National Exam, December, 2017

16-Elec-A1 Circuits

3 hours duration

NOTES:

1. **No questions to be asked**. If doubt exists as to the interpretation of any question, the candidate is urged to submit with the answer paper, a clear statement of any logical assumptions made.

2. **One of two calculators is permitted; any Casio or Sharp approved models.**

3. This is a **closed book** examination.

4. Any **five questions** constitute a complete paper. Please **indicate in the front page of your answer book which questions you want to be marked.** *If not indicated, only the first five questions as they appear in your answer book will be marked.*

5. All questions are of equal value. **Part marks will be given for right procedures.**

6. **Some useful equations and transforms** are given in the last page of this question paper.

Q1:(a) In the circuit shown in Figure-1, calculate the equivalent resistance at terminals a-b, **R**$_{ab}$. [10]

(b) Calculate the current, I_T shown in the circuit. [4]

(c) Calculate the current, I_o in the 3Ω resistance. [6]

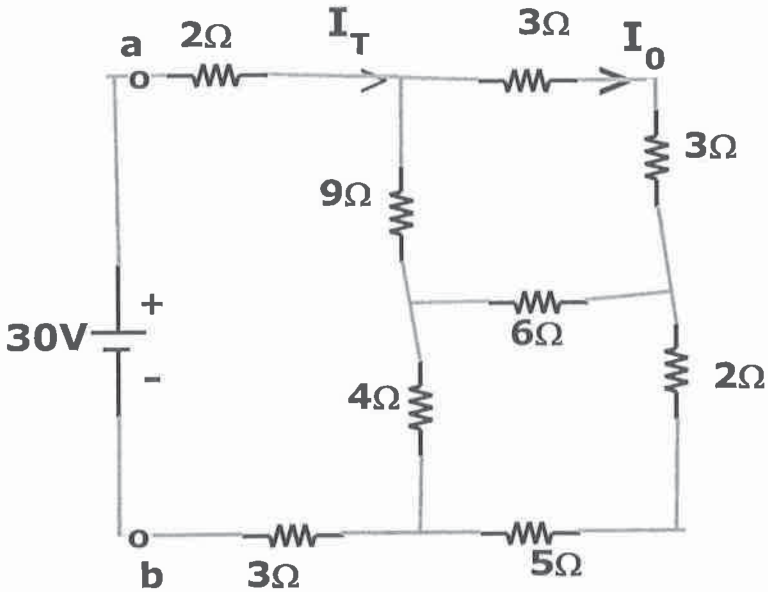


Figure-1

Q2: (a) Write the Node Voltage equations of the circuit shown in Figure-2. [8]

(b) Solve the Node Voltages. [8]

(c) What is the power dissipation in the 5Ω resistance? [4]

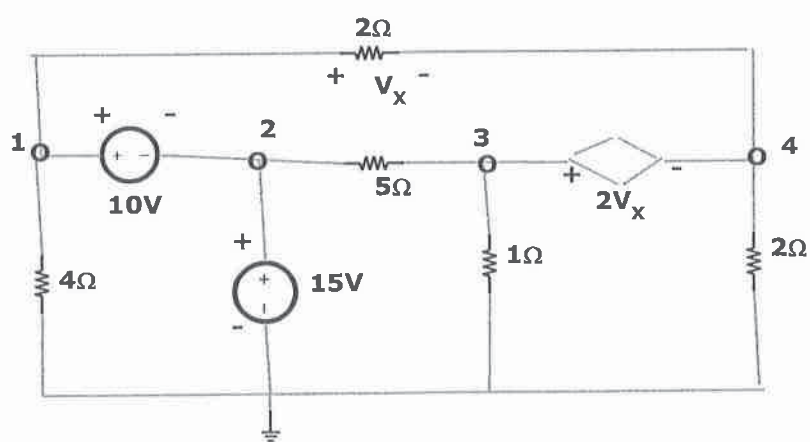


Figure-2

Q3: For the Circuit shown in Figure-3, the switch was initially open for a long time.

At t=0, the switch is closed.

