

**National Exam December, 2014**

**07-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. Candidates may use one of two calculators, a Casio or Sharp approved models. **No programmable models** are allowed.
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.
6. **Laplace Table** and some useful equations are given in the last page of this exam 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  $I$  at the location shown. [5]
- (c) Calculate the Power dissipation in the  $12\Omega$  resistance. [5]

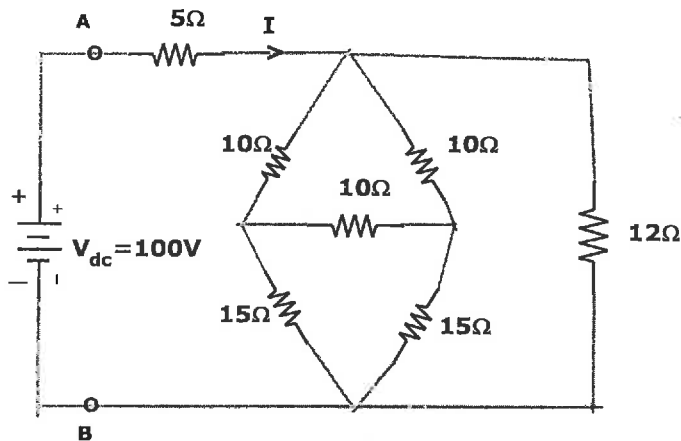


Figure-1

Q2: For the circuit shown in Figure-2,

- (i) Write the mesh current equations for the mesh currents shown. [8]
- (ii) Solve the mesh currents  $I_1$  and  $I_2$ . [8]
- (iii) Solve the power dissipation in the  $5\Omega$ . [4]

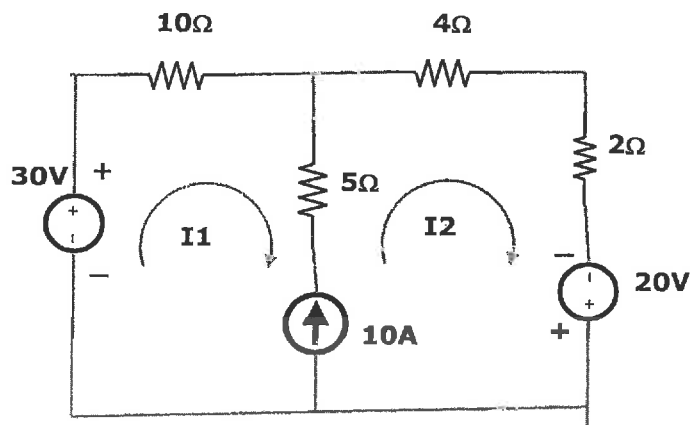


Figure-2

Q3: In the circuit shown, the switch was initially closed between A and B. The switch is opened at  $t = 0$ .

- (i) Solve  $i_{(0)}$ . [4]
- (ii) Solve  $\frac{di}{dt}(0^+)$  [6]
- (iii) Solve  $i_{(t)}$  for  $t \geq 0$ . [10]

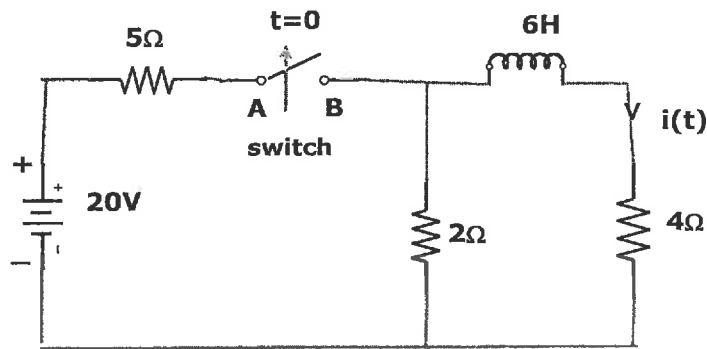


Figure-3

Q4: In circuit shown in Figure-4, solve  $v_o(t)$  by Superposition theorem. [20]

