BENGAL ENGINEERING & SCIENCE UNIVERSITY, SHIBPUR
B.E. (ETCE) Part-II 3rd Semester Final Examination, 2013-14

NETWORK THEORY
(ET-302)

Time : 3 Hours | Full Marks : 70

Answer **Question no.1 and any FOUR** from the rest
(Extra Answers will be discarded)

1. Pick up the right answer(s) (any **Six**). 1×6=6

(a) *D* in *ABCD* parameters is
(i) short circuit forward current gain (ii) open circuit forward current gain
(iii) short circuit reverse current gain (iv) open circuit reverse current gain

(b) The condition at which maximum power transfer takes place in a circuit containing complex load impedance is
(i) load is pure resistive (ii) load is equal to admittance of the circuit
(iii) load is complex conjugate of the impedance of the circuit
(iv) load is equal to the magnitude of circuit impedance (v) both (i) and (iv)

(c) Combined inductance of two inductors L_1 and L_2 connected in parallel is
(i) $L_1 + L_2$ (ii) $(L_1 + L_2) / L_1$ (iii) $(L_1 + L_2) / L_1L_2$
(iv) $L_1L_2 / (L_1 + L_2)$ (v) $L_1 / (L_1 + L_2)$

(d) Poles and zeros of an one-port *L-C* network are
(i) complex (ii) imaginary (iii) real (iv) None of these

(e) An *R-C* impedance function is
(i) $Z(s) = \dfrac{(s+1)(s+4)}{(s+2)(s+3)}$ (ii) $Z(s) = \dfrac{(s+2)(s+3)}{(s+1)}$ (iii) $Z(s) = \dfrac{(s+1)(s+3)}{s(s+4)}$
(iv) $Z(s) = \dfrac{(s-1)(s+3)}{s(s+4)}$ (v) $Z(s) = \dfrac{(s+1)(s+3)(s+5)}{s(s+2)(s+4)}$

(f) Laplace transform of e^{at} is
(i) $(s - a)$ (ii) $1 / (s + a)$ (iii) $(s + a)$ (iv) $1 / (s - a)$

(g) Quality of a coil Q is given by
(i) $\dfrac{\omega_0 L}{R}$ (ii) $\dfrac{\omega_0}{\Delta f}$ (iii) $\dfrac{\Delta f}{\omega_0}$ (iv) $\dfrac{R}{L}$

2. (a) (i) When a step dc voltage V is applied to series *R-C* circuit, determine the complete solution for the current by using differential equation and solving it.
(ii) Define time constant τ with appropriate diagram.
(iii) Show that the voltage across the capacitor is given by $v_C = V(1 - e^{-t/RC})$ and power in the resistor is given by $p_R = (V^2 / R)\, e^{-2t/RC}$
(iv) Draw the waveforms of the current, voltages across the capacitor and resistor and power across the capacitor.

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

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

Realize the first Foster network showing all the calculations in details.
Explain the presence or absence of first element and last element from the poles and zeros of this network function at s = 0 and s = ∞. 8+8

3. (a) State and prove Millman theorem.

(b) With suitable simple circuit diagrams describe the current source shifting technique.
Determine the current through the 2 ohm resistor branch of the given network [Fig.3(b)]. Apply source shifting method and mesh analysis.

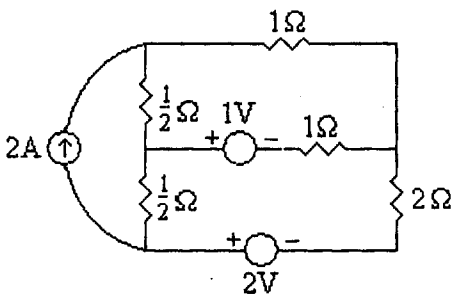


Fig.3(b) 6+10

4. (a) Write the general nodal equations for a two-node circuit from which the coefficients of these variables can be obtained directly by inspection method. Interpret each coefficient.
For the circuit shown in Fig.4(a), write the node equations by the inspection method (without applying KCL). By solving the equations find each branch current.

