

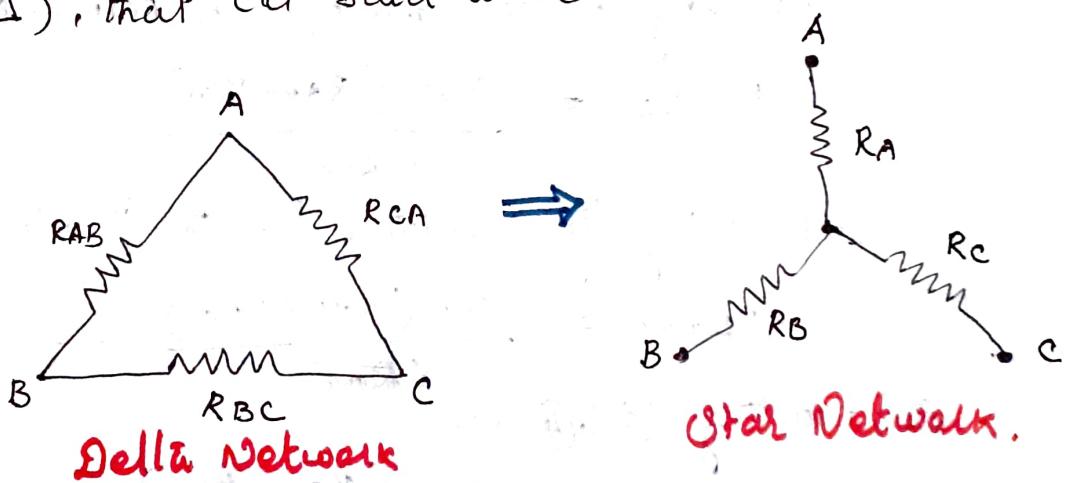
Star - Delta Transformation :-
 It is very much useful in solving complex networks.

Types of Network :

- * Star (γ) network..
- * Delta (Δ) network..

Delta to star Transformation (or) Conversion.

Three elements are connected like a delta (Δ), that can be said to be in delta connections.



$$R_A = \frac{R_{AB} \times R_{AC}}{R_{AB} + R_{BC} + R_{AC}}$$

$$R_B = \frac{R_{AB} \times R_{BC}}{R_{AB} + R_{BC} + R_{AC}}$$

$$R_C = \frac{R_{BC} \times R_{AC}}{R_{AB} + R_{BC} + R_{AC}}$$

Proof :-

~~Considered~~ In Delta, The open resistance of terminal A & B is,

$$R_{eq} = \frac{R_{AB} (R_{BC} + R_{CA})}{R_{AB} + R_{BC} + R_{CA}} \quad \text{--- (1)}$$

In Star, The open resistance of terminal A & B is,

$$R_{eq} = R_A + R_B \quad \text{--- (2)}$$

$$\Rightarrow R_A + R_B = \frac{R_{AB} (R_{BC} + R_{CA})}{\Sigma R_{AB}} \quad \text{--- (3)}$$

Equating the resistance b/w the terminal B & C

$$R_B + R_C = \frac{R_{BC} (R_{AB} + R_{CA})}{\Sigma R_{AB}} \quad \text{--- (4)}$$

Equating the resistance b/w the terminal C & A.

$$R_C + R_A = \frac{R_{CA} (R_{AB} + R_{BC})}{\Sigma R_{AB}} \quad \text{--- (5)}$$

Subtracting (5) & (4) \Rightarrow

$$R_A - R_B = \frac{R_{AB} (R_{CA} - R_{BC})}{\Sigma R_{AB}} \quad \text{--- (6)}$$

