National Exam December, 2012

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 models. **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: Part-a

In figure-1a, calculate the equivalent resistance R_{AB} between the terminals **A** and **B**.

[10]

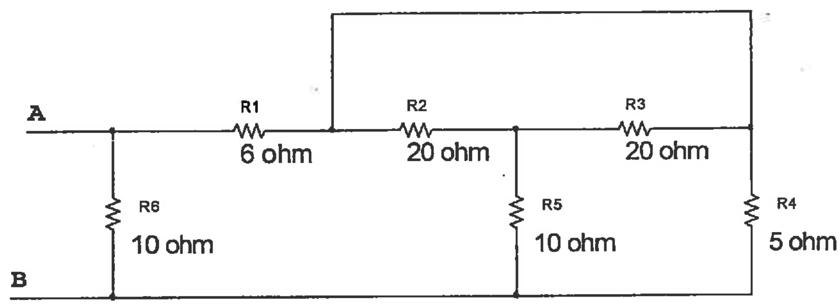

Figure-1

Q1: Part-b

In the circuit shown in figure-1b, calculate the voltage V_0 . [10]

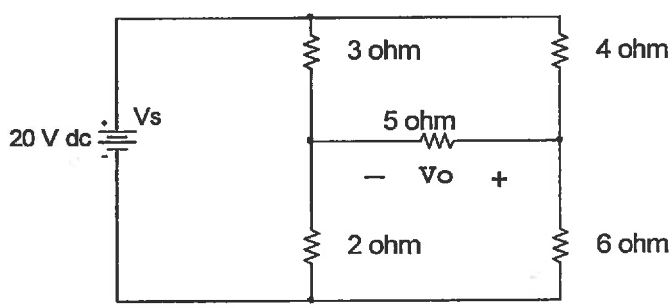

Figure-2

Q2: Part-a

Use mesh-current analysis to find the net power supplied by the voltages sources shown in Figure-2a. [12]

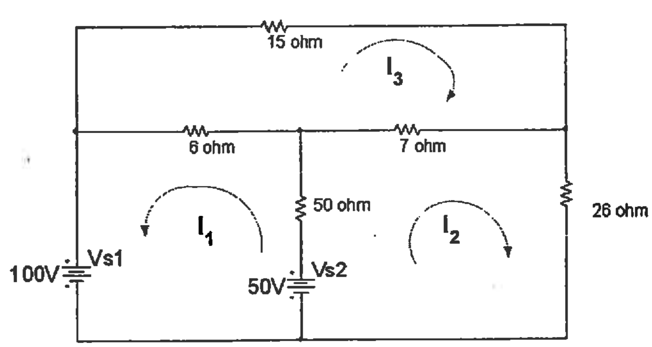

Figure-2a

Q2: **Part-b**

Write the node-voltage equations of the circuit shown in figure-2b, where Ix is the current in the 4 ohm resistance. Use **Node-4 as the reference** node. **Do not solve the equations.** [8]

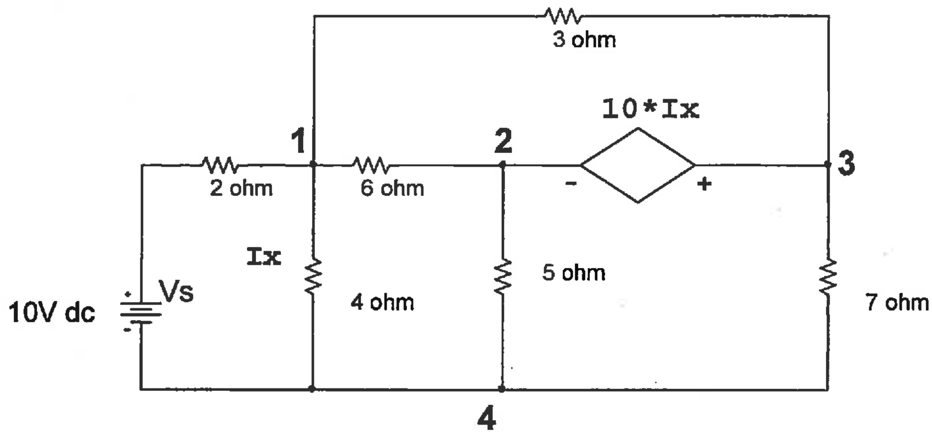

Figure-4

Q3: In the Figure-3, (a) calculate the transfer function, $H(jw) = \dfrac{V_0(jw)}{V_i(jw)}$. [8]