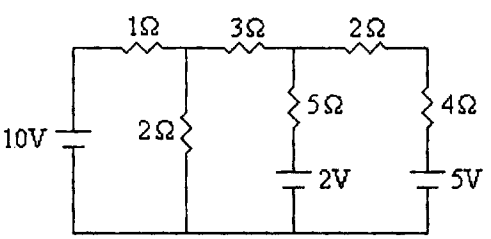


Fig.4(a)

(b) For the circuit shown in Fig.4(b), find the current equation in the loop when the switch *S* is opened at t = 0.

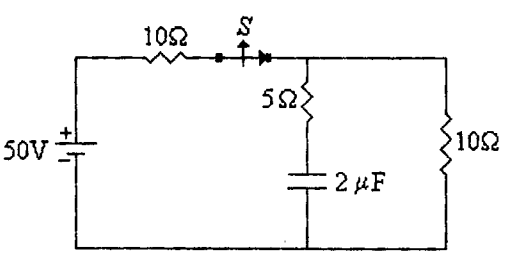


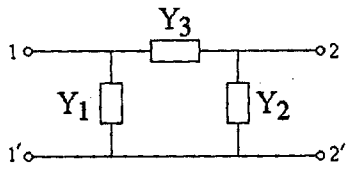
Fig.4(b) 11+5

5. (a) Show with necessary neat diagrams that a unit pulse extending from $t = a$ to $t = b$ may be formed as a sum of two unit step functions.

   (b) Draw a two-port network showing port currents and voltages. Write h-parameters equations and define the parameters. Why are these parameters so called?

   (c) For the π-network shown in Fig., derive the ABCD parameters as

$$A = \frac{Y_2 + Y_3}{Y_3} \qquad B = \frac{1}{Y_3} \qquad C = Y_3 + \frac{Y_1 Y_2}{Y_3} + Y_1 \qquad D = \frac{Y_1 + Y_3}{Y_3}$$



   Write the expressions for the elements of an equivalent T-network in terms of the elements of this π-network. Find the equivalent T-network for the given π-network with $Y_1 = 0.2$ mho, $Y_2 = 0.5$ mho, $Y_3 = 1$ mho. 3+4+9

6. (a) Find the current $i(t)$ in a series R-C circuit consisting of R = 2 Ω and C = 1/4 farad when each of the following driving force voltage is applied:
   (i) ramp voltage 2r(t-3), and (ii) step voltage 2u(t-3).

   (b) By using source transformation, source combination and resistance combination, convert the circuit shown in Fig.6(b) into a single voltage source and single resistance.

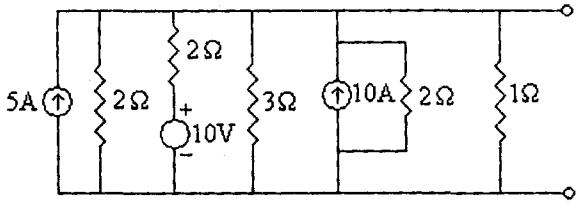


Fig.6(b) 10+6

7. (a) Synthesize First and Second Cauer forms of the one-port network function given by $Z(s) = \frac{s(s+3)}{(s+2)(s+4)}$ showing the comparisons with general ladder network.

   (b) Determine the z parameters of the network shown in Fig.7(b)

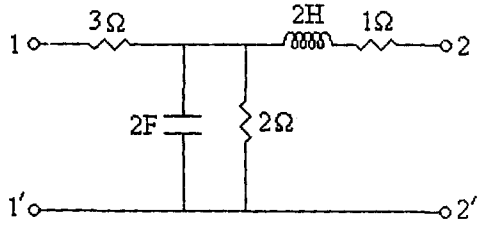


Fig.7(b) 8+8

8. (a) What do you understand by a symmetrical network? Explain. Directly from the *ABCD* parameters equations derive the relationship between *ABCD* parameters for a two-port symmetrical network.

   (b) Neatly plot the variation of conductance, inductive susceptance, capacitive susceptance, net susceptance, admittance and current with frequency of a parallel *RLC* resonant circuit.

   (c) A 20Ω resistor is connected in series with an inductor, a capacitor and an ammeter across a 25V variable frequency supply. When the frequency is 400 Hz, the current is at its maximum value of 0.5A and the potential difference across the capacitor is 150V. Calculate (i) the capacitance of the capacitor, (ii) the resistance and inductance of the inductor. 6+6+4