(a) Solve Vc (0^+) i.e just after the switch was closed. [4]
(b) Solve Vc(t) at t >0, i.e after the switch is closed. [10]
(c) Sketch Vc(t) vs t (time). [6]

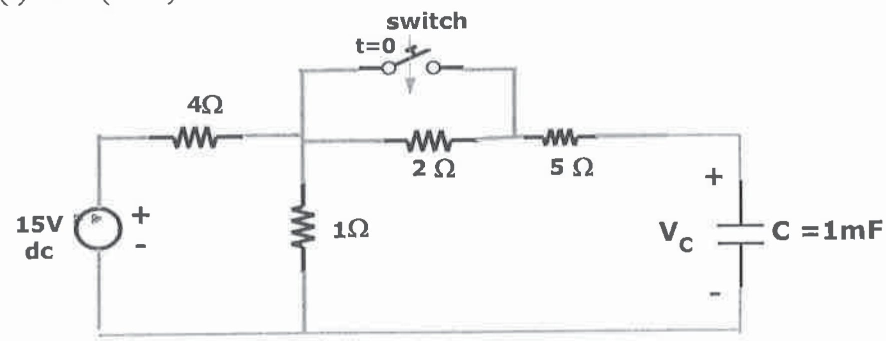


Figure-3

Q4: In the circuit shown in Figure-4 , V_m=100V, f =60 Hz, L1=L2=4mH, R1=R2=1Ω
(a) Calculate **i_s(t)** and **v_c (t)** [5+5]
(b) Show the phasor diagram of $\overline{V_S}$, $\overline{I_S}$, and $\overline{V_C}$. [4+2+4]

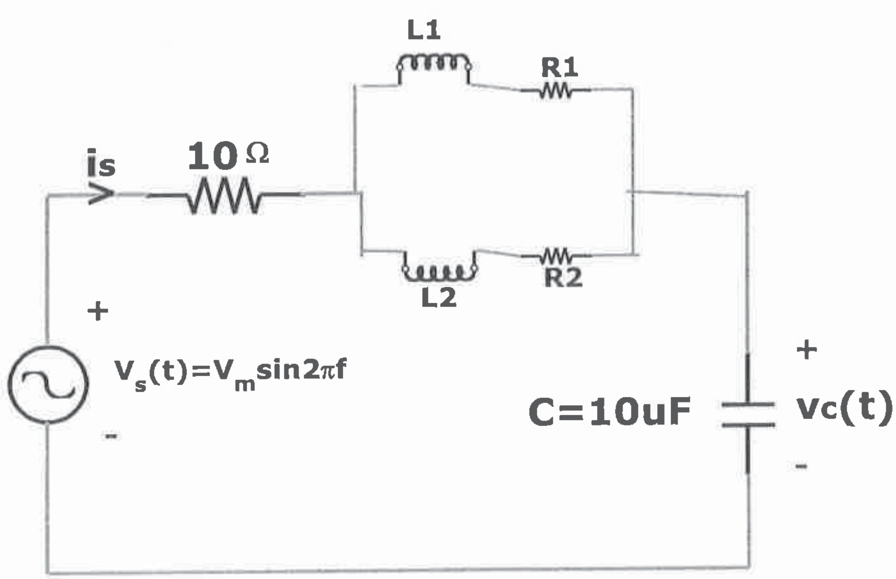


Figure-4

Q5: (a) Calculate the Thevenin's Voltage, V_{th} and Thevenin's impedance, Z_{th} at the terminals **a-b** of the circuit shown in Figure-5. [8+4]

(b) What value of load impedance Z_L which can be connected at terminals **a-b** for maximum power dissipation in Z_L ? [2]

(c) Calculate the maximum power, P_{max} which can be dissipated in Z_L . [6]

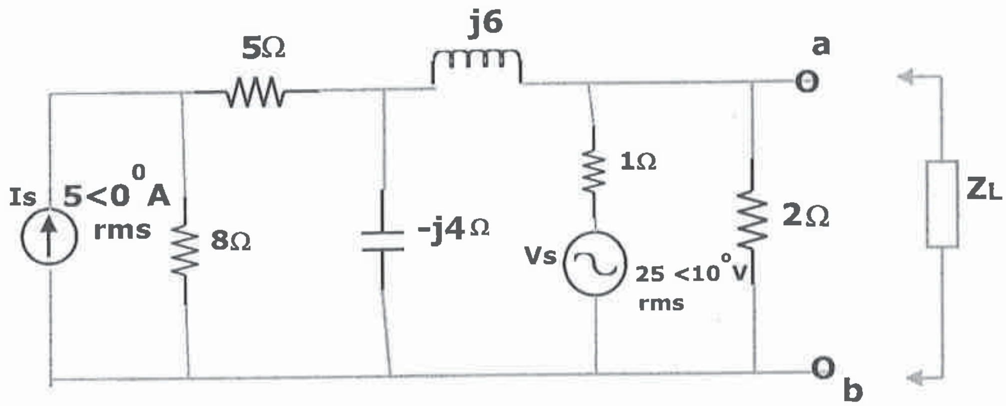


Figure-5

Q6: In the circuit shown in Figure-6, the switch was initially open. At t = 0, it is closed.

