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

PAPER ID : 0325 Roll No.

B.Tech.

(SEM. III) ODD SEMESTER THEORY EXAMINATION 2012-13

FUNDAMENTALS OF NETWORK ANALYSIS AND SYNTHESIS

Time : 3 Hours *Total Marks : 100*

Note : *This paper contains **five** questions. Attempt **all** of them.*

1. Attempt any **four** parts : **(5×4=20)**

(a) What is complex frequency ? What do its real and imaginary parts describe ? Explain.

(b) What is the difference between network analysis and network synthesis ? Explain giving an example.

(c) What is a unit step function ? What is its relationship with a unit impulse function ? Draw the following signals :

(i) u(–t)

(ii) u(1 – t)

(iii) –u(t + 1)

(d) What is the relationship between the transfer function and impulse response ? Elaborate.

(e) Find the current i(t) and plot it for the Figure 1 shown below for an impulse input.

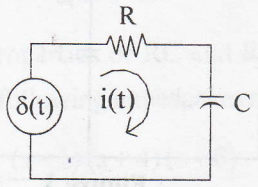

Figure 1

(f) For the circuit shown in Figure 2, the switch 'S' moves from 'a' to 'b' at t = 0. Find and sketch $v_1(t)$ for $0^- < t < \infty$. The circuit is in a steady state at t = 0.

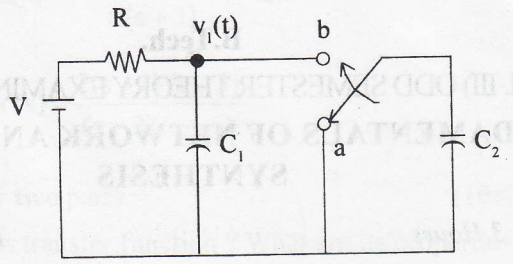

Figure 2

2. Attempt any **four** parts : **(5×4=20)**

(a) State and prove the initial value theorem for a function f(t) having a step discontinuity at t = 0.

(b) Find the initial and final values of the following functions :

(i) $F(s) = \dfrac{2(s+1)}{s^2 + 2s + 5}$

(ii) $f(t) = 3u(t) + 2e^{-t}$

(c) State and prove convolution theorem.

(d) The switch is opened at t = 0 in the network shown in Figure 3. Find $v_1(t)$ and $v_2(t)$.

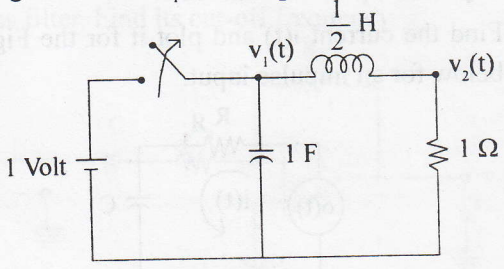

Figure 3

Use Laplace transform method.

(e)

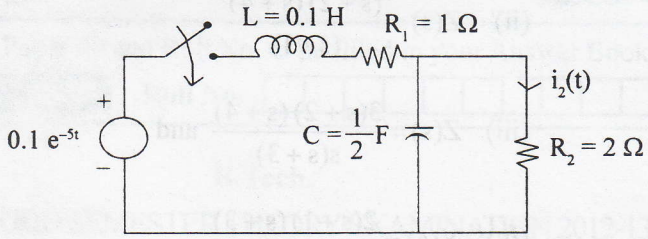

Figure 4

The switch is closed at t = 0 in the initially relaxed circuit of Figure 4. Find $i_2(t)$ using Norton's theorem.

(f) Comment on the relationship between the h parameters of two 2-port networks on being connected in a specific manner.

3. Attempt any **two** parts : **(10×2=20)**

(a) What are Hurwitz polynomials ? Write their properties. What are positive real functions ? Derive the necessary conditions for a function to be positive real. Test whether the following polynomial is Hurwitz :

$$G(s) = s^3 + 2s^2 + 3s + 6.$$

(b) What are LC driving point immittances ? Write their properties. Synthesize the Foster I and Foster II forms of the following impedance function :

$$Z(s) = \frac{2(s^2+1)(s^2+9)}{s(s^2+4)}.$$

(c) Write the properties of RC and RL immittances. Check whether the following impedances are RC or RL or neither :

(i) $Z(s) = \frac{(s+1)(s+4)(s+8)}{s(s+2)(s+6)}$

(ii) $Z(s)=\dfrac{(s+2)(s+4)}{(s+1)}$

(iii) $Z(s)=\dfrac{3(s+2)(s+4)}{s(s+3)}$ and

(iv) $Y(s)=\dfrac{2(s+1)(s+3)}{(s+2)(s+6)}$

4. Attempt any **two** parts : **(10×2=20)**

(a) What is transfer function ? What are its properties ?

(b) What are minimum phase and non minimum phase functions ? Prove that any transfer function of a passive reciprocal ladder network must be minimum phase.

(c) Explain the synthesis of an L-C ladder network with a 1-Ω resistive termination to meet a specified transfer impedance Z_{21} or transfer admittance Y_{21}.

5. Attempt any **two** parts : **(10×2=20)**

(a) What is meant by the word 'Active' in network synthesis ? Explain the properties of an ideal Op-Amp.

(b) Explain and derive the operations of an (i) integrator, (ii) differentiator, (iii) finite gain differential amplifier, (iv) current controlled voltage source.

(c) Prove that the circuit shown below (Figure 5) is a high pass filter. Find its cut-off frequency.

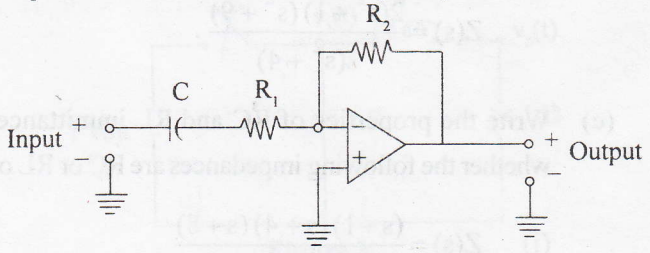

Figure 5