National Exam, May 2019

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 model.

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: For the circuit shown in Figure-1,

(a) Calculate the equivalent resistance of the circuit , R_{AB} at the terminals A and B. [10]

(b) Solve for the current I_1 at the location shown. [5]

(c) Calculate current I_2 through the 3Ω resistance. [5]

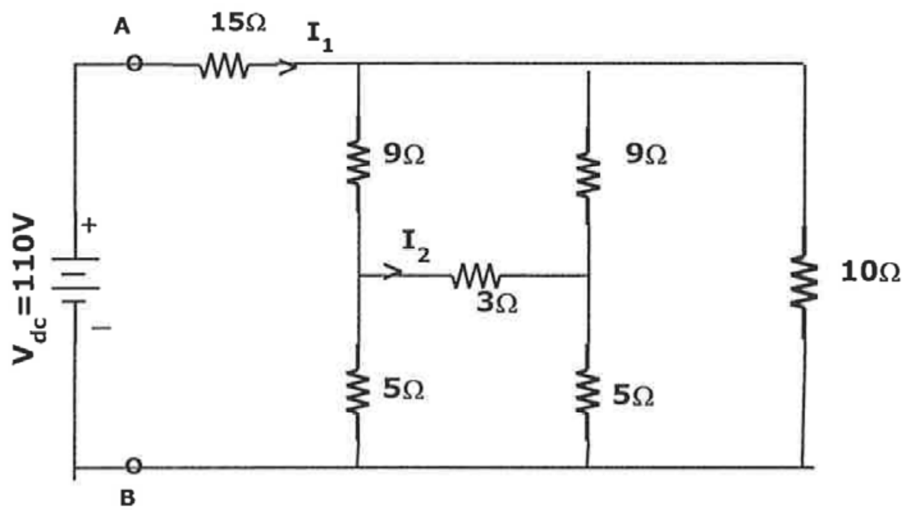


Figure-1

Q2: In the circuit shown in Figure-2,

(a) Write the node voltage equations for V_1 , V_2 and V_3 . [10]

(b) Solve the node voltages. [10]

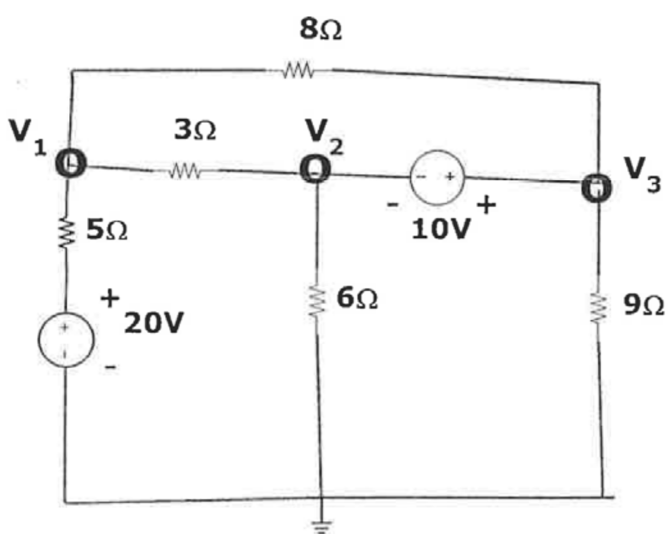


Figure-2

Q3: In Figure-3, the switch was in position-a for a long time. At t = 0, it is moved to Position-b.

Calculate (i) $v_c(0+)$, $\frac{dv_c}{dt}(0+)$, $i_c(0+)$ and $v_c(\infty)$ [4+4+2+2]

(ii) $v_c(t)$ when $t \geq 0$ [8]

