53 (IE 301) NWTH

2019

NETWORK THEORY

Paper : IE 301

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Choose the correct answer from the given problems : 1×8=8

(A) A capacitor has a capacitance of $5\mu F$. Calculate the stored energy in it if d.c. voltage of $100V$ is applied across it.

(i) 2.5×10^{-2} joule

(ii) 5×10^{-2} joule

(iii) 2.7×10^{-2} joule

(iv) 5 joule.

Contd.

(B) Energy per unit charge is ——.

(i) power (ii) voltage (iii) current (iv) capacitance *(Fill in the blank)*

(C) In case of ideal current sources, they have

(i) zero internal resistance

(ii) low value of voltage

(iii) large value of current

(iv) infinite internal resistance

(D) With some initial charge at $t = 0^+$ a capacitor will act as

(i) open circuit (ii) short circuit (iii) voltage source (iv) current source

(E) The circuit is said to be in resonance if the current is ——— with the applied voltage.

(i) in phase (ii) out of phase (iii) 45° out of phase (iv) 90° out of phase. *(Fill in the blank)*

(F) The concept on which superposition theorem is based is

(i) Reciprocity (ii) Duality (iii) Non-linearity (iv) Linearity

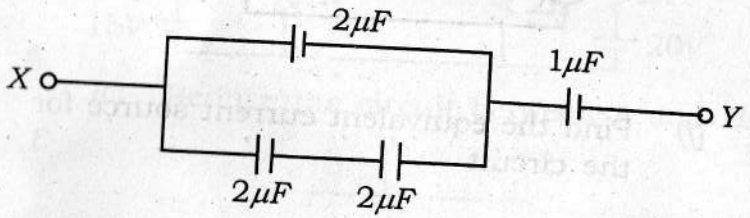
(G) Kirchoffs law is not applicable to circuits with

(i) Lumped parameters (ii) Passive elements (iii) Distributed parameters (iv) Non-linear resistances.

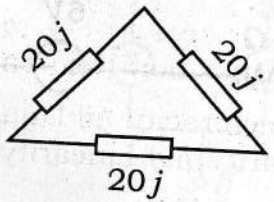
(H) Millman's theorem yields

(i) Equivalent resistance
(ii) Equivalent impedance
(iii) Equivalent voltage source
(iv) Equivalent voltage or current source.

(b) Find the equivalent capacitance of the circuit shown between X - Y.

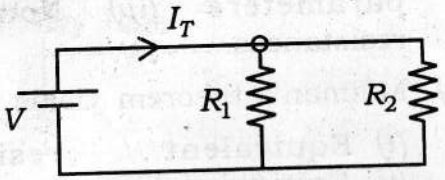


(c) Find the equivalent star network. 2

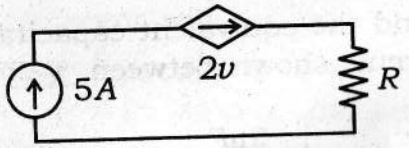


Contd.

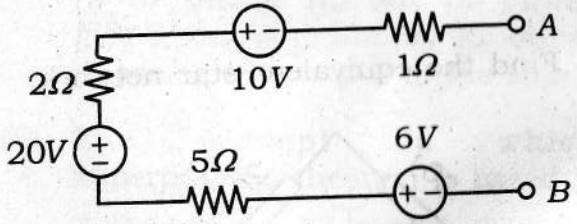
(d) Find total current I_T, current through R_1 and R_2 if $R_1 = 10\Omega$, $R_2 = 20\Omega$ and $V = 50V$ 3



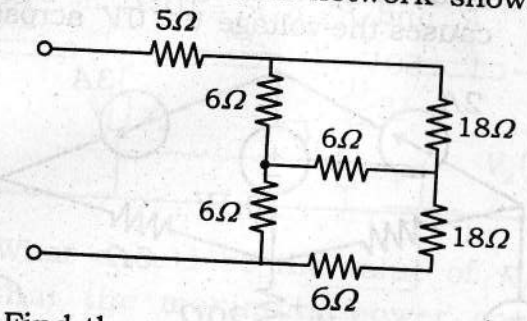
(e) Obtain the value of R in the circuit 2



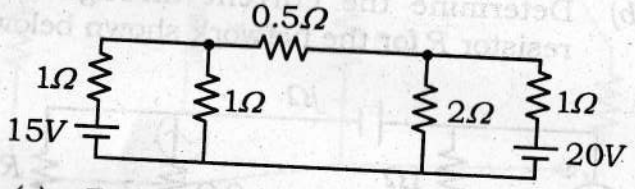
(f) Find the equivalent current source for the circuit 3



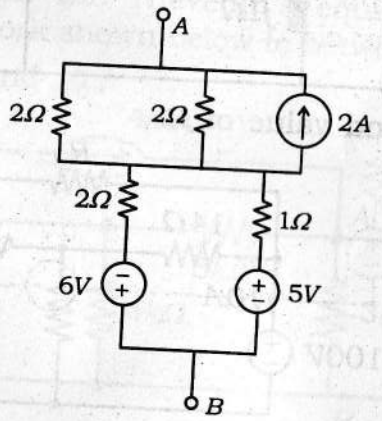
2. (a) Determine R_{in} using Star-Delta transformation in network shown. 6



