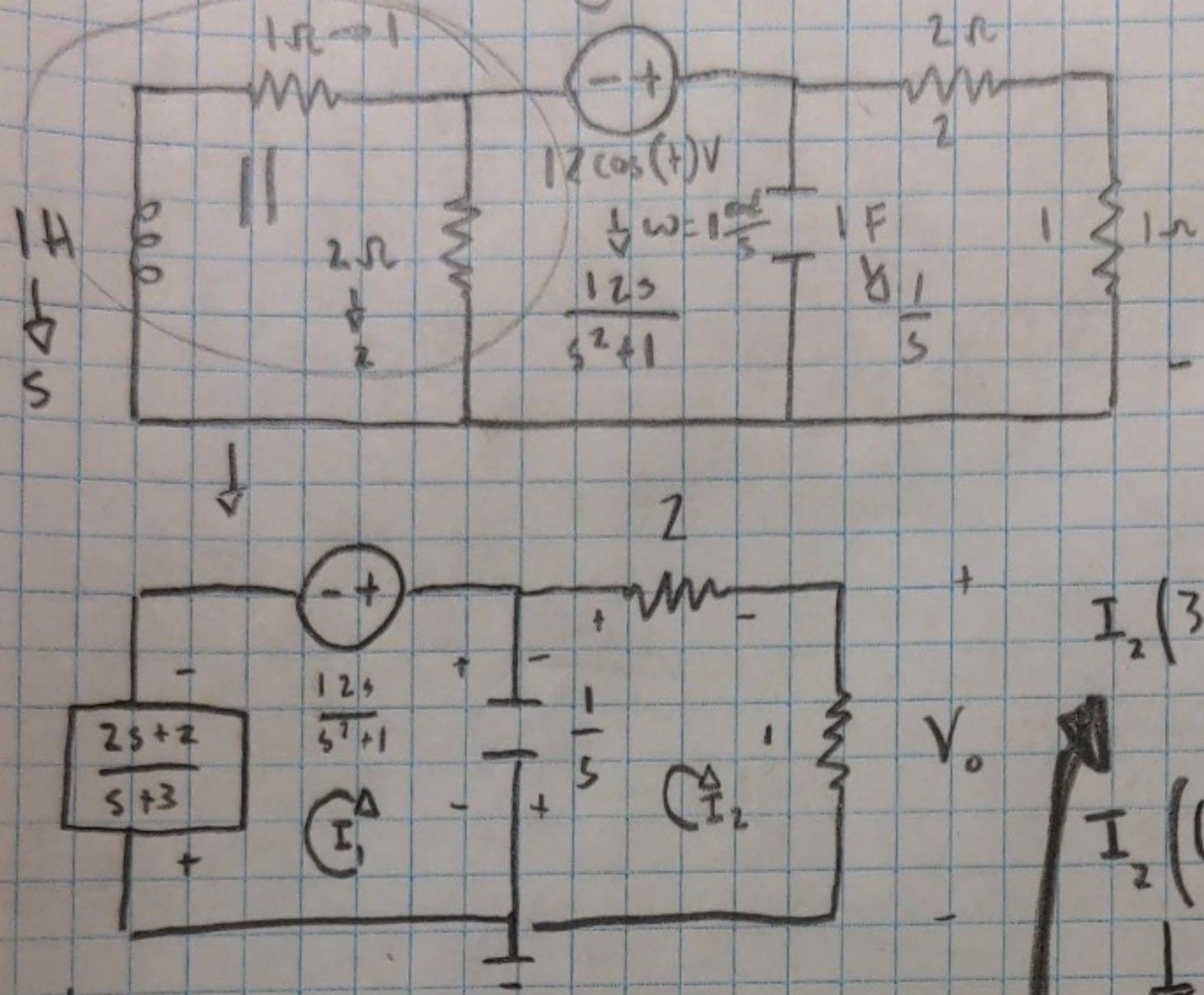
Chris Hunt HW12 ENGR203

12.1) Find the steady state response $V_o(t)$ for the network



Mesh I_1)

$$I_1\left(\frac{2s+2}{s+3}\right) - \frac{12s}{s^2+1} + \frac{1}{s}\left(I_1 - I_2\right) = 0$$

$$I_1\left(\frac{2s+2}{s+3} + \frac{1}{s}\right) + I_2\left(-\frac{1}{s}\right) = \frac{12s}{s^2+1}$$

Mesh I_2)

$$\frac{1}{s}\left(I_2 - I_1\right) + I_2(3) = 0$$

$$-\frac{1}{s}I_1 + I_2\left(\frac{1}{s}+3\right) = 0$$

$$\frac{1}{s}I_1 = I_2\left(\frac{1}{s}+3\right)$$

$$I_1 = I_2(3s+1)$$

$$I_2\left(3s+1\right)\left(\frac{2s+2}{s+3} + \frac{1}{s}\right) + I_2\left(-\frac{1}{s}\right) = \frac{12s}{s^2+1}$$

$$I_2\left(\left(3s+1\right)\left(\frac{2s+2}{s+3} + \frac{1}{s}\right) - \frac{1}{s}\right) = \frac{12s}{s^2+1}$$

$$I_2 = \frac{12s}{s^2+1}\left(\left(3s+1\right)\left(\frac{2s+2}{s+3} + \frac{1}{s}\right) - \frac{1}{s}\right)$$

