Control Systems

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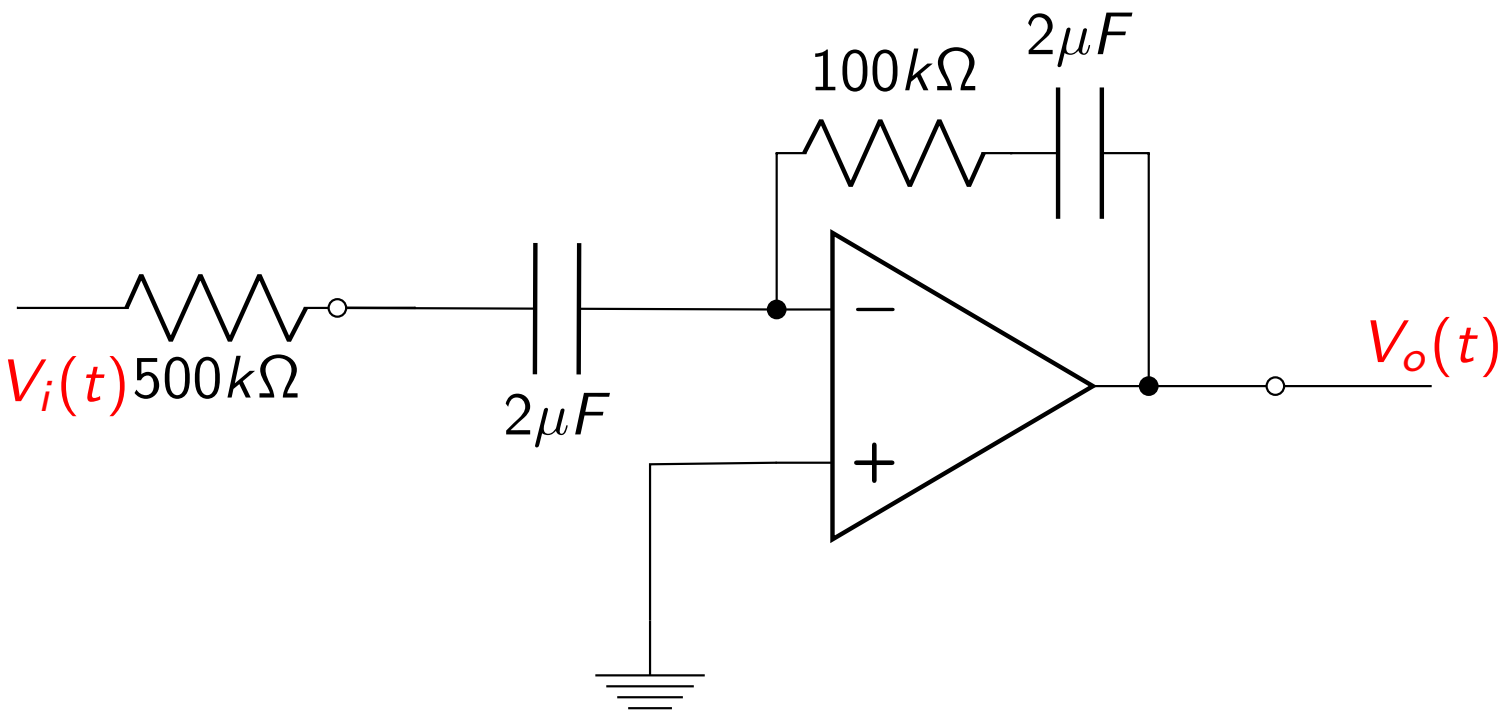
Question

