Marwari college Darbhanga

Subject---physics (Hons)

Class--- B. Sc. Part 2

Paper. –04

Group. –A

Topic--- LCR Parallel circuit (Electricity)

Lecture series – 56

By:-. Dr. Sony Kumari,

Assistant professor

Marwari college Darbhanga

LCR Parallel circuit

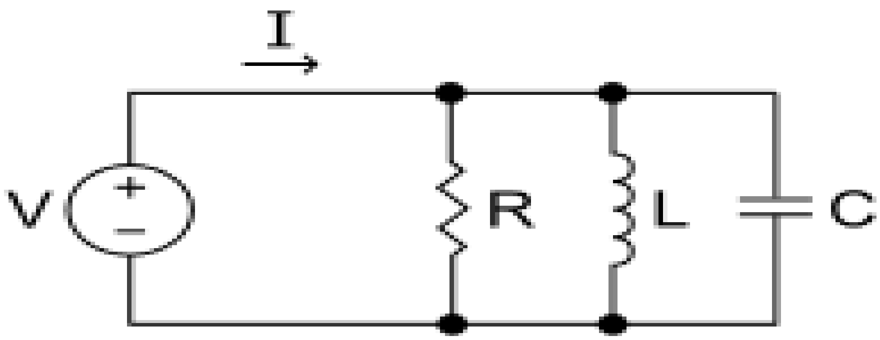

Figure 2. RLC parallel circuit

Where,
V – the voltage source powering the circuit
I – the current admitted through the circuit
R – the equivalent resistance of the combined source, load, and components
L – the inductance of the inductor component
C – the capacitance of the capacitor component

The properties of the parallel RLC circuit can be obtained from the duality relationship of electrical circuits and considering that the parallel RLC is the dual impedance of a series RLC. Considering this, it becomes clear that the differential equations describing this circuit are identical to the general form of those describing a series RLC.

For the parallel circuit, the attenuation α is given by:

$$\alpha = \frac{1}{2\,R\,C}$$

and the damping factor is consequently

$$\zeta = \frac{1}{2\,R}\sqrt{\frac{L}{C}}\ .$$

Likewise, the other scaled parameters, fractional bandwidth and Q are also reciprocals of each other. This means that a wide-band, low-Q circuit in one topology will become a narrow-band, high-Q circuit in the other topology when constructed from components with identical values. The fractional bandwidth and Q of the parallel circuit are given by

$$B_\mathrm{f} = \frac{1}{R}\sqrt{\frac{L}{C}}$$
$$Q = R\sqrt{\frac{C}{L}}\ .$$

Notice that the formulas here are the reciprocals of the formulas for the series circuit, given above.

Frequency domain

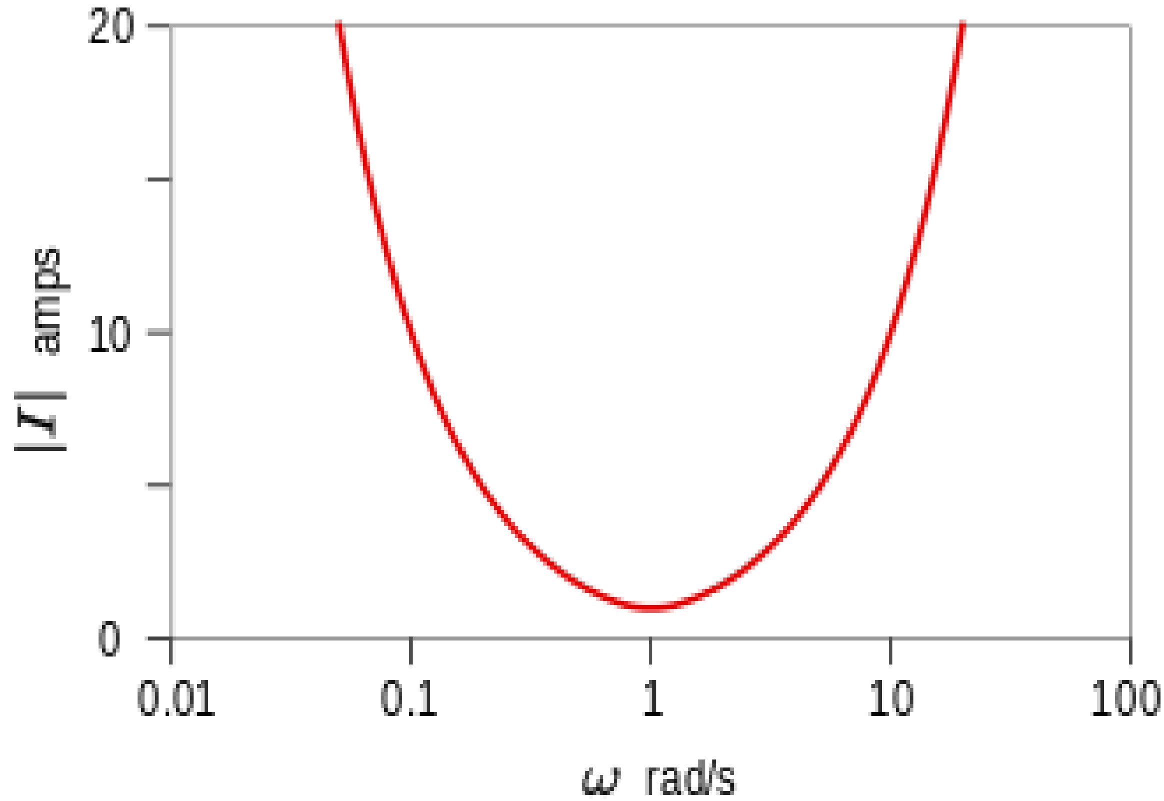

Figure 3. Sinusoidal steady-state analysis. Normalised to R = 1 Ω, C = 1 F, L = 1 H, and V = 1 V.

$$\begin{aligned}\frac{1}{Z} &= \frac{1}{Z_L} + \frac{1}{Z_C} + \frac{1}{Z_R} \\ &= \frac{1}{j\omega L} + j\omega C + \frac{1}{R}\,.\end{aligned}$$

The complex admittance of this circuit is given by adding up the admittances of the components:

The change from a series arrangement to a parallel arrangement results in the circuit having a peak in impedance at resonance rather than a minimum, so the circuit is an anti-resonator.

The graph opposite shows that there is a minimum in the frequency response of the current at the resonance frequency $\omega_0 = 1 / \sqrt{LC}$ when the circuit is driven by a constant voltage. On the other hand, if driven by a constant current, there would be a maximum in the voltage which would follow the same curve as the current in the series circuit.