# National Exam December, 2013

## 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 FX or Sharp EL . **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** is given in the last page of this question paper.

**Q1:** **(a)** Write the node voltage equations at nodes 1 and 2 of the dc circuit shown in Figure-1. Solve node voltages V1 and V2 . [12]

**(b)** After solving the node voltages, calculate the power dissipations in **5Ω** and **4Ω** resistances. [8]

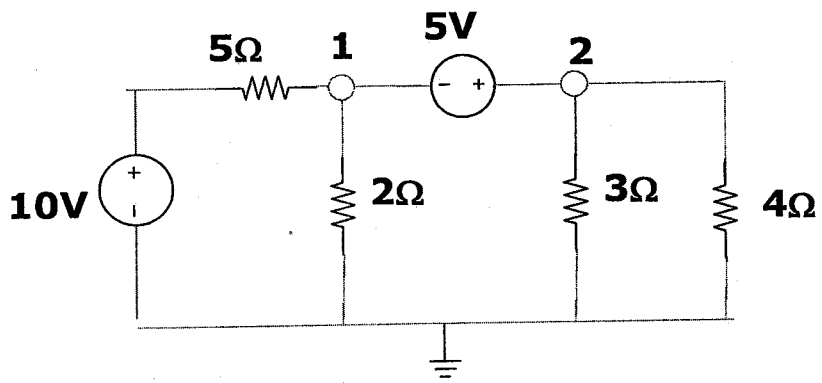


Figure-1

**Q2:** In the circuit shown in Figure-2, the switch was in position-a for a long time. At time t=0, the switch is moved to position-b.

(i) At $t=0^+$ , calculate $V_c$ (+). [5]

(ii) Solve $V_c$ (t) at $t \geq 0$. [10]

(iii) Find $V_c$ at t = 2 sec. [5]

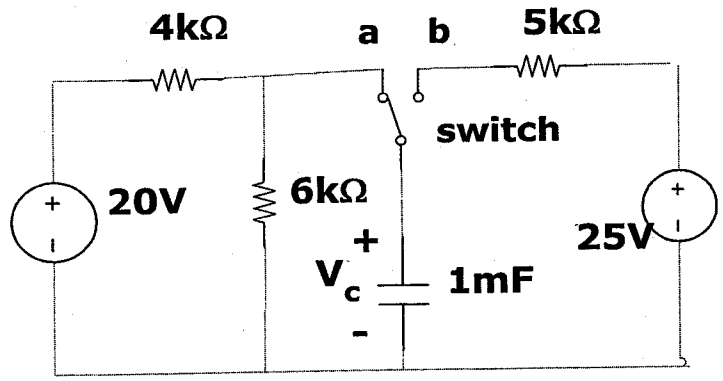


Figure-2

**Q3:** (a) Write the current mesh equations of the circuit shown in Figure-3. [10]

(b) Solve the mesh currents. [5]

(c) After solving the mesh currents, calculate the voltage, $V_o$ across the resistance 4Ω. [5]

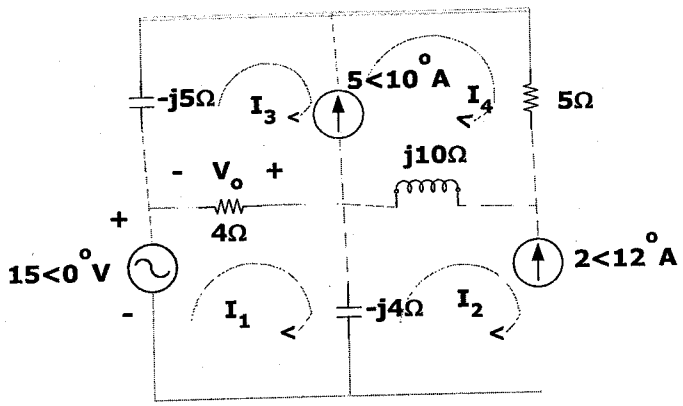


Figure-3

**Q4:** (a) Calculate the Thevenin's equivalent circuit ( $V_{th}$ and $Z_{th}$) at terminals A-B of the of the circuit shown in Figure-4. [12]