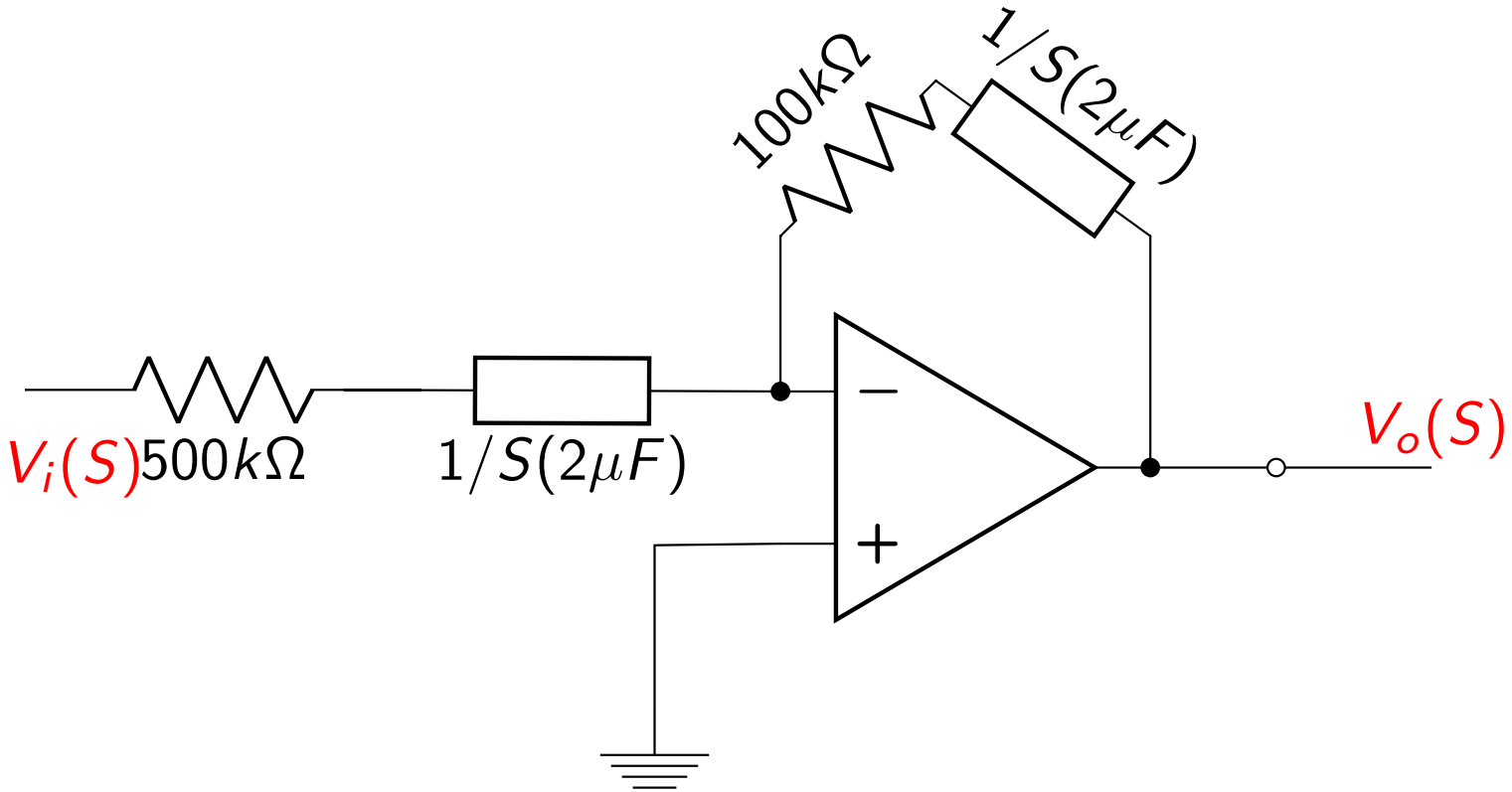
Find the transfer function, G(s) = V 0 (s)/Vi(s), for each operational amplifier circuit shown below

Circuit 1



Frequency Domain

Redrawing the Circuit in Frequency Domain



Here we have two Impedance

1) $Z_2(S) = 100\text{k}\Omega + \dfrac{1}{S(2\mu F)} = 10^5 + \dfrac{1}{2 \times 10^{-6} S} = 10^5 \dfrac{S+5}{S}$

2) $Z_1(S) = 500\text{k}\Omega + \dfrac{1}{S(2\mu F)} = 5 \times 10^5 + \dfrac{1}{2 \times 10^{-6} S} = 10^6 \dfrac{S+1}{2S}$

