

Tutorial 9

Solⁿ 4

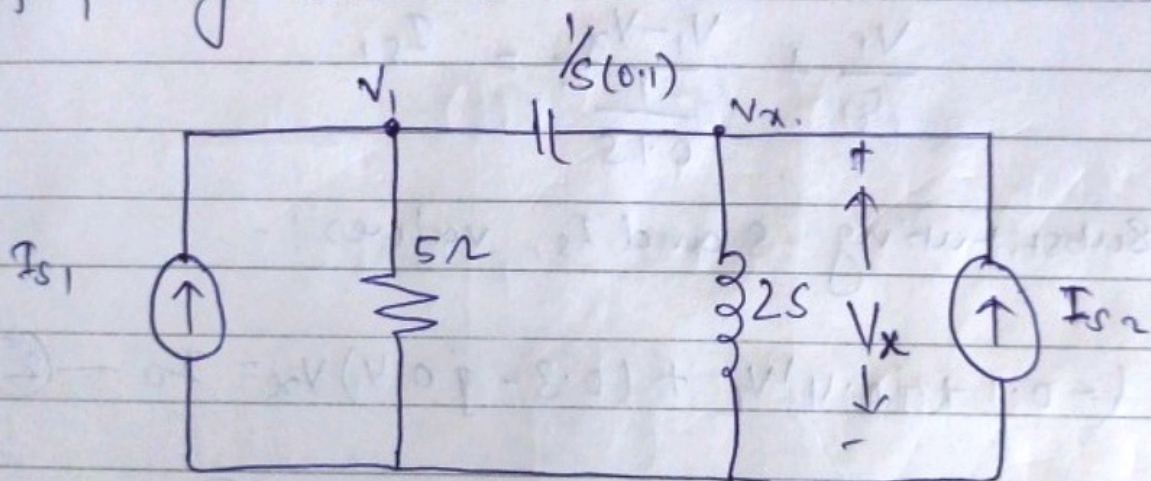
$$\begin{aligned} i_{s1} &= 20 e^{-3t} \cos 4t \text{ A} \\ i_{s2} &= 30 e^{-3t} \sin 4t \text{ A} \end{aligned} \quad \left. \begin{array}{l} \\ \end{array} \right\} \text{ given}$$

$$\sigma = -3; \omega = 4 \text{ rad/sec}; \theta = 0^\circ$$

$$s = -3 + j4$$

(a)

frequency domain



Nodal at V_x :-

$$\frac{V_x - V_1}{1/0.1s} + \frac{V_x}{2s} = I_{s2}$$

put I_{s2} and s and solve

$$\frac{V_x - V_1}{\frac{1}{0.1(-3+j4)}} + \frac{V_x}{2(-3+j4)} = -30 \angle 90^\circ$$

$$(0.7 + j2.4)V_1 + (-0.2 - j2.4)V_x = 2(-3 + j4)(-30 \angle 90^\circ)$$

$$(0.7 + j2.4)V_1 + (-0.2 - j2.4)V_x = 120 + j96$$

— (1)

Nodal at V_1

$$\frac{V_1}{5} + \frac{V_1 - V_x}{\frac{1}{0.15}} = I_{s1}$$

on substituting S and I_{s1} values :-

$$(-0.1 + j0.4)V_1 + (0.3 - j0.4)V_x = 20 \quad \text{--- (2)}$$

on solving eqⁿ (1) and (2)

$$V_x = 185.15 \angle -47.58^\circ \text{ V}$$

b) $V_m = 185.15$; $\theta = -47.58^\circ$; $s = -3 + j4$

$$v(t) = V_m e^{\sigma t} \cos(\omega t + \theta)$$

$$= 185.15 e^{-3t} \cos(4t - 47.58^\circ) \text{ Volt}$$

Solⁿ 5 (a) $F(s) = \frac{1}{s}$

$$f(t) = L^{-1} \left\{ \frac{1}{s} \right\}$$

from Laplace transform pair.

$$u(t) \Leftrightarrow \frac{1}{s}$$

$$f(t) = u(t) \quad \underline{\text{Ans.}}$$

(b) $F(s) = 1.55 - \frac{2}{s}$

$$f(t) = L^{-1} \left\{ 1.55 - \frac{2}{s} \right\}$$

$$= L^{-1} \left\{ 1.55 \right\} - L^{-1} \left\{ \frac{2}{s} \right\}$$

$$= 1.55 L^{-1} \left\{ 1 \right\} - 2 L^{-1} \left\{ \frac{1}{s} \right\}$$

$$u(t) \Leftrightarrow \frac{1}{s} ; \delta(t) \Leftrightarrow 1$$

$$f(t) = 1.55 \delta(t) - 2 u(t) \quad \underline{\text{Ans.}}$$

(c)

$$F(s) = \frac{1}{s+1.5}$$

$$f(t) = \mathcal{L}^{-1} \left\{ \frac{1}{s+1.5} \right\}$$

$$e^{-at} u(t) \Leftrightarrow \frac{1}{s+a}$$

$$f(t) = e^{-1.5t} u(t) \quad \underline{\text{Ans}}$$

(d)

$$F(s) = \frac{5}{s^2} + \frac{5}{s} + 5$$

$$f(t) = 5 \mathcal{L}^{-1} \left\{ \frac{1}{s^2} \right\} + 5 \mathcal{L}^{-1} \left\{ \frac{1}{s} \right\} + 5 \mathcal{L}^{-1} \{ 1 \}$$

$$t u(t) \Leftrightarrow \frac{1}{s^2}; \quad u(t) \Leftrightarrow \frac{1}{s}; \quad \delta(t) \Leftrightarrow 1$$

$$f(t) = 5 (t u(t) + u(t) + \delta(t)) \quad \underline{\text{Ans}}$$