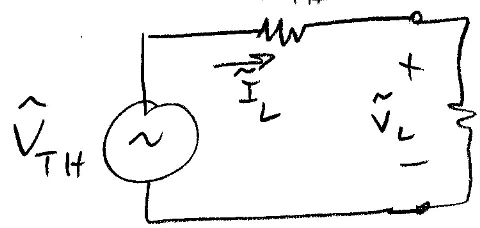
MAX POWER TRANSFER

$Z_{TH} = R_{TH} + j X_{TH}$ — X_{TH}: + or − (ωL, or $\frac{-1}{\omega C}$)



$Z_L = R_L + j X_L$ — X_L: ωL, or $\frac{-1}{\omega C}$

$$S_L = \tilde{V}_L \tilde{I}_L^* = P_L + j Q_L \quad , \quad \hat{I}_L = \frac{\hat{V}_{TH}}{(R_{TH}+R_L) + (j X_{TH} + j X_L)}$$

P_L: want to max

Note: $\tilde{I}_L$ bigger when $X_L = -X_{TH}$

$$P_L = |\hat{I}_L|^2 R_L = \frac{|\hat{V}_{TH}|^2}{(R_{TH}+R_L)^2 + (X_{TH}+X_L)^2} R_L$$

$$= |\tilde{V}_{TH}|^2 R_L \left[(R_{TH}+R_L)^2 + (X_{TH}+X_L)^2\right]^{-1}$$

$$\frac{\partial P_L}{\partial R_L} = \frac{|V_{TH}|^2}{(R_{TH}+R_L)^2 + (X_{TH}+X_L)^2} - \frac{|V_{TH}|^2 R_L \cdot 2(R_{TH}+R_L)}{\left[(R_{TH}+R_L)^2 + (X_{TH}+X_L)^2\right]^2} = 0$$

$$= \frac{|V_{TH}|^2}{(R_{TH}+R_L)^2 + (X_{TH}+X_L)^2}\left[1 - \frac{2R_L(R_{TH}+R_L)}{(R_{TH}+R_L)^2 + (X_{TH}+X_L)^2}\right] = 0$$

MUST = 0 for MAX power xfer to R_L

so
$$\frac{2R_L(R_{TH}+R_L)}{(R_{TH}+R_L)^2 + (X_{TH}+X_L)^2} = 1$$

$$2R_L R_{TH} + 2R_L^2 = R_{TH}^2 + 2R_{TH}R_L + R_L^2 + (X_{TH}+X_L)^2$$

so (A) then (B)

(B) Note, if $X_L = -X_{TH}$, $R_L = R_{TH}$, so $Z_L = Z_{TH}^*$ yields MAX power to R_L

(A) $R_L^2 - R_{TH}^2 = (X_{TH}+X_L)^2$ $\Rightarrow$ (A) $R_L^2 = R_{TH}^2 + (X_{TH}+X_L)^2$ FOR MAX POWER TO R_L