(b) What should be the value of load impedance, $Z_{load}$ at A-B to get maximum Power output in $Z_{load}$. [2]

(c ) What is the maximum power dissipation in the load $Z_{load}$ ? [6]

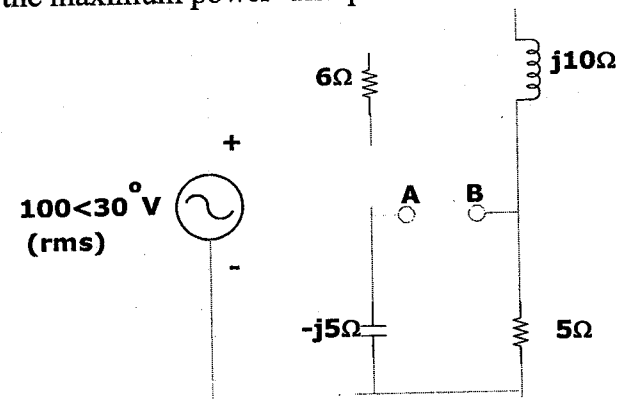


Figure-4

**Q5:** (a) Calculate the resonance frequency, $f_o$ of the circuit shown in Figure-5. [12]

(b) Calculate the cut-off frequencies $f_1$ and $f_2$ of the circuit. [8]

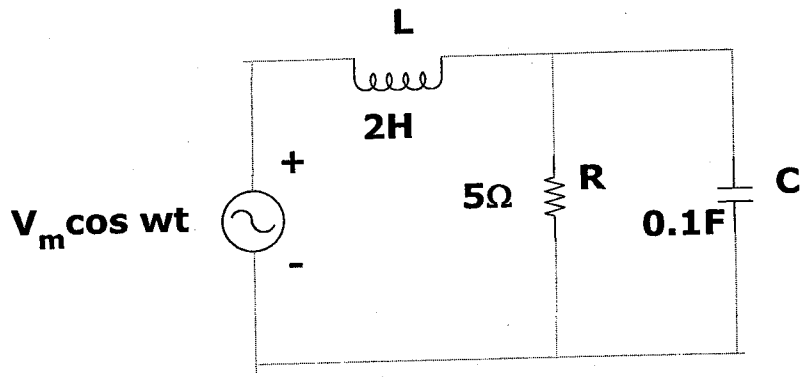


Figure-5

**Q6:** The circuit shown in Figure-6 has initial capacitor voltage of 8V, and initial Inductor current of 4A.

(a) Draw Laplace transformed circuit of the network. [10]

(b) Calculate Laplace inductor current, $I_L(s)$. [5]

(c) Solve $i_{L(t)}$ . [5]

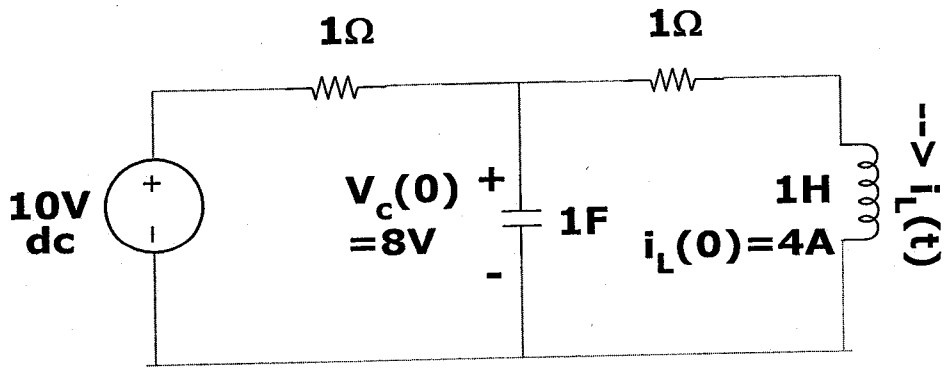


Figure-6

# Appendix

Some useful **Laplace Transforms:**

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