Tutorial 9

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Soln) 1(a))

$$f(t) = 5e^{-7t}\cos(80t)$$
$$= 5e^{-7t}\left(\frac{e^{j80t}+e^{-j80t}}{2}\right)$$
$$= 2.5e^{(-7+j80)t} + 2.5e^{(-7-j80)t}$$

Comparing with a general expression for a real sinusoidal voltage,

$$V(t) = K_1 e^{s_1 t} + K_2 e^{s_2 t}$$

Where, s_1 and s_2 are the complex frequencies. Thus,

Complex frequencies : $\boxed{-7 \pm j80}$ Ans

1(b))

$$g(t) = (4e^{-2t} - e^{-t})\cos(4t - 95^\circ)$$
$$= (4e^{-2t} - e^{-t})(\cos(4t)\cos(95^\circ) + \sin(4t)\sin(95^\circ))$$

$(\because \cos(A-B) = \cos A \cos B + \sin A \sin B)$

$$\Rightarrow (4e^{-2t} - e^{-t})(-0.087\cos(4t) + 0.996\sin(4t))$$

now, substitute the above with :-

$$\cos(4t) = \frac{e^{j4t} + e^{-j4t}}{2}$$

$$\sin(4t) = \frac{e^{j4t} - e^{-j4t}}{2j}$$

$$\Rightarrow g(t) = -(0.087)\left\{\frac{4e^{(-2+4j)t} + 4e^{(-2-j4)t} - e^{(1-j4)t} - e^{(-1-j4)t}}{2}\right\}$$
$$+ (0.996)\left\{\frac{4e^{(-2+j4)t} + 4e^{(-2-j4)t} - e^{(-1+j4)t} - e^{(-1-j4)t}}{2j}\right\}$$

$\Rightarrow$ Complex frequencies :- $\boxed{-2 \pm j4,\ -1 \pm j4}$ Ans

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Soln (2)

~~$Ae^{Bt}\sin(100t+\theta)$~~

Given;

$$v(t) = Ae^{Bt}\cos(Ct+\theta) \quad \text{---} \ (1)$$

$A = 1V,\ B = 0.2\,Hz,\ C = 0,\ \theta = 45°$

Substitute all the values in (1).

$$\Rightarrow v(t) = e^{0.2t}\cos(45°)$$

$$= e^{0.2t}/\sqrt{2}$$

now, using ohms law:-

$$i(t) = v(t)/R$$

$$= \frac{e^{0.2t}}{280\sqrt{2}}$$

Substitute, $t = 0s$

$$i(0) = v(0)/R$$

$$= \frac{e^{0}}{280\sqrt{2}} = 2.525\,mA$$ B

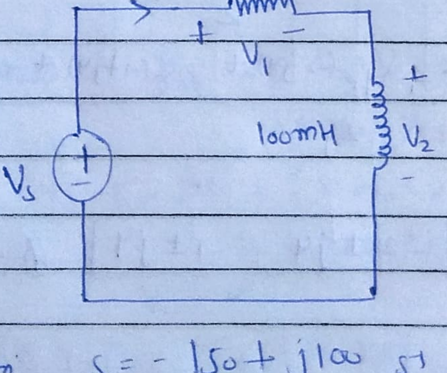
Substitute, $t = 0.1s$

$$i(0.1) = \frac{e^{0.2\times 0.1}}{280\sqrt{2}} = 2.576\,mA$$ B

Substitute: $t = 0.5s$

$$i(0.5) = \frac{e^{0.2\times 0.5}}{280\sqrt{2}} = 2.791\,mA$$ B

Soln 3)



Given; $s = -150 + j100\ s^{-1}$

$V_2 = 5\angle -25\ V$

time domain voltage corresponding to V_2 = ?

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Apply KVL;

$$V_s = Ri(t) + L\frac{di(t)}{dt} \quad \text{— (1)}$$

Convert into phasor domain.

$$\Rightarrow \quad V_s e^{st} = RIe^{st} + Ls\,Ie^{st} \quad \text{— (2)}$$

where,

$$V_2 = Ls\,Ie^{st}$$

now,

$$I = V_2/Ls$$

$$= \frac{5\angle -25^\circ}{0.1(-150 + j100)}$$

$$= 0.277\angle -171.3^\circ\ A$$

→ Substitute the value in eqn (2) :-

$$V_s = 21\,I + Ls\,I$$

$$= 21\,I + Ls\,I$$

$$= 21(0.277\angle -171.3^\circ) + 0.1(-150 + j100)(0.277\angle -171.3^\circ)$$

$$= 3.23\angle 112.21^\circ\ V$$

therefore;

$$V_m = 3.23$$

$$\theta = 112.21^\circ$$

Since; $s = -150 + j100$, hence,

$$\sigma = -150$$

$$\omega = 100$$

Now, as per the general form of time domain voltage is given by,

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

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Thus,

$$V_s(t) = 3.23\, e^{-150t} \cos(100t + 112.27°)\ V$$