Department of EEE, IIT Guwahati EE1103-04H : Electric Circuits MID-SEM EXAM 20-09-2026

Model Solutions

Roll No.: Name: Signature: .....

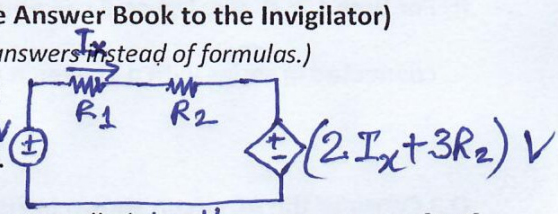
(Invigilator)

(Write answers on this Question Paper Cum Answer Sheet. Use the Answer Book for Solving the Questions.)

(Submit both the Question Paper Cum Answer Sheet and the Answer Book to the Invigilator)

(Round off answers to 2 decimal places. Provide numerical answers instead of formulas.)

Figure-1 by source transformation:



Q.1 Consider the DC circuit shown in Figure-1 and answer accordingly.

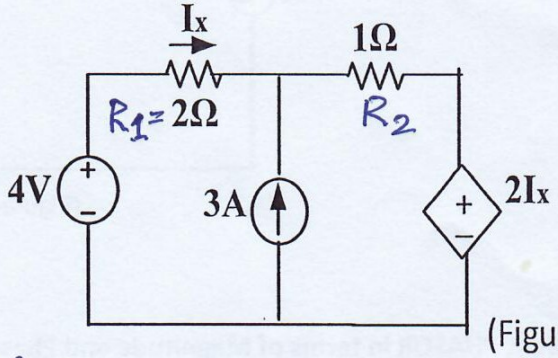
(a) It has 4 NODES and 3 LOOPS. Also, it has a current controlled voltage source. [1x4]

(b) Using **SOURCE TRANSFORMATION**, it is reduced to a **SINGLE MESH** circuit with an independent voltage source of 4 V and a dependent voltage source with $(2I_x+3R_2)$ Volts. [2+2+6]

(Hints: last answer of above (b) will be an expression instead of a numerical value).

(c) Current through 2 Ω resistor, I_x is

$I_x = \frac{4-3R_2}{R_1+R_2+2} = 0.2$ A [4]



(Figure-1)

(d) 50% of above calculated I_x can be obtained when 1Ω resistor is replaced by 1.16 Ω. [2]

$0.1 = \frac{4-3R_2}{2+R_2+2} \Rightarrow R_2 = \frac{36}{31} = 1.16\,\Omega$

Q.2 The switch shown in Figure-2 was open for a very long period before closing at time t = 0 sec.

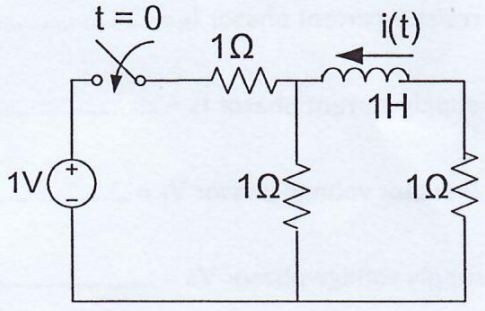
(a) The inductor current i(t) at time $t = 0^+$ sec is

0 A [2]

(b) The inductor current i(t) at time $t = \infty$ sec after closing the switch is $-\frac{1}{3} = -0.33$ A [2]

(c) Time constant of the circuit for time $t \geq 0$ sec is

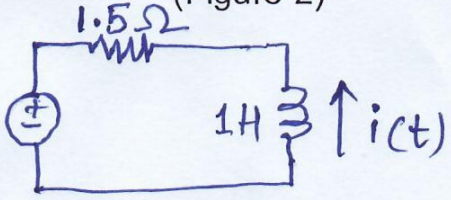
$\tau = \frac{2}{3} = 0.667$ sec [2]



(Figure-2)

(P. T. O.)

Figure-2 : Thevenin Equivalent:



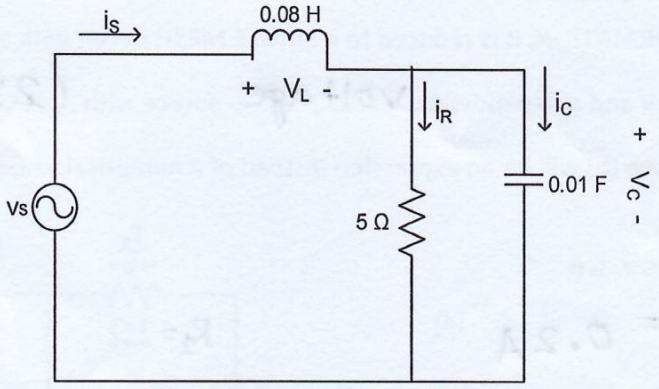
(d) Expression for inductor current for time t > 0 sec is

i(t) = $-\frac{1}{3}(1-e^{-1.5t})$ A [6]

(e) The inductor current i(t) at time t = 3 τ is $i(2) = -\frac{1}{3}(1-e^{-3}) = -0.317$ A [4]

(f) For time $t \geq 0$ sec, Figure-2 can equivalently be represented by a Thevenin voltage source of 0.5 V connected in series with a Thevenin resistance of 1.5 Ω and the inductor of 1 H. [4]

Q.3 Consider the AC circuit shown in Figure-3 where $i_c(t) = 20 \sin(40t+30^0)$ A.



(Figure-3)

Represent PHASOR in terms of Magnitude and Phase Angle in DEGREES only.

(a) The capacitor current phasor Ic = $20\angle 30^\circ$ A (given) [2]

(b) The capacitor voltage phasor Vc = $\frac{1}{j\times 40\times 10^{-2}} \times I_c = 2.5\angle -90^\circ \times 20\angle 30^\circ = 50\angle -60^\circ$ V [4]

(c) The resistor current phasor I_R = $\frac{V_c}{5} = \frac{50\angle -60^\circ}{5} = 10\angle -60^\circ$ A [2]

(d) The supply current phasor Is = $I_R + I_c = 10\angle -60^\circ + 20\angle 30^\circ = 22.32 + j1.34 = 22.36\angle 3.44^\circ$ A [4]

(e) The inductor voltage phasor V_L = $j\times 40\times 0.08\,(22.32+j1.34) = 71.55\angle 93.44^\circ$ V [2]

(f) The supply voltage phasor Vs = $50\angle -60^\circ + 71.55\angle 93.44^\circ = 34.93\angle 53.63^\circ$ V [6]

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