Potencia en AC.

Corrección del Factor de Potencia

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$Q = VI \sin\theta$ (volt-ampere reactive, VAR)

Potencia Reactiva

Para el Inductor:

$Q_L = VI$ (VAR)

$Q_L = I^2 X_L$ (VAR)

$Q_L = \frac{V^2}{X_L}$ (VAR)

$Q = VI \sin\theta$ (volt-ampere reactive, VAR)

Potencia Reactiva

Para el Capacitor:

$Q_C = VI$ (VAR)

$Q_C = I^2 X_C$ (VAR)

$Q_C = \frac{V^2}{X_C}$ (VAR)

Triángulo de Potencias:

Las Potencias Reactivas y Real se relacionan:

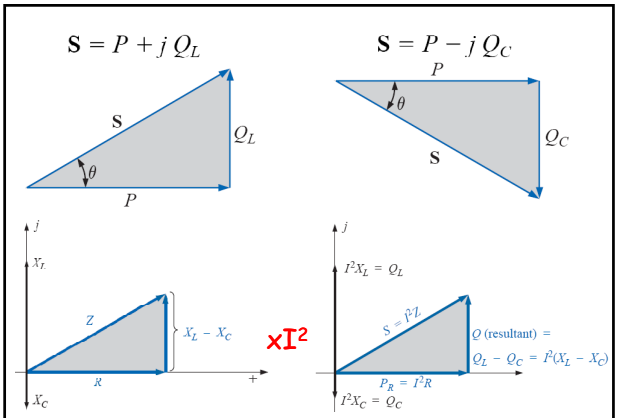
$S = P + Q$ $\quad S = VI$

S es la Potencia Aparente. [VA]

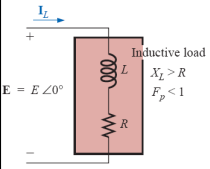
$S = P + j(Q_L - Q_C)$

$\mathbf{P} = P\angle 0°$ $\quad \mathbf{Q}_L = Q_L\angle 90°$ $\quad \mathbf{Q}_C = Q_C\angle -90°$

$S = VI^*$



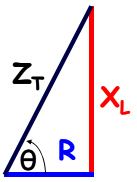
Ejemplo: Fuente de 110V y 60 Hz. R= 200Ω, L=1H.