For an inverting Operational Amplifier,

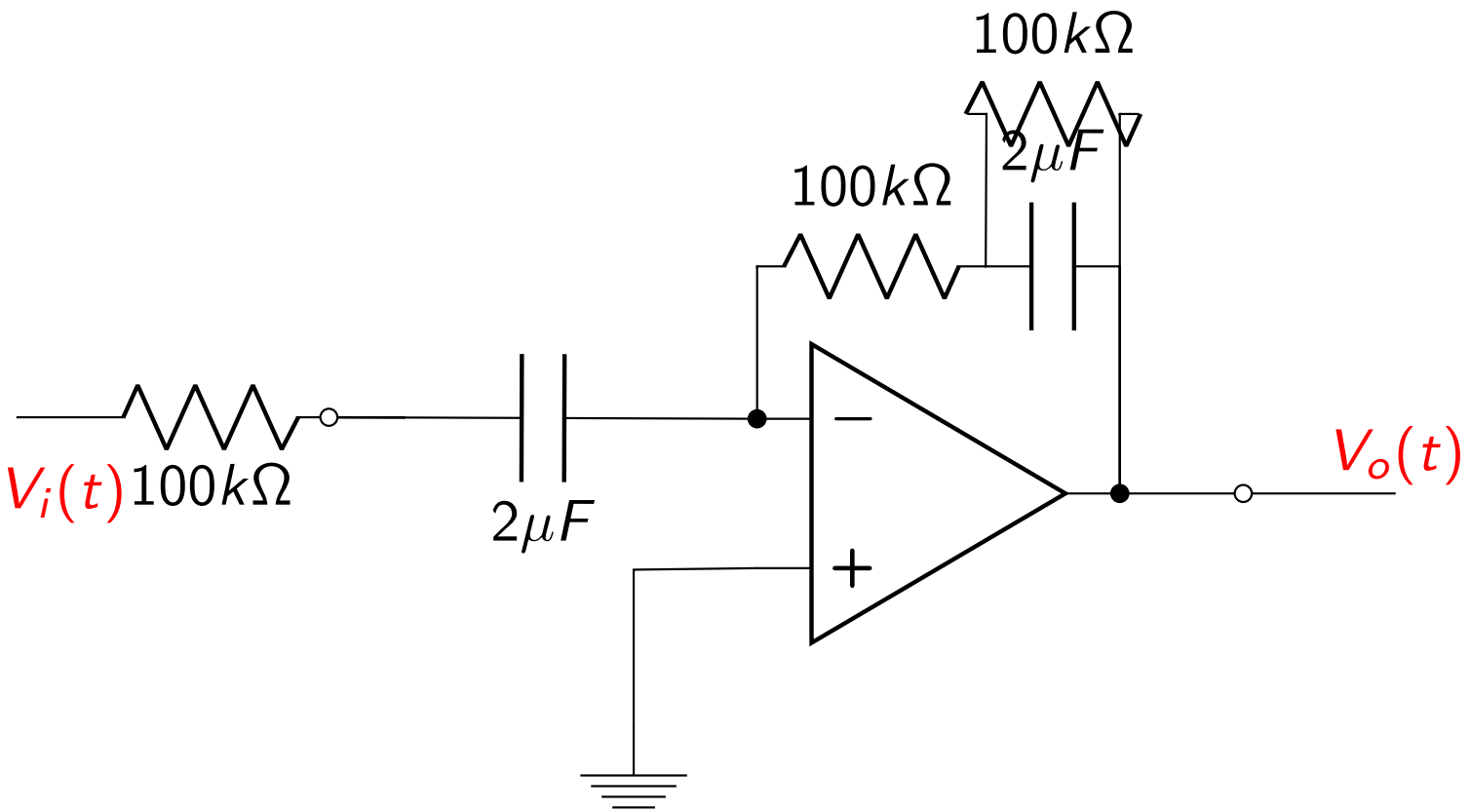
FORMULA:

