53 (IE 301) NWTH

2017

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)* What are active and passive elements ? A series circuit with $R = 2\Omega, L = 2mH, C = 500\mu F$ has a current which increases linearly from zero to $10A$ in the interval $0 \le t \le 1ms$, remains at $10A$ for $1ms \le t \le 2ms$ and decreases linearly from $10A$ at $t = 2ms$ to zero at $t = 3ms$. Sketch V_R, V_L and V_C. 2+7=9

(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 $0{\cdot}4\,mWb$, when the current in this coil is $3A$. When i_1 is charged from $3A$ to zero linearly in 3 milliseconds, the voltage induced in coil 2 is $70V$. Calculate L_1, L_2, M, N_2. 5

(c) What are the advantages of three phase systems ? 4

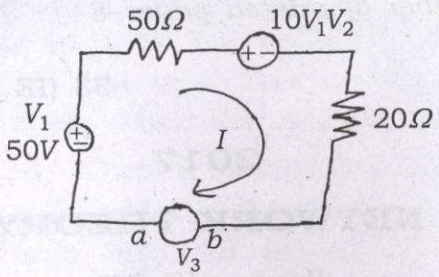
(d) Three impedances each having a resistance of 20