$$V_o = I_2 \cdot 1\Omega \rightarrow V_o = I_2$$

$$V_o = \underbrace{\frac{12s}{s^2+1}}_{V_s}\underbrace{\left(\left(3s+1\right)\left(\frac{2s+2}{s+3} + \frac{1}{s}\right) - \frac{1}{s}\right)}_{V_o/V_s}$$

$$V_o = \frac{12s}{s^2+1}\left(2.6 + j2.8\right)$$

$$V_o = \frac{s}{s^2+1}\left(31.2 + j33.6\right)$$

$$V_o = 45.85\angle 47.12\,\frac{s}{s^2+1}$$

$$\mathcal{L}^{-1}\left[V_o\right] = 45.85\,e^{j47.12^\circ}\cos(t)$$

$$V_o(t) = 45.85\,e^{j47.12^\circ}\left(\frac{e^{jx} + e^{-jx}}{2}\right)$$

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12.1) $V_o(t) = 45.85 e^{j47.12°}\left(\frac{e^{j\frac{\pi}{4}} + e^{-j\frac{\pi}{4}}}{2}\right)$

$V_o(t) = \frac{45.85}{2}\left(e^{j(47.12+\frac{\pi}{4})} + e^{-j(47.12+\frac{\pi}{4})}\right)$

$V_o(t) = 22.9\cos(t + 47.12°)\ V$

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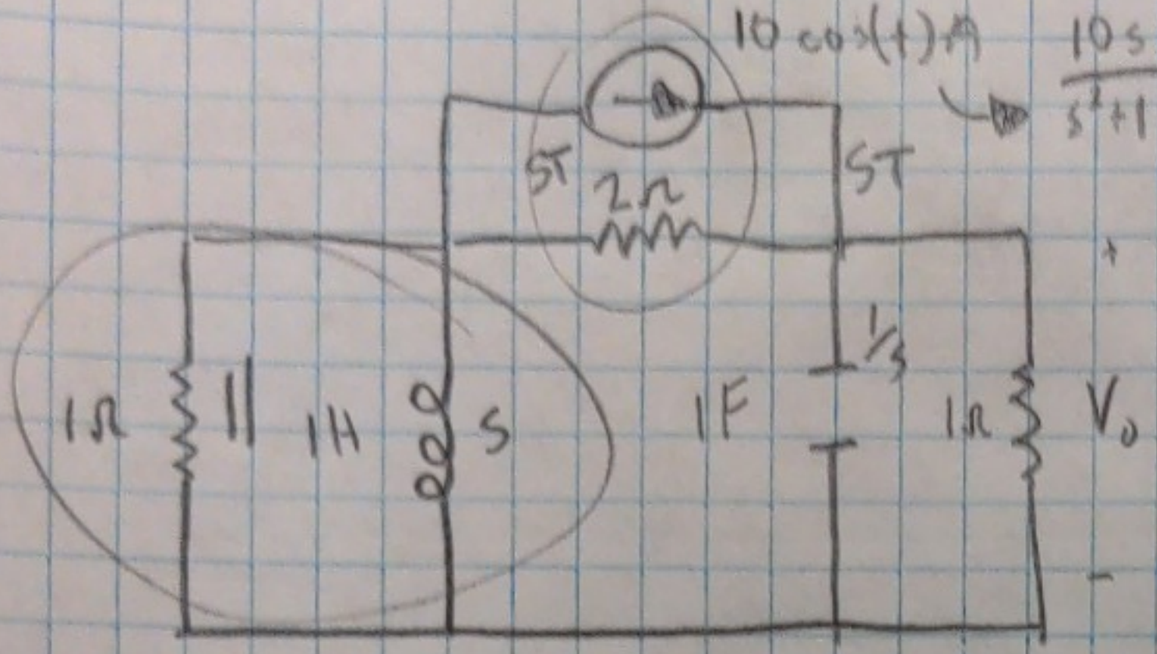
12.2) Find the steady state response $V_o(t)$ for the circuit.



Mesh I_1)

$$I_1\left(\frac{s}{s+1}+2\right)-\frac{20s}{s^2+1}+\frac{1}{s}\left(I_1-I_2\right)=0$$

$$I_1\left(\frac{s}{s+1}+2+\frac{1}{s}\right)-\frac{1}{s}I_2=\frac{20s}{s^2+1}$$

Mesh I_2)

$$\frac{1}{s}\left(I_2-I_1\right)+I_2=0$$

$$-\frac{1}{s}I_1+I_2\left(\frac{1}{s}+1\right) \rightarrow I_1=I_2(s+1)$$

$$I_2(s+1)\left(\frac{s}{s+1}+2+\frac{1}{s}\right)-\frac{1}{s}I_2=\frac{20s}{s^2+1}$$

let $s=j\omega=j$

$$I_2(3+j3)=\frac{20s}{s^2+1}$$

$$I_2=\left(\frac{20}{3+j3}\right)\frac{s}{s^2+1}$$

$$I_2=(3.33-j3.33)\frac{s}{s^2+1}$$

$$I_2=4.71\angle -45\,\frac{s}{s^2+1}$$

$$V_o=I_1\cdot 1\Omega=I_2$$

$$\mathcal{L}^{-1}[V_o]=4.71e^{-j45^\circ}\cos(t)\ V$$

$$V_o=4.71e^{-j45^\circ}\left(\frac{e^{jt}+e^{-jt}}{2}\right)$$

$$\boxed{V_o(t)=2.36\cos(t-45^\circ)\ V}$$