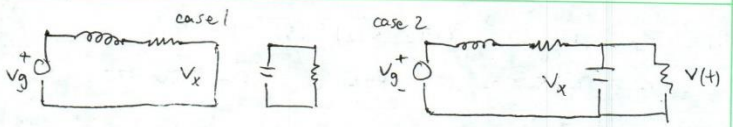
43.5/45

# Homework 5

1.a




$\langle v_x(t) \rangle = 0$

$\langle v_x(t) \rangle = v(t)$

$\langle v_x(t) \rangle = [0]\,d(t) + [v(t)]\,d'(t)$

$\langle v_x(t) \rangle = (1 - d(t))\, v(t)$

-0.5 (Did not use avg. symbols. Also d does not change wrt time)

b) case 1

$v_g = \langle i(t) \rangle R_L$

case 2

$v_g = \langle i(t) \rangle R_L + V_x$

$\langle v_g(t) \rangle = L \frac{d}{dt} \langle i(t) \rangle + \langle i(t) \rangle R_L + \langle v_x(t) \rangle$

$\langle v_g(t) \rangle - \langle v_x(t) \rangle = L \frac{d}{dt} \langle i(t) \rangle + \langle i(t) \rangle R_L$

$\langle v_g(t) \rangle - \underbrace{[1 - d(t)]}_{d'(t)} \langle v(t) \rangle = L \frac{d}{dt} \langle i(t) \rangle + \langle i(t) \rangle R_L$

$\langle v_g(t) \rangle - d'(t) \langle v(t) \rangle = sLi + R_L i$

$\langle i(t) \rangle = \frac{\langle v_g(t) \rangle - d'(t) \langle v(t) \rangle}{sL + R_L}$

-1 (Incorrect L term. Also did not express in terms of vx)

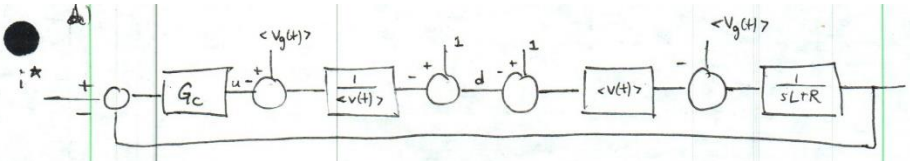
c) $u = \langle v_g(t) \rangle - \langle v(t) \rangle d'(t)$

$d'(t) = \frac{\langle v_g(t) \rangle - u}{\langle v(t) \rangle}$

$1 - d(t) = \frac{\langle v_g(t) \rangle - u}{\langle v(t) \rangle}$

$d(t) = 1 - \frac{\langle v_g(t) \rangle - u}{\langle v(t) \rangle}$

d)