Adding (6) & (3) \Rightarrow

$$2R_A = \frac{R_{AB} (2R_{CA})}{\Sigma R_{AB}}$$

$$R_A = \frac{R_{AB} \cdot R_{CA}}{R_{AB} + R_{BC} + R_{CA}}$$

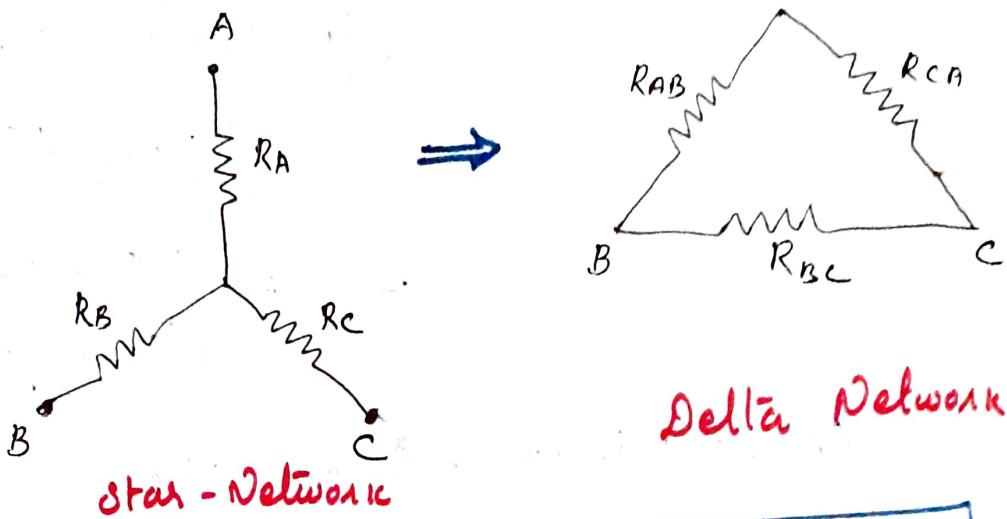
11th

$$R_B = \frac{R_{AB} \cdot R_{BC}}{R_{AB} + R_{BC} + R_{CA}}$$

$$R_C = \frac{R_{BC} \cdot R_{CA}}{R_{AB} + R_{BC} + R_{CA}} \quad //$$

Star - Delta Transformation (or) Conversion:

Three elements are connected like a star (Δ), then the circuit said to be in star connection.



$R_{AB} = \frac{R_A \cdot R_B + R_B R_C + R_C R_A}{R_C}$
$R_{BC} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_A}$
$R_{CA} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_B}$

Proof :-

From Delta to Star equations,

multiply R_A & R_B on R_{AB}

$$R_A R_B = \frac{(R_{AB})^2 R_{BC} R_{CA}}{(\sum R_{AB})^2} \quad \text{--- (1)}$$

likewise

$$R_B R_C = \frac{(R_{BC})^2 R_{AB} \cdot R_{CA}}{(\sum R_{AB})^2} \quad \text{--- (2)}$$

$$R_C \cdot R_A = \frac{(R_{CA})^2 \cdot R_{BC} R_{AB}}{(\sum R_{AB})^2} \quad \text{--- (3)}$$

Adding 1, 2, 3 \Rightarrow

$$\begin{aligned} R_A R_B + R_B R_C + R_C R_A &= \frac{R_{AB} \cdot R_{BC} \cdot R_{CA} (\sum R_{AB} + R_{BC} + R_{CA})}{(\sum R_{AB})^2} \\ &= \frac{R_{AB} \cdot R_{BC} \cdot R_{CA} (\sum R_{AB})}{(\sum R_{AB})^2} \\ &= R_{AB} \left[\frac{R_{BC} \cdot R_{CA}}{\sum R_{AB}} \right] \end{aligned}$$

$$R_A R_B + R_B R_C + R_C R_A = R_{AB} \times R_C$$

$$R_{AB} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_C}$$

111¹⁴

$$R_{BC} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_A}$$

$$R_{CA} = \frac{R_A R_B + R_B R_C + R_C R_A}{R_B}$$

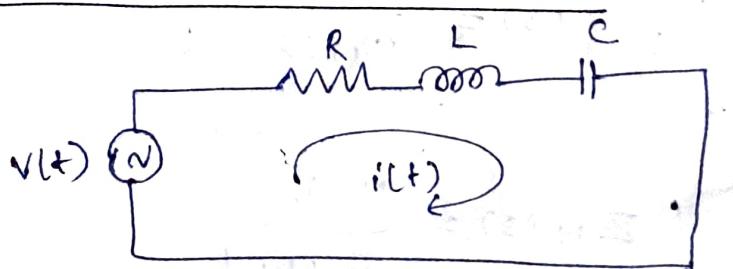
11.

