53 (IE 301) NWTH

2018

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)* How a voltage source can be converted into a current source and vice versa? 4

   (b) Determine the resistance between the terminals *A* and *B* of the following network : 5

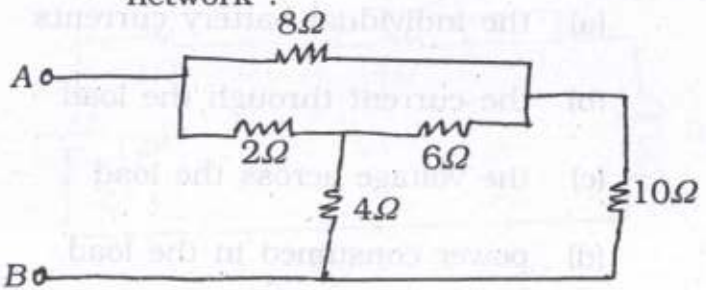

Fig. 1

(c) Determine the current in the 1Ω resistor in the circuit : 6

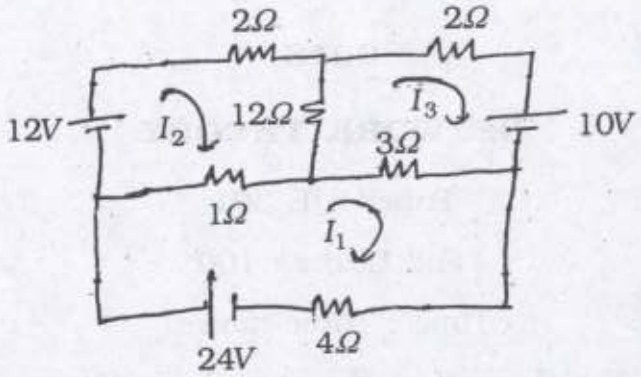

Fig. 2

(d) Two batteries having *emf* of 10V and 7V and internal resistance of 2Ω and 3Ω respectively, are connected in parallel across a load resistance 1Ω. Calculate —

(a) the individual battery currents

(b) the current through the load

(c) the voltage across the load

(d) power consumed in the load. 5

2. (a) State the prove initial value and final value theorem. 6

(b) How a series RLC circuit will respond to

(i) Step function ?

(ii) Impulse function ? 7+7=14

3. (a) The dc voltage is applied to the circuit shown in *Fig.* 3 keeping the switch *K* open so that steady state is reached. Determine the complete response for the circuit after closing the switch *K*. 6

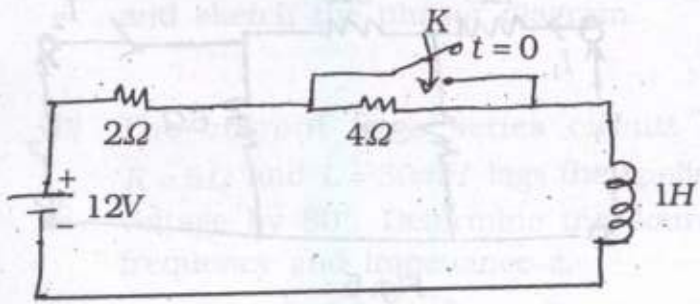

Fig. 3

(b) In the circuit shown in *Fig.* 4 the switch K is thrown from position A to position B at time $t = 0$, the current having previously reached its steady state. Determine $i(t)$ after switching. 4

