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.***

1. *(a)* How a voltage source can be converted into current source and vice versa? Explain. 6

   *(b)* What are active elements and passive elements? 4

   *(c)*

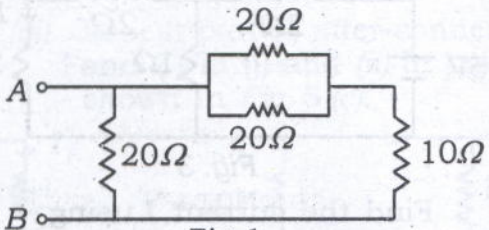


*Fig.* 1

Find the equivalent resistance of the circuit. 6

*Contd.*

(d) State Kirchoff's current and voltage law. 4

2. Obtain the response of an RL and an RC circuit to the following inputs : 20

(i) Unit impulse

(ii) Unit step

(iii) Unit ramp.

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

(b)

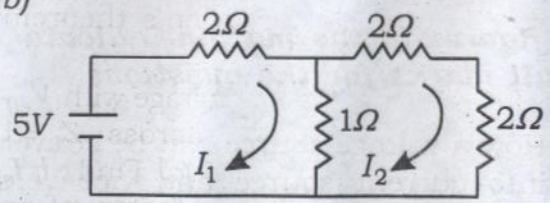


Fig. 2

Find the currents $I_1$ and $I_2$. 4

(c)

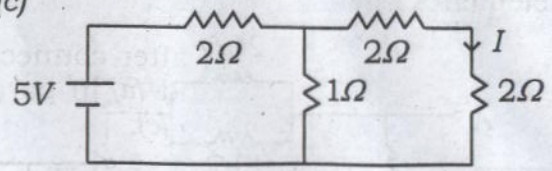


Fig. 3

Find the current $I$ using — 5+5=10

(i) Thevenin's theorem

(ii) Norton's theorem.



4. (a) Determine the condition under which the input impedance of the network shown in *Fig.* 4 will be equal to R. 5

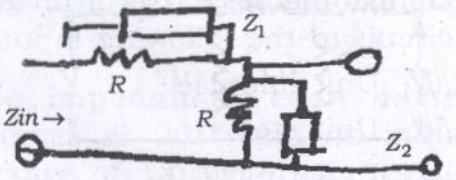


*Fig.* 4

(b) State Reciprocity and Millman's theorem. 10

(c) State and explain compensation theorem and Telegen's theorem. 10

5. (a) (i) A sinusoidal voltage with $V_{eff} = 10V$ is connected across $Z_1 = 1 + j$ as shown in *Fig.* 5 *(a)*. Find : $i$, $I_{eff}$, $P(t)$, $P_1$, $Q_1$, power factor $pf$ and $S$.

(ii) Repeat part *(i)* replacing the load $Z_1$ in *(i)* by $Z_2 = 1 - j$ as shown in *Fig.* 5 *(b)*.

(iii) Repeat part (i) after connecting $Z_1$ and $Z_2$ in (i) and *(ii)* in parallel as shown in *Fig.* 5 *(c)*. 10

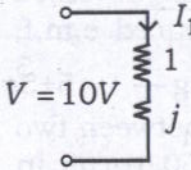


*Fig.* 5(a)

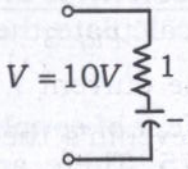


*Fig.* 5(b)

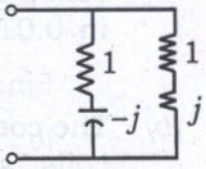


*Fig.* 5(c)

(b) Find the $Z$ parameters of the network shown in *Fig.* 6. 5

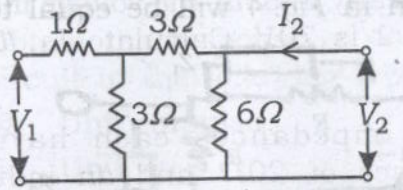


*Fig.* 6

(c) Using Maximum power transfer theorem find the maximum power transferred to the load in the following network — 5

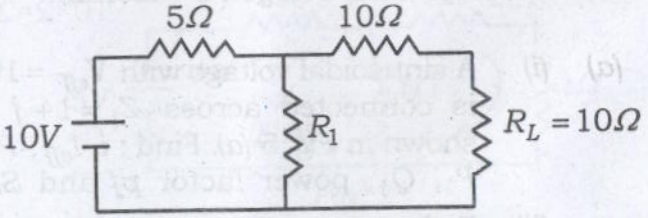


*Fig.* 7

6. (a) If a coil of 150 turns is linked with a flux of 0.01 *Wb* when carrying current of 10*A*, calculate the inductance of the coil. If this current is uniformly reversed in 0.01 s, calculate the induced e.m.f. 5

(b) The coefficient of coupling between two coils is 0.75. There are 250 turns in coil 1. The total flux linking coil 1 is





0.4 *mWb*, 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 $L_1$, $L_2$, $M$, $N_2$. 7

(c) Three impedances each having a resistance of 20Ω and an inductive reactance of 15Ω are star connected across a 400*V*, three phase supply. Calculate *(i)* line current, *(ii)* power factor, *(iii)* total power in *kW*. 8

7. Write short notes on : 10×2=20

(a) Inductive coupling in series

(b) Three phase system.