Himanshu Dixit
2110326
B11

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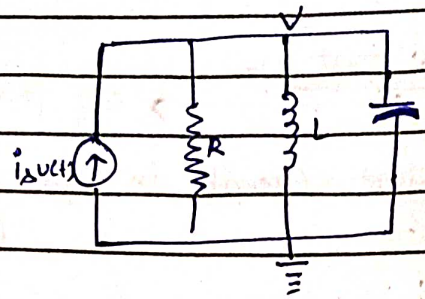
# GS-2 (Take Away -2)

Q.1.




$i_s = 8e^{-2t}$ A
$R = 6\Omega$
$L = 7H$
$C = 1/42$ F

$$i + \frac{V}{R} + C\frac{dV}{dt} = i_s \quad — (1)$$

$$V = L\frac{di}{dt} \quad — (2)$$

$$\frac{dV}{dt} = L\frac{d^2i}{dt^2} \quad — (3)$$

from (1), (2), (3) :

$$i + \frac{L}{R}\frac{di}{dt} + CL\frac{d^2i}{dt^2} = i_s \quad — (4)$$

$$\frac{d^2i}{dt^2} + \frac{1}{RC}\frac{di}{dt} + \frac{1}{LC}i = \frac{i_s}{LC} \quad — (5)$$

$\frac{d^2i}{dt^2} + \frac{1}{RC}$

from (4) & (5) we get :

$$\frac{d^2i}{dt^2} + 7\frac{di}{dt} + 6i = 48e^{-2t} \quad — (6)$$

$$i_f = Be^{-2t} \quad — (7)$$

from (6) & (7) :

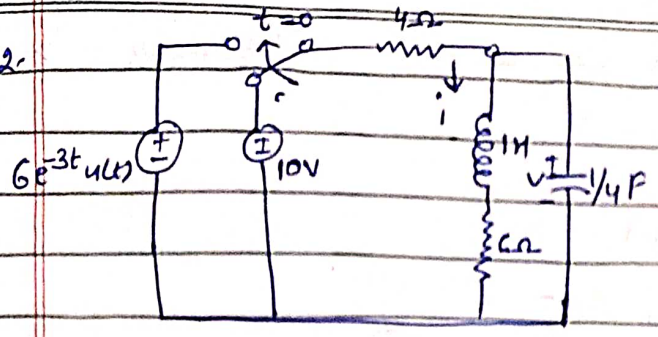
$$48e^{-2t} + 7(-2Be^{-2t}) + 6Be^{-2t} = 48e^{-2t}$$

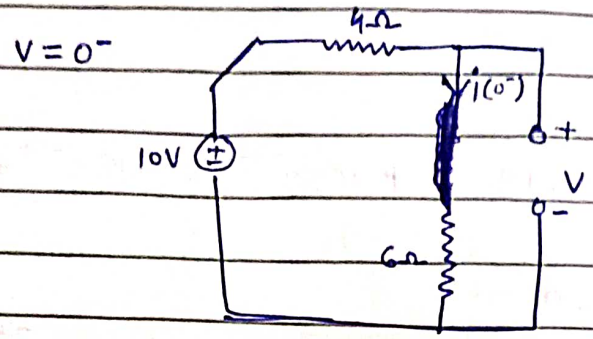
$$(4 - 14 + 6)Be^{-2t} = 48e^{-2t}$$

$\therefore B = -12$

$$\boxed{i_f = -12e^{-2t} \text{ A}}$$

Q.2.




$v(0^-) = 6V$

$i(0^-) = \frac{10}{10} = 1A$

After switch is thrown,

$$-v + \frac{di}{dt} + 6i = 0$$

$$\frac{v - v_s}{4} + i + \frac{1}{4}\frac{dv}{dt} = 0$$

$$\left(\frac{di}{dt} + 6i\right) - v = 0$$

$$i + \left(\frac{v}{4} + \frac{1}{4}\frac{dv}{dt}\right) = \frac{v_s}{4}$$

$$(s+6)\,i - v = 0 \quad \text{—— ①}$$

$$i + \frac{v}{4} + \frac{1}{4}sv = \frac{v_s}{4} \quad \text{—— ②}$$

from ① & ② –

$$((s+6)(s+1)+4)\,v = (s+6)\,v_s$$

$$(s^2 + 7s + 10)\,v = (s+6)\,v_s$$

$$\frac{d^2v}{dt^2} + 7\frac{dv}{dt} + 10v = \frac{dv_s}{dt} + 6v_s$$

CF :

$$(s^2 + 7s + 10) = 0$$

$$s_1 = -2, \quad s_2 = -5$$

$$v_n = A_1 e^{-2t} + B_1 e^{-5t}$$

$$v_f = Be^{-3t}$$

$v_s$ in diff. eq :

$$9Be^{-3t} + 21Be^{-3t} + 10Be^{-3t} = -18e^{-3t} + 36e^{-3t}$$

$$B = -9$$

$$v_f = -9e^{-3t}$$

$$v = v_n + v_f = A_1 e^{-2t} + A_2 e^{-5t} - 9e^{-3t}$$

$\because v(0) = 6$

$$6 = A_1 + A_2 - 9$$

$$A_1 + A_2 = 15$$

$\because i(0) = 1A$

$$\frac{dv(0)}{dt} = ? \quad \text{at } t = 0$$

$$\frac{dv}{dt} = -4i - v + v_s$$

At $t = 0$,

$$\frac{dv(0)}{dt} = -4i(0) - v(0) + v_s(0) = -4 - 6 + 6 = -4$$

$$\frac{dv}{dt} = -2A_1 e^{-2t} + -5A_2 e^{-5t} + 27e^{-3t}$$

At $t = 0$,

$$\frac{dv(0)}{dt} = -2A_1 - 5A_2 + 27 = -4$$

$$2A_1 + 5A_2 = 31$$

$$A_1 = \frac{44}{3}, \quad A_2 = \frac{1}{3}$$

$$v = \frac{44}{3}e^{-2t} + \frac{1}{3}e^{-5t} - 9e^{-3t} \text{ V}$$