National Exams May 2012

07Elec-A1 – Circuits

3 hours duration

Notes:

1. **No questions to be asked.** If doubt exits 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 on 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)14,(b) 6

Q2: (a) 12, (b) 8

Q3: (a) 12, (b) 4,()4

Q4: (a) 6, (b) 8, (c) 6

Q5: (a) 15, (b) 5

Q6: (a) 10, (b) 10

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

(b) Solve the mesh currents, I1,I2 and I3. [6]

(c) Calculate the power dissipation in the 6Ω. [6]

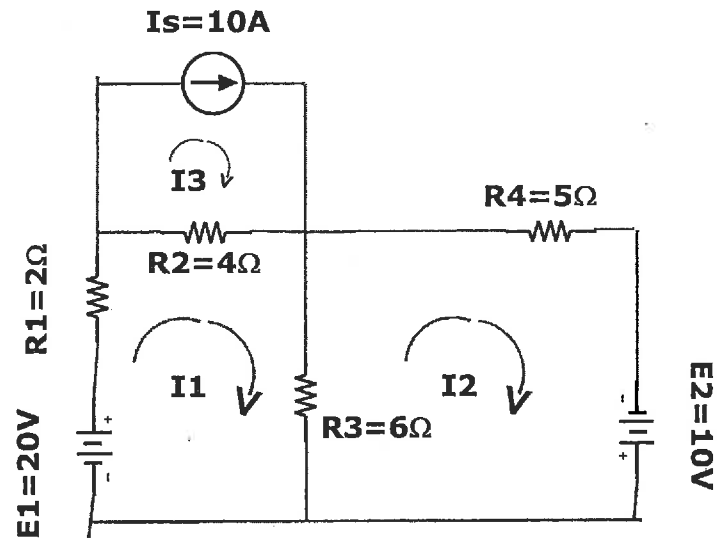

Figure-1

Q2: (a) Write the Nodal voltage equations of the circuit shown in Figure-2. [12]

(b) Solve for the current, I as a function of time, i(t). [8]

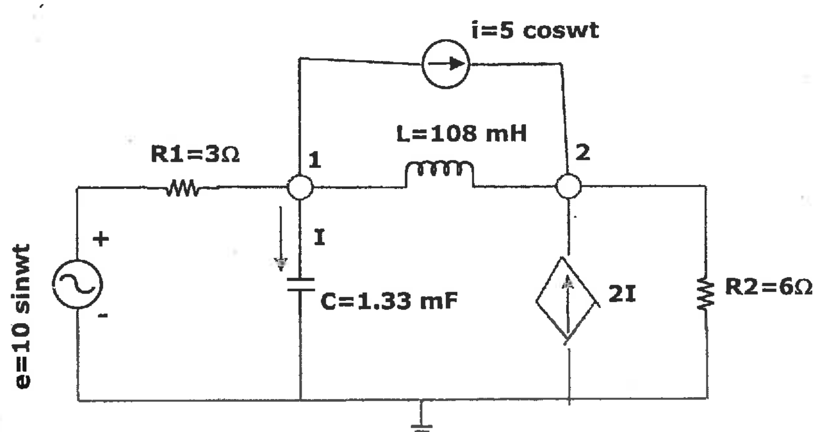

Figure-2

Q3: (a) Calculate the Thevenin's equivalent circuit parameters (V_{th} and Z_{th}) at the terminals A-B of the circuit shown in Figure-3. [12]

(b) What must be the value of the load impedance, Z_{load} for maximum power dissipation in it ? [4]

(c) Calculate the maximum power dissipation in Z_{load} . [4]

