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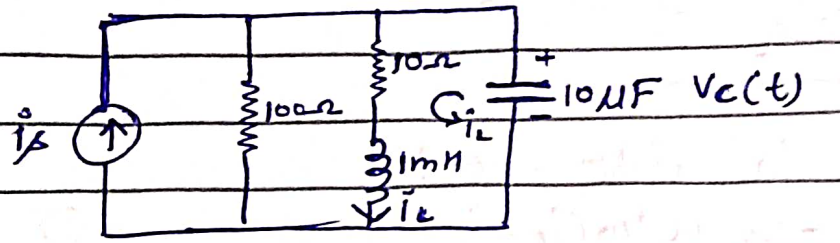
ES-2 (Take-Away-3)

Q.1.



Apply KVL,

$$-10i_L - 10^{-3}\frac{di_L}{dt} + V_C = 0$$

$$V_C = 10i_L + 10^{-3}\frac{di_L}{dt} \quad \text{—②}$$

Apply KCL, $-i_s + \frac{V_C}{100} + i_C + C\frac{dv_C}{dt} = 0$

$$-i_s + \frac{V_C}{100} + i_L + 10^{-5}sV_C = 0 \quad \text{—①}$$

from ① & ② ;

$$-i_s + \frac{10i_L}{100} + \frac{si_L \times 10^{-3}}{100} + i_L + 10^{-5}(10si_L + s^2 i_L \times 10^{-3}) = 0$$

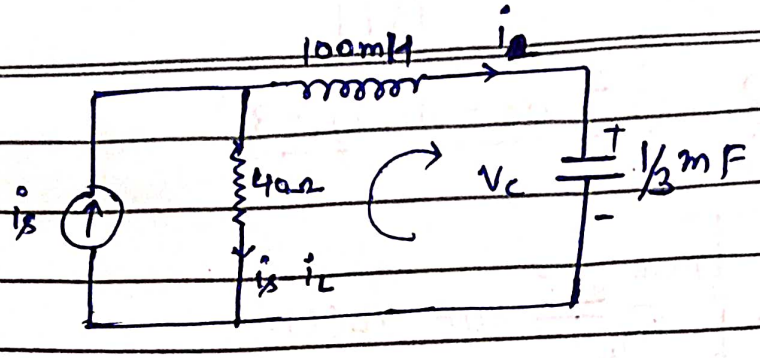
$$-i_s + \frac{i_L}{10} + 10^{-5}si_L + i_L + 10^{-5}(s^2 i_L \times 10^{-3}) + 10^{-5} \times 10 s i_L = 0$$

$$10^{-8}s^2 i_L + (10^{-5} + 10^{-4})s i_L + 1.1 i_L = i_s$$

$$s^2 i_L + (10^3 + 10^4)s i_L + 1.1 \times 10^8 i_L = i_s \times 10^8$$

$$\frac{d^2 i_L}{dt^2} + 11000\frac{d i_L(t)}{dt} + 1.1 \times 10^8 i_L(t) = i_s(t)\, 10^8$$

Q.2.



Apply KVL in right mesh:

$$-L\frac{di_L}{dt} - V_c + 40(i_s - i_L) = 0 \quad \text{—— ①}$$

$$i_L = C\frac{dv_c}{dt} \quad \text{—— ②}$$

Substitute ② in ①:

$$-LC\frac{d^2V_c}{dt} - V_c - 40C\frac{dv_c}{dt} = -40\dot{i}_s$$

$$\left(\frac{10^{-4}}{3}s^2 + \frac{4}{3}\times 10^{-2}s + 1\right)V_c = 40\dot{i}_s$$

$$(s^2 + 400s + 3\times 10^4)V_c = 12\times 10^5\,\dot{i}_s$$

characteristic eqn: $s^2 + 400s + 3\times 10^4 = 0$

$$(s+300)(s+100) = 0$$

$s_1 = -300$, $s_2 = -100$ Ans