7 Resonance

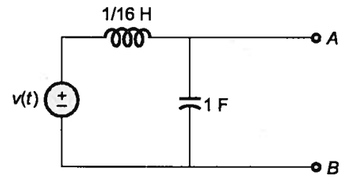
Multiple Choice Questions

Q.1 A series resonant circuit has an inductive reactance of 1000 Ω, a capacitive reactance of 1000 Ω and a resistance of 0.1 Ω. If the resonant frequency is 10 MHz, then the bandwidth of the circuit will be

(a) 1 kHz (b) 10 kHz
(c) 1 MHz (d) 0.1 kHz

[ESE-1999]

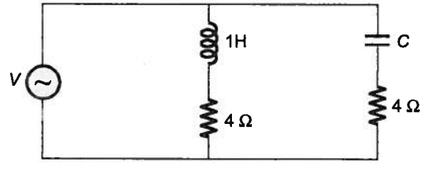
Q.2 The circuit shown in the figure below, will act as an ideal current source with respect to terminals *A* and *B*, when frequency is



(a) zero (b) 1 rad/s
(c) 4 rad/s (d) 16 rad/s

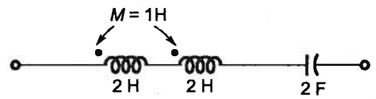
[ESE-2000]

Q.3 The value of the capacitance '*C*' in the given ac circuit to make it a constant resistance circuit OR for the supply current to be independent of its frequency is



(a) 1/16 F (b) 1/12 F
(c) 1/8 F (d) 1/4 F [ESE-2001]

Q.4 The resonant frequency of the given series circuit is



(a) $1/2\pi\sqrt{3}$ Hz (b) $1/4\pi\sqrt{3}$ Hz
(c) $1/4\pi\sqrt{2}$ Hz (d) $1/\pi\sqrt{2}$ Hz

[ESE-2001]

Q.5 **Assertion (A):** A series $R_1 - L$ and a series $R_2 - C$ are connected in parallel. Parallel resonance will occur at all frequencies when $R_1^2 = R_2^2 = L/C$.

Reason (R): An inductor must be operated below the self-resonant frequency.

(a) Both A and R are true and R is the correct explanation of A
(b) Both A and R are true but R is NOT the correct explanation of A
(c) A is true but R is false
(d) A is false but R is true [ESE-2002]

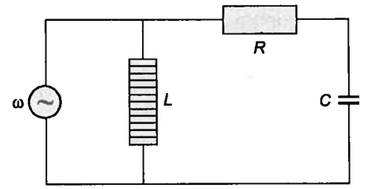
Q.6 The impedance of a parallel RLC network is $Z(s)=\frac{5s}{s^2+0.5s+100}$. Then the value of R, L and *C* are, respectively

(a) 10 Ω, 1/20 H, 1/5F
(b) 1 Ω, 1/2 H, 1/5F
(c) 10 Ω, 1/20 H, 1/2 F
(d) 2 Ω, 1/20 H, 1/5 F [ESE-2003]

Q.7 A series L-C-R circuit has a resonant frequency f_0, with $R = 1\,\Omega$, $L = 1$ H and $C = 1$ F. If the components' values are tripled, the new resonant frequency will be

(a) $3f_o$ (b) unaltered
(c) $\frac{f_o}{\sqrt{3}}$ (d) $\frac{f_o}{3}$ [ESE-2012]

Q.8 Consider the following circuit:



For what value of ω, the circuit shown above exhibits unity power factor?

