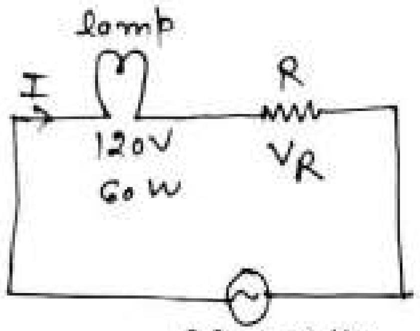
Q.71> A, 60 W, 120 V lamp Connected across 220V, 50 Hz. A.C. Supply find the Value of (i) Resistor (ii) Inductor Connected in Series with the lamp So that lamp run on Correct Voltage.

Ans.> (i)



" lamp to be Considered as pure Resistor "

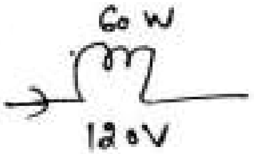
$$V_R + 120 = 220$$

$$V_R = 100\,V$$

$$IR = 100\,V$$

$$\boxed{R = 200\,\Omega}$$ Ans

for lamp

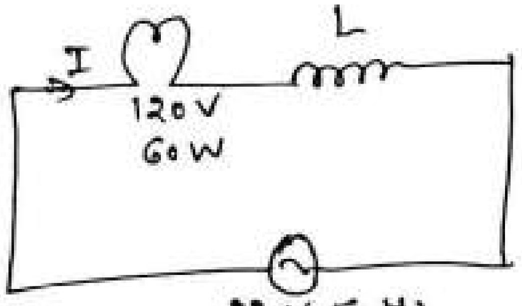


$$P = VI$$

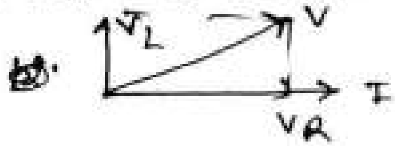
$$I = 60/120$$

$$= 0.5\,A$$

(ii) for Inductor →



• If Inductor is Connected in Series then ckt behave as like R-L circuit



$$V_R^2 + V_L^2 = V$$

$$(120)^2 + (IX_L)^2 = 220$$

$$IX_L = 184.4$$

$$X_L = \frac{184.4}{0.5}$$

$$\boxed{L = 1.174\,H}$$ Ans

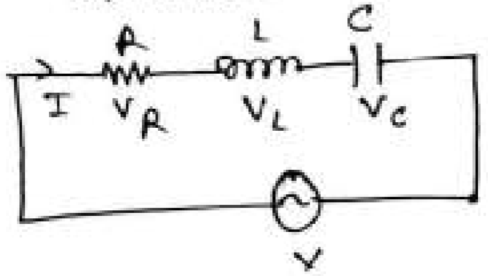
Ques. 12) What is Resonance?

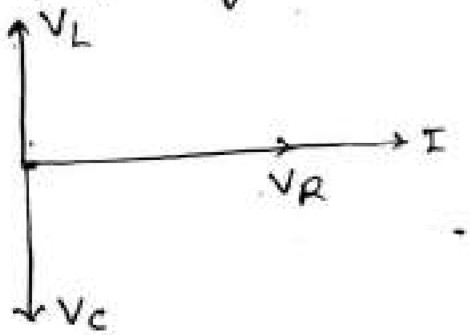
Ans.) The Resonance is a phenomenon which takes place in the Circuit containing two types of Energy storing element (like Inductor & Capacitor) Such that Energy can Interchange b/w them.

"At Resonance the Voltage & Current of R-L-C cht becomes in same phase"

Ques. 13) Define Resonant frequency and Derive the expression for it (for Series R-L-C cht).

Ans.) The frequency at which Resonance takes place is known as Resonant frequency.





Resonance takes place when

$$V_L = V_C$$

$$IX_L = IX_C$$

$$X_L = X_C$$

$$2\pi f_r L = 1/2\pi f_r C$$

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

$$V_L = IX_L$$

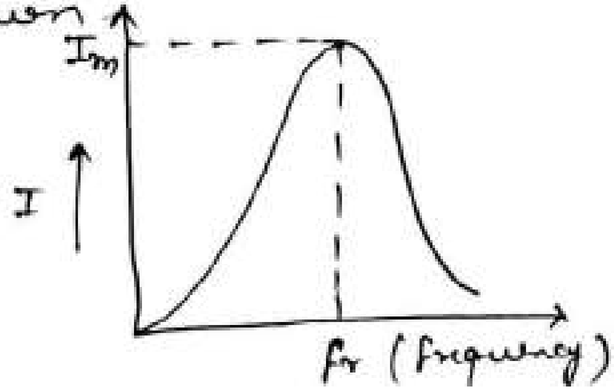
$$V_C = IX_C$$

$$V_R = IR$$

Ques. 14) What is Resonance curve.

