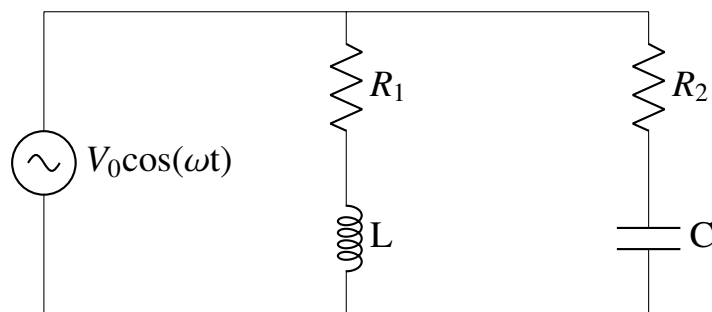


# GATE 2023 Assignment

## EE1205 Signals and Systems

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EE23BTECH11036

**Question(IN 46):** In the circuit shown , $\omega = 100\pi\text{rads/s}$ ,  $R_1=R_2=2.2\Omega$  and  $L=7\text{mH}$ . the capacitance  $C$  for which  $Y_{in}$  is purely real is mF



(GATE ST 2023)

**Solution:**

variable	value	description
$Y_{in}$		Admittance of circuit
$X_L$	$7j\omega\Omega$	Inductive reactance
$X_C$	$\frac{-j}{\omega C}\Omega$	Capacitive reactance
$\omega$	$100\pi\text{rads/s}$	Angular frequency

Table: Input Parameters

$$X_L = \omega L j \quad (1)$$

$$= 100\pi \times 7 \times 10^{-3} j \quad (2)$$

$$= 2.2 j \Omega \quad (3)$$

$$X_C = \frac{-j}{\omega C} \Omega \quad (4)$$

$$Y_{in} = \frac{1}{2.2 + 2.2j} + \frac{1}{2.2 - \frac{j}{\omega C}} \quad (5)$$

$$= \frac{1 - j}{4.4} + \frac{2.2 + \frac{j}{\omega C}}{(2.2)^2 + \left(\frac{1}{\omega C}\right)^2} \quad (6)$$

According to the question given,  $Y_{in}$  is purely real , so imaginary part should be equal to zero

$$\frac{-1}{4.4} + \frac{\frac{1}{\omega C}}{(2.2)^2 + \left(\frac{1}{\omega C}\right)^2} = 0 \quad (7)$$

$$\frac{\frac{1}{\omega C}}{(2.2)^2 + \left(\frac{1}{\omega C}\right)^2} = \frac{1}{4.4} \quad (8)$$

$$(2.2)^2 - \frac{4.4}{\omega C} + \left(\frac{1}{\omega C}\right)^2 = 0 \quad (9)$$

$$\left(2.2 - \frac{1}{\omega C}\right)^2 = 0 \quad (10)$$

$$\frac{1}{\omega C} = 2.2 \quad (11)$$

$$C = \frac{700}{484} \text{mF} \quad (12)$$

$$C = 1.446281 \text{mF} \quad (13)$$

The capacitance of capacitor C is 1.45mF

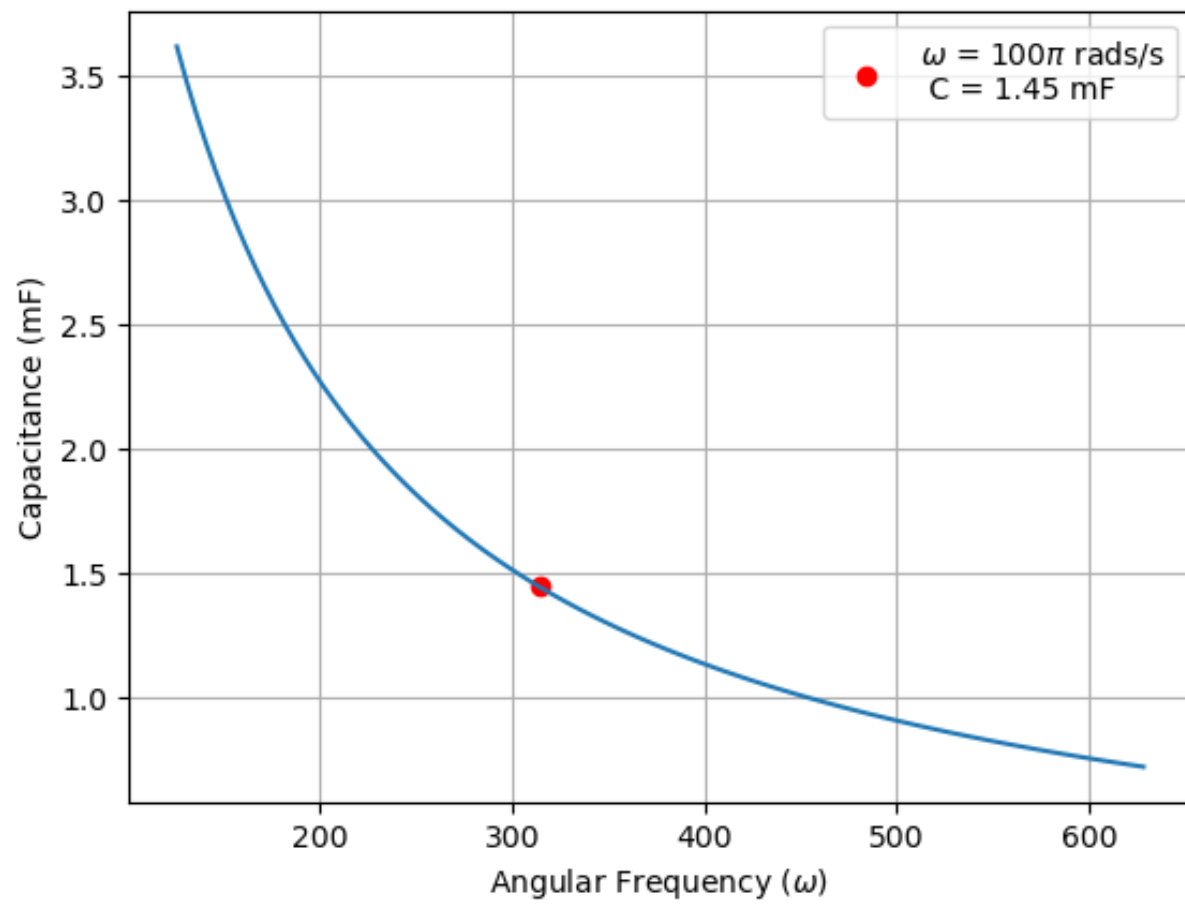


Fig. 0. Graph of Capacitance(mF) vs Angular Frequency( $\omega$ )