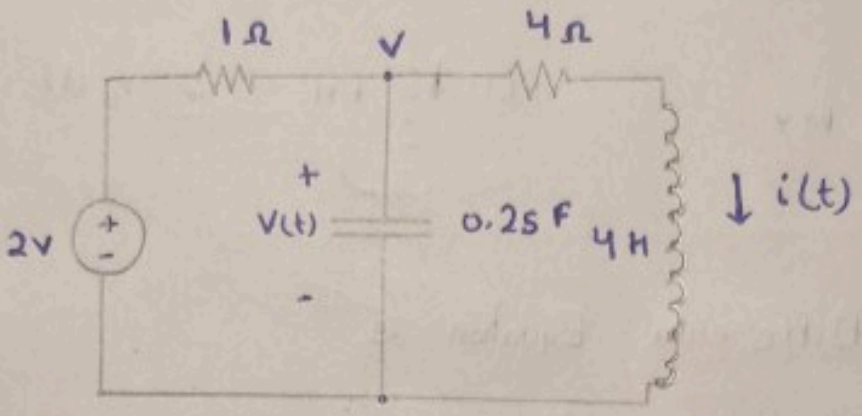
ASSIGNMENT 1

Name :- Rahi Agarwal Batch :- F4 Enroll :- 9921103145

Ans 1)



$$\Rightarrow \frac{V-2}{1} + C\frac{dv}{dt} + i(t) = 0$$

$$\Rightarrow i = \frac{V - L\frac{di}{dt}}{4} \quad \Rightarrow \quad 4i + L\frac{di}{dt} = V$$

$$\Rightarrow \frac{dv}{dt} = 4\frac{di}{dt} + L\frac{d^2i}{dt^2}$$

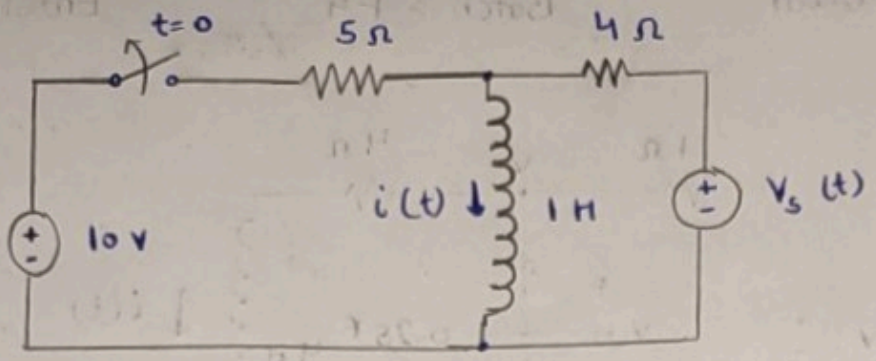
$$\Rightarrow 4i + L\frac{di}{dt} - 2 + C\left(4\frac{di}{dt} + L\frac{di^2}{dt^2}\right) + i = 0$$

$$\Rightarrow 4i + 4\frac{di}{dt} - 2 + 0.25\left(4\frac{di}{dt} + 4\frac{d^2i}{dt^2}\right) + i = 0$$

$$\Rightarrow 4i + 4\frac{di}{dt} - 2 + \frac{di}{dt} + \frac{d^2i}{dt^2} + i = 0 \qquad \{4 \times 0.25 = 1\}$$

$$\Rightarrow \boxed{\frac{d^2i}{dt^2} + 5\frac{di}{dt} + 5i - 2 = 0}$$

Ans 2.) for $V_s = 10e^{-2t}\, u(t)$ V



For $t > 0$ Differential Equation is

$$\frac{di}{dt} + 4i = 10e^{-2t} \quad \text{— (i)}$$

$$i(t) = i_n(t) + i_f(t)$$

For $i_f(t)$

$i_f = Be^{-2t}$, which satisfy Equ (i)