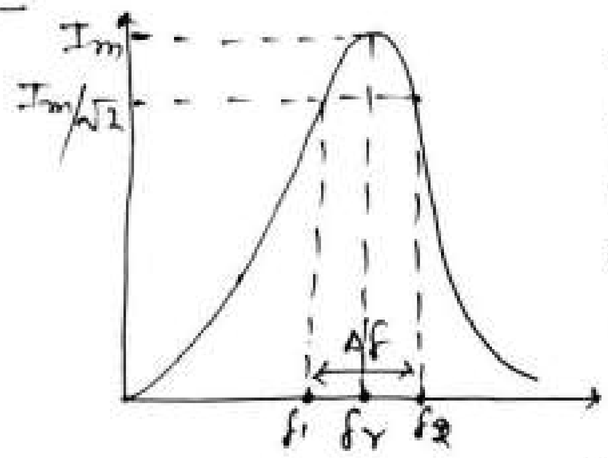
Ans.) The Curve Drawn b/w Current & frequency for Series R-L-C cht is known as Resonant Curve

$f_r \rightarrow$ frequency at which Voltage & Current becomes in same phase.



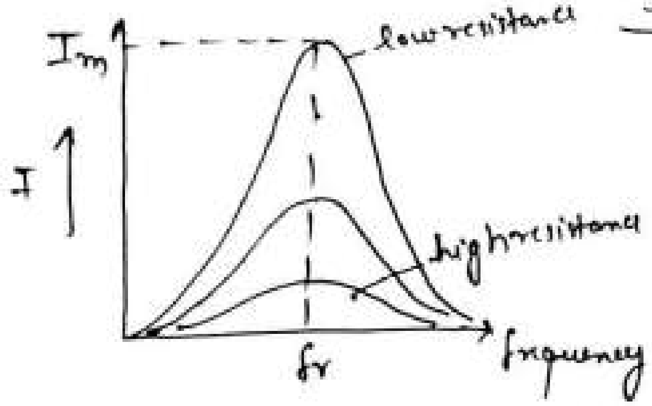
Que.15 > Explain Selectivity & Bandwidth.

Ans. >



Bandwidth → The band of frequencies either side of Resonance frequency where current becomes $1/\sqrt{2}$ times Maximum current.

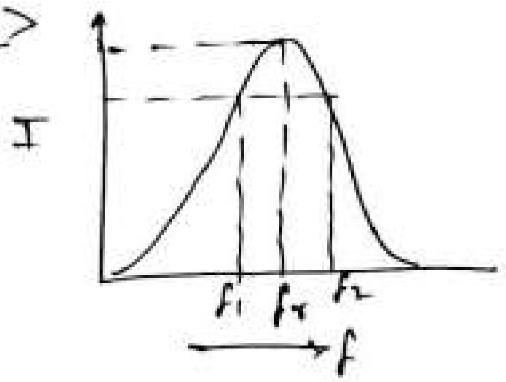
$\boxed{\Delta f = f_2 - f_1}$ bandwidth



Selectivity → If Resonant curve is highly peaked then it is high selective & if the curve is flat then it is low selective. Selectivity depend upon Resistance of ckt.

Que.16 > Derive the Expression for Bandwidth in Series R-L-C ckt >

Ans. >



ω_1 & ω_2 Corresponding frequencies of point when current is $I_m/\sqrt{2}$

* for maximum current

$$Z = R$$

+ if $I = I_m/\sqrt{2} = \frac{V}{\sqrt{2}R}$

means $Z = \sqrt{2}R$

Now → $\sqrt{R^2 + (X_L - X_C)^2} = \sqrt{2}R$

$$X_L - X_C = \pm R$$

⇒ for lower cut off frequency ω_1 →

$$\omega_1 L - 1/\omega_1 C = -R$$

$$\omega_1^2 LC - 1 + R\omega_1 C = 0$$

- Deviding whole eq. by LC

$$\omega_1^2 + \frac{R}{L}\omega_1 - 1/LC = 0$$

now

$$\omega_1 = \frac{-R/L \pm \sqrt{(R/L)^2 + 4/LC}}{2}$$

$$\omega_1 = -R/2L \pm \sqrt{\left(\frac{R}{2L}\right)^2 + \left(\frac{1}{\sqrt{LC}}\right)^2}$$