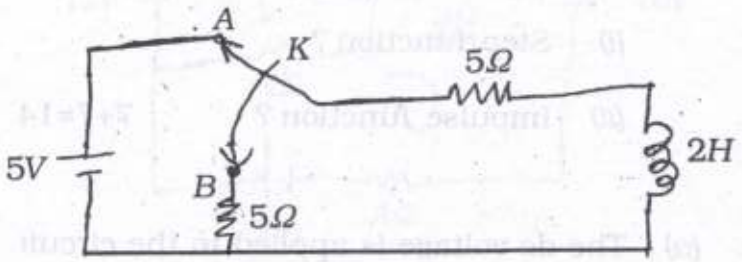

Fig. 4

(c) Determine the z-parameters of the network shown in *Fig.* 5. 6

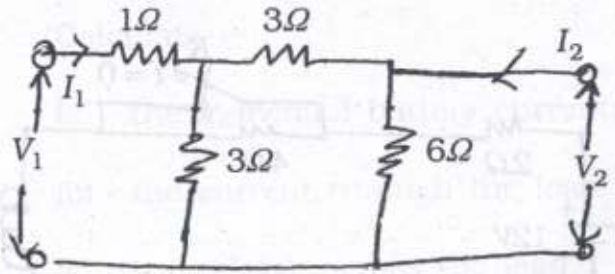

Fig. 5

(d) Determine the condition under which the input impedance of the network shown in *Fig.* 6 will be equal to R. 4

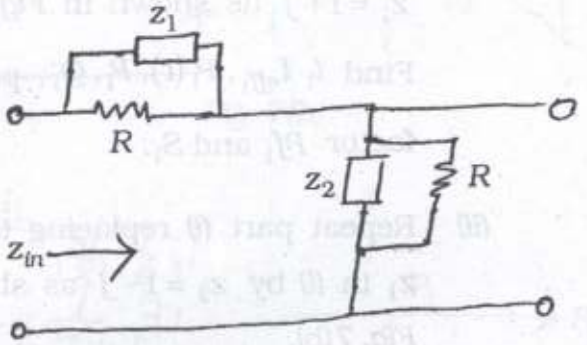

Fig. 6

4. (a) A series combination of $R = 10\Omega$ and $L = 20mH$ has a current $i = 5{\cdot}0\cos(500t + 10°)$ A. Obtain the voltages v and V, the phasor current I and sketch the phasor diagram. 6

(b) The current in a series circuit of $R = 5\Omega$ and $L = 30mH$ lags the applied voltage by 80°. Determine the source frequency and impedance z. 4

(c) (i) A sinusoidal voltage with $V_{eff} = 10V$ is connected across $z_1 = 1 + j$ as shown in *Fig. 7(a)*. Find i_1 I_{eff_1}, $P_1(t)$, P_1, Q_1, power factor Pf_1 and S_1.

(ii) Repeat part *(i)* replacing the load z_1 in *(i)* by $z_2 = 1 - j$ as shown in *Fig. 7(b)*.

(iii) Repeat part *(i)* after connecting in parallel z_1 in *(i)* and z_2 in *(ii)* as shown in *Fig. 7(c)*. 10

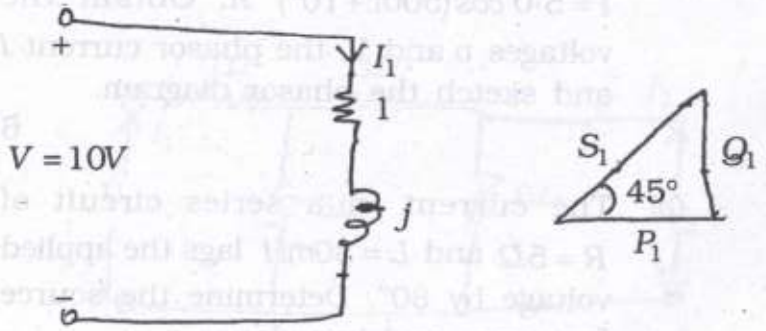

Fig. 7(a)

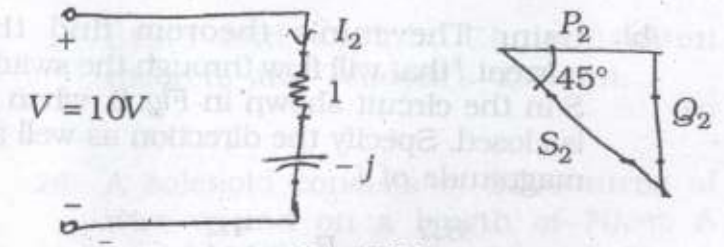

Fig. 7(b)

