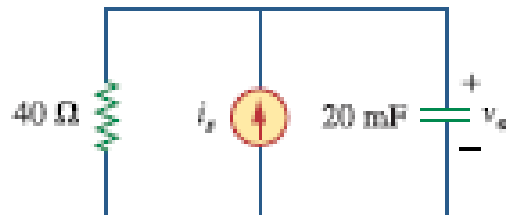


Fourier transform problems

Find $v_o(t)$ in the circuit of Fig. 18.45, where $i_s = 5e^{-t}u(t)$ A.



$$20 \text{ mF} \longrightarrow \frac{1}{j\omega C} = \frac{1}{j20 \times 10^{-3} \omega} = \frac{50}{j\omega}, \quad i_s = 5e^{-t} \longrightarrow I_s = \frac{5}{1+j\omega}$$

$$V_o = \frac{40}{40 + \frac{50}{j\omega}} I_s \bullet \frac{50}{j\omega} = \frac{250}{(s+1)(s+1.25)}, \quad s = j\omega$$

$$V_o = \frac{A}{s+1} + \frac{B}{s+1.25} = 1000 \left[\frac{1}{s+1} - \frac{1}{s+1.25} \right]$$

$$\underline{v_o(t) = 1000(e^{-1t} - e^{-1.25t})u(t) \text{ V}}$$

Use the Fourier transform to find $i(t)$ in the circuit of Fig. 18.47 if $v_s(t) = 10e^{-2t}u(t)$.



$$I = \frac{1}{1+j\omega} \cdot \frac{V_s}{2} = \frac{1}{1+j\omega} \cdot \frac{5}{2+j\omega} = \frac{5}{(s+1)(s+2)}, \quad s = j\omega$$

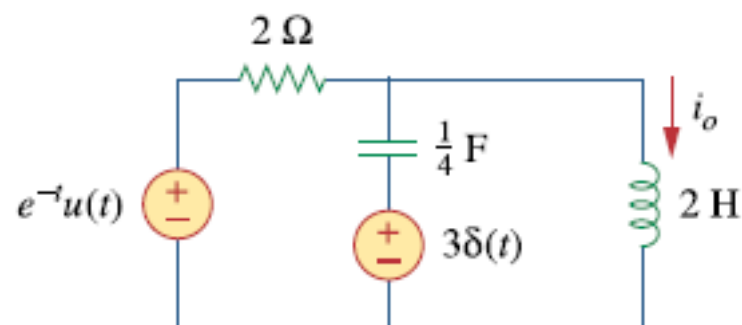
$$= \frac{A}{s+1} + \frac{B}{s+2}$$

where $A = 5/1 = 5$, $B = 5/-1 = -5$

$$I = \frac{5}{s+1} - \frac{5}{s+2}$$

$$\underline{i(t) = 5(e^{-t} - e^{-2t})u(t) \text{ A}}$$

Determine the Fourier transform of $i_o(t)$ in the circuit of Fig. 18.48.

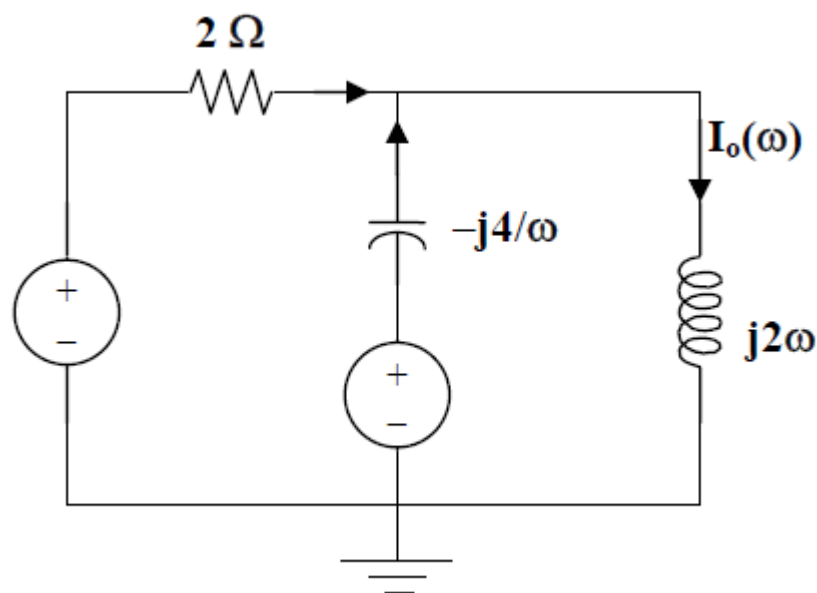


$$\frac{1}{4} \text{ F} \longrightarrow \frac{1}{j\omega \frac{1}{4}} = \frac{-j4}{\omega}$$

