National Exam May, 2015

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 **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: (i) Write the mesh current equations of the circuit shown in Figure-1. [8]

(ii) Solve the mesh currents I1, I2, I3 and I4 [8]

(iii) Solve the output voltage, Vo. [4]

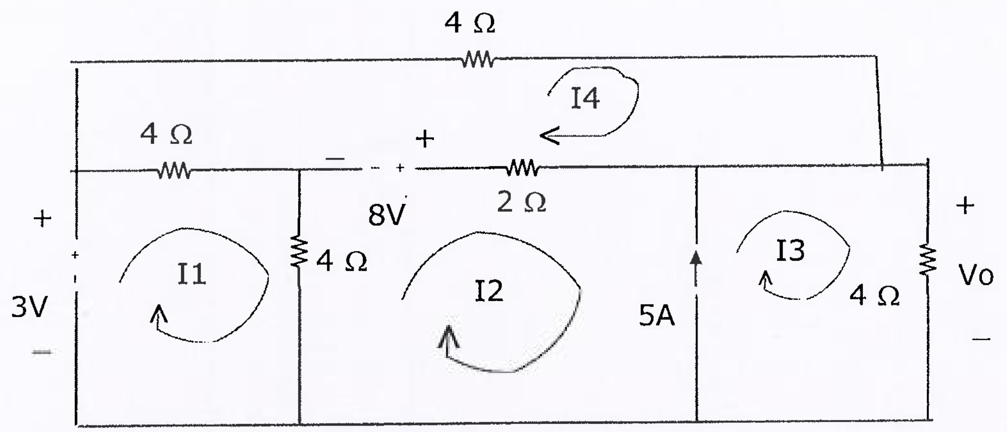

Figure-1

Q2: In the circuit shown in Figure-2, the switch was closed for a long time in position-A. At time t =0, the switch is moved to position B (open position). The voltage source Vs1 is a step function of 25V, i.e. Vs1=0 for $t < 0$, and Vs1 = 25V for $t > 0$.

(i) Calculate V_c (0+), and $V_c(\infty)$. [4+4]

(ii) Calculate V_c (t), for $t \geq 0$. [8]

(iii) Calculate V_c when t = one Time Constant . [4]

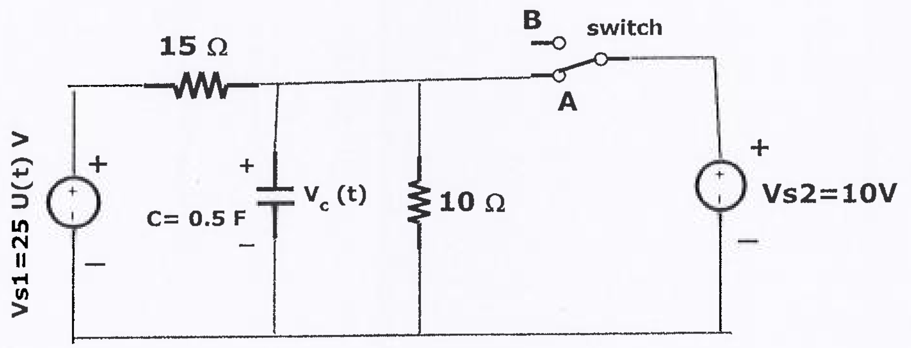

Figure-2

Q3: In the ac circuit shown in Figure-3,

(i) write the NODE voltage equations. [8]
(ii) Solve the node voltages V_1, V_2 and V_3. [6]
(iii) Find the current flow through the voltage source, V_{s2}. [6]

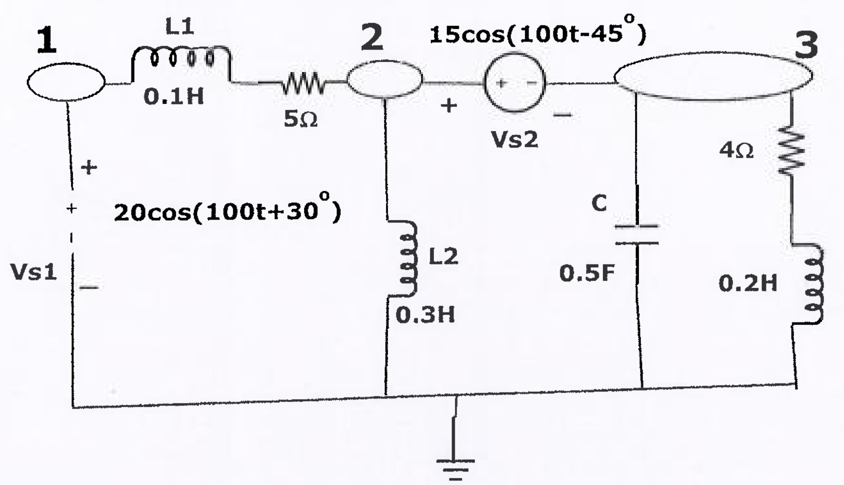

Figure-3

Q4: For the circuit shown in figure-4,

(i) Calculate the source current Is, and source voltage Vs. [3+3]
(ii) Draw the phasor diagram of Vo, Is, and Vs. [2+2+2]
(iii) Calculate the complex power S, real power P and reactive power Q supplied by the source; also calculate its power factor. [2+2+2+2]

