

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0325

Roll No.

B. Tech.

(SEMESTER-III) THEORY EXAMINATION, 2012-13

FUNDAMENTALS OF NETWORK ANALYSIS AND SYNTHESIS

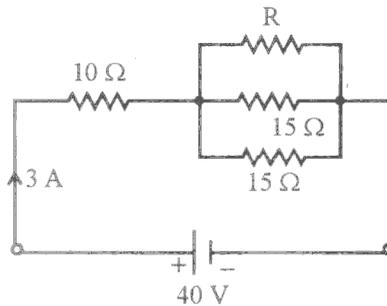
Time : 3 Hours]

[Total Marks : 100

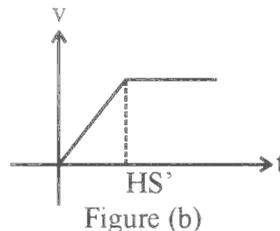
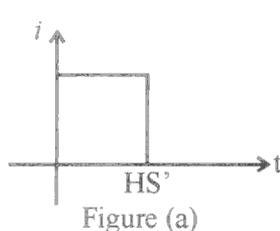
1. Attempt **all** parts.

10 × 2 = 20

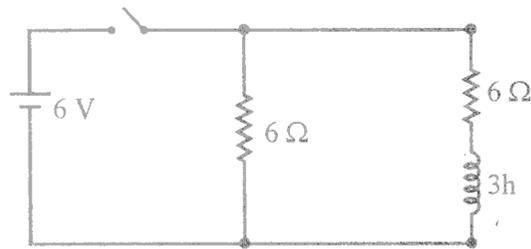
- (a) Draw the line spectra for the signal $S(t) = 3 \sin \left(t + \frac{\pi}{4} \right)$.
- (b) Define frequency transformation and frequency normalization.
- (c) Draw the even and odd signal functions for the unit-step function.
- (d) In the below figure, calculate the value of R.



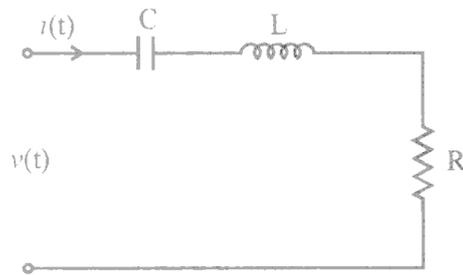
- (e) Two capacitors of $1 \mu\text{F}$ and $2 \mu\text{F}$ and connected in parallel across a 25 V dc battery. After the capacitors have been charged, calculate the charge across the two capacitors.
- (f) The current wave shape shown in figure (a) is applied to a circuit element. The voltage across the element is shown in figure (b). Find the type of element used.



- (g) In figure below, the switch is closed at $t = 0$. At $t = 0^+$, calculate the value of current supplied by battery.



- (h) For the figure below, calculate the ratio $V(s) / I(s)$.

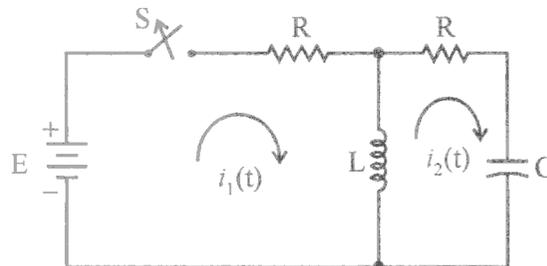


- (i) List the three properties to recognize an R-C impedance in synthesis.
 (j) Enlist the two important properties of positive real functions.

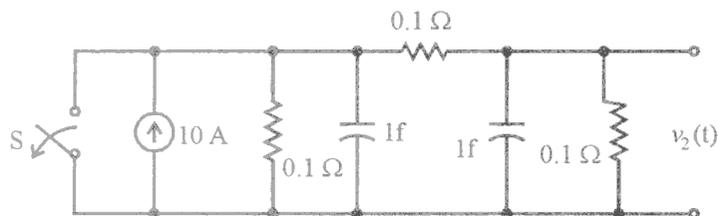
2. Attempt any **three** parts :

$3 \times 10 = 30$

- (a) The network shown has reached steady state before the switch S is opened at $t = 0$. Determine the initial conditions for the currents $i_1(t)$ and $i_2(t)$ and their derivatives.



- (b) For the circuit shown, the switch S is opened at $t = 0$. Use Thevenin's or Norton's theorem to determine the output voltage $v_2(t)$. Assume zero initial energy.



- (c) Explain with the suitable expressions, two-port equivalent with (i) one controlled-voltage source and (ii) one controlled-current source.