$X_L = 2\pi fL = 377\Omega$

$Z_T = 426.5\Omega \angle 62.05°$

$I_L = 0.258 \angle -62.05°$

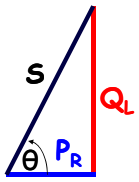


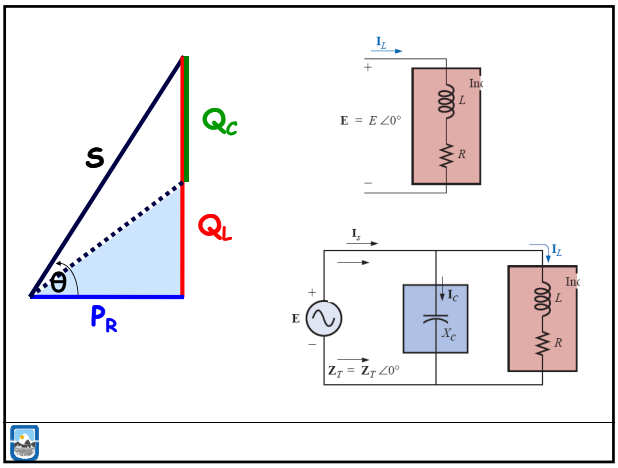
$P_R = I^2R = 13.31$ W

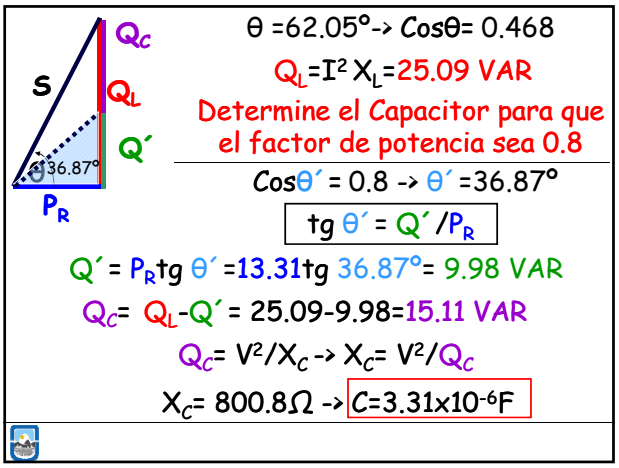
$Q_L = I^2 X_L = 25.09$ VAR

$S = VI = 28.38$ VA

$\cos\theta = 0.468$







θ =62.05°-> Cosθ= 0.468

$Q_L = I^2 X_L = 25.09$ VAR

Determine el Capacitor para que el factor de potencia sea 0.8

Cosθ´ = 0.8 -> θ´ =36.87°

$\text{tg}\,\theta' = Q'/P_R$

$Q' = P_R \text{tg}\,\theta' = 13.31 \text{tg}\,36.87° = 9.98$ VAR

$Q_C = Q_L - Q' = 25.09 - 9.98 = 15.11$ VAR

$Q_C = V^2/X_C$ -> $X_C = V^2/Q_C$

$X_C = 800.8\Omega$ -> $C = 3.31 \times 10^{-6}$F

$Z_{RL} = 426.5\Omega \angle 62.05° = 199.9 + j376.75$

$Z_C = 800.8 \angle -90° = -j800.8$

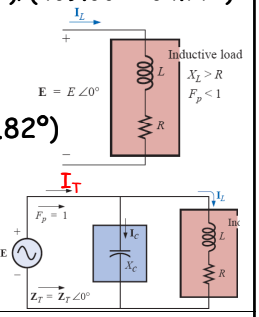
$Z_T = Z_{RL//} Z_C = (341541.2 \angle -27.95°)/(469.03 \angle -64.77°)$

