National Exam December, 2010

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 approved Casio or Sharp calculators.

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.

Marking Scheme

Q1: (a) 8, (b)12 Q2: (a) 8,(b) 12 Q3: (i) 10, (ii) 10 Q4: (a) 8 ,(b) 12
Q5: (i) 4, (ii) 6, (iii) 10 Q6: (i) 5, (ii) 5, (iii) 10

Q1: (a) Write the mesh current equations of the dc circuit shown in Figure-1. [8]

(b) Solve I1,I2,I3 and V_o of the circuit. [12]

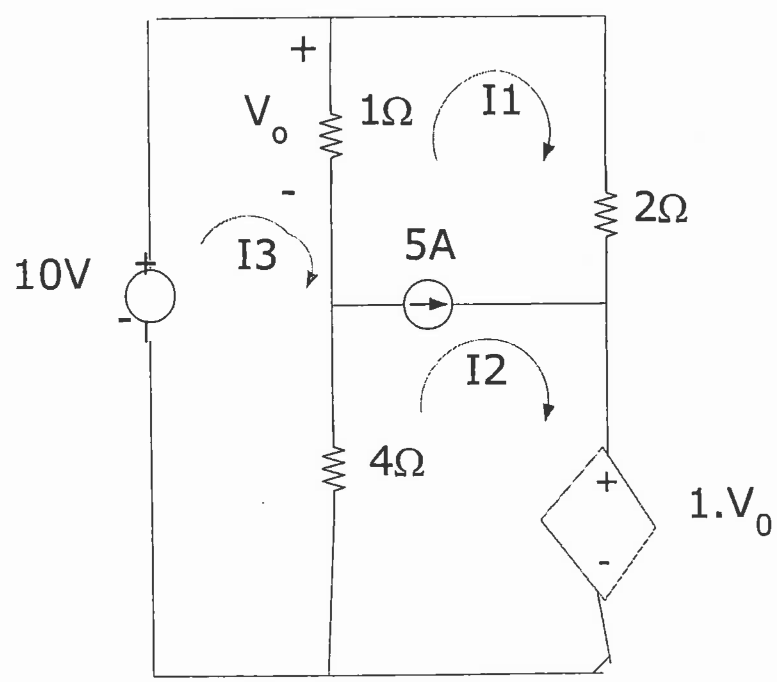

Figure-1

Q2: (a) Write the Node Voltage equations of the following ac circuit where the frequency is 60 Hz. [8]

(b) Solve the node voltages, and calculate the power supplied by the voltage source, e. [6+6]