$u_{pp} = \langle v_g(t) \rangle$

$H_c = \frac{1}{\langle v(t) \rangle}$

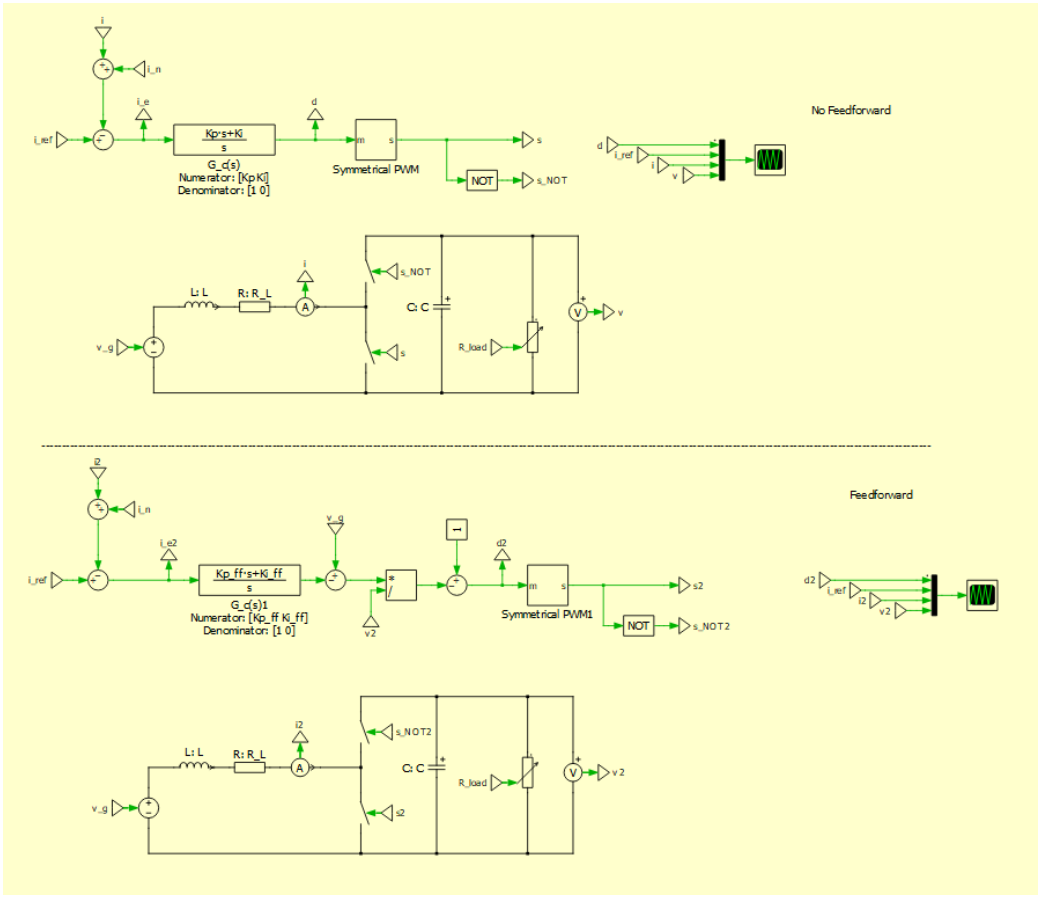
$c = 1$

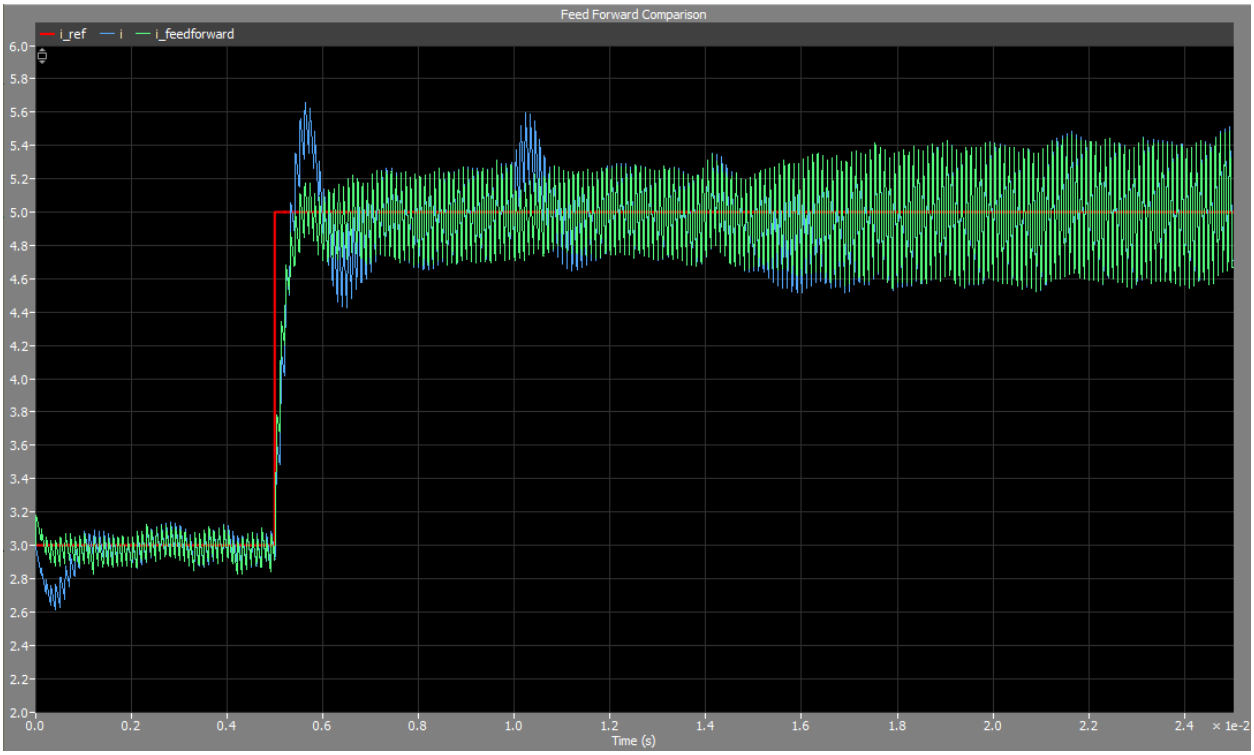
$f_{sw} = 10\,kHz$

e.) $K_p = \omega_{cg} L = (2\pi \cdot 1kHz)(1.3E-3) = 8.17$

$K_i = \omega_g R_L = (2\pi \cdot 1kHz)(60\,E-3) = 377$

20/20 Problem 2



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Problem 3

$\lambda = -N\Phi_{pk}\cos(\theta_e) + Li$

induced back EMF $\mathcal{E}$

$$-\frac{d\lambda}{dt} = -\frac{d}{dt}\left[-N\Phi_{pk}\cos(\theta_e) + Li\right]$$