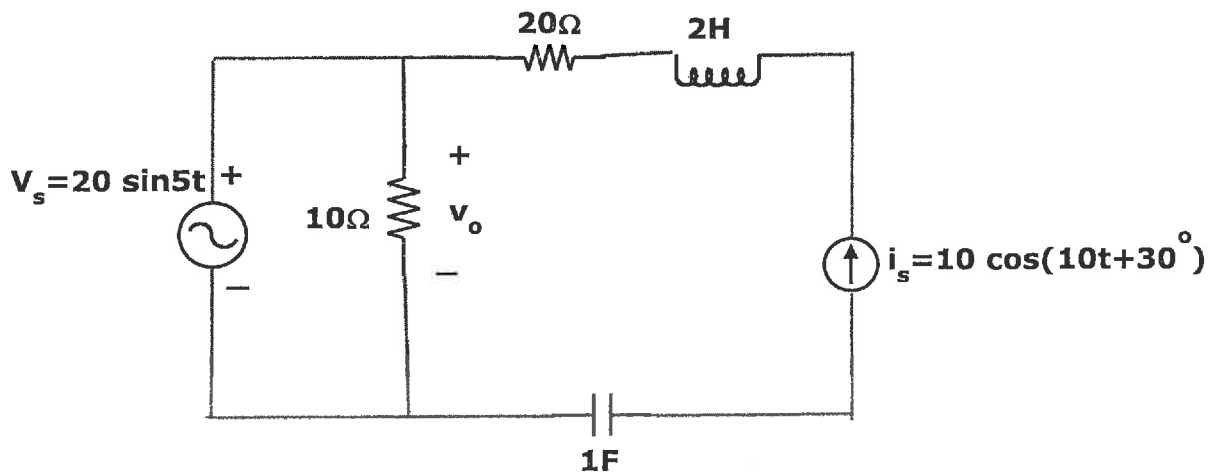


Figure-4

Q5: For the circuit shown in Figure-5,

- (i) Thevenize the circuit at terminals A and B. [10]
- (ii) What  $Z_{Load}$  to be connected at terminals A and B to get maximum power in  $Z_{Load}$ ? [4]
- (iii) Calculate the maximum power in  $Z_{Load}$ . [6]

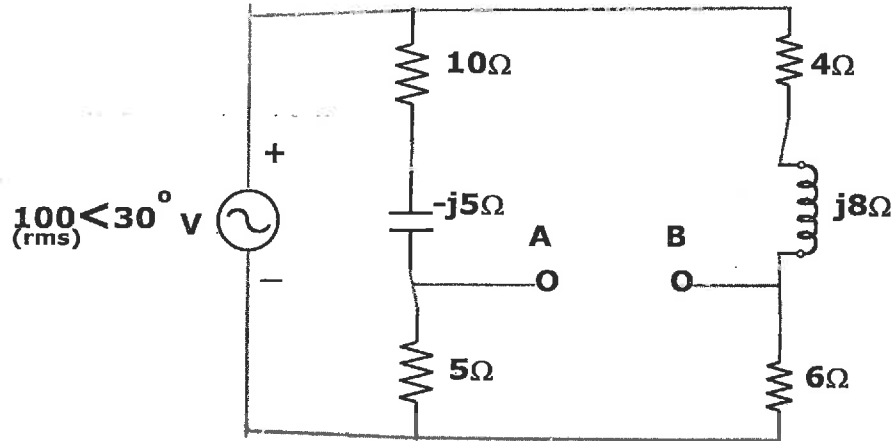


Figure-5

Q6: In Figure-6, the switch was initially at position A. It is moved to position B at  $t = 0$ .

