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]

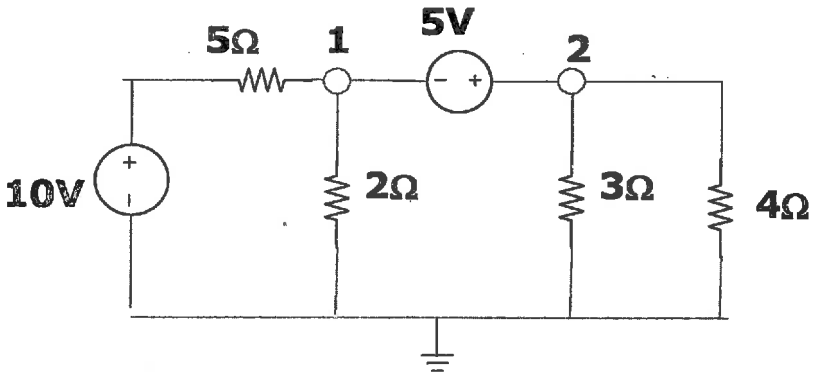

Figure-1

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]

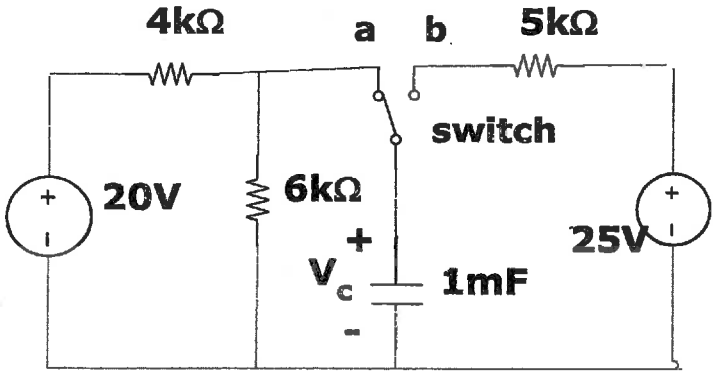

Figure-2

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]

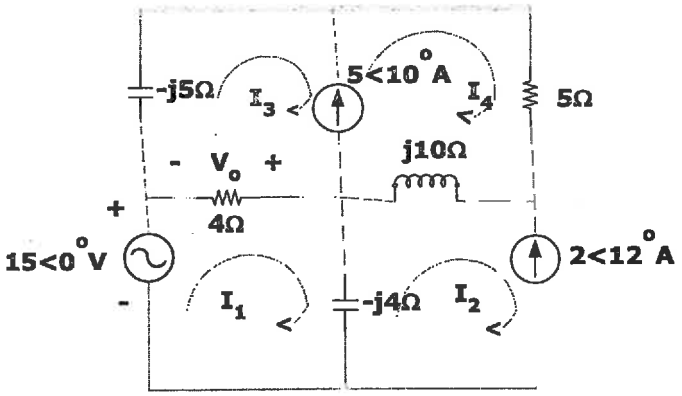

Figure-3

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]

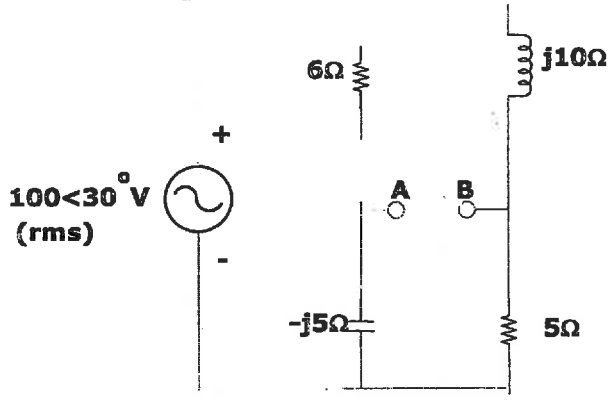

Figure-4

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]

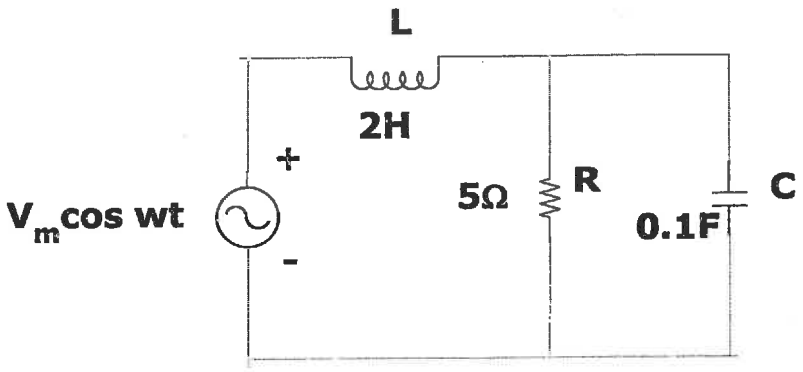

Figure-5

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]

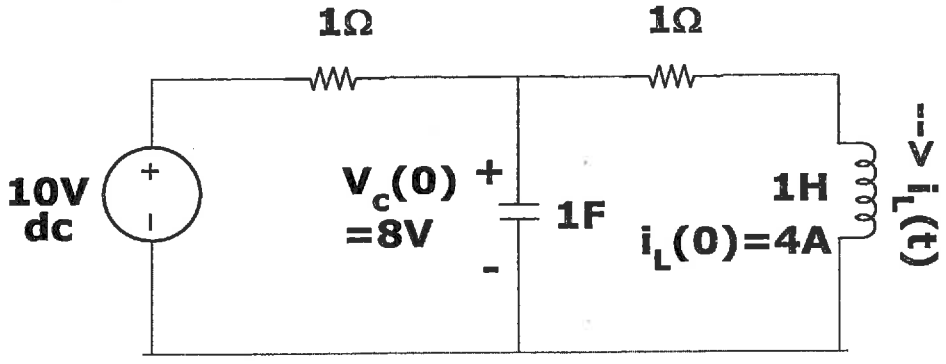

Figure-6

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)		$s / (s^2+w^2)$
$e^{-\alpha t} \sin \omega t$		$\frac{\omega}{(s+\alpha)^2+\omega^2}$
$e^{-\alpha t} \cos \omega t$		$\frac{(s+\omega)}{(s+\omega)^2+\omega^2}$
$\frac{df(t)}{dt}$		$s F(s) - f(0^-)$
$\frac{d^2 f(t)}{dt^2}$		$s^2F(s) - s f(0^-) - f^1(0^-)$
$\int_{-\infty}^{t} f(q)dq$		$\frac{F(s)}{s} + \int_{-\infty}^{0} f(q)dq$