$$-2Be^{-2t} + 4Be^{-2t} = 10e^{-2t}$$

$$2B = 10 \Rightarrow \boxed{B = 5}$$

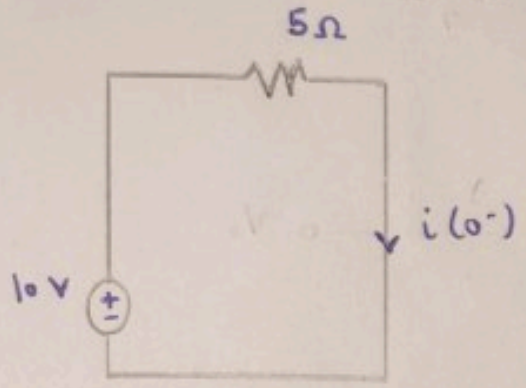
$$\boxed{i_f(t) = 5e^{-2t}}$$

$$i_n(t) = Ae^{-4t}$$

$$\boxed{i(t) = Ae^{-4t} + 5e^{-2t}} \quad \text{— (ii)}$$

Now, for initial condition

for $t < 0$



$$i(0^-) = \frac{10}{5} = 2A = i(0^+)$$

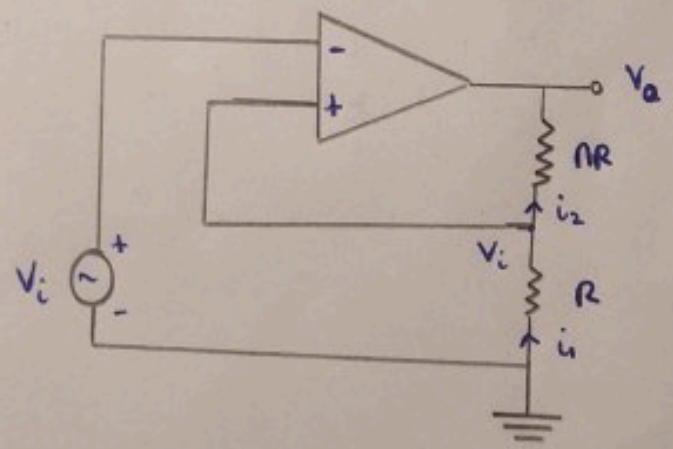
Put $t = 0^+$ in equ (ii)

$$i(0^+) = A + 5$$

$$2 = A + 5 \quad \Rightarrow \quad A = -3$$

Therefore $\boxed{i(t) = -3e^{-4t} + 5e^{-2t}}$ for $t > 0$

Ans 3)



$V_o = V_i$

Applying KCL at node V_i $\Rightarrow i_1 = i_2$

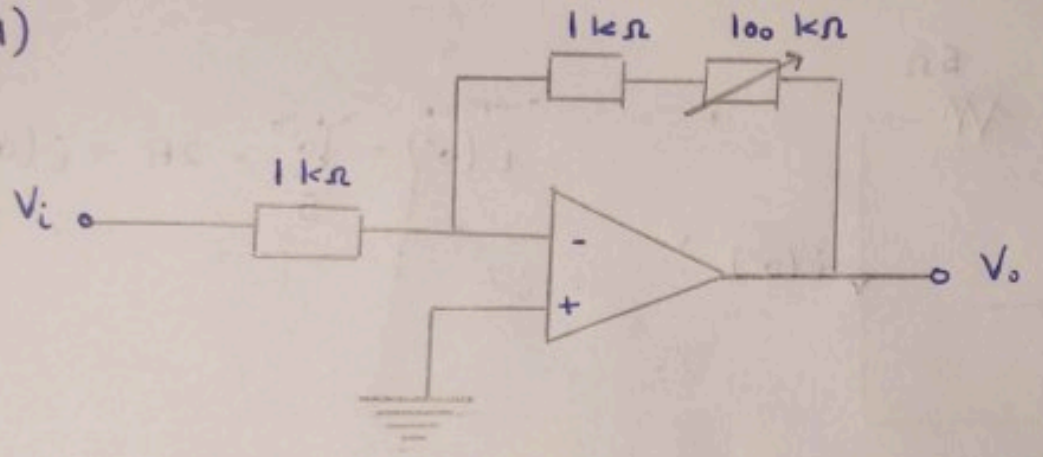
$$\frac{0 - V_i}{R} = \frac{V_i - V_o}{nR}$$

$$\Rightarrow -nV_i = V_i - V_o$$

$$\Rightarrow V_o = V_i (n+1)$$

$$\Rightarrow \frac{V_o}{V_i} = (n+1) \qquad \left[\frac{V_o}{V_i} = \text{Gain}\right]$$

Ans 4)



$$\frac{V_i}{1} = \frac{V_i - V_o}{1+R} \Rightarrow V_i(1+R) = V_i - V_o$$

$$V_o = -V_i R \Rightarrow \frac{V_o}{V_i} = -R$$

Min Gain = 1

Max Gain = 100