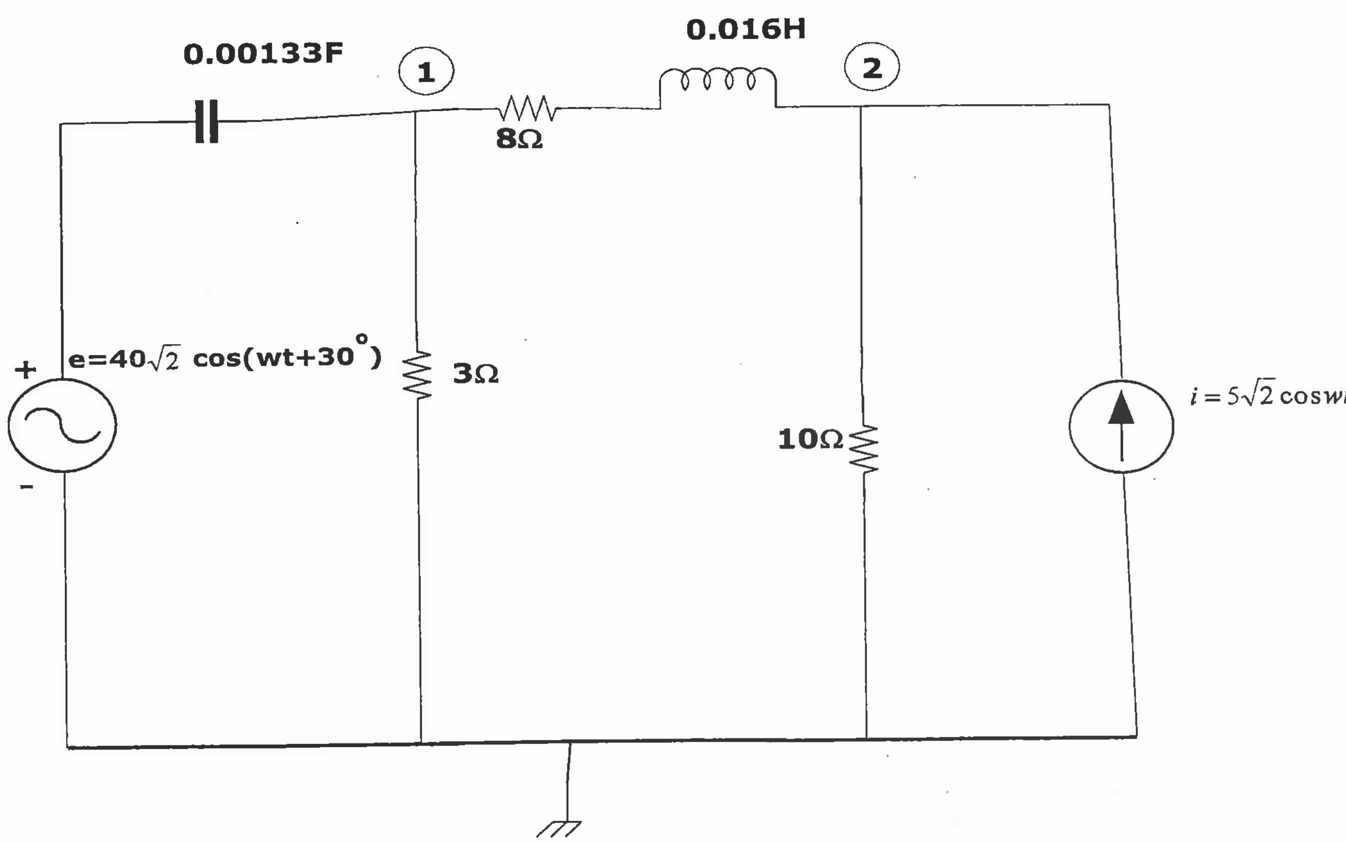

Figure-2

Q3: (i) Thevenize the circuit shown in Figure-3 at terminals **a** and **b**. [10]

(ii) (a) What is the load, Z_{Load} which should be connected to get maximum power output in Z_{Load} ? [4]

(b) Calculate the maximum power which can be dissipated in Z_{Load} . [6]

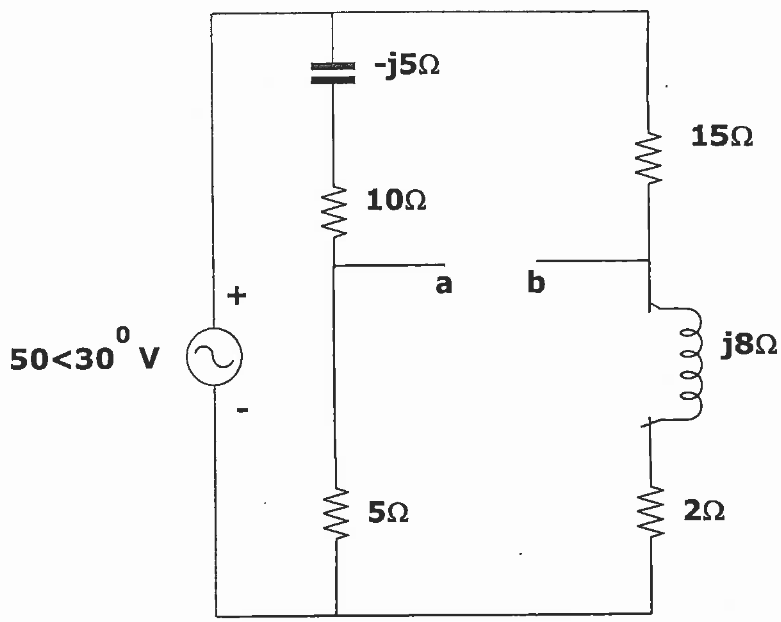

Figure-3

Q4: (a) Calculate the Transfer Function, $H(jw) = \frac{V_{out}(jw)}{V_{in}(jw)}$ of the circuit shown in Figure-4. [8]

(b) (i) State what type of filter is this circuit. (ii) Calculate its cut-off frequency, w_c. [4+8]

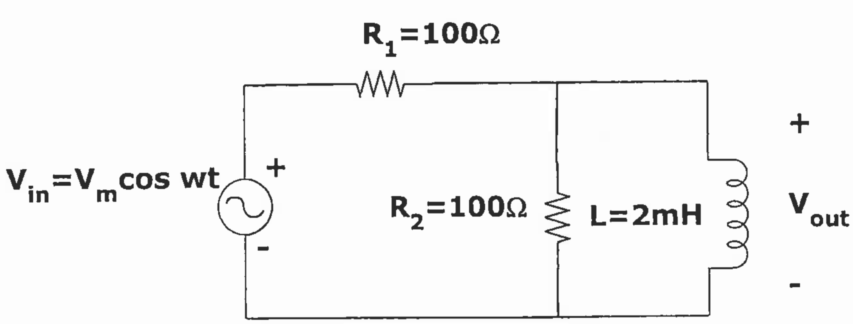

Figure-4

Q5: In Figure-5, the switch was initially closed for a long time. At t = 0, the switch is opened.

