

14.51 Determine the transfer function for the network shown in Fig. P14.51. If a step function is applied to the network, what type of damping will the network exhibit?

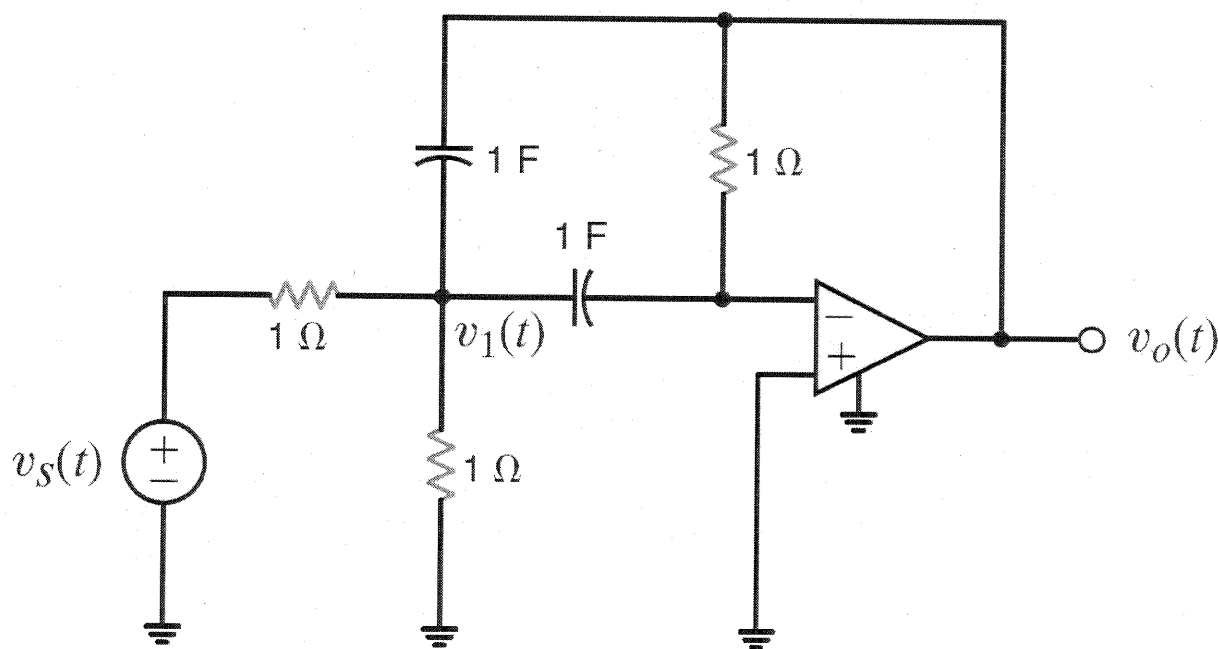
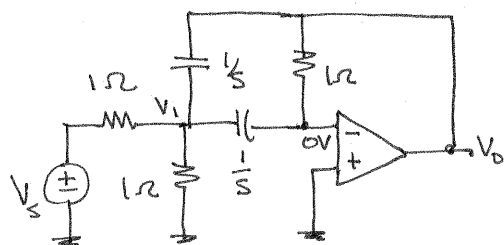


Figure P14.51

SOLUTION:



$$\frac{V_s - V_1}{1} = \frac{V_1}{1} + V_1 s + (V_1 - V_o) s$$

$$\frac{V_o}{1} + V_1 s = 0 \Rightarrow V_1 = -V_o/s$$

$$V_s = V_1 (2s + 2) - sV_o = -V_o \left(\frac{s^2 + 2s + 2}{s} \right)$$

$$\boxed{\frac{V_o}{V_s} = \frac{-s}{s^2 + 2s + 2}}$$

$$\text{Roots at } s = \frac{-2 \pm \sqrt{4 - 8}}{2} = -1 \pm j1$$

complex conjugate poles.
Network is
UNDERDAMPED!