(b) What are the values of $|H(jw)|$ at w = 0 and w = ∞ ? [6]

(c) Sketch $|H(jw)|$, and from this sketch ,state what type of filter it is. [6]

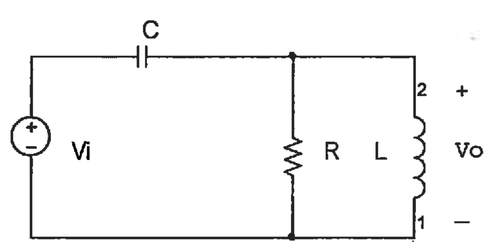

Figure-3

Q4: For the circuit shown in Figure-4, the switch was open for a long time. At t = 0, it is closed.

(i) Find $i_L(0)$ and $\frac{di_L}{dt}(0)$. [4]

(ii) Write the differential equation for i_L . [5]

(iii) Calculate the complete solution of i_L. [8]

(iv) Is the response under-damped, critically damped or over-damped ? [3]

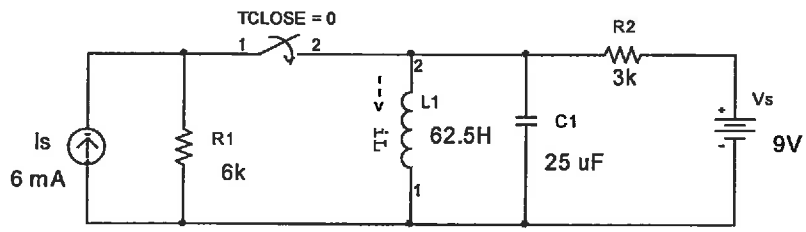

Figure-4

Q5: What is the value of the resistance to be connected at terminals a-b in the circuit shown in Figure-5 to get maximum power dissipation? Calculate what this maximum power is.

[10+10]

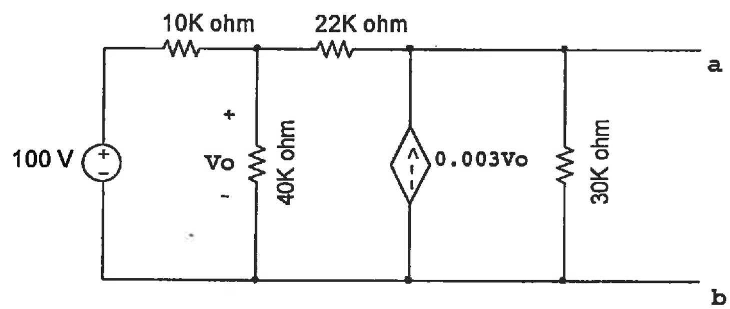

Figure-5

Q6: For the circuit shown in Figure-6, (a) draw the Laplace transformed circuit assuming $v_c(0^-) = 0$ and $i_L(0^-) = 0$. (b) Solve for $i_L(t)$, t > 0. [10+10]

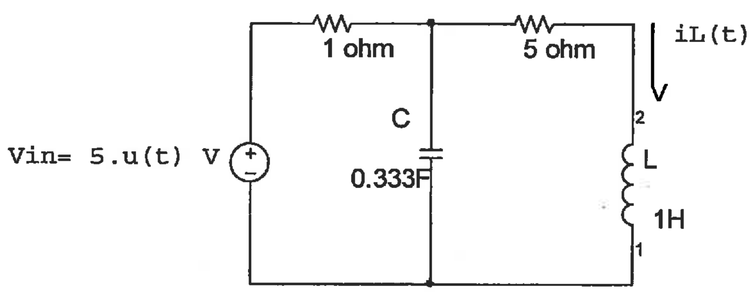

Figure-6

Appendix

Some useful **Laplace Transforms:**

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