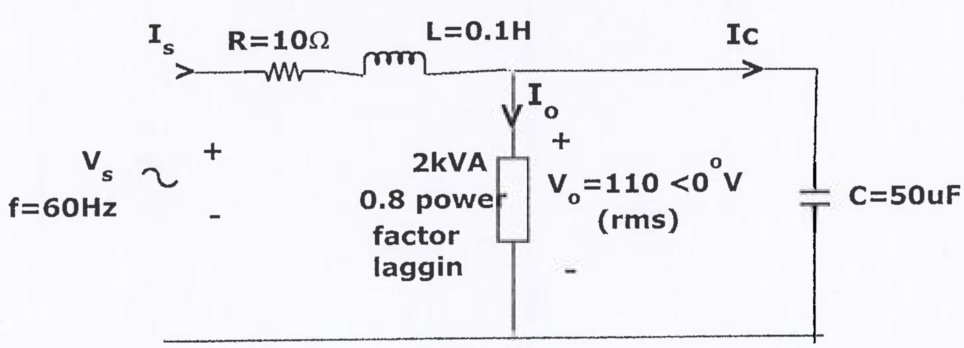

Figure-4

Q5: (i) Calculate Thevenin's equivalent circuit parameters (V_{th} and Z_{th}) at terminals **a-b** of the circuit shown in Figure-5. [5+5]

(ii) What load impedance, Z_L to be connected at terminals a-b for maximum power transfer ? [4]

(iv) Calculate the maximum power which can be transferred to Z_L . [6]

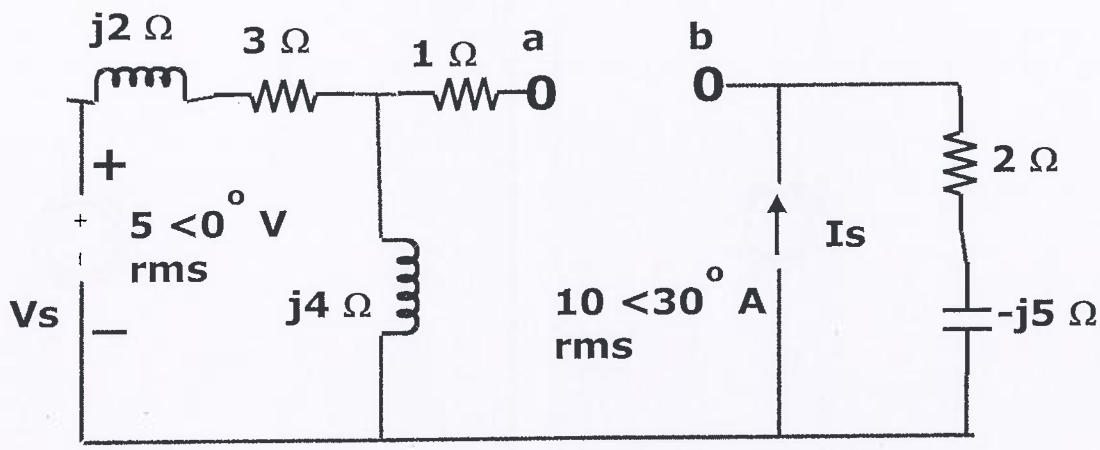

Figure-5

Q6: In the circuit shown in Figure-6, the switch was initially open. At time t = 0, the switch is closed. The initial voltage in the capacitor, $V_c(0) = 4V$, and initial current in the inductor was $i_L(0) = 1A$.

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

(ii) Find the voltage across the inductor $V_{L(s)}$ in the S-domain. [4]

(iii) Solve the inductor voltage, $V_L(t)$ in time domain. [6]

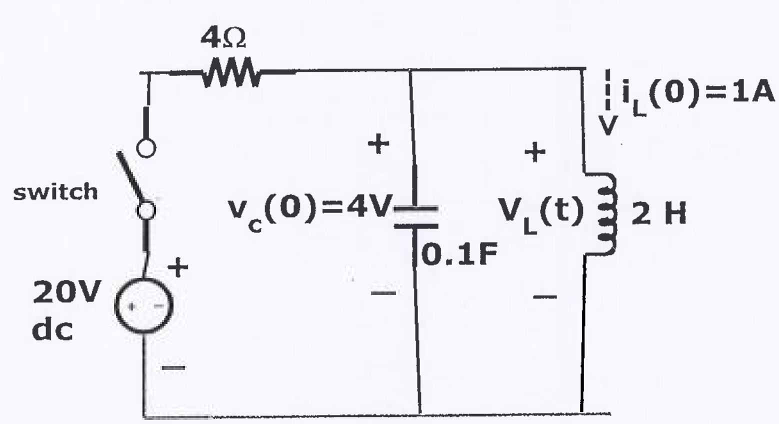

Figure-6

Appendix

Some useful **Laplace Transforms:**

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