The initial current in the inductor, $i_L(o^-)= 0$, and the initial voltage in the capacitor, $v_c(0^-)=5V$.

(a) Convert the circuit to its Laplace equivalent. [8]

(b)Solve the capacitor voltage $V_c(t)$ from $V_c(s)$ in the time domain, at $t \geq 0$. [12]

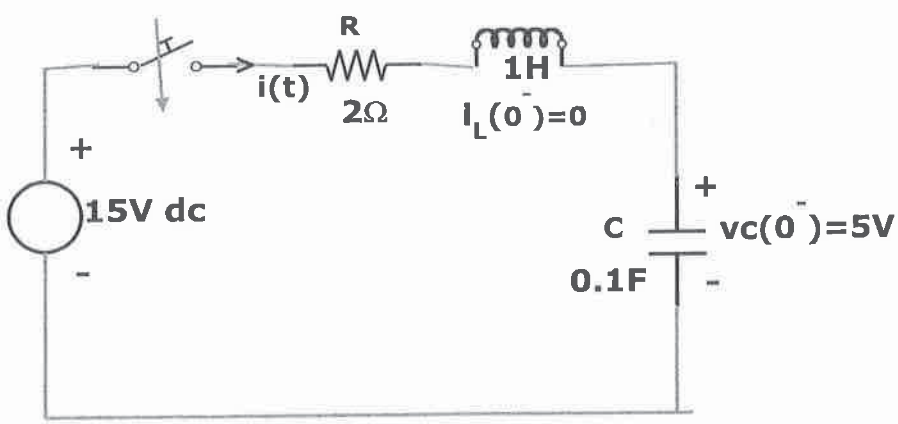


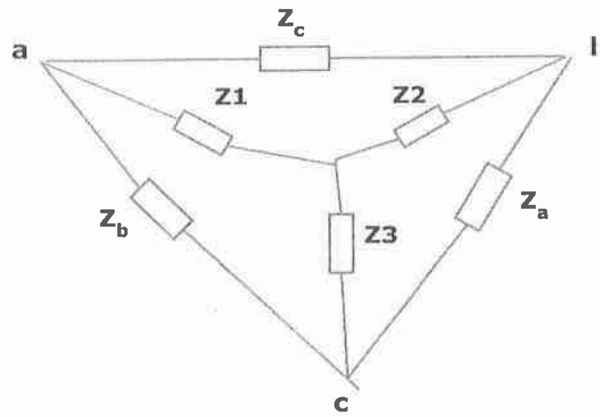
Figure-6

Appendix

Some useful **Laplace Transforms:**

f(t)	→	**F(s)**
Ku(t)		K /s
$\partial(t)$		1
t		$1/s^2$
e^{-at} u(t)		$1 / (s+a)$
sin wt .u(t)		$w / (s^2+w^2)$
cos wt . u(t)		$s / (s^2+w^2)$
$e^{-\alpha t} \sin \omega t$		$\frac{\omega}{(s+\alpha)^2+\omega^2}$
$e^{-\alpha t} \cos \omega t$		$\frac{(s+\alpha)}{(s+\alpha)^2+\omega^2}$
$\frac{d f(t)}{dt}$		$s F(s) - f(0^-)$
$\frac{d^2 f(t)}{dt^2}$		$s^2F(s) - s f(0^-) - f^1(0^-)$
$\int_{-\infty}^{t} f(q)dq$		$\frac{F(s)}{s} + \int_{-\infty}^{0} f(q)dq$

Star – Delta conversion:



$$Z_1 = \frac{Z_b . Z_c}{Z_a + Z_b + Z_c} \qquad Z_2 = \frac{Z_a . Z_c}{Z_a + Z_b + Z_c} \qquad Z_3 = \frac{Z_a . Z_b}{Z_a + Z_b + Z_c}$$

$$Z_a = \frac{Z_1 . Z_2 + Z_2 . Z_3 + Z_3 . Z_1}{Z_1} \qquad Z_b = \frac{Z_1 . Z_2 + Z_2 . Z_3 + Z_3 . Z_1}{Z_2} \qquad Z_c = \frac{Z_1 . Z_2 + Z_2 . Z_3 + Z_3 . Z_1}{Z_3}$$