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Gate 2023- Instrumentation Engineering

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Question 60: In the circuit shown, the input voltage $V_{in} = 100mV$. The switch and the opamp are ideal. At time t = 0, the intial charge stored in the 10nF capacitor is 1nC, with the polarity as indicated in the figure. The switch S is controlled using a 1KHz square-wave voltage signal V_s as shown. Whenever V_s is 'High', S is in position '1' and when V_s is 'Low', S is in position '2'.

At t = 20ms, the magnitude of the voltage V_o will be

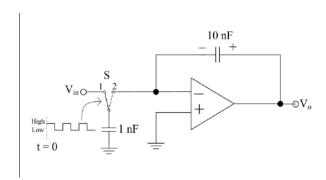
(GATE ST 2023)

$$q_{10nF} = 1nC - 20(0.1nC) \tag{5}$$

$$= -1nC \tag{6}$$

$$V_o = \frac{-1nC}{10nF} \tag{7}$$

$$= -100mV \tag{8}$$



Solution: 0 < t < 0.5 ms

Parameter	Value	Description
V_{in}	100mV	Input voltage
q_{10nF}	1nC	Intial charge on 10nF
q_{1nF}		Charge on 1nF
f	1 <i>KHz</i>	Frequency of V_s
T	1ms	Time period
V_o		Output voltage

TABLE 0
INPUT PARAMETERS

$$q_{1nF} = 100mV \times 1nF \tag{1}$$

$$=0.1nC \tag{2}$$

0.5ms < t < 1ms

Both the capcitors will discharge

$$q_{10nF} = 1nC - 0.1nC (3)$$

$$=0.9nC \tag{4}$$