Solution of ECE 316 Test #12 S03 4/9/03 #1

1. $H(s) = \dfrac{10}{s+10}$ Impulse invariant, $h(t) = 10e^{-10t}u(t) \to h[n] = 10e^{-n}u[n] = 10(0.368)^n u[n]$,

$$H(z) = \dfrac{10z}{z - 0.368} \to K = 10 , a = 0.368$$

2. $H(s) = \dfrac{3s}{s+8}$ Step invariant, $h_{-1}(t) = 3e^{-8t}u(t) \to h_{-1}[n] = 3e^{-0.8n}u[n] = 3(0.449)^n u[n]$,

$$H(z) = \dfrac{z-1}{z}\dfrac{3z}{z - 0.449} = \dfrac{3(z-1)}{z - 0.449} \to K = 3 , a = 0.449$$

3. $H(s) = \dfrac{4}{s+6}$ Difference equation method $\quad H(z) = \left[\dfrac{4}{s+6}\right]_{s \to \frac{1-z^{-1}}{T_s}} = \dfrac{4}{\dfrac{1-z^{-1}}{0.1} + 6} = \dfrac{0.4}{1.6 - z^{-1}}$

(using backward differences)

$$H(z) = \dfrac{0.4z}{1.6z - 1} = \dfrac{0.25z}{z - 0.625} \to K = 0.25 , a = 0.625$$

4. $H(s) = \dfrac{4}{s+7}$ Matched z-transform method $\quad H(z) = \left[\dfrac{4}{s+7}\right]_{s-a \to 1 - e^{aT_s}z^{-1}} = \dfrac{4}{1 - e^{-0.7}z^{-1}}$

$$H(z) = \dfrac{4}{1 - 0.4966z^{-1}} = \dfrac{4z}{z - 0.4966} \to K = 4 , a = 0.4966$$

5. $H(s) = \dfrac{4}{s+9}$ Bilinear z-transform method $\quad H(z) = \left[\dfrac{4}{s+9}\right]_{s \to \frac{2}{T_s}\frac{z-1}{z+1}} = \dfrac{4}{20\dfrac{z-1}{z+1} + 9} = \dfrac{4(z+1)}{29z - 11}$

$$H(z) = \dfrac{\dfrac{4}{29}(z+1)}{z - \dfrac{11}{29}} = \dfrac{0.138(z+1)}{z - 0.3793} \to K = 0.138 , a = 0.3793$$