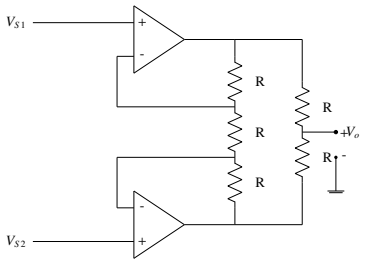
Gate 2023- Instrumentation Engineering

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_0 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

$$= V_{s1} - V_{s2} \tag{1}$$

by KVL,

$$V_{s2} - V_2 = V_{s1} - V_{s2} \tag{2}$$

$$V_2 = 2V_{s2} - V_{s1} \tag{3}$$

$$V_1 - V_{s1} = V_{s1} - V_{s2} \tag{4}$$

$$V_1 = 2V_{s1} - V_{s2} \tag{5}$$

$$V_o = \frac{V_1 + V_2}{2} \tag{6}$$

$$= \frac{V_{s1} + V_{s2}}{2} \tag{7}$$

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

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

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

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

$$= 0.5 \tag{12}$$

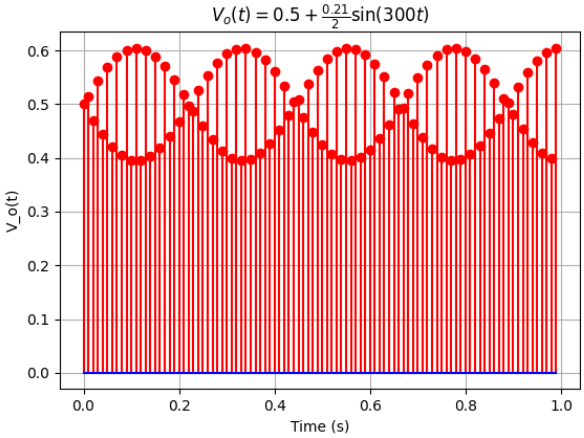


Fig. 0. stem plot