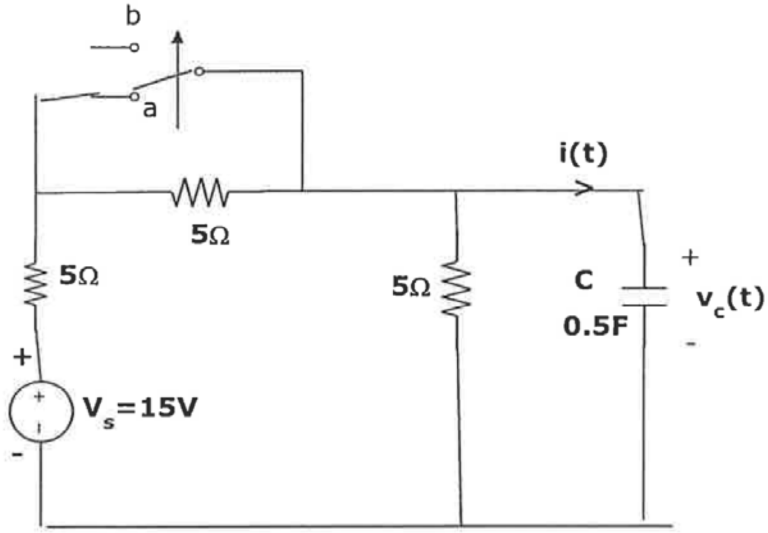


Figure-3

Q4: (a) Thevenize (find V_{th} and Z_{th}) at terminals A –B of the circuit shown in Figure-4. [6+6]

(c) Calculate Z_L, to be connected across the terminals A and B for maximum power dissipation in Z_L. [2]

(b) Calculate this maximum possible power dissipation in Z_L. [6]

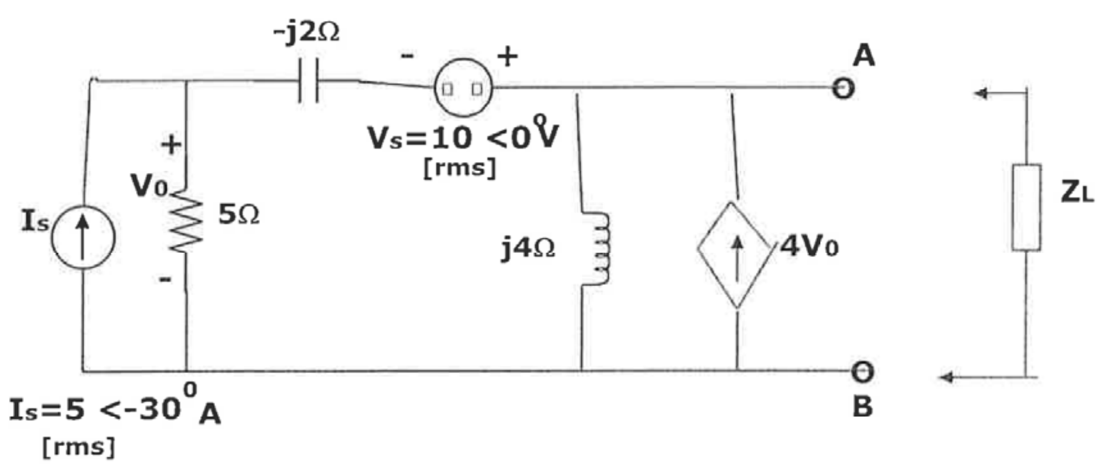


Figure-4

Q5: (a) Write the Node Voltage equations of the following ac circuit, shown in Figure-5. [9]

(b) Solve the node voltages v1(t), v2(t), v3(t), and find current $i_o(t)$. [9+2]

