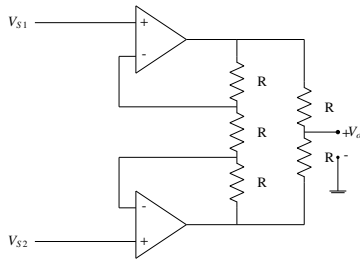


Gate 2023- Instrumentation Engineering

EE23BTECH11037 - M Esha*

Question 59: The op amps in the circuit are ideal. The input signals are $V_{s1} = 3 + 0.10 \sin(300t)$, V and $V_{s2} = -2 + 0.11 \sin(300t)$ V. The average value of the voltage V_o is _____ volts (rounded off to two decimal places).



(GATE IN 2023)

Solution:

Variable	Value	Description
V_{s1}	$3 + 0.10 \sin(300t)$	Input voltages
V_{s2}	$-2 + 0.11 \sin(300t)$	
R		Resistances of the resistors
V_o		Output voltage
V_1		Output voltage of V_{s1} opamp
V_2		Output voltage of V_{s2} opamp

TABLE 0
INPUT PARAMETERS

the current does not flow through op-amp. voltage drop by each R

$$= V_{s1} - V_{s2}$$

by KVL,

$$V_{s2} - V_2 = V_{s1} - V_{s2} \quad (2)$$

$$V_2 = 2V_{s2} - V_{s1} \quad (3)$$

$$V_1 - V_{s1} = V_{s1} - V_{s2} \quad (4)$$

$$V_1 = 2V_{s1} - V_{s2} \quad (5)$$

$$V_o = \frac{V_1 + V_2}{2} \quad (6)$$

$$= \frac{V_{s1} + V_{s2}}{2} \quad (7)$$

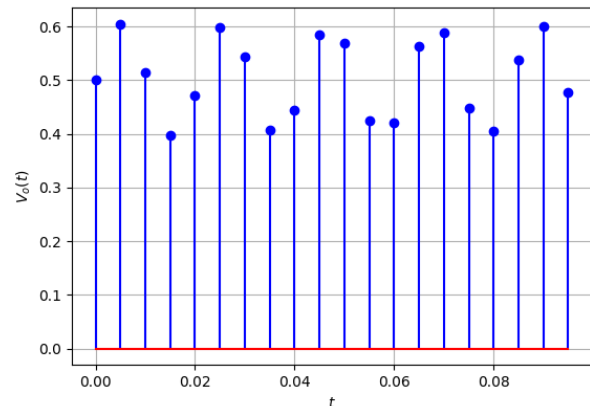
$$= \frac{3 + 0.10 \sin(300t) + -2 + 0.11 \sin(300t)}{2} \quad (8)$$

$$= 0.5 + \frac{0.21 \sin(300t)}{2} \quad (9)$$

$$V_{avg} = \frac{1}{T} \int_0^T V(t) dt \quad (10)$$

$$= \frac{300}{2\pi} \int_0^{\frac{2\pi}{300}} \left(0.5 + \frac{0.21 \sin(300t)}{2} \right) dt \quad (11)$$

$$= 0.5 \quad (12)$$



(1) Fig. 0. stem plot