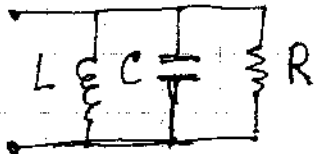


1. a) Define the cut set of a network graph and illustrate with an example. (1)
- b) Prove that reduced incidence matrix and loop matrix of a graph are orthogonal to each other. (3)
2. The driving point impedance of the following network is  $Z(s) = \frac{0.2s}{s^2 + 0.1s + 2}$ . Find the Component values. (1)



3. i) An absolutely integrable signal  $x(t)$  is known to have a pole at  $s=2$ 
  - a) Can  $x(t)$  be of finite duration? b) Can  $x(t)$  be left sided? c) Can  $x(t)$  be right sided? d) Can  $x(t)$  be two sided? (2)
- ii) Let  $x(t)$  be a signal that has a rational Laplace transform with exactly two poles located at ~~at~~  $s=-1$  and  $s=-3$ . If  $g(t) = e^{2t} x(t)$  and the Fourier transform  $G(j\omega)$  converges, determine whether  $x(t)$  is left sided, right sided or two sided. (3)
4. At  $t=0$ , a switch is closed, connecting a voltage source  $v = V \sin \omega t$  to a series RL circuit. By the

method of Laplace transformation derive an expression for the current in terms of the quantities given above assuming the initial current to be zero. (3)

5. Consider an electronic system whose input is a linear combination of eigenfunctions  $\phi_k(t)$  each of which has a corresponding eigenvalue  $\lambda_k$  that is

$$x(t) = \sum_{k=-\infty}^{\infty} c_k \phi_k(t)$$

- a) Express the output of the system in terms of  $\phi_k(t)$ ,  $\lambda_k$  and  $c_k$ .

- b) Consider a system characterized by the differential equation
- $$y(t) = t^2 \frac{d^2 x(t)}{dt^2} + t \frac{dx(t)}{dt}$$

Is this system linear? Is it time invariant?

- c) Show that the function  $\phi_k(t) = t^k$  are eigenfunctions of the system in part (b). For each  $\phi_k(t)$ , determine the corresponding eigenvalue  $\lambda_k$ .

- d) Determine the output of the system if

$$x(t) = 10t^{-10} + 3t + \frac{1}{2}t^4 + \pi \quad (5)$$

6. A network has  $n$  nodes and  $b$  branches. State and explain the number of KVL equations for the network. (1)

7. Shows that convolution in the time domain is multiplication in the transformed domain (1)