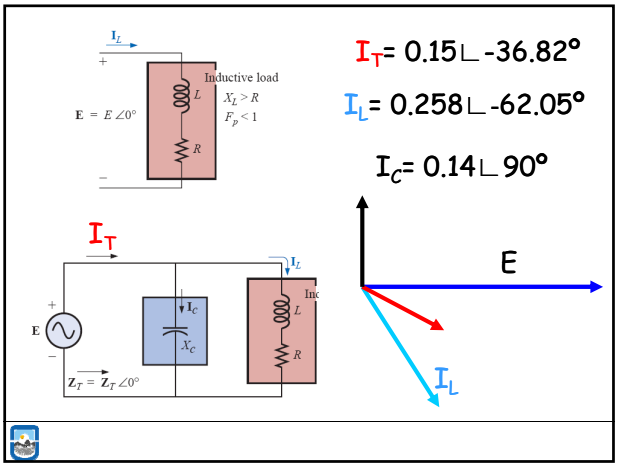
$Z_T = (728.18 \angle 36.82°)$

$I_T = (110 \angle 0°)/(728.18 \angle 36.82°)$

$I_T = 0.15 \angle -36.82°$

$I_L = 0.258 \angle -62.05°$

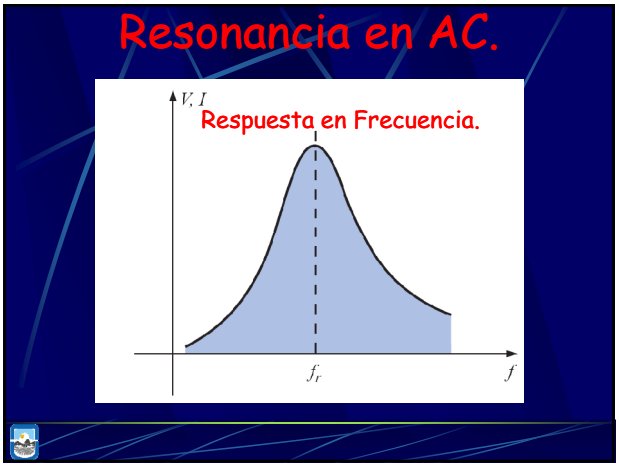


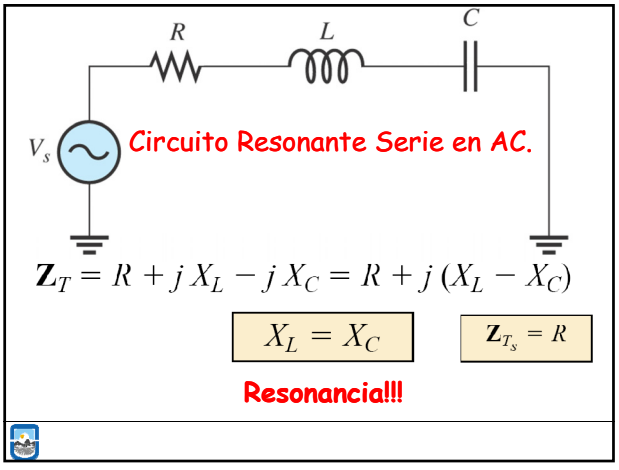


$I_T = 0.15 \angle -36.82°$

$I_L = 0.258 \angle -62.05°$

$I_C = 0.14 \angle 90°$



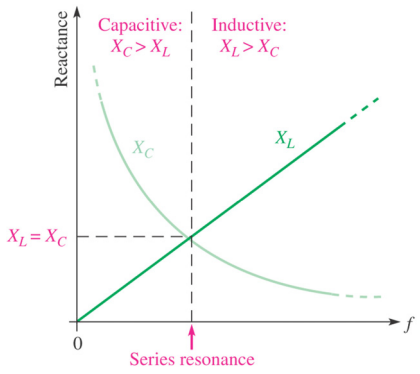


$\mathbf{Z}_T = R + jX_L - jX_C = R + j(X_L - X_C)$

$X_L = X_C$

$\mathbf{Z}_{T_s} = R$

Resonancia!!!



Frecuencia Resonante:

$$X_L = X_C \qquad \omega L = \frac{1}{\omega C} \qquad \omega^2 = \frac{1}{LC}$$

$$\omega_s = \frac{1}{\sqrt{LC}} \qquad f_s = \frac{1}{2\pi\sqrt{LC}}$$

$$\mathbf{I} = \frac{E\angle 0^\circ}{R\angle 0^\circ} = \frac{E}{R}\angle 0^\circ$$

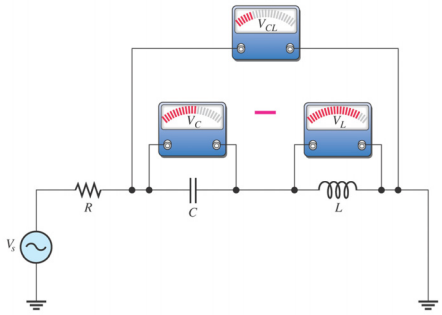
En Resonancia I es máxima

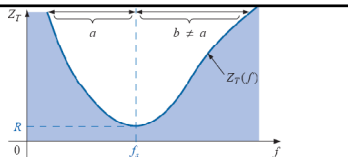
$$\mathbf{V}_L = (I\angle 0^\circ)(X_L\angle 90^\circ) = IX_L\angle 90^\circ$$
$$\mathbf{V}_C = (I\angle 0^\circ)(X_C\angle -90^\circ) = IX_C\angle -90^\circ$$

180° out of phase

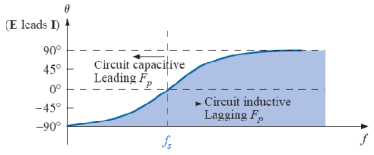
$$V_{L_s} = V_{C_s}$$

En Resonancia!





