BENGAL ENGINEERING & SCIENCE UNIVERSITY, SHIBPUR
B.E. (ETCE) Part-II 3rd Semester Final Examination, 2012-13

# 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 correct answer(s) (any **Six**). 1×6=6

(a) The number of loop equations required to completely analyze a network comprising nine independent branches and five nodes including the reference node shall be
(i) 5 (ii) 4 (iii) 3 (iv) 6

(b) The impedance of a capacitive reactance varies
(i) linearly with frequency (ii) hyperbolically with frequency
(iii) parabolically with frequency (iv) exponentially with frequency (v) none of these

(c) Power dissipated in a pure capacitor is
(i) zero (ii) maximum (iii) minimum (iv) none of these

d) The product *RC* has dimension of
(i) ohm (ii) farad (iii) second (iv) herz

(e) Bandwidth (Δf) of a series resonant circuit is given be
(i) $\frac{R}{L}$ (ii) $\frac{Q_0}{f_0}$ (iii) $\frac{R}{4\pi L}$ (iv) $\frac{R}{2\pi L}$

(f) Condition for reciprocity of network (pick up wrong relation)
(i) $z_{12} = z_{21}$ (ii) $y_{12} = y_{21}$ (iii) $h_{12} = -h_{21}$ (iv) AD + BC = 1

(g) Branches removed form a graph in forming a tree are called
(i) links (ii) cotree (iii) twigs (iv) chords

(h) Laplace transform of '*t*' is
(i) 1 (ii) s (iii) 1 / s (iv) $1 / s^2$

2. (a) Define poles and zeros of a network function. Draw the pole-zero diagram of the network function $N(s) = \frac{(s+1)^2(s+5)}{(s+2)(s^2+6s+13)}$

(b) The driving point impedance of a one-port network is given by $Z(s) = \frac{2s(s^2+2)(s^2+4)}{(s^2+1)(s^2+3)}$
Determine the first Foster form of the network showing all the calculations in details.

(c) The driving point impedance of a network is given by $Z(s) = \frac{(s+2)(s+4)}{s+3}$
By inspection find the type and number of elements in the synthesis of the network for the above function. State the criteria that you have used here in reaching your results.

4+9+3=16

3. (a) Derive the condition for maximum power transfer from a source to a load when the load resistance and reactance are varied independently. Show all the detailed steps of derivative while deriving. From the condition write the statement of maximum power transfer to a load.

(b) For the circuit shown in Fig.3(b), what load impedance $Z_L$ absorbs maximum average power and what is this power?

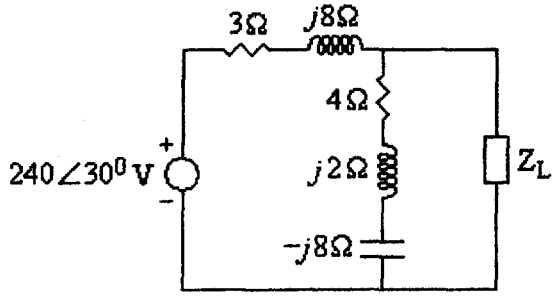


Fig.3(b) 9+7=16

4. (a) Derive with necessary diagrams the equivalence between a voltage source $V_S$ with series impedance $Z_v$ and a current source $I_S$ in parallel with impedance $Z_I$.

(b) With suitable diagrams explain voltage source shifting technique. In which kind of circuit configuration is this method used conveniently?

(c) Find the equivalent voltage generator and current generator separately across the terminals *A* and *B* for the network given in Fig.4(c). Estimate the current in each case that would flow if a load of 5 Ω is connected across the terminals *A* and *B* of the network. Show all the calculations and necessary diagrams.