$$\frac{V_o(S)}{V_i(S)} = -\frac{Z_2(S)}{Z_1(S)}$$

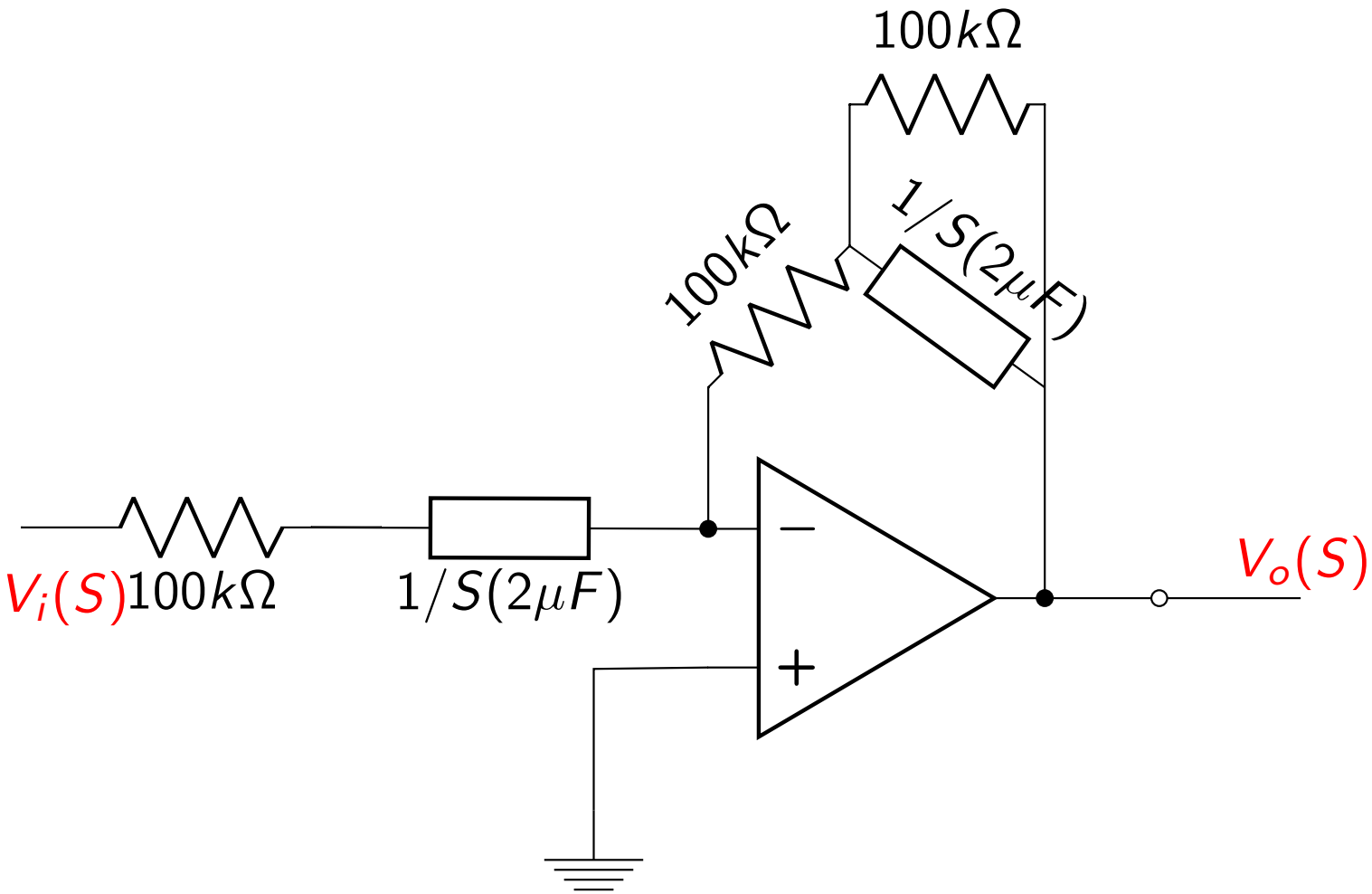
Therefore,

$$\frac{V_o(S)}{V_i(S)} = -\frac{S+5}{5S+5}$$

Circuit 2



Frequency Domain



Here we have two Impedance

$$1)\ Z_2(S) = 100\text{k}\Omega + \frac{100k\Omega \times \frac{1}{S(2\mu F)}}{100k\Omega + \frac{1}{S(2\mu F)}} = 10^5 \frac{S+10}{S+5}$$

$$2)\ Z_1(S) = 100\text{k}\Omega + \frac{1}{S(2\mu F)} = 10^5 \frac{S+5}{S}$$

For an inverting Operational Amplifier,

FORMULA:

$$\frac{V_o(S)}{V_i(S)} = -\frac{Z_2(S)}{Z_1(S)}$$

Therefore,

$$\frac{V_o(S)}{V_i(S)} = -\frac{S(S+10)}{(S+5)^2}$$