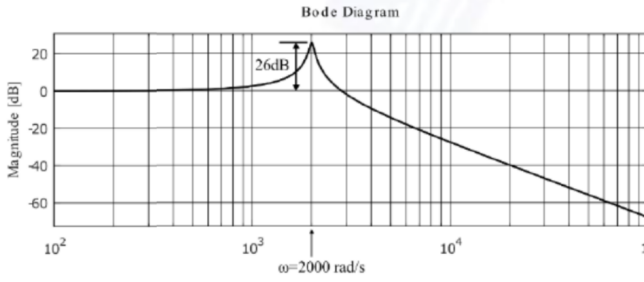
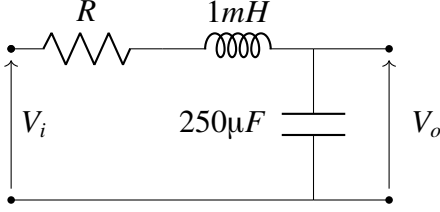


# GATE 2021 EE.20

EE23BTECH11010 - VENKATESH BANDAWAR\*

**Question:** The Bode magnitude plot for the transfer function  $\frac{V_o(s)}{V_i(s)}$  of the circuit is as shown. The value of R is \_\_\_\_\_  $\Omega$ . (GATE 2021 EE Q20)



**Solution:** Applying KVL,

Parameter	Description	Value
$C$	Capacitance	$250\mu F$
$L$	Inductor	$1mH$
$I$	Current	
$I(0)$	Initial Current	$0A$
$V_o$	Voltage across capacitor	
$V_i$	Input Voltage	
$T(s)$	Transfer Function	$\frac{V_o(s)}{V_i(s)}$

TABLE I: Given Parameters table

$$V_i - RI - L \frac{dI}{dt} - \frac{\int Idt}{C} = 0 \quad (1)$$

Taking Laplace Transform ,

$$V_i(s) - RI(s) - LsI(s) + LI(0^+) - \frac{I(s)}{sC} = 0 \quad (2)$$

$$I(s) = \frac{V_i(s) + LI(0)}{R + sL + \frac{1}{sC}} \quad (3)$$

$$V_o(s) = \frac{V_i(s) + LI(0)}{RsC + s^2LC + 1} \quad (4)$$

Substituting  $I(0) = 0$  and  $s = j\omega$ ,

$$\frac{V_o(j\omega)}{V_i(j\omega)} = \frac{1}{\omega RCj - \omega^2 LC + 1} \quad (5)$$

$\therefore$  Magnitude in bode plot  $= 20 \log |T(s)|$   
From given graph, At  $\omega = 2000$

$$26 = 20 \log \left| \frac{V_o}{V_i} \right| \quad (6)$$

$$\left| \frac{V_o}{V_i} \right| = 20 \quad (7)$$

$$\Rightarrow 20 = \left| \frac{1}{\omega RCj - \omega^2 LC + 1} \right| \quad (8)$$

$$R = 0.1 \Omega \quad (9)$$

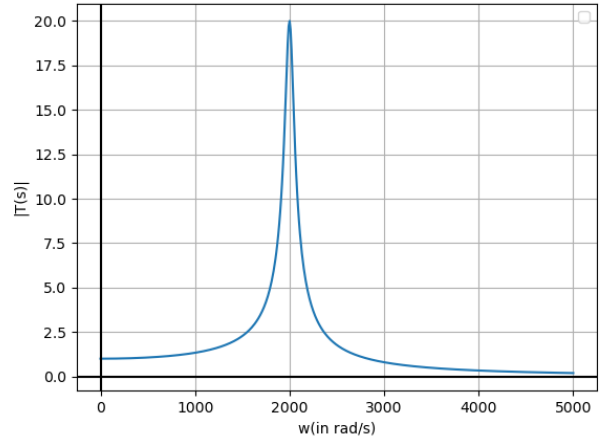


Fig. 1: Frequency response of  $V_o$