$$2 \text{ H} \longrightarrow j\omega 2$$

$$3\delta(t) \longrightarrow 3$$

$$e^{-t}u(t) \longrightarrow \frac{1}{1+j\omega}$$



—

At node V_o , KCL gives

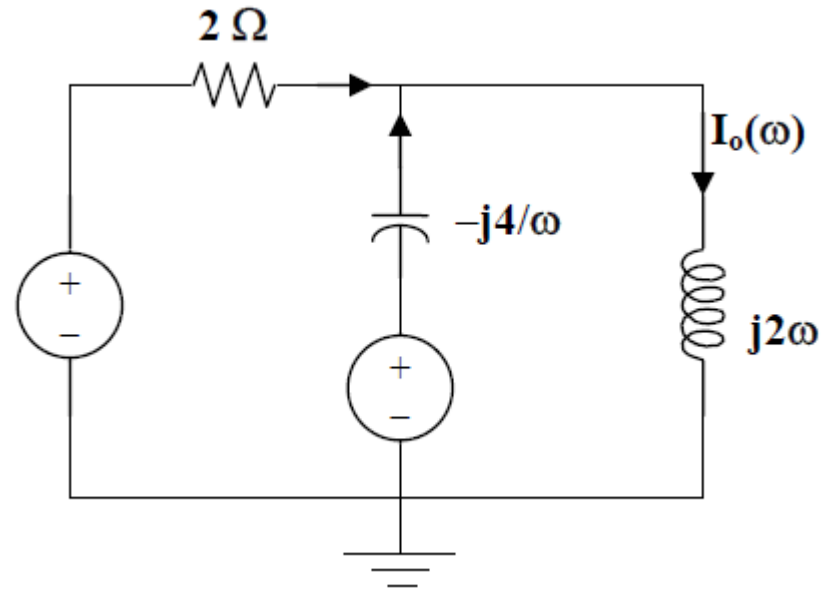
$$\frac{1}{\frac{1+j\omega}{2} - V_o} + \frac{3 - V_o}{\frac{-j4}{\omega}} = \frac{V_o}{j2\omega}$$

$$\frac{2}{1+j\omega} - 2V_o + j\omega 3 - j\omega V_o = -\frac{j2V_o}{\omega}$$

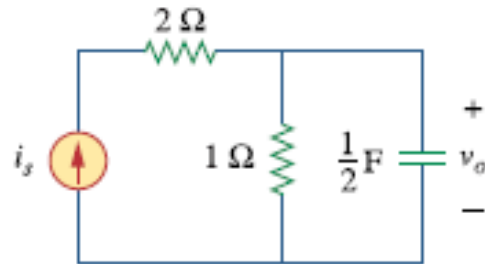
$$V_o = \frac{\frac{2}{1+j\omega} + j\omega 3}{2 + j\omega - \frac{j2}{\omega}}$$

$$I_o(\omega) = \frac{V_o}{j2\omega} = \frac{\frac{2 + j\omega 3 - 3\omega^2}{1 + j\omega}}{j2\omega \left(2 + j\omega - \frac{j2}{\omega} \right)}$$

$$I_o(\omega) = \underline{\underline{\frac{2 + j\omega^2 - 3\omega^2}{4 - 6\omega^2 + j(8\omega - 2\omega^3)}}}$$



Find the voltage $v_o(t)$ in the circuit of Fig. 18.49. Let $i_s(t) = 8e^{-t}u(t)$ A.



$$\frac{1}{2}F \longrightarrow \frac{1}{j\omega C} = \frac{2}{j\omega}$$

$$I_o = \frac{1}{1 + \frac{2}{j\omega}} I_s$$

$$V_o = \frac{2}{j\omega} I_o = \frac{\frac{2}{j\omega}}{1 + \frac{2}{j\omega}} I_s = \frac{2}{2 + j\omega} \frac{8}{1 + j\omega}$$

$$= \frac{16}{(s+1)(s+2)}, s = j\omega$$

$$= \frac{A}{s+1} + \frac{B}{s+2}$$

where $A = 16/1 = 16$, $B = 16/(-1) = -16$

Thus,

$$v_o(t) = \underline{16(e^{-t} - e^{-2t})u(t) \text{ V.}}$$