let $R/2L = \alpha$ $\quad \omega_r = 1/\sqrt{LC}$

$$\omega_1 = -R/2L \pm \sqrt{(R/2L)^2 + (1/\sqrt{LC})^2}$$

$$\boxed{\omega_1 = -\alpha \pm \sqrt{\alpha^2 + \omega_r^2}}$$

Discording Negative frequency

$$\omega_1 = -\alpha + \sqrt{\alpha^2 + \omega_r^2}$$

* for upper cutoff frequency ω_2 →

$$X_L - X_C = +R$$

$$\omega_2 L - 1/\omega_2 C = R$$

$$\boxed{\omega_2 = +\alpha + \sqrt{\alpha^2 + \omega_r^2}}$$

now band width $\omega_2 - \omega_1 = 2\alpha$

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

$$\boxed{\Delta f = R/2\pi L}$$

also $\omega_1\omega_2 = \alpha^2 + \omega_r^2 - \alpha^2$

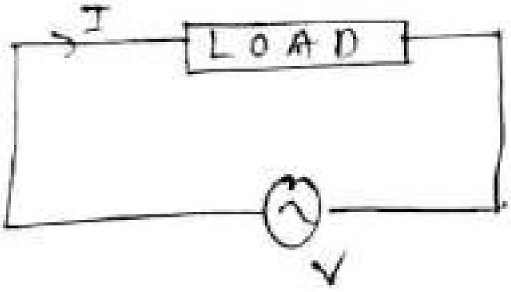
$$\omega_1\omega_2 = \omega_r^2$$

$$\omega_1\omega_2 = \omega_r^2$$

$$\boxed{f_1 f_2 = f_r^2}$$

Qus.17? Write Down Disadvantages of low power factor How Can we Improve power factor.

Ans.?



The Current for a Given load Supplied at Constant Voltage is given by

$$I = \frac{P}{V\cos\phi}$$

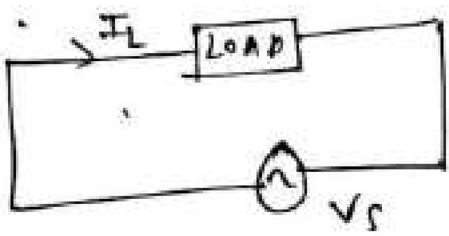
- If $\cos\phi$ is low then current is high which result following Disadvantages →

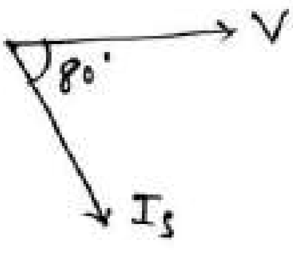
(i) Rating of generator's and Transformer's are proportional to their output current hence Inversly proportional to Power factor.

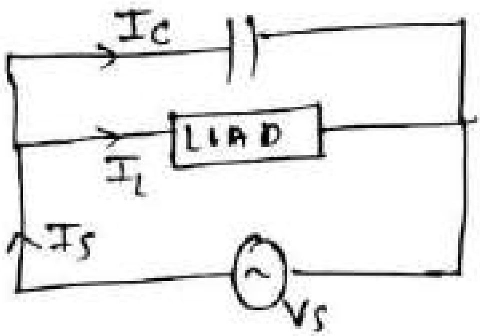
(ii) The Conducting material required is proportional to current So large Conducting material required for transmission of Power at low power Factor.

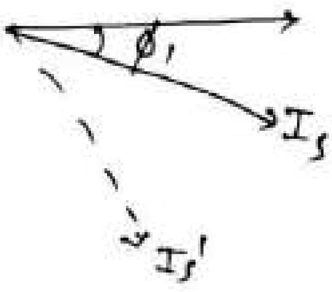
(iii) copper loss is propotional to current So low power Factor Result High Copper-loss (I^2R).

Power Factor Improvement → (i) by using capacitor with Parallel to load ↓





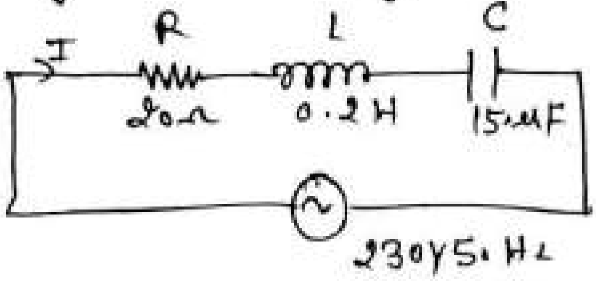




(ii) by using Induction motor with Phase advancer.

Qus.18> A Series R-L-C Circuit Consisting $R = 20\Omega$, Inductance 0.2 H and a Capacitance of 150 μF is Connected across a 230V, 50 Hz. Source. Calculate. (i) Impedance (ii) the current (iii) Power Factor (iv) Resonant frequency (v) Quality Factor.