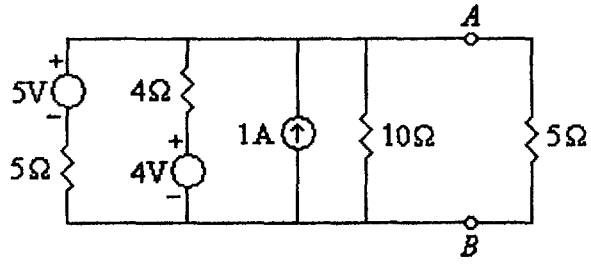


Fig.4(c) 5+5+6=16

5. (a) A pulse voltage of magnitude 10 volts and extending from 0 to 2 sec is applied at time $t = 0$ to a series *R-L* circuit consisting of resistance $R = 4\Omega$ and inductor $L = 2$ Henry. Assume zero current through the inductor $L$ before application of the voltage pulse. By using Laplace transformation find current $i(t)$, voltages $v_R(t)$ and $v_L(t)$. Neatly plot each of them superimposing with the pulse. Show the construction of $i(t)$ waveform by drawing individual waveforms of all the terms of itself.

(b) When a load impedance $Z_L$ is connected across port-2 of a two-port network, find the expression for the input impedance in terms of *z*-parameters and the load impedance. From this show that when $Z_L = \infty$, the input impedance = $z_{11}$ and for $Z_L = 0$, the input impedance = $1/y_{11}$.

11+5=16

6. (a) Draw a series *RLC* resonant circuit. Define its bandwidth (BW). Why is it also called 3-dB BW and half-power BW? Explain with the help of its response curve and necessary calculations. Derive that for a series *RLC* circuit the bandwidth is given by $\Delta\omega = R / L$

(b) Write the formula of the Laplace transform of any function that repeats itself. Fig.6(b) shows a square wave $v(t)$ of amplitude unity and periodic time $2a$. Derive (i) without using that formula and (ii) using that formula that its Laplace transform is $F(s)=\frac{1}{s}.\frac{1-e^{-as}}{1+e^{-as}}$

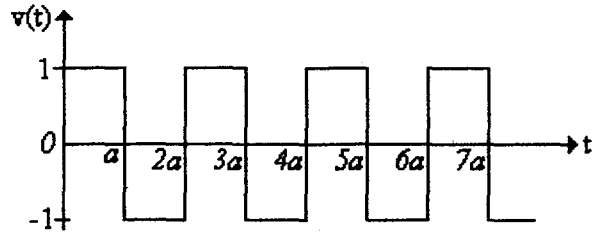


Fig.6(b)

10+6=16

7. (a) Define h-parameters. Find the y-parameters (from the definition) for the given resistive network of Fig.7(a) containing a controlled voltage.

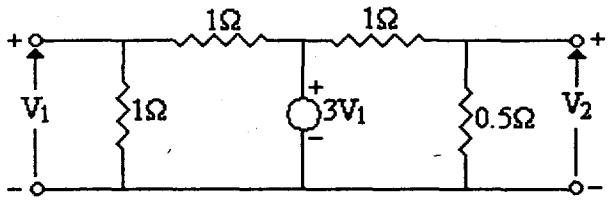


Fig.7(a)

(b) For the circuit shown in Fig.7(b), find the complete expression for the current when the switch $K$ is closed at $t = 0$.

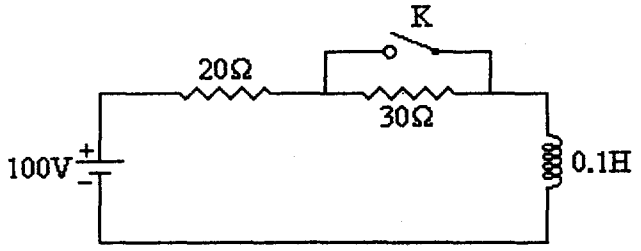


Fig.7(b)

11+5=16

8. (a) Define the terms: (i) Graph, (ii) Tree.
(b) For the given resistive network [Fig.8(b)] draw a graph and 12 trees. Select a tree and write a tie-set schedule and equilibrium equations on the current basis. Solve these equations and calculate the branch currents and branch voltages. Given that R1=5Ω, R2=5Ω, R3=R4=R6=10Ω and R5=2Ω.

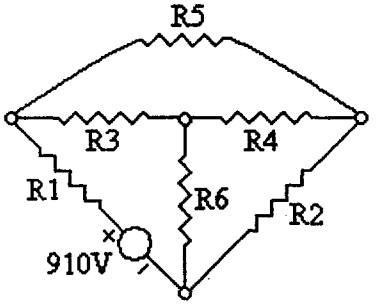


Fig.8(b)

3+13=16