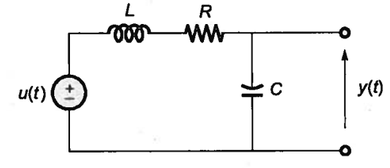
(a) $\frac{1}{\sqrt{LC}}$ (b) $\frac{1}{\left[\sqrt{LC+R^2C^2}\right]}$
(c) $\frac{1}{\left[\sqrt{LC-R^2C^2}\right]}$ (d) $\frac{1}{RC}$ [ESE-2004]

Q.9 The transfer function $H(s)=\frac{V_0(s)}{V_1(s)}$ of an R-L-C circuit is given by $H(s)=\frac{10^6}{s^2+20s+10^6}$. The Quality factor (*Q*-factor) of this circuit is

(a) 25 (b) 50
(c) 100 (d) 5000

[GATE-2004]

Q.10 The condition on R, L and C such that the step response $y(t)$ in the figure has no oscillations, is



(a) $R \geq \frac{1}{2}\sqrt{\frac{L}{C}}$ (b) $R \geq \sqrt{\frac{L}{C}}$
(c) $R \geq 2\sqrt{\frac{L}{C}}$ (d) $R = \frac{1}{\sqrt{LC}}$

[GATE-2005]

Q.11 In a series RLC circuit,

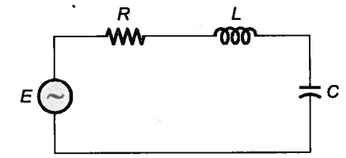
$R = 2\,k\Omega$, $L = 1$H, and $C = \frac{1}{400}\,\mu$F.

The resonant frequency is

(a) 2×10^4 Hz (b) $\frac{1}{\pi} \times 10^4$ Hz
(c) 10^4 Hz (d) $2\pi \times 10^4$ Hz

[GATE-2005]

Q.12 Which one of the following statements is not correct for the circuit shown below at resonant frequency?



(a) The current is maximum
(b) The equivalent impedance is real
(c) The inductive and capacitive reactances are equal in magnitude
(d) The quality factor equals $\frac{1}{R}\sqrt{\frac{C}{L}}$

[ESE-2005]

Q.13 In a series R-L-C circuit, the maximum voltage across the capacitor occurs at a frequency

(a) double the resonant frequency
(b) equal to resonant frequency
(c) $\sqrt{2}$ times the resonant frequency
(d) below the resonant frequency

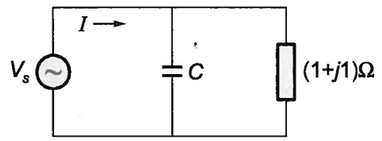
[ESE-2006]

Q.14 A series R-L-C circuit, excited by a 100 V, variable frequency source has a resistance of 10 Ω and an inductive reactance of 50 Ω at 100 Hz. If the resonance frequency is 500 Hz, what is the voltage across the capacitor at resonance?

(a) 100 V (b) 500 V
(c) 2500 V (d) 5000 V

[ESE-2006]

Q.15 In the circuit shown in the figure below, for what value of C will the current I be in phase with the sinusoidal source voltage $V_s = \sin 2t$?



(a) $\frac{1}{4}$F (b) $\frac{1}{2}$F

(c) $\frac{1}{\sqrt{2}}$F (d) 1 F **[ESE-2006]**

Q.16 Width of resonance curve in an R-L-C network is determined by which one of the following?

(a) R alone (b) L alone

(c) C alone (d) All R, L and C **[ESE-2008]**

Q.17 A series RLC circuit has a bandwidth of 300 rad/sec at a resonant frequency of 3000 rad/sec when excited by a voltage source of 100 V. The inductance of the coil is 0.1 H. The value of R and the voltage across C are, respectively

(a) 10 Ω and 100 V

(b) 30 Ω and 100 V

(c) 30 Ω and 1000 V

(d) 300 Ω and 1000 V **[ESE-2013]**

Q.18 Two magnetically uncoupled inductive coils have Q factors q_1 and q_2 at the chosen operating frequency. Their respective resistance are R_1 and R_2. When connected in series, their effective Q factor at the same operating frequency is

