# GATE 2022 IN 60

EE23BTECH11213 - MUTHYALA NIKHITHA SRI

Question: A 1kHz sine wave generator having an internal resistance of 50Ω generates an open-circuit voltage of $10V_p$. When a capacitor is connected across the output terminals, the voltage drops to $8V_p$. The capacitance of the capacitor (in microfarads) is   (GATE IN 2022)

Solution:

Parameter	Description	Value
V_i	Input voltage	$10V_p$
V_o	Output voltage	$8V_p$
R	Internal resistance	50Ω
f	Frequency of sine wave	1kHz
ω	Angular frequency	$2\pi f$
C	Capicatance of capacitor	?
X_c	Reactance of capicator	$\frac{1}{j\omega C}$

TABLE I

INPUT PARAMETERS
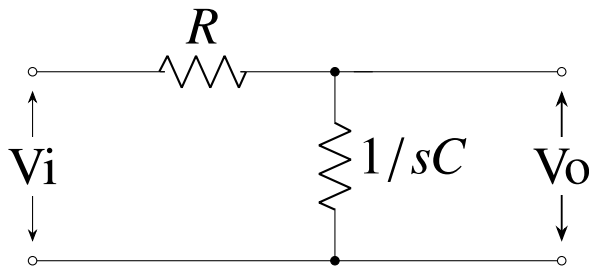
$$V_o = \frac{X_c}{\sqrt{R^2 + X_c^2}} \cdot V_i \quad (1)$$

$$\implies 8V_p = \frac{X_c}{\sqrt{50^2 + X_c^2}} \cdot 10V_p \quad (2)$$

$$\implies X_c^2 - 1.5625X_c^2 + 2500 = 0 \quad (3)$$

$$\implies X_c = \frac{200}{3} \quad (4)$$

$$\implies C = \frac{1}{2\pi \cdot 10^3 \cdot \frac{200}{3}} \quad (5)$$

$$\implies C = 2.387\mu F \quad (6)$$