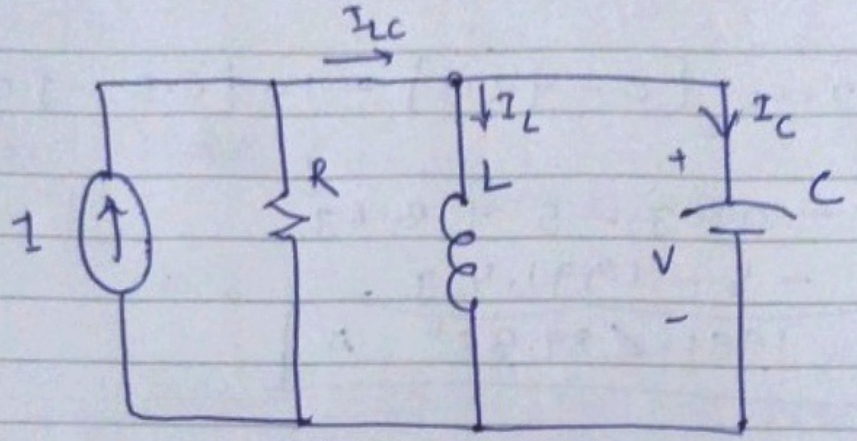
Tutorial 4

Soln 2.



$L = 1\,mH \qquad C = 100\,\mu F$

$Q_0 = 15$

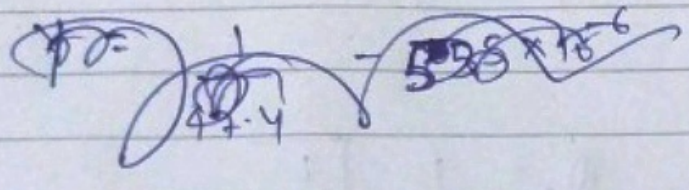
(a) $\omega_0 = 3162$ rad/s

$$B = \frac{\omega_0}{Q_0} = \frac{3162}{15} = 210.8 \text{ rad/s}$$

$$Y = \frac{1}{R} + j\left(\omega C - \frac{1}{\omega L}\right)$$

$$R = \frac{Q_0}{\sqrt{\frac{C}{L}}} = \frac{15}{\sqrt{\frac{100\times10^{-6}}{1\times10^{-3}}}} = 47.4\,\Omega$$

$$Y = \frac{1}{47.4} + j\left(3162 \times 100\times10^{-6} - \frac{1}{3162\times1\times10^{-3}}\right)$$



$$Y = \frac{1}{47.4} - j55.5\times10^{-6}$$

$$Y = 0.02 - j(55.5\times10^{-6}) \simeq 0.02\ S$$

$$Z = 47.4\ \Omega.$$

(b) $$Y = \frac{1}{47.4} + j\left(3000 \times 100\times10^{-6} - \frac{1}{3000\times1\times10^{-3}}\right)$$

$$Y = 0.02 + j(-0.03)$$

$$Y = 0.04\ \angle -56.31\ S$$

$$Z = 25\ \angle 56.31\ \Omega$$

Similarly,

(c) $Z(3200) = 44.7\ \angle -20^\circ\ \Omega$ (d) $Z(2000) = 4.3\ \angle 85^\circ\ \Omega$

Soln 3.

$R = 100\,\Omega \quad L = 1.5\,mH \quad Q_0 = 7$

$v_s = 2.5 \cos(425 \times 10^6 t)\ V$

(a) $|Z|$ at 500×10^6 rad/sec = ?

$C = ? \quad ; \quad Q_0 = \frac{1}{R}\sqrt{\frac{L}{C}}$

$$7 = \frac{1}{100}\sqrt{\frac{1.5 \times 10^{-3}}{C}}$$

$$C = 3\,mF$$

$$Z = R + j\left(\omega L - \frac{1}{\omega C}\right)$$

$$= 100 + j\left(500 \times 10^6 \times 1.5 \times 10^{-3} - \frac{1}{500 \times 10^6 \times 3 \times 10^{-9}}\right)$$

$$= 100 + j(750{,}000 - 0.66)$$

$$Z(j500\,M) = 750 \times 10^3 \angle 89.99^\circ\ \Omega$$

$$|Z| = 750\,K\Omega$$

(b) $I_s = \dfrac{V_s}{Z_t(j\omega)}$ $\omega = 425$ Mrad/s

$$Z_t(j425M) = 100 + j\left(425\times10^{6}\times1.5\times10^{-3} - \frac{1}{425\times10^{6}\times3\times10^{-9}}\right)$$

$$Z_t = 637.5\times10^{3}\angle 89.99^{\circ}\ \Omega$$

$$I_s = \frac{2.5\angle 0^{\circ}}{637.5\times10^{3}\angle 89.99^{\circ}}$$

$$I_s = 3.92\times10^{-6}\angle -89.99 \text{ A}$$

$$\Rightarrow i_s(t) = 3.92\times10^{-6}\cos(425\times10^{6}t - 89.99^{\circ}) \text{ A}$$