

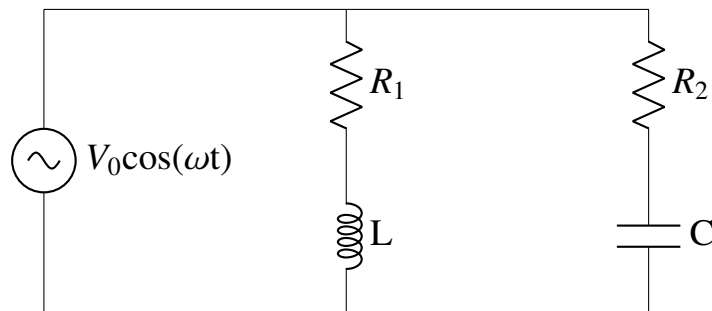
GATE 2023 Assignment

EE1205 Signals and Systems

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Question 11.9.3.8: In the circuit shown, $\omega = 100\pi \text{ rad/s}$, $R_1 = R_2 = 2.2\Omega$ and $L = 7 \text{ mH}$. the capacitance C for which Y_{in} is purely real is mF

Circuit Diagram :



Solution:

variable	value	description
Y_{in}		Admittance of circuit
X_L	$2.2j\Omega$	Inductive reactance
X_C	$\frac{-j}{\omega C}$	Capacitive reactance
ω	$100\pi \text{ rad/s}$	Angular frequency
Z		Impedance of circuit

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

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

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

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

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

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

$$(7)$$

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

$$\frac{-1}{4.4} + \frac{\frac{1}{\omega C}}{(2.2)^2 + \left(\frac{1}{\omega C}\right)^2} = 0 \quad (8)$$

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

$$(2.2)^2 - \frac{4.4}{\omega C} + \left(\frac{1}{\omega C}\right)^2 = 0 \quad (10)$$

$$\left(2.2 - \frac{1}{\omega C}\right)^2 = 0 \quad (11)$$

$$\frac{1}{\omega C} = 2.2 \quad (12)$$

$$C = \frac{700}{484} \text{mF} \quad (13)$$

$$C = 1.446281 \text{mF} \quad (14)$$

The capacitance of capacitor C is 1.47mF

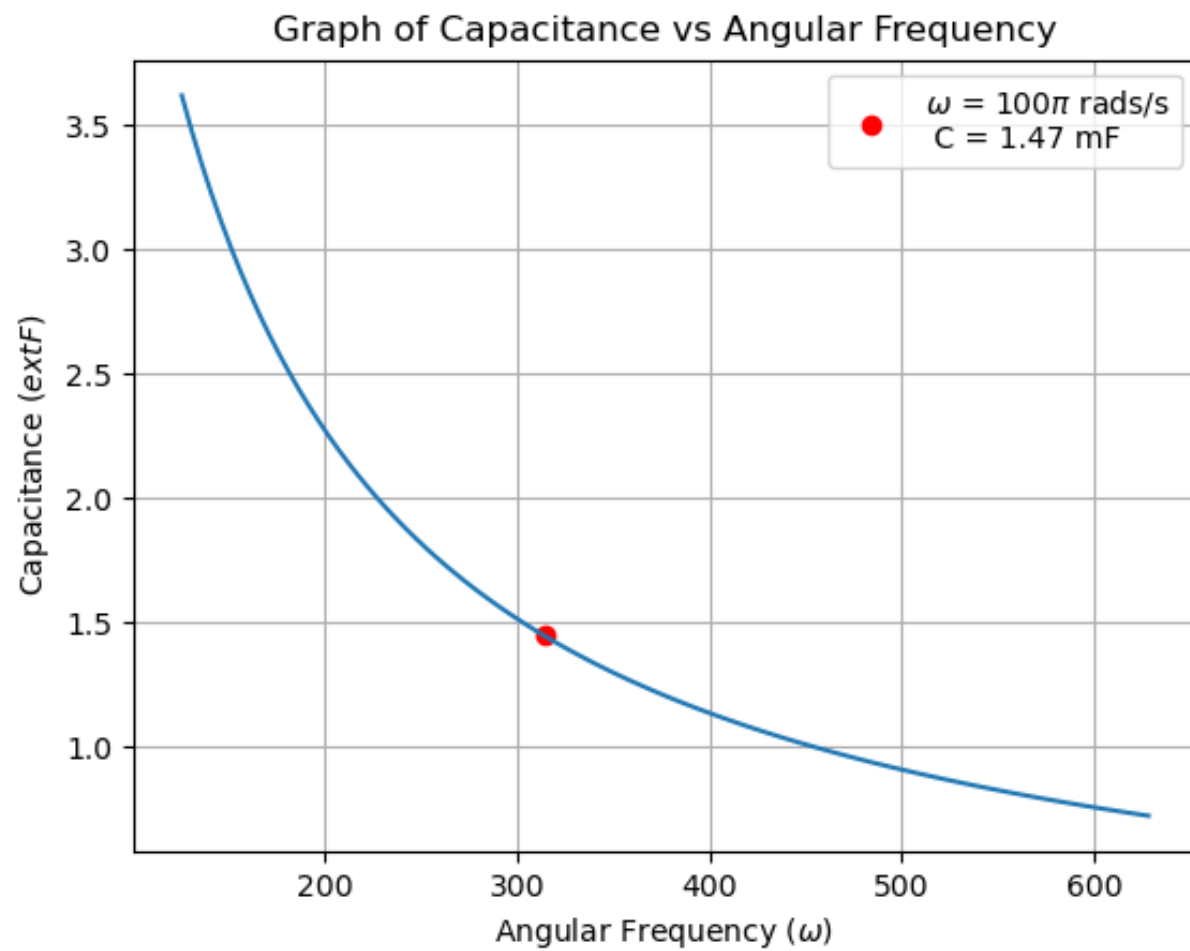


Fig. 0. Graph of Capacitance(mF) vs Angular Frequency(ω)