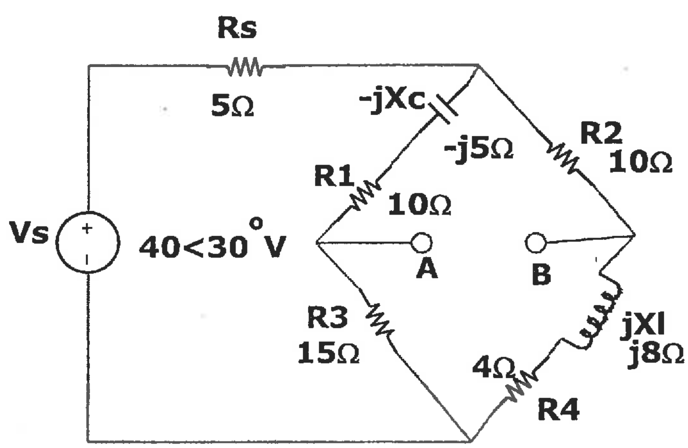

Figure-3

Q4: Inside a household, loads are connected to the 60 Hz supply as shown in Figure-4.

(a) Calculate the total apparent power, S of the household. [6]

(b) The real power (P), and reactive power (Q) of the household. [4+4]

(c) What is the overall power factor of total household load ? [6]

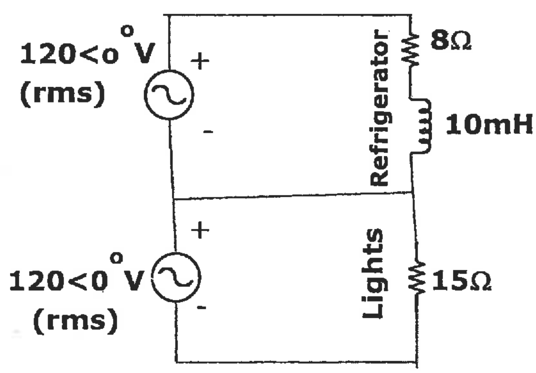

Figure-4

Q5: (a) For the circuit shown in Figure-5, calculate its resonance frequency, f_o. [14]

(b) State showing reasons, what type of filter this circuit is . [6]

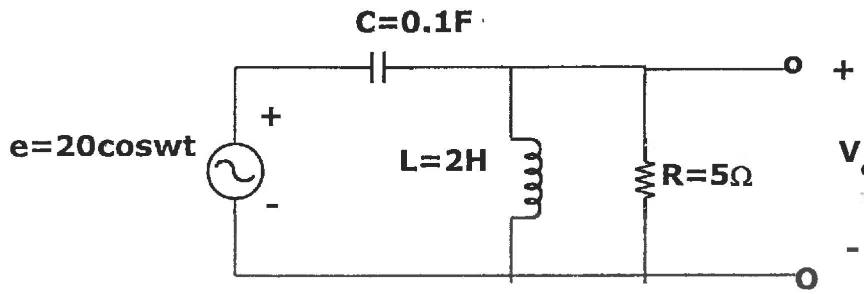

Figure-5

Q6: In the circuit shown in Figure-6, assume $i_{L(0^+)} = 0$.

(a) Calculate the transfer function, $H(s) = \frac{V_{o(s)}}{V_{in(s)}}$. [10]

(b) If $v_{in}(t) = 1V$ dc at t = o, calculate its output response, $v_o(t)$ for $t \geq 0$. [10]

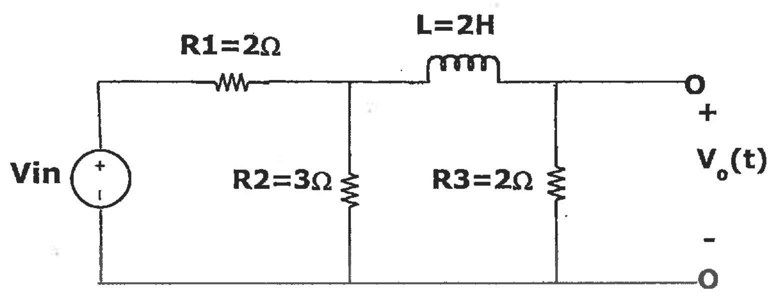

Figure-6

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