- (d) Given $F(s) = \frac{4(S+1)(S+3)}{(S+2)(S+6)}$, obtain a partial fraction expansion, with all positive residues and hence realize the network in foster form when
- $F(s)$ is an impedance $z(s)$.
 - $F(s)$ is an admittance $y(s)$.
- (e) (i) Enlist the main properties of a ACTIVE FILTERS.
(ii) Draw the attenuation characteristics of LPF, BPF, HPF and BRF.

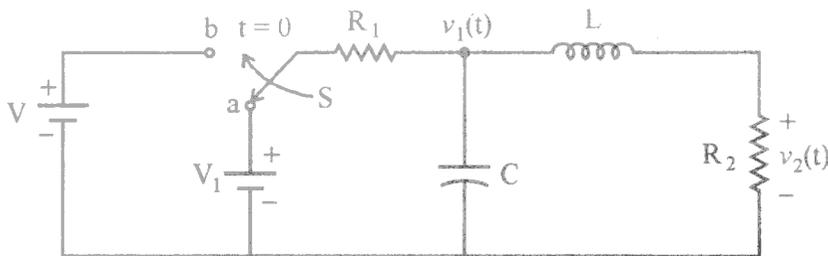
Answer **all** the questions :

$5 \times 10 = 50$

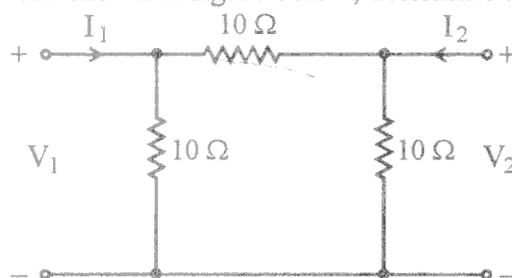
3. (a) The unit-step response of a linear system is
 $x(t) = (2e^{-2t} - 1) u(t)$
- Find the response $r(t)$ to the input $f(t)$.
 - Sketch the response. Show all pertinent dimensions.
- (b) For the following driving point functions find their simplest network realizations.
- $z(s) = 3 + 2s + \frac{1}{3s}$
 - $y(s) = 2s + \frac{3s}{s+2}$

OR

The network shown has reached steady-state before the switch moves from a to b. Determine the initial conditions for the voltages $V_1(t)$ and $V_2(t)$ and their first derivatives.



4. For the two-port network shown in figure below, determine the admittance matrix.

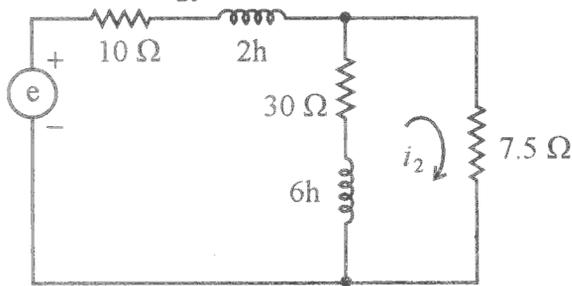


OR

Prove that in a parallel-parallel interconnected two networks with admittance matrix $[Y_A]$ and $[Y_B]$ respectively, the overall y -matrix is given as

$$[Y] = [Y_A] + [Y_B]$$

5. In figure below, find $i_2(t)$ using Thevenin's theorem. The excitation is $e(t) = 100 \cos 20 u(t)$. Assume zero initial energy.



OR

Suppose $F_1(s)$ and $F_2(s)$ are both positive real functions. Discuss the conditions such that $F(s) = F_1(s) - F_2(s)$ is also positive real function.

6. Given $z(s) = \frac{s^2 + xs}{s^2 + 5s + 4}$

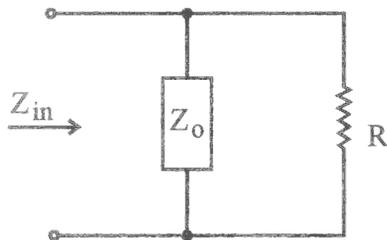
- What are the restrictions on X for Z(s) to be a positive real function ?
- Find X for $\text{Re}[Z(jw)]$ to have a second order zero at $w = 0$.
- Choose a numerical value for X and synthesize Z(s).

OR

The input impedance for the network shown is

$$Z_{in} = \frac{2s^2 + 2}{s^3 + 2s^2 + 2s + 2}$$

If Z_0 is an L-C network, (a) Find the expression for Z_0 , (b) Synthesize Z_0 as a Foster series form.



7. Draw the circuit of non-inverting and inverting differentiator using ideal Op-Amp and determine its transfer function, input impedance and output impedance.

OR

Design an active low pass 2nd order filter and define its f-3dB, Roll-off-rate and also draw its phase response.