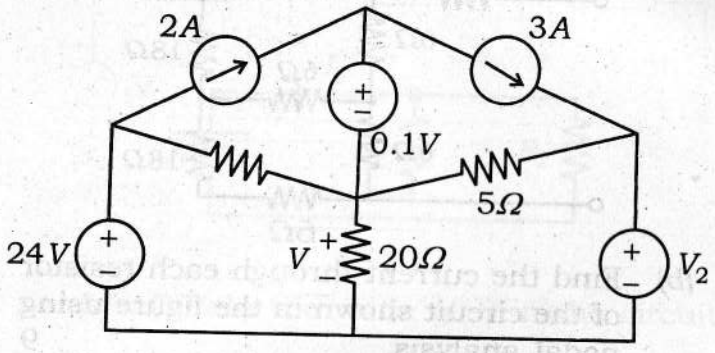
(b) Find the current through each resistor of the circuit shown in the figure using nodal analysis. 9



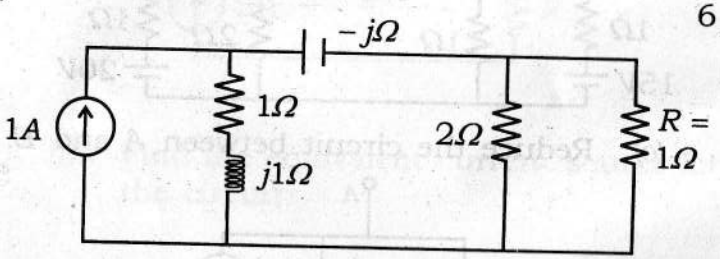
(c) Reduce the circuit between A and B. 5



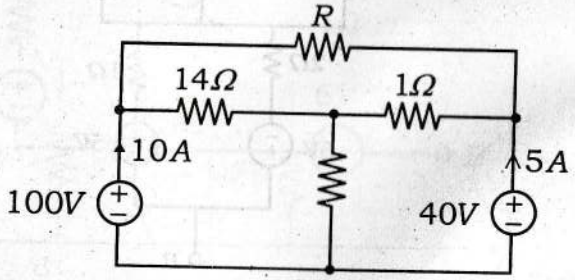
3. *(a)* Use mesh analysis to determine what value of V_2 in the network in the figure causes the voltage $V = 0V$ across 20Ω. 7



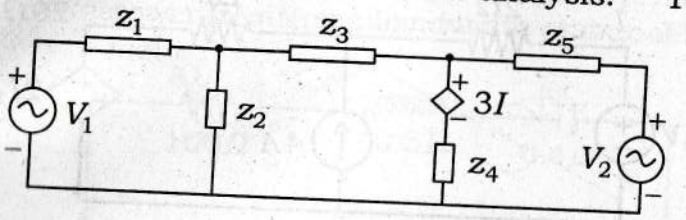
(b) Determine the current through load resistor R for the network shown below : 6



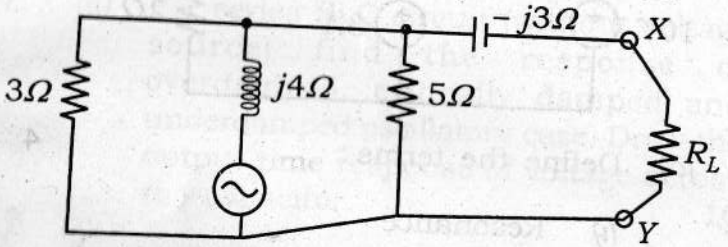
(c) Find value of R. 7



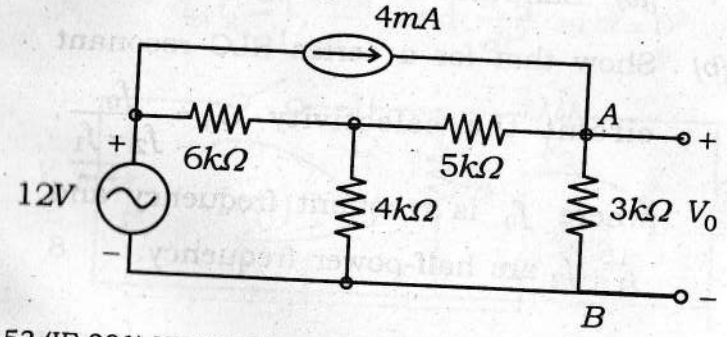
4. *(a)* Find the matrix form of the network shown using AC nodal analysis. 10