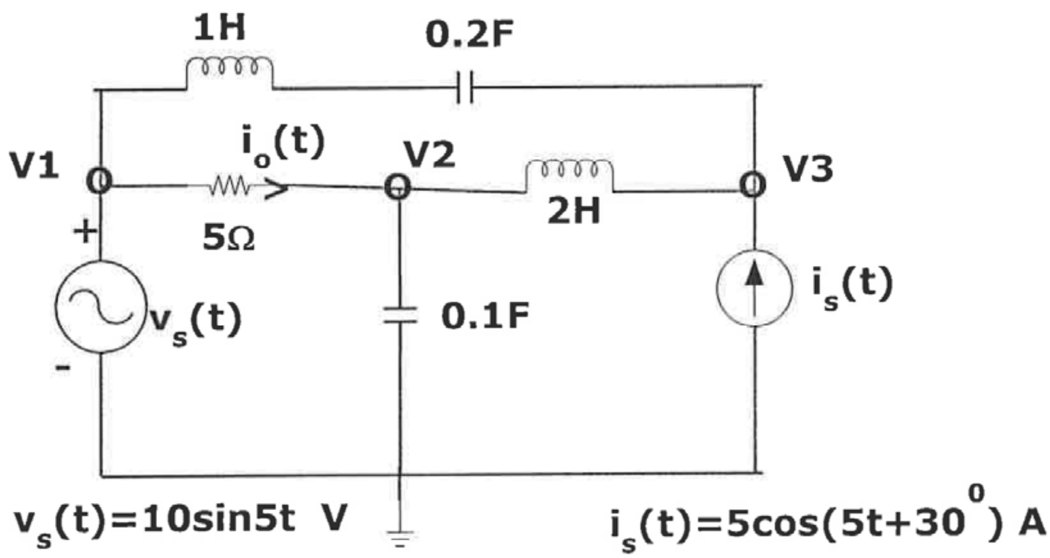


Figure-5

Q6: (a) In the circuit shown in Figure-6, the switch was on position-a for a long time. At t = 0, the switch is moved to position-b. Calculate $V_c(0^+)$ and $i_L(0^+)$. [4]

(b) Draw the Laplace Transformed circuit at $t \geq 0$. [8]

(c) Solve $V_c(t)$. [8]

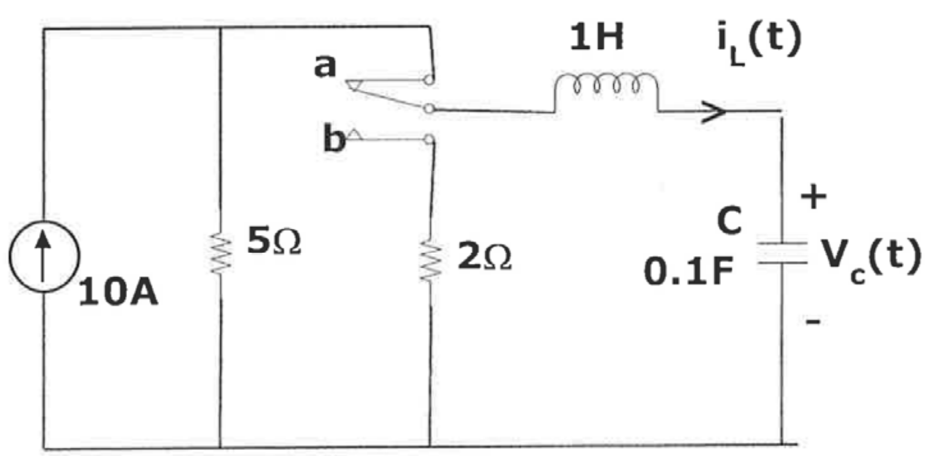


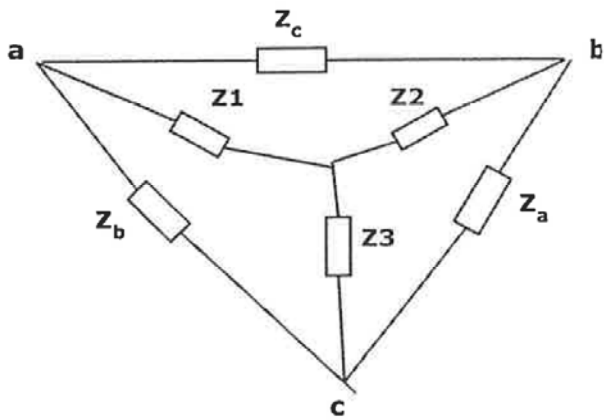
Figure-6

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:



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

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

$$Z \quad = \frac{Z_1 . Z_2 + Z_2 . Z_3 + Z_3 . Z_1}{Z_3}$$