frequency Response

Introduction

- ⇒ AC circuit is said to be in Resonance if the current in the Ckt is in phase with applied Voltage
- ⇒ At this condition, the circuit behaves like a pure resistive circuit.
- ⇒ power factor of the ckt will be Unity.
- ⇒ Voltage & current amplification takes place.
- ⇒ Inductive Reactance = Capacitive Reactance
- $$X_L = X_C$$

Series Resonance Circuit (RLC Series Ckt)



Impedance of RLC Series Ckt,

$$Z = V/I$$

$$Z = R + j(X_L - X_C)$$

At resonance $X_L = X_C \Rightarrow \omega L = 1/\omega C$

$$X_L = 2\pi f L$$

$$X_C = \frac{1}{2\pi f C}$$

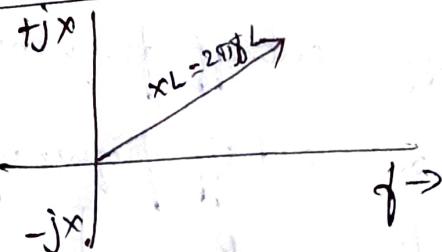
$$2\pi f L = \frac{1}{2\pi f C}$$

$$f_r^2 = \frac{1}{4\pi^2 LC}$$

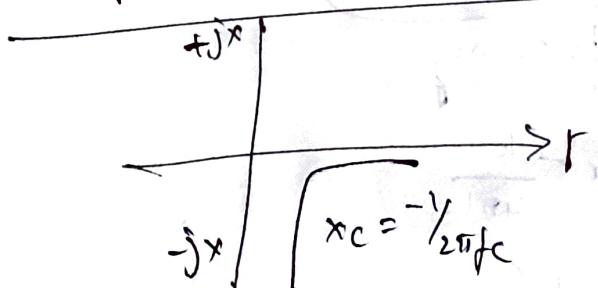
$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$\omega_r = \frac{1}{\sqrt{LC}}$$

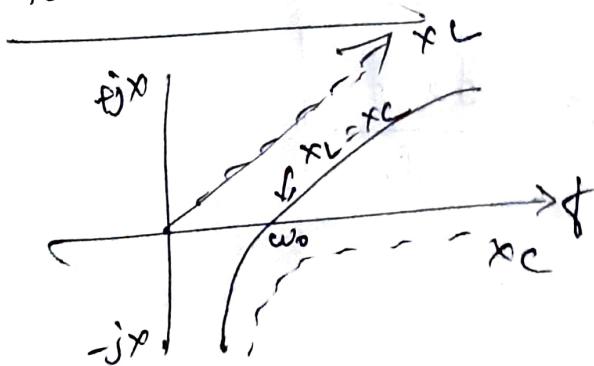
Inductive Reactance Curve (x_L)



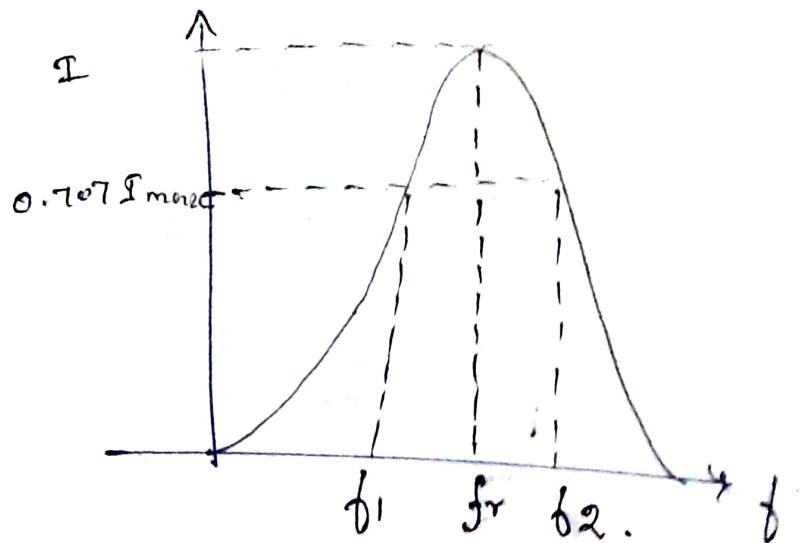
Capacitive Reactance (x_C)