(i) Find Vc(0+) and i(0+) [4]

(ii) Determine $\frac{dVc}{dt}(0+)$ and $\frac{di}{dt}(0+)$ [6]

(iii) Derive the differential equation of Vc(t) for t >0. **Do not solve the equation.** [10]

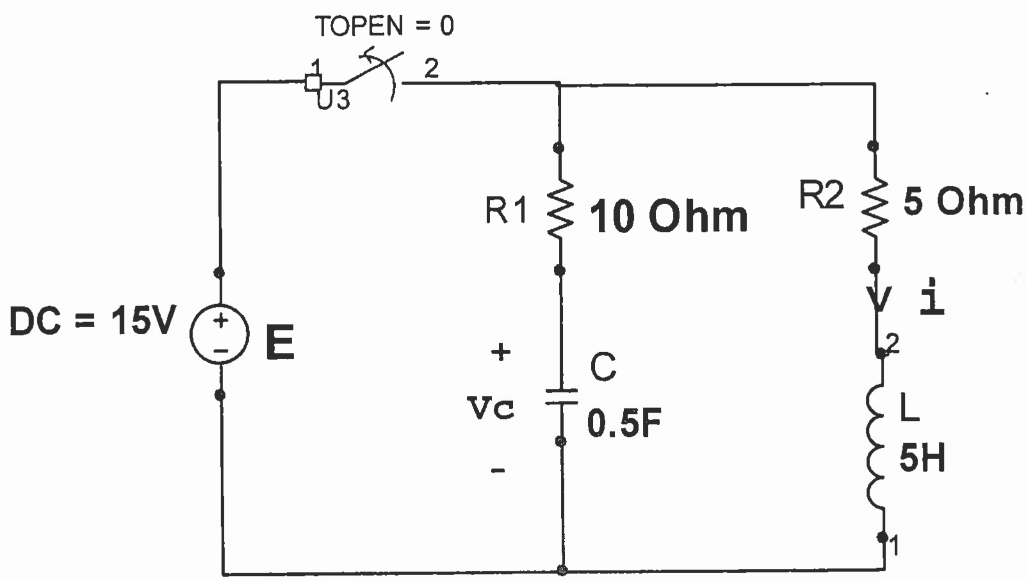

Figure-5

Q6: The switch in the circuit shown in Figure-6 was initially closed for a long time. At $t = 0$, it is opened.

(i) Draw the Laplace Transformed circuit at $t > 0$. [5]

(ii) Derive the expression of I(s). [5]

(iii) Solve i(t) for $t > 0$. [10]

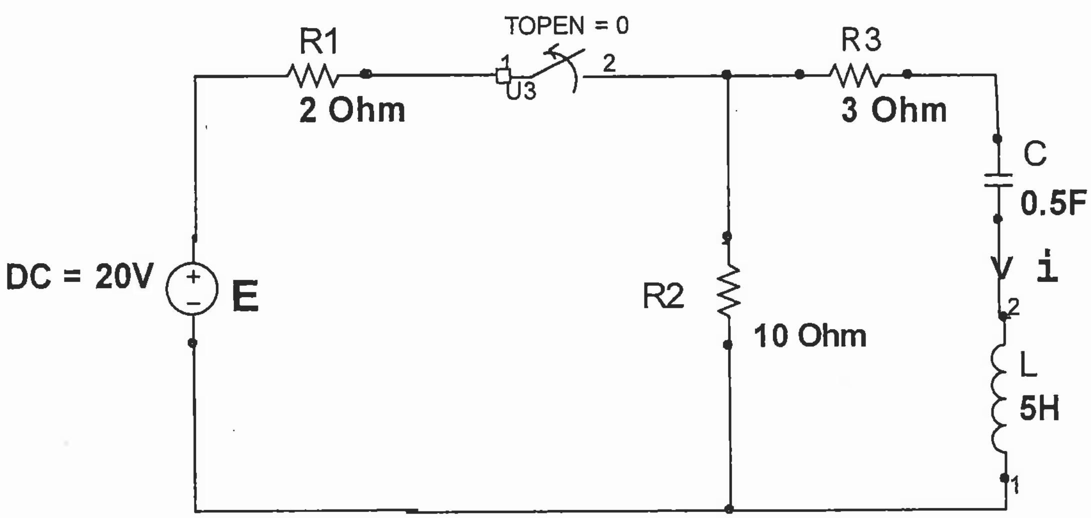

Figure-6

Appendix

Some useful **Laplace Transforms:**

f(t)	→	**F(s)**
Ku(t)		K /s
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)
$\frac{d\,f(t)}{dt}$		s F(s) – f(0^-)
$\frac{d^2 f(t)}{dt^2}$		s^2F(s) – s f(0^-) –f^1(0^-)
$\int_{-\infty}^{t} f(q)\,dq$		$\frac{F(s)}{s} + \int_{-\infty}^{0} f(q)\,dq$