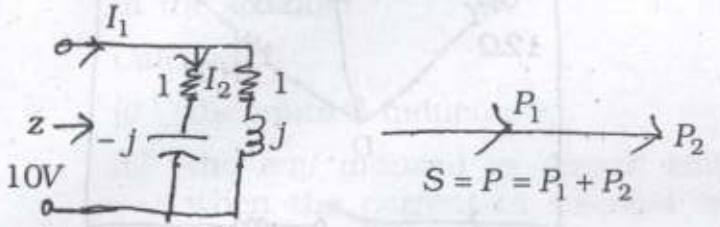

Fig. 7(c)

5. (a) Determine the current through the 3Ω resistor in the circuit shown in *Fig. 8* by using Superposition theorem 5

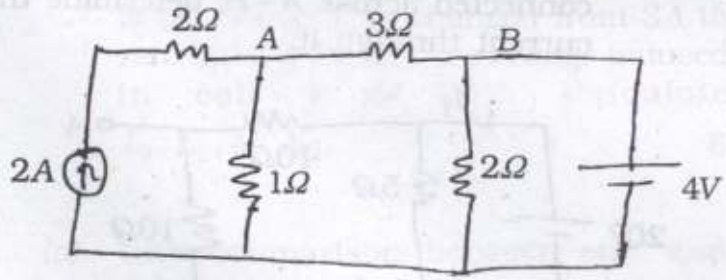

Fig. 8

(b) Using Thevenin's theorem find the current I that will flow through the switch S in the circuit shown in *Fig.* 9, when it is closed. Specify the direction as well as magnitude of I. 7

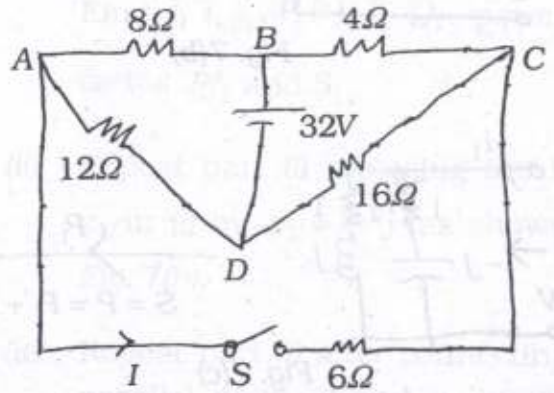

Fig. 9

(c) Draw the Norton's equivalent circuit at the terminals $A-B$ for the given circuit of *Fig.* 10. If a 2Ω resistance is connected across $A-B$, determine the current through it. 8

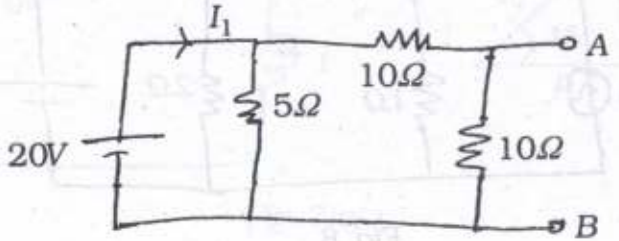

Fig. 10

6. (a) State and explain Compensation theorem and Tellegen's theorem. 10

(b) A solenoid consists of 2000 turns of wire wound on a length of 70*cm*. A search coil of 500 turns enclosing a mean area of $30cm^2$ is placed centrally in the solenoid.

Calculate :

(i) the mutual inductance

(ii) the *emf* induced in search coil when the current in solenoid is changing uniformly at a rate of $260A/sec$. 4

(c) The coefficient of coupling between two coils is 0·75. There are 250 turns in coil 1. The total flux linking coil 1 is $0{\cdot}4mWb$, when the current in this coil is 3*A*. When i_1 is changed from 3*A* to zero linearly in 3*ms*, the voltage induced in coil 2 is 70*V*. Calculate L_1, L_2, M, N_2. 6

7. (a) Give comparison between star and delta-connected three-phase systems. 7

(b) A 220V, three-phase voltage is applied to a balanced, delta-connected three-phase load by phase impedance $(15 + j20)\Omega$.

Find —

(i) the current in each line

(ii) the power consumed per phase

(iii) the phasor sum of the three line currents. 6

(c) State the advantages of Three-phase systems. 7