p + K_I)z - K_p}{z-1} \cdot C(z)}{1 + \frac{(K_p + K_I)z - K_p}{(z-1)} \cdot C(z)} = \frac{\frac{(3z-2)}{z-1} \cdot \frac{0.47}{(z-0.43)}}{1 + \frac{3z-2}{z-1} \cdot \frac{0.47}{(z-0.43)}}$$

$$= \frac{1.417 - .94}{(z-1)(z-0.43) + 1.417 - 0.94}$$

$$= \frac{1.417 - 0.94}{z^2 - 1.43z + 0.43 + 1.417 - 0.94}$$

$$K = \frac{1.417 - 0.94}{z^2 - 0.027 - 0.51}$$

b) dominant closed loops $\Rightarrow z^2 - 0.027 - 0.51 = 0$

$\Rightarrow \frac{0.02 \pm \sqrt{(0.02)^2 + 4(1)(0.51)}}{2}$

$\Rightarrow \frac{0.02 \pm 1.428}{2}$

$\Rightarrow 0.724, -0.704.$

$K_s = \frac{-4}{\log|0.724|} = 28.52$ ✗

$M_p = 0$ (Since the dominant poles is positive).

$az^2 + bx + c = 0$.

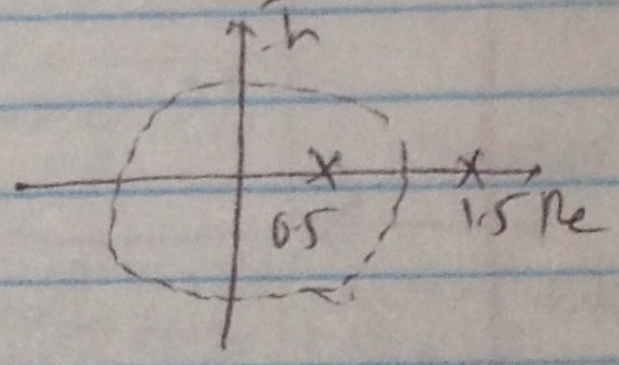
$\frac{0.5}{4}$ ✗

1.04

0.0004

2.0404

(6.3) a) $\frac{4}{(z-1.5)(z-0.5)}$. (d) $p_1 = 1.5$ $p_2 = 0.5$



(b)(iii) No, Since one pole is outside the Unit Circle

(iv) Its not stable

(v). plot step response.

(vi). unstable

$\frac{12}{8}$ 1v

.96

(b) $\frac{-1}{(z+0.2)(z-0.2)}$ (c) $p_1 = 0.2$ $p_2 = -0.2$

(d) Steady state gain $G(1) = \frac{-1}{(1.2)(0.8)} = -1/0.96 = -1.04$.

(c) yes Since poles are inside Unit circle

(f) Settling time: $T_s = \frac{-4}{\log|0.2|} = 5.722$