EE 225 – Network Theory
Tutorial Sheet
Laplace Transform and it's applications

Note : This tutorial contains three pages and eight questions.

Q 1. Verify the following Laplace transformations for following $f(t), t \geq 0$

a) $\mathcal{L}\ t^2 = \frac{2}{s^3}$

b) $\mathcal{L}\ \sin(\omega t + \theta) = \frac{s\sin\theta + \omega\cos\theta}{s^2 + \omega^2}$

c) $\mathcal{L}\ \cos(\omega t + \theta) = \frac{s\cos\theta - \omega\sin\theta}{s^2 + \omega^2}$

d) $\mathcal{L}\ e^{-\alpha t}\sin(\omega t + \theta) = \frac{\omega}{(s+\alpha)^2 + \omega^2}$

e) $\mathcal{L}\ e^{-\alpha t}\sin(\omega t + \theta) = \frac{\omega}{(s+\alpha)^2 + \omega^2}$

Q 2. Verify the following Laplace transformation $\mathcal{L}^{-1} F(s) = f(t)$:

a) $\mathcal{L}^{-1}\ \frac{3s}{(s^2+1)(s^2+4)} = \cos t - \cos 2t$

b) $\mathcal{L}^{-1}\ \frac{1}{s(s^2-2s+5)} = \frac{1}{5}[1 + \frac{1}{2}e^t(-2\cos 2t + \sin 2t)]$

c) $\mathcal{L}^{-1}\ \frac{1}{(s+1)(s+2)^2} = e^{-t} - e^{-2t}(1+t)$

d) $\mathcal{L}^{-1}\ \frac{s^2}{(s^2+1)^2} = \frac{1}{2}t\cos t + \sin t$

e) $\mathcal{L}^{-1}\ \frac{s^2+2s+1}{(s+2)(s^2+4)} = \frac{1}{8}e^{-2t} + \frac{7}{8}\cos 2t + \frac{1}{8}\sin 2t$

Q 3. Solve the following differential equation using the Laplace transformation method.

a) $\frac{d^2i}{dt^2} - i = 25 + e^{2t}$

b) $\frac{d^2i}{dt^2} + 4i = \sin t - \cos 2t$

c) $\frac{d^2i}{dt^2} + \frac{di}{dt} = t^2 + 2t, i(t<0) = 4, \frac{di}{dt}(t<0) = -2$

Q 4. In the two networks shown in Fig 1, C is charged to voltage V and the switch K is closed at t = 0. Solve for the current i(t) using the Laplace transformation method.

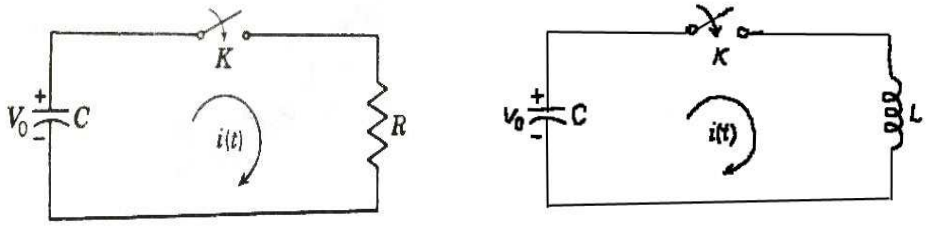

Fig 1.

Q 5. In the two networks shown in the Fig 2, the switch K is moved from position a to position b at t=0, a steady state having previously been established at position a. Solve for the current i(t) using the Laplace transformation method.

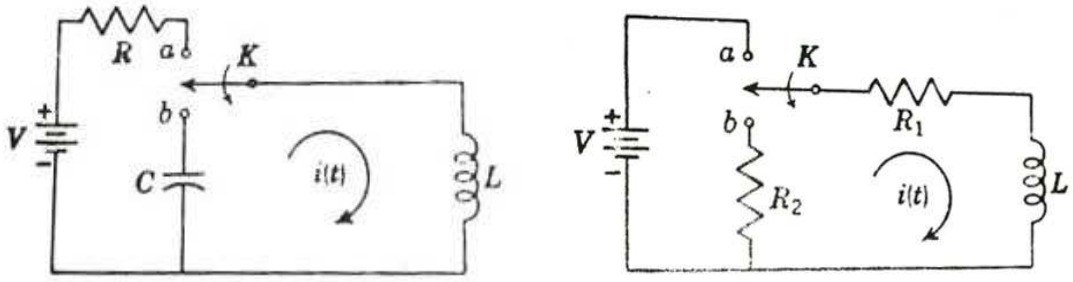

Fig 2.

Q 6. In the network of the Fig 3, the switch K is in position a for a long period of time. At t=0, the switch is moved from a to b. Find $v_2(t)$ using Laplace transformation method.

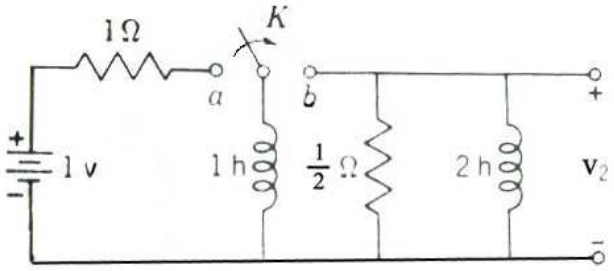

Fig 3

Q 7. The network given in the Fig 4 has a controlled source, $v_1(t) = 5u(t)$, determine $v_a(t)$ if the network is not energized at t=0. Use $K_1 = -3$. Use Laplace transformation method.

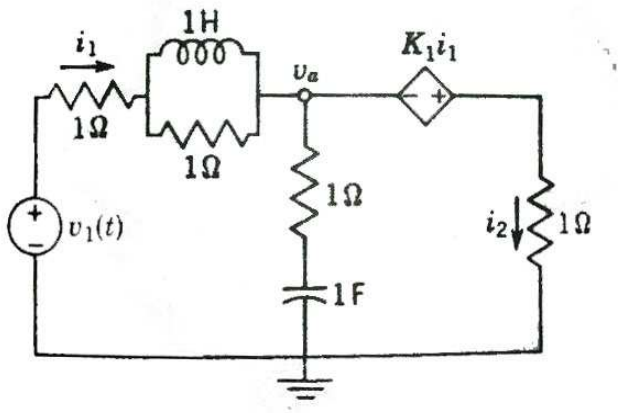

Fig 4.

Q 8. For conditions and network given for Q 7. solve for $i_2(t)$ if K1 = +3. Use laplace transformation method.