BENGAL ENGINEERING & SCIENCE UNIVERSITY, SHIBPUR

B.E. (ETCE) Part-II 3rd Semester Final Examination, 2011-12

NETWORK THEORY
(ET-302)

Time : 3 Hours | Full Marks : 70

Answer **any FIVE** questions

1. (a) State the procedure of drawing a tree from a graph. Write the relation between the number of branches, the number of links and the number of nodes in a graph.

   (b) Write the general mesh equations by inspection method for a typical three-mesh circuit. Interpret each term of the equations. State the rules in details in this regard.

   For the circuit shown in Fig.1(b) apply that method to write the mesh equations directly (without applying KVL). Find the solutions for the currents in the circuit.

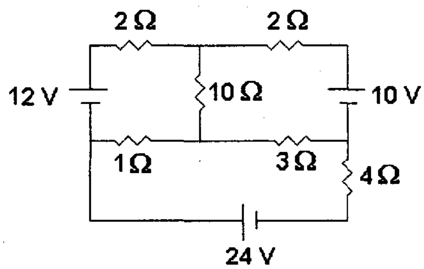

Fig.1(b) 3+11=14

2. (a) Write an expression for a half-cycle of sinewave with period T starting from t = 0. Explain elaborately with the help of neat sketches the procedure of deriving that expression.

   (b) A voltage pulse of width '*a*' starting from t = 0 and magnitude V_0 is applied at time t = 0 to a series R-C circuit. Assume zero charge across the capacitor C before application of voltage pulse. Find the current i(t) in the circuit by using Laplace transformation. Determine the time domain expression for voltages across the capacitor (V_C). Neatly plot the current *i*, V_C against time superimposing with the pulse. 6+8=14

3. (a) What is image impedance? Explain. Straight from the ABCD parameter equations derive separately the image impedances of a two-port network which are given by

$$Z_{i_1} = \sqrt{\frac{AB}{CD}} \quad \text{and} \quad Z_{i_2} = \sqrt{\frac{BD}{AC}}$$

   where, A, B, C and D are the transmission parameters of the network.

   For a symmetrical network write the expressions of these image impedances. What is the terminology of the image impedance in a symmetrical circuit?

   (b) The z-parameters of a two-port network are: $z_{11} = 5\ \Omega$, $z_{22} = 2\ \Omega$, $z_{12} = z_{21} = 3\ \Omega$. Write the z-parameter equations. A load resistor of 4 Ω is connected across the output port, i.e. port 2. Calculate the input impedance by using those z-parameter equations (using of any formula is not allowed). 9+5=14

4. (a) Define ABCD parameters. Draw a T-network with two-ports. Label the impedances. Find the ABCD parameters directly (without using any conversions formulae) in terms of the elemental impedances of that network.

   (b) State the difference with diagrams between the first Foster and second Foster forms of LC network realization. Describe how the presence or absence of the first and last elements of the first Foster form of LC network can be found just by inspection of the driving point impedance functions. 8+6=14

5. (a) Write the equations in time domain relating the voltage and current in a capacitor and an inductor. Show the time domain representation of those elements with initial conditions. From those equations derive the expressions for individual transform impedances of them. Draw their transform representation (in s-domain) with voltage due to initial condition.

   (b) In the given network (Fig.5(b)) switch K is closed at time t = 0. The initial current through inductor L is 1 Ampere and the initial voltage across capacitor C is 2 volts as shown. Draw the transform network showing all initial conditions. Find the transform current I(s) that flows through the series circuit.

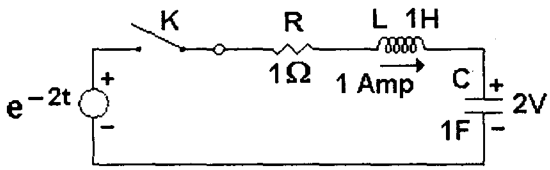

Fig.5(b) 7+7=14

6. (a) Neatly draw the v-i characteristics of ideal and practical current sources.

   (b) Compute the z-parameters for the resistive network of Fig.6(b):

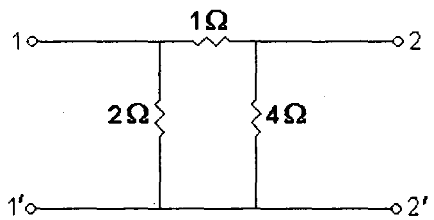

Fig.6(b)

   (c) Find the first Cauer form of the given function. Write the detailed procedure in synthesizing the network.

$$Z(s) = \frac{(s+1)(s+3)}{s(s+2)}$$

What is the rule in finding the type of elements whether RC or RL by inspection from the impedance function? 2+5+7=14

7. (a) The driving point impedance of an L-C network is given by $Z(s) = \frac{(s^2+4)(s^2+16)}{s(s^2+9)}$

   Obtain by inspection, the location of poles and zeros.

(b) The driving point impedance of a one port network is given by,

$$Z(s) = 2\frac{s(s^2+4)}{(s^2+1)(s^2+25)}$$

Obtain the first and second Foster forms of equivalent networks. Show all the calculations in details. 2+12=14

8. (a) State the maximum power transfer theorem for DC network. Derive the condition for maximum power transfer from a DC network to a resistive load (show the details of derivative). Plot power vs. load resistance.

(b) A source of 200 V feeds a load impedance $\mathbf{Z}_L$ through a series impedance $\mathbf{Z}_S = (50 + j80)\ \Omega$. Determine the load impedance for maximum power transfer and the value of the maximum power.

(c) In the circuit shown in Fig.8(c), find the current equation (without Laplace transformation) when the switch K is changed from position 1 to position 2 at time t = 0.

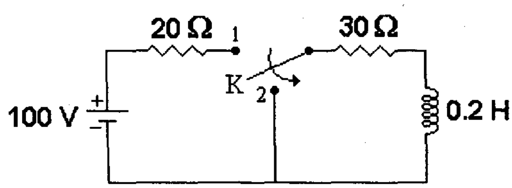

Fig.8(c) 7+3+4=14

9. (a) State the initial and final value theorems. For the following Laplace transform find the value of $i(\infty)$ and $i(0)$ making use of the theorems:

$$I(s) = \frac{s}{s^2+3s+2}$$

Expand the function by partial fraction expansion method. Verify the result by solving for i(t).

(b) In the given circuit Fig.9(b), switch K is moved from position 1 to position 2 at time t = 0, the steady-state current having previously established in the R-L circuit. Find the solution for the current i(t) after switching by using Laplace transformation.

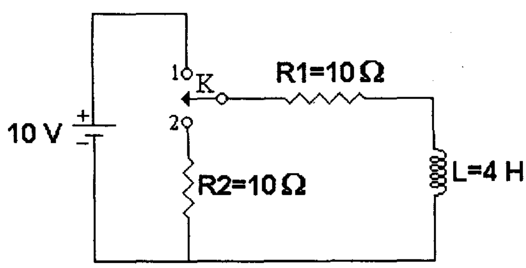

Fig.9(b) 9+5=14