$$Z_I(f) = \sqrt{[R(f)]^2 + [X_L(f) - X_C(f)]^2}$$

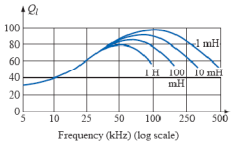


$$\theta = \tan^{-1}\frac{(X_L - X_C)}{R}$$

Factor de Calidad Q_S (en resonancia):

$$Q_s = \frac{\text{reactive power}}{\text{average power}} \qquad Q_s = \frac{I^2X_L}{I^2R} \qquad Q_s = \frac{X_L}{R} = \frac{\omega_s L}{R}$$

$$Q_{\text{coil}} = Q_l = \frac{X_L}{R_l}$$



$$V_L = \frac{X_L E}{Z_T} = \frac{X_L E}{R} \qquad V_{L_s} = Q_s E \qquad V_{C_s} = Q_s E$$

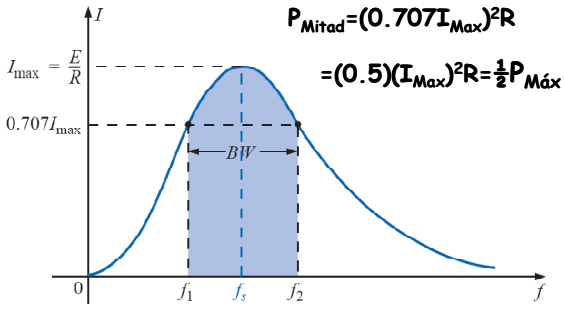
En Resonancia!

Selectividad:

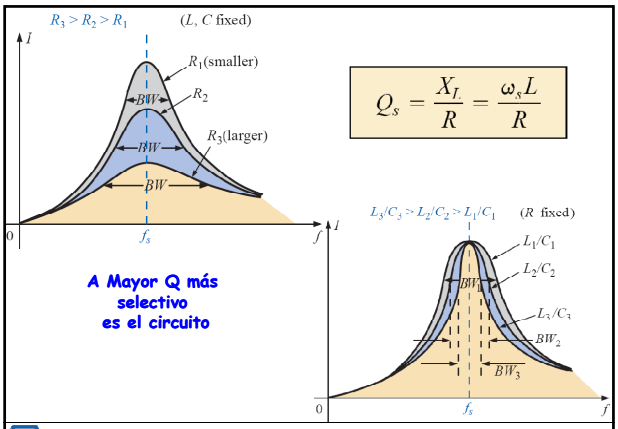
$P_{Mitad} = \frac{1}{2}P_{Máx}$ $P_{Máx} = I^2_{Máx}R$

$P_{Mitad} = (0.707I_{Max})^2R$

$= (0.5)(I_{Max})^2R = \frac{1}{2}P_{Máx}$

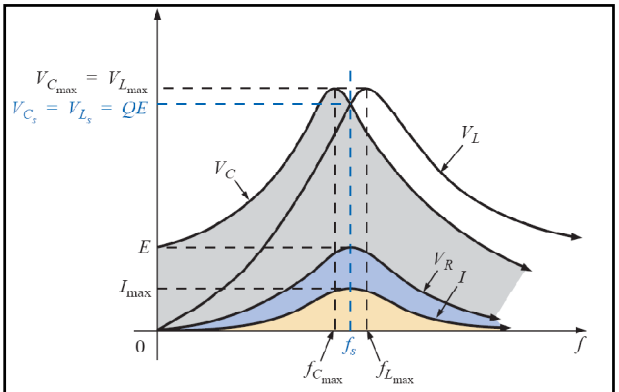


$f_2 - f_1 = f_s/Q$



A Mayor Q más selectivo es el circuito

Obtener Q en función de los parámetros del circuito (R, L y C)



Como calcularía las frecuencias?

Conclusiones. En Resonancia Serie RLC:

1. X_L es igual a X_C.
2. La impedancia Total es mínima y es puramente resistiva.
3. La corriente es máxima.
4. El ángulo de fase entre V e I es 0°.
5. La frecuencia de resonancia está dada por:

$$f_s = \frac{1}{2\pi\sqrt{LC}}$$

Mañana Miércoles 19 de Septiembre:

Laboratorio 6:
Resonancia Serie RLC