$$= N\Phi_{pk}\frac{d}{dt}\cos(\theta_e) - L\frac{di}{dt}$$

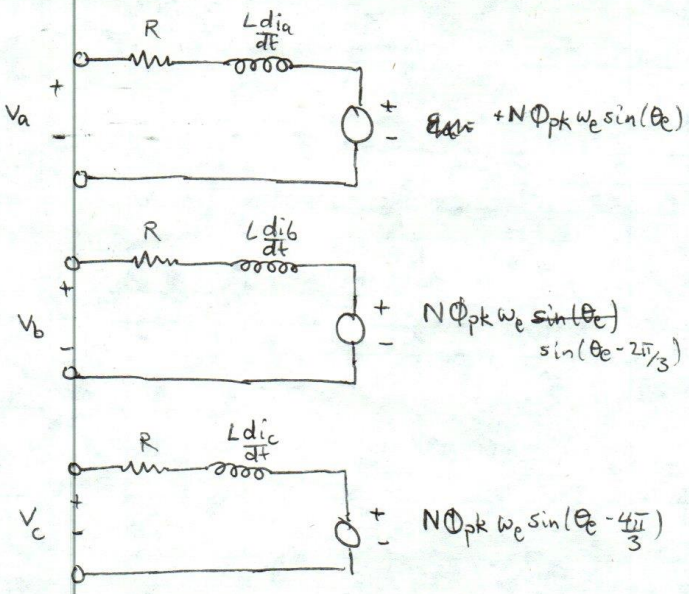
$$= -N\Phi_{pk}\sin(\theta_e)\omega_e - L\frac{di}{dt}$$

$$= -N\Phi_{pk}\omega_e\sin(\theta_e) - L\frac{di}{dt}$$

$$\mathcal{E}_a = -N\Phi_{pk}\omega_e\sin(\theta_e) - L\frac{di_a}{dt}$$

$$\mathcal{E}_b = -N\Phi_{pk}\omega_e \sin(\theta_e - 2\pi/3) - L\frac{di_b}{dt}$$

$$\mathcal{E}_c = -N\Phi_{pk}\omega_e \sin(\theta_e - 4\pi/3) - L\frac{di_c}{dt}$$




-3 (did not mark ind emf in eqv ckts)

Late submission: -15.1
Total: 60.4