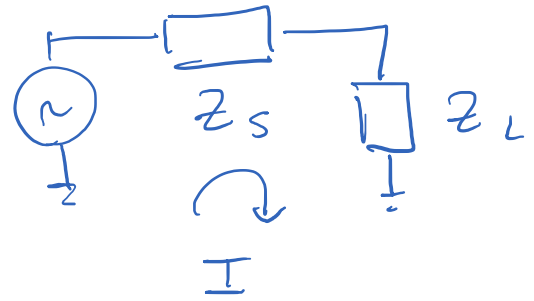
PS 2 SOLUTIONS

(2)



WRITE $Z_S = R_S + jX_S$

$Z_L = R_L + jX_L$

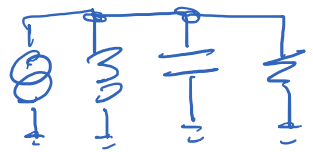
INSTANTANEOUS POWER TO LOAD = $I^2 R_S$

$$I = \frac{V}{Z_S + Z_L} = \frac{V}{R_S + R_L + j(X_S + X_L)}$$

CLEARLY, IMAGINARY PART OF $Z_S + Z_L$ ONLY REDUCES CURRENT WITHOUT CONTRIBUTING TO POWER DISSIPATION IN LOAD. CURRENT IS MAXIMIZED FOR $X_S = -X_L$. WITH THIS CONDITION, PROBLEM REDUCES TO USUAL POWER MATCHING WITH RESISTIVE SOURCE + LOAD. DESIRED POWER MATCH CONDITION IS A

CONJUGATE MATCH $Z_L = Z_S^*$.

(2)



$$Y = \frac{1}{j\omega L} + j\omega C + 1/R \equiv 1/R + jX$$

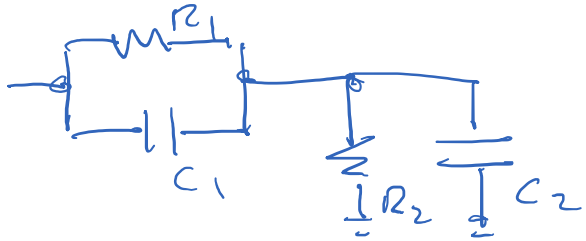
$$V = I/Y = \frac{1/R - jX}{1/R^2 + X^2}\, I$$

TAKE $Q >> 1 \longrightarrow X \equiv \omega C - \frac{1}{\omega L} \approx \frac{2}{Z_0}\frac{\Delta}{\omega_0}$

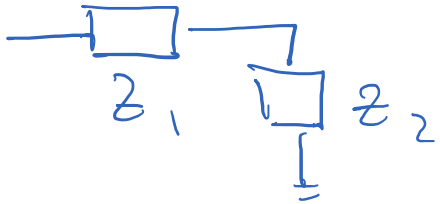
A. $$V = \left[\frac{1 - j2Q\,\Delta/\omega_0}{1 + 4Q^2(\Delta/\omega_0)^2}\right] Q Z_0 I_0 e^{j\omega t}$$

B.C. ON RESONANCE, $I_L = -jQI_0 e^{j\omega_0 t} = -I_C$

(3) CONSIDER



THIS IS SIMPLE VOLTAGE DIVIDER
w/ COMPLEX IMPEDANCES



PROVIDED $Z_1 = \text{CONST} \times Z_2$,

WILL GET SAME VOLTAGE DIVISION @ ALL FREQUENCIES

FOR $R \| C$, $Z = \dfrac{-j\frac{R}{\omega C}}{R - j\omega C} = \dfrac{R}{1 + j\omega\tau}$; $\tau \equiv RC$

OVER →

CLEARLY, WE WANT $R_1 C_1 = R_2 C_2$

IN ORDER TO GET VOLTAGE DIVISION THAT IS INDEPENDENT OF FREQUENCY.

TO HAVE 10× DIVISION, REQUIRE

$$R_1 = 9 R_2$$

$$C_1 = \frac{1}{9} C_2$$

$\therefore$ $R_1 = 9\,M\Omega$, $C_1 = 13\,pF$

$$Z_{in} = Z_1 + Z_2 = (R_1 + R_2)\frac{1}{1+j\omega\tau} \; ; \; \tau = 1\,M\Omega \cdot 120\,pF$$

$$= 10\,M\Omega \frac{1}{1+j\omega\tau}$$

LOOKS LIKE $10\,M\Omega$ in parallel with $12\,pF$