Ans. >



$X_L = 2\pi f L$

$= 2 \times \pi \times 50 \times 0.2$

$= 62.83\Omega$

$X_C = 1/2\pi f C = 21.22\Omega$

(i) Impedance $Z = \sqrt{R^2 + (X_L - X_C)^2}$

$= \sqrt{(20)^2 + (62.83 - 21.22)^2}$

$Z = 46.167\,\Omega$

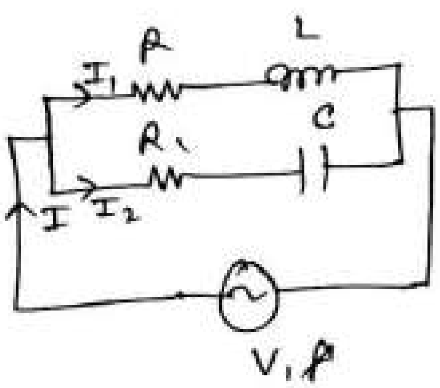
(ii) $I = V/Z = \frac{230}{46.167} = 4.98\,A$

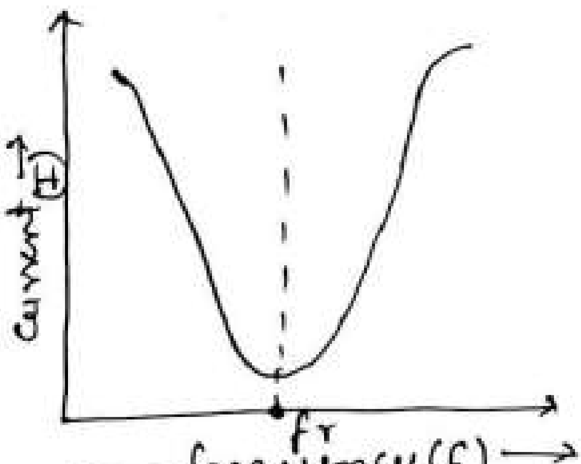
(iii) $\cos\phi = R/Z = \frac{20}{46.167} = 0.4332$ lagging

(iv) $f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC}} = 29.06\,Hz$. (v) $Q = \frac{1}{R}\sqrt{\frac{L}{C}}$

Qus. 19> Drive the Expression for band width in Parallel R-L-C. Circuit. (Current Resonance)

Ans. >





* Current is minimum at Resonance.

in case of Parallel circuit at bandwidth frequencies the net Susceptance B is equal to Conductance G So at frequency f_1 the Net Susceptance

$$B_{L_1} - B_{C_1} = G$$

at f_2 $\quad B_{C_2} - B_{L_2} = G$

Thus $\quad Y = \sqrt{G^2 + B^2} = \sqrt{2}G$

and $\quad \phi = \tan^{-1} B/G = \tan^{-1} 1 = 45°$

Q Factor > $\quad Q = \dfrac{\text{Circulating Current b/w L \& C}}{\text{Line current}}$

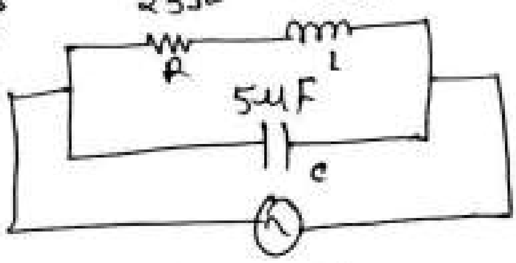
now $\quad I_C = 2\pi f_r C V$

$$I = \frac{V}{L/CR} = VCR/L$$

$$Q = \frac{I_C}{I} = \frac{2\pi f_r L}{R} \quad \text{but } f_r = \frac{1}{2\pi}\sqrt{\frac{1}{LC}}$$

$$\boxed{Q = \frac{1}{R}\sqrt{\frac{L}{C}}} \quad \text{neglecting R in } f_r$$

Que. 20 >



for the circuit find
(i) Resonant frequency
(ii) Impedance at Resonance
(iii) Bandwidth
(iv) Quality Factor

(i) $f_r = \dfrac{1}{2\pi}\sqrt{\dfrac{1}{LC} - \dfrac{R^2}{L^2}} = 100.34 \text{ Hz}.$

(ii) Impedance of ckt at Resonance $Z = L/CR = 4000\,\Omega$

(iii) $\Delta f = R/2\pi L = \dfrac{25}{2\pi \times 0.5} = 7.958 \text{ Hz}.$

(iv) Quality Factor $Q = \dfrac{1}{R}\sqrt{\dfrac{L}{C}} = \dfrac{1}{25}\sqrt{\dfrac{0.5}{5\times10^{-6}}} = 12.65$