GATE 2023 Assignment
EE1205 Signals and Systems

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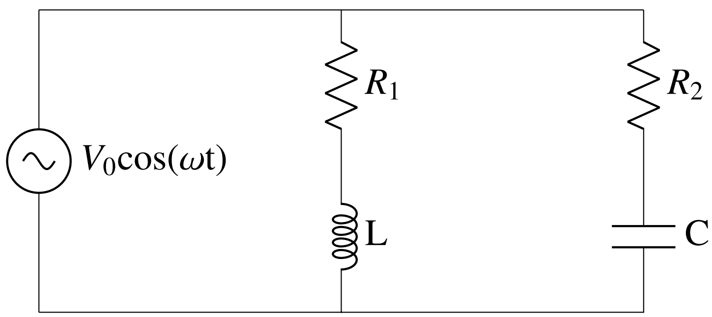
EE23BTECH11036

Question 11.9.3.8: In the circuit shown ,$\omega = 100\pi$rads/s, R1=R2=2.2Ω and L=7mH. 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	2.2jΩ	Inductive reactance
X_C	$\frac{-j}{\omega C}$Ω	Capacitive reactance
ω	100πrads/s	Angular frequency

$$X_L = \omega L j \tag{1}$$
$$= 100\pi \times 7 \times 10^{-3} j \tag{2}$$
$$= 2.2 j\Omega \tag{3}$$
$$X_C = \frac{-j}{\omega C}\Omega \tag{4}$$
$$Y_{in} = \frac{1}{2.2 + 2.2j} + \frac{1}{2.2 - \frac{j}{\omega C}} \tag{5}$$
$$= \frac{1-j}{4.4} + \frac{2.2 + \frac{j}{\omega C}}{(2.2)^2 + \left(\frac{1}{\omega C}\right)^2} \tag{6}$$

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

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

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

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

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

$$\frac{1}{\omega C} = 2.2 \tag{11}$$

$$C = \frac{700}{484} \text{mF} \tag{12}$$

$$C = 1.446281 \text{mF} \tag{13}$$

The capacitance of capacitor C is 1.45mF

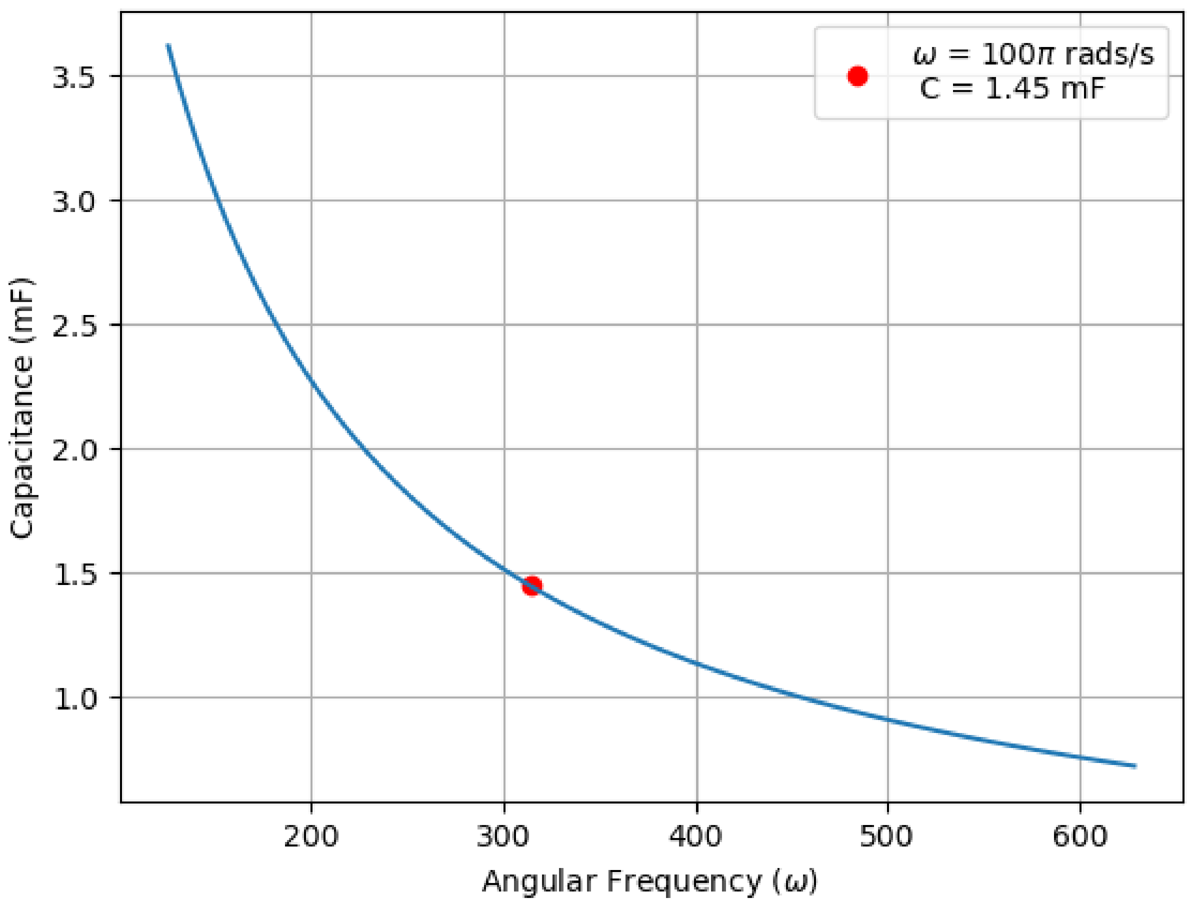


Fig. 0. Graph of Capacitance(mF) vs Angular Frequency(ω)