- (i) Draw the Laplace transformed circuit at  $t \geq 0$ . [10]
- (ii) Solve from the Laplace transformed circuit, the current  $i(t)$  in time domain. [10]

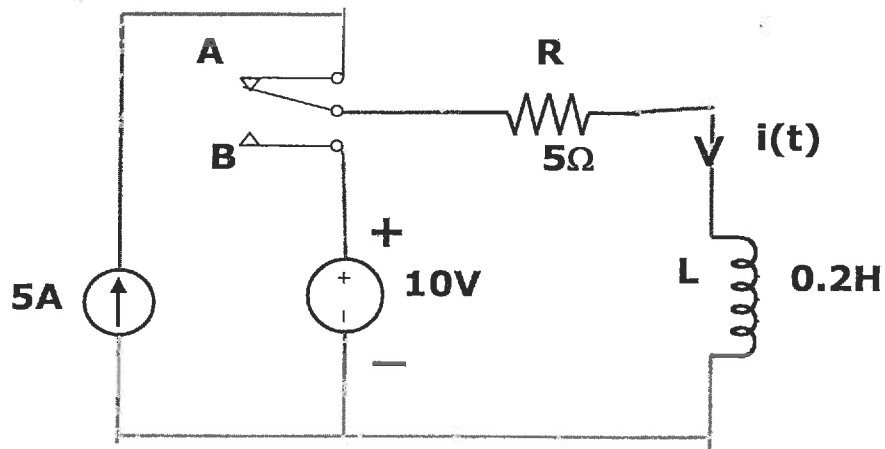
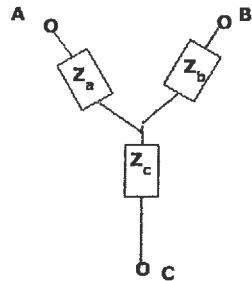


Figure-6

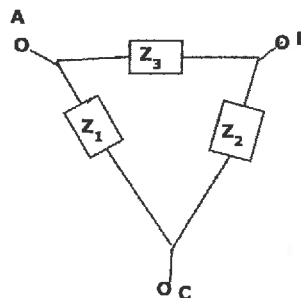
**Appendix**

Some useful Laplace Transforms and equations:

<u>f(t)</u>	→	<u>F(s)</u>
Ku(t)		K / s
e <sup>-at</sup> u(t)		1 / (s+a)
sin wt . u(t)		w / (s <sup>2</sup> +w <sup>2</sup> )
cos wt . u(t)		s / (s <sup>2</sup> +w <sup>2</sup> )
e <sup>-at</sup> sin wt		$\frac{\omega}{(s+\alpha)^2+\omega^2}$
e <sup>-at</sup> cos wt		$\frac{(s+\alpha)}{(s+\alpha)^2+\omega^2}$
$\frac{df(t)}{dt}$		s F(s) - f(0 <sup>-</sup> )
$\frac{d^2 f(t)}{dt^2}$		s <sup>2</sup> F(s) - s f(0 <sup>-</sup> ) - f'(0 <sup>-</sup> )
$\int_{-\infty}^t f(q) dq$		$\frac{F(s)}{s} + \int_{-\infty}^0 f(q) dq$



Y-connection



Δ-connection

$$Z_a = \frac{Z_1 \cdot Z_3}{Z_1 + Z_2 + Z_3}, \quad Z_b = \frac{Z_2 \cdot Z_3}{Z_1 + Z_2 + Z_3}, \quad Z_c = \frac{Z_1 \cdot Z_2}{Z_1 + Z_2 + Z_3}$$

$$Z_1 = \frac{Z_a \cdot Z_b + Z_b \cdot Z_c + Z_a \cdot Z_c}{Z_b}, \quad Z_2 = \frac{Z_a \cdot Z_b + Z_b \cdot Z_c + Z_a \cdot Z_c}{Z_a}, \quad Z_3 = \frac{Z_a \cdot Z_b + Z_b \cdot Z_c + Z_a \cdot Z_c}{Z_c}$$