National Exam December, 2011

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 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.

6. **Laplace Table** is given in the last page of this question paper.

Q1: For the circuit shown in Figure-1, (a) write the mesh current equations. [8]

(b) Solve I_1 , I_2 and I_3 . [12]

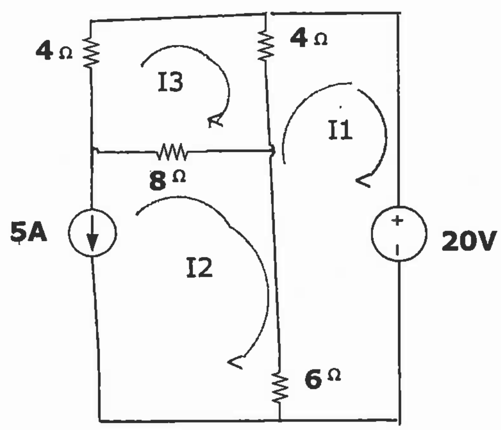

Figure-1

Q2: Solve $v_o(t)$ by the superposition theorem in the circuit shown in Figure-2. [20]

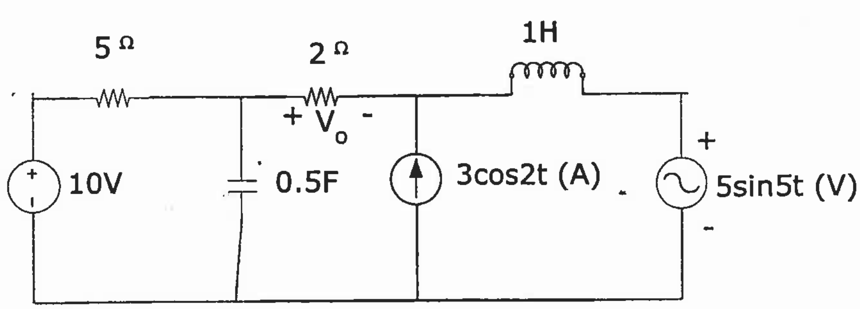

Figure-2

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

(ii) What is the load, Z_{Load} which should be connected to get maximum power output in Z_{Load} ? [5]

(iii) What is the P_{max} at Z_{load} ? [5]

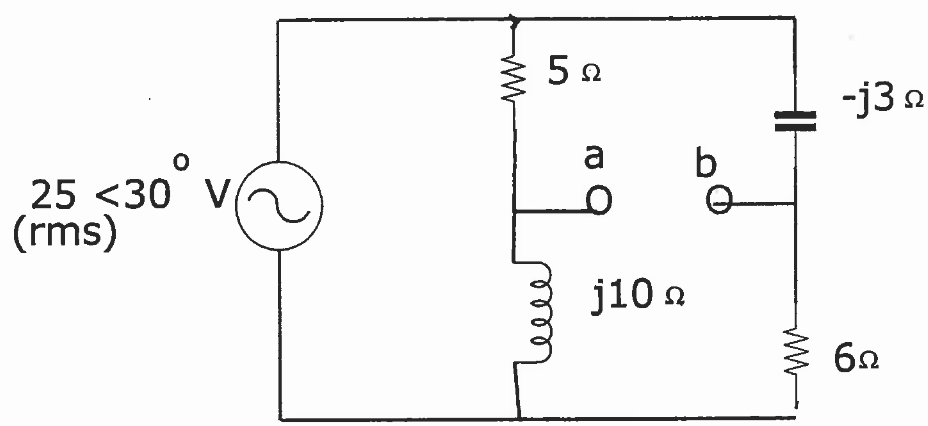

Figure-3

Q4: (a) Determine the Transfer Function, $H(s) = \frac{V_{out}(s)}{V_{in}(s)}$ of the circuit shown in Figure-4. [10]

(b) (i) State what type of filter is this circuit. (ii) Calculate its cut-off frequency, w_c. [4+6]

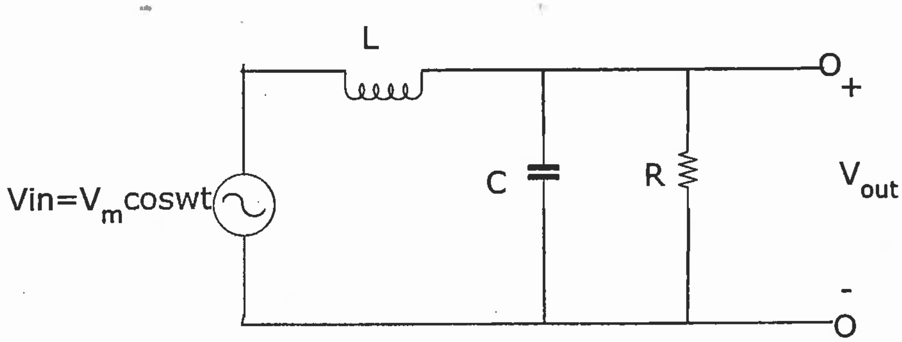

Figure-4

Q5: (a) Solve, $v_o(t)$ when it's Laplace transform is $V_o(s) = \frac{1}{2s(s+1.5)}$ [8]

(b) Solve, $v_o(t)$ when it's Laplace Transform is $V_o(s) = \frac{4s}{(s^2+4)(s+1.5)}$ [12]

Q6: In the circuit shown in Figure-5, the switch was open for a long time. At t = 0, the switch is closed. The initial conditions are $i_L(0-)=0$, $v_c(0-)=2V$.

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

(b) Solve, $v_o(t)$ at $t \geq 0$, when $R = 6\Omega$, $L = 1H$ and $C = 0.1F$. [12]

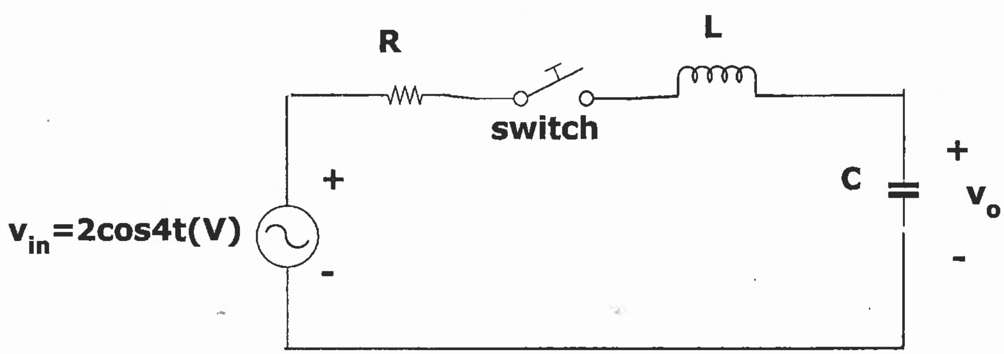

Figure-5

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