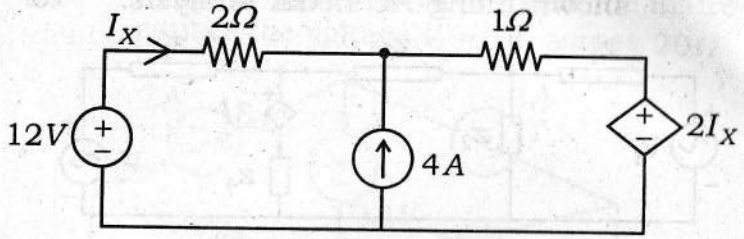
(b) What should be the value of R_L so that the maximum power can be transferred from the source to R_L. 10



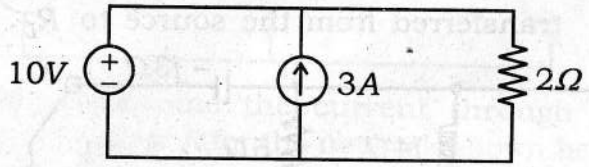
5. *(a)* Obtain the Thevenin's equivalent of network shown below in between A and B. Find V_0. 8



(b) Find the value of I_X. 9



(c) Prove Tellegans theorem for the following circuit. 3



6. (a) Define the terms : 4

(i) Resonance

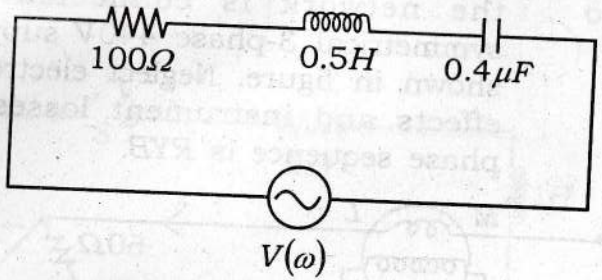
(ii) Q-factor

(iii) Half-power frequency

(iv) Bandwidth.

(b) Show that for a series RLC resonant circuit the selectivity $Q_0 = \frac{f_0}{f_2 - f_1}$, where f_0 is resonant frequency and f_1, f_2 are half-power frequency. 8

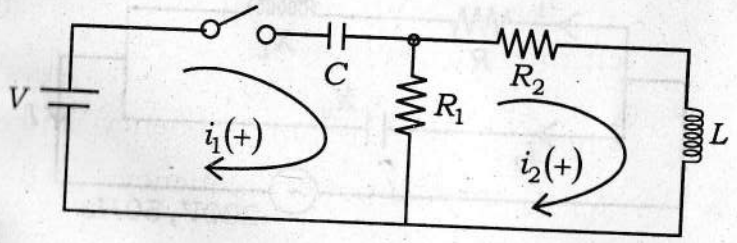
(c) For the series RLC circuit of *figure* below find the resonant frequency, half power frequency, bandwidth and quality factor. 8



7. (a) For series RLC circuit (without voltage source) find the response of overdamped, critically damped and underdamped oscillatory case. Draw the output time response of voltage across the capacitor. 10

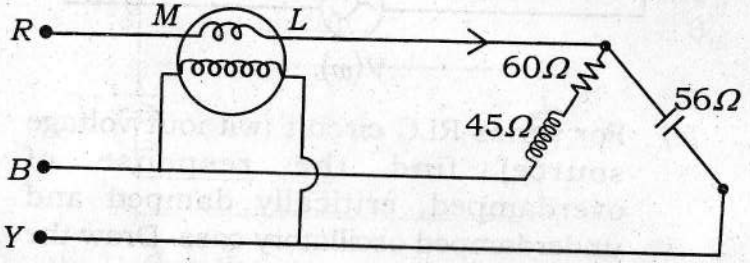
(b) In the network shown below assuming all initial conditions as zero, find

$i_1, i_2, \frac{di_1}{dt}, \frac{d^2i_1}{dt^2}$ and $\frac{d^2i_2}{dt^2}$ at $t = 0^+$ 10

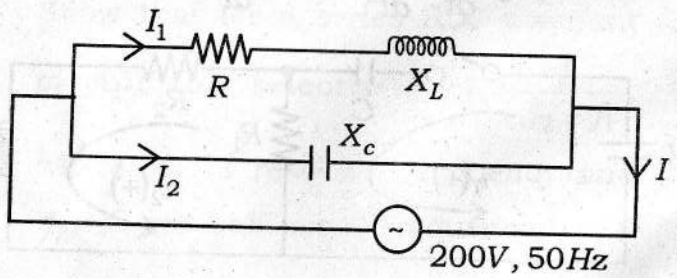


8. *(a)* Give the advantage of 3-phase system. 2

(b) Find the reading on the wattmeter when the network is connected to a symmetrical 3-phase $440V$ supply as shown in figure. Neglect electrostatic effects and instrument losses. The phase sequence is *RYB*. 7



(c) A series RL circuit has $R = 25\Omega$ and $X_L = 32\Omega$. It is connected in parallel to a capacitor of $100\mu F$ and the combination is connected across a $200V$, $50Hz$ supply. Find the current in each branch. 5



(d) Using Laplace transform determine the current in the circuit when the switch S is closed at $t = 0$. Assume zero initial condition. 6