EERI 418

Semestertoets 2 15/04/2014

VRAAG 1

$$E(s) = \frac{2(1-e^{-0,5s})e^{-1,1s}}{s(s+1)} \qquad T = 0,5\,s$$

$$= \frac{2(1-e^{-sT})}{s(s+1)} e^{-2,2sT}$$

$$t_0 = 2,2T, \quad k = 2, \quad \Delta = 0,2, \quad m = 0,8$$

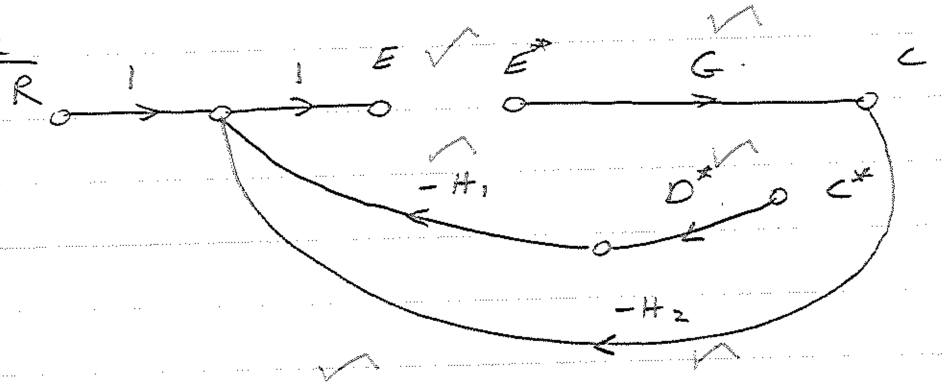
$$E(z) = 2 \cdot \mathcal{Z}(1-e^{-sT}) z^{-k} \mathcal{Z}_m \left[\frac{1}{s(s+1)}\right]_{m=0,8}$$

$$= 2 \frac{z-1}{z} z^{-2} \frac{z(1-e^{-0,5})}{(z-1)(z-e^{-0,5})}$$

$$= \frac{0,787}{z^2(z-0,607)}$$

[6]

VRAAG 2



$$C = GE^* \quad \therefore \quad C^* = G^*E^*$$

$$E = R - H_1 D^* C^* - H_2 C$$

$$= R - H_1 D^* G^* E^* - H_2 G E^*$$

$$\therefore \quad E^* = R^* - H_1^* D^* G^* E^* - \overline{H_2 G}^* E^*$$

$$\therefore E^* = \frac{R^*}{1 + H_1^* D^* G^* + \overline{H_2 G}^*}$$

$$C^* = \frac{G^* R^*}{1 + H_1^* D^* G^* + \overline{H_2 G}^*}$$

$$\therefore \frac{C(z)}{R(z)} = \frac{G(z)}{1 + H_1(z)D(z)G(z) + \overline{H_2 G}(z)}$$

[8]

VRAAG 3.

3.1 $$\frac{\Theta(z)}{R(z)} = \frac{G(z)}{1+G(z)}$$ (1)

3.2 $$G(z) = \mathcal{Z}\left[\frac{1-e^{-sT}}{s}\frac{200}{(s+2)(s+5)}\right]$$ $T = 0{,}03$

$$= \frac{z-1}{z}\,\mathcal{Z}\left[\frac{200}{s(s+2)(s+5)}\right]$$

$$= \frac{z-1}{z}\,\frac{(Az+B)\,z\,200}{(z-1)(z-0{,}942)(z-0{,}861)}$$

$$= \frac{200(Az+B)}{(z-0{,}942)(z-0{,}861)}$$

$$A = \frac{0{,}291-0{,}279}{10(3)} = 0{,}0004$$

$$B = \frac{0{,}2624-0{,}2506}{30} = 0{,}000393$$

$$G(z) = \frac{200\times 0{,}0004\,(z+0{,}9825)}{(z-0{,}942)(z-0{,}861)}$$

$$= \frac{0{,}08\,(z+0{,}9825)}{(z-0{,}942)(z-0{,}861)}$$

$$\frac{\Theta(z)}{R(z)} = \frac{0{,}08(z+0{,}9825)}{(z-0{,}942)(z-0{,}861)+0{,}08(z+0{,}9825)}$$

$$= \frac{0{,}08\,(z+0{,}9825)}{z^2-1{,}723z+0{,}889}$$

(5)

Stelsel is tipe 0

3.3. $$E(z) = \frac{R(z)}{1+G(z)} = \frac{\frac{z}{z-1}}{1+\frac{0{,}08(z+0{,}9825)}{(z-0{,}942)(z-0{,}861)}}$$

$$e(kT)_{k\to\infty} = \lim_{z\to 1}(z-1)E(z) = \frac{1}{1+\frac{0{,}08\,(1{,}9825)}{(1-0{,}942)(1-0{,}861)}} = 0{,}048$$ (4)

3.4. Pole lê by:

$$z^2 - 1{,}723z + 0{,}889 = 0$$

$$\therefore z_{12} = \frac{1{,}723 \pm \sqrt{1{,}723^2 - 4\,0{,}889}}{2}$$

$$= 0{,}8615 \pm j0{,}3832$$

$$= 0{,}9429 \underline{/\pm 0{,}4185}$$

$$= r \underline{/\pm\theta}$$

$$\omega_n = \frac{1}{T}\sqrt{\ln^2 r + \theta^2}$$

$$= \frac{1}{0{,}03}\sqrt{\ln^2 0{,}9429 + 0{,}4185^2}$$

$$= 14{,}07 \text{ rad/s}$$

$$\tau = \frac{1}{\zeta\omega_n}$$

$$\zeta = \frac{-\ln r}{\sqrt{\ln^2 r + \theta^2}} = \frac{-\ln 0{,}9429}{\sqrt{\ln^2 0{,}9429 + 0{,}4185^2}}$$

$$= 0{,}14$$

$$\therefore \tau = \frac{1}{0{,}14 \cdot 14{,}07}\text{ s} = 0{,}507 \text{ s.}$$ (5)

3.5 Vir kontinue stelsel is $T(s) = \dfrac{\frac{200}{(s+2)(s+5)}}{1 + \frac{200}{(s+2)(s+5)}}$

$$= \frac{200}{s^2 + 7s + 210}$$

$$\therefore 2\zeta\omega_n = 7$$

$$\tau = \therefore \frac{1}{\zeta\omega_n} = \frac{1}{3{,}5} = 0{,}285 \text{ s}$$

$$\therefore \text{kies } T = \frac{1}{10}\tau = 0{,}028 \text{ s} \simeq 0{,}03 \text{ s}$$

$\therefore$ *T* is sinvol gekies.

Nie nodig om monstertempo verder te verhoog nie

(5)

[20]