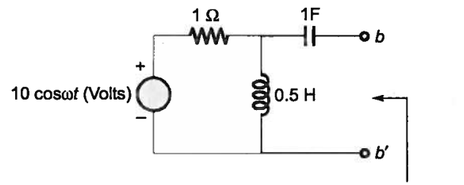
(a) $q_1 + q_2$

(b) $(1/q_1) + (1/q_2)$

(c) $(q_1R_1 + q_2R_2)/(R_1 + R_2)$

(d) $(q_1R_2 + q_2R_1)/(R_1 + R_2)$ **[ESE-2013]**

Q.19 In the circuit shown in the figure, the angular frequency ω (in rad/s), at which the Norton equivalent impedance as seen from terminals b-b' is purely resistive, is _____.



[GATE-2014]

Q.20 The low-frequency circuit impedance and the high-frequency circuit impedance for a series resonant circuit respectively are

(a) capacitive and inductive

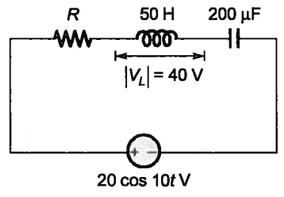
(b) inductive and capacitive

(c) resistive and inductive

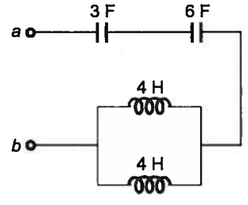
(d) capacitive and resistive **[ESE-2015]**

Numerical Data Type Questions

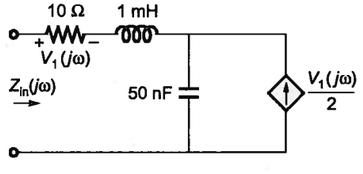
Q.21 The quality factor of the circuit shown in figure is



Q.22 The resonant frequency of the circuit shown in figure is _____ rad/sec.

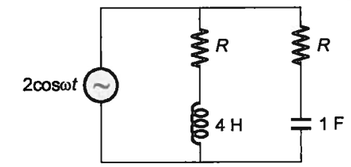


Q.23 For the circuit shown below resonant frequency f_0 is _____ kHz.

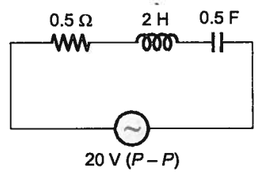


Try Yourself

T1. In the given network. Find the value of 'R' such that the reactive power generated by the source is zero. Value of 'R' in ohms_____



T2. Find the voltage across capacitor when voltage across resistor is maximum



(a) $\frac{40}{\sqrt{2}}$ V (b) 40 V

(c) 20 V (d) 10 V

T3. In a series RLC circuit with frequency of resonance as f_0, voltage across resistor, capacitor and inductor are V_R, V_C and V_L respectively. Then at any frequency f, which of the following is true

(*i*) $|V_C| > |V_L|$ if $f > f_0$

(*ii*) $|V_C| < |V_L|$ if $f < f_0$

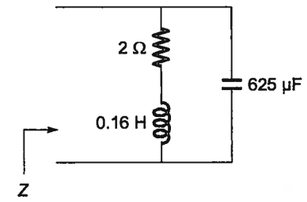
(*iii*) V_R leads source voltage if $f < f_0$

(*iv*) $|V_L| = |V_C| = |V_R|$ if $f = f_0$

(a) (*i*) and (*ii*) (b) (*iii*) and (*iv*)

(c) (*iii*) only (d) (*iv*) only

T4. Find impedance (Z) at resonance.

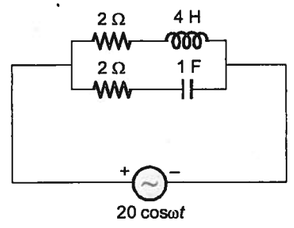


(a) 1.28 Ω (b) 12.8 Ω

(c) 2 Ω (d) 128 Ω

T5. Find average power conumer by the circuits at resonance.

(*i*)



(*ii*)