Total reactance



19

Bandwidth

$$W = f_2 - f_1 \quad W = R$$

 $f_2 \rightarrow$ upper cut off frequency $f_1 \rightarrow$ lower cut off frequency

$$W = \frac{R}{2\pi L}$$

Half power frequency

$$f_1 = f_r - \frac{R}{4\pi L}$$

$$f_2 = f_r + \frac{R}{4\pi L}$$

Selectivity

$$\delta = \frac{f_2 - f_1}{f_r}$$

(15)

Q-factor

$Q = 2\pi \times \frac{\text{maximum Energy stored per cycle}}{\text{Energy dissipated per cycle.}}$

$$Q = \frac{f_r}{f_2 - f_1}$$

$$\Rightarrow f_2 - f_1 = \frac{R}{2\pi L}$$

Divide both side by f_r

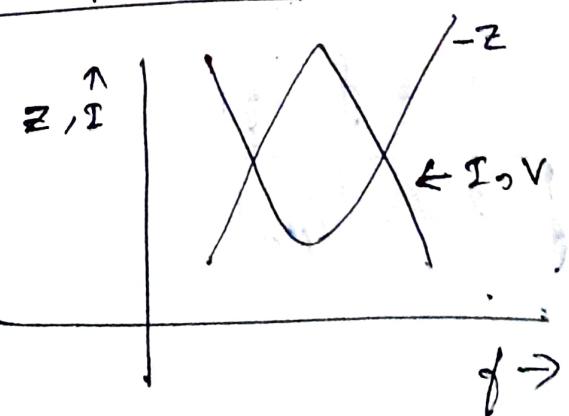
$$\frac{f_2 - f_1}{f_r} = \frac{R}{2\pi f_r L}$$

$$\Rightarrow Q = \frac{x_L}{R} = \frac{2\pi f_r L}{R} = \frac{\omega_r L}{R}$$

$$\therefore \omega_r = \frac{1}{\sqrt{LC}}$$

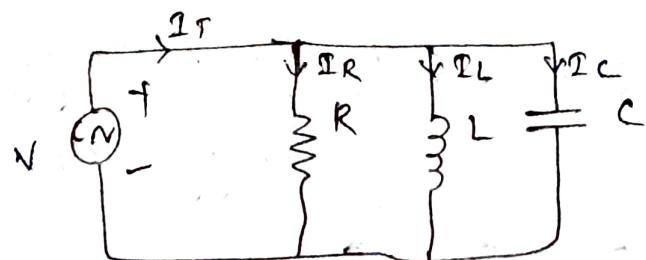
$$Q = \sqrt{L/C}$$

Voltage & Current



(16)

parallel Resonance circuit :-



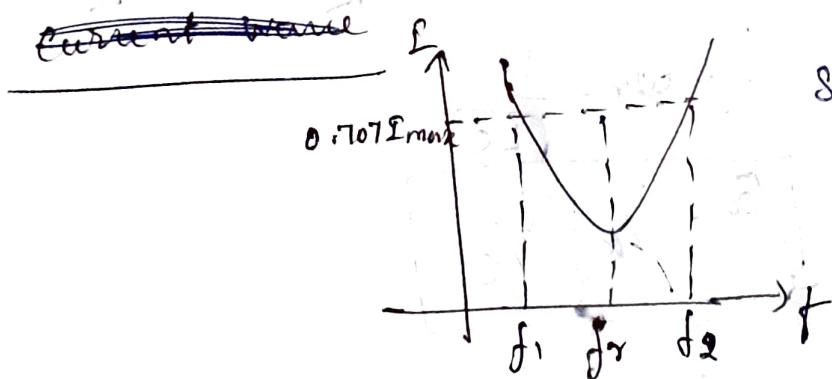
$$Y = G + jB = Y_R + j\omega C + \frac{1}{j\omega L}$$

$$= Y_R + j(wC - \frac{1}{\omega L})$$

$$\omega_r C - \frac{1}{\omega_r L} = 0$$

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

$$\omega_r = \frac{1}{\sqrt{LC}}$$



Selectivity curve.

band width

$$\omega = f_2 - f_1$$

$$\omega = \frac{1}{RC}$$

Quality factor :-

$$Q = 2\pi \times \frac{\text{maximum Energy stored / cycle}}{\text{Energy dissipated / cycle}}$$

$$Q = \frac{f_r}{f_2 - f_1}$$

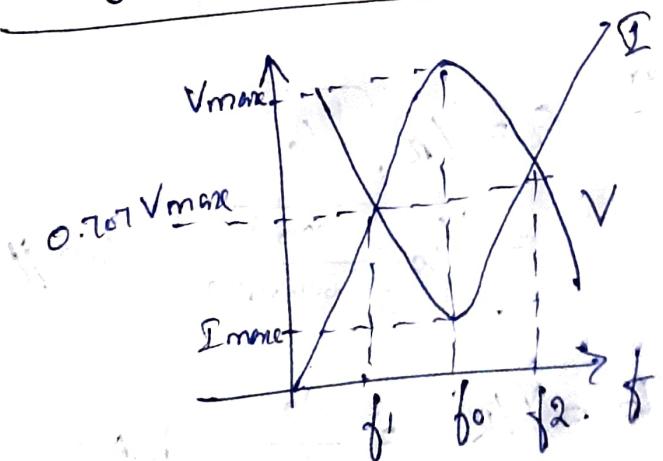
$$Q = 2\pi f_r R C$$

$$Q = \omega_r R C$$

$$\Rightarrow \omega_r = \frac{1}{LC}$$

$$Q = R \sqrt{C/L}$$

Voltage & current



(18)

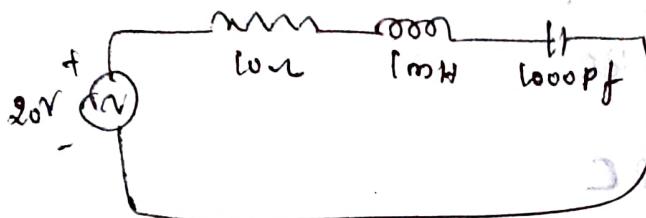
① ~~Q~~

A RLC Series Circuit, have $R = 10\Omega$, $L = 1mH$, $C = 1000\text{ pF}$ excited a ac source voltage of 20V. find.

a) fr

b) Q factor

c) current & Impedance



$$\text{① } f_r = \frac{1}{2\pi\sqrt{LC}}$$

$$= \frac{1}{2\pi\sqrt{1 \times 10^{-3} \times 1000 \times 10^{-12}}}$$

$$f_r = 159155\text{ Hz}$$

fr = resonance frequency
surge impedance

$$\text{② } \underline{\text{Q factor}} \quad Q = \frac{1}{R} \sqrt{\frac{L}{C}} \Rightarrow Q = \frac{Z}{R} = \frac{X_L}{R} = \frac{X_C}{R}$$

$$= \frac{1}{10} \sqrt{\frac{1 \times 10^{-3}}{1000 \times 10^{-12}}} = 100 \parallel$$

$$\text{③ } I = V/Z = V/R = \frac{20}{10} = 2A \parallel$$

$$\text{④ } \text{Impedance } Z = R = 20\Omega$$

$$\cos \phi = \frac{P}{VZ}$$

⑤ Voltage across the Resistor

$$V_R = IR$$

$$= 1 \times 10$$

$$= 10V \parallel$$

$$\cos \phi = \frac{P}{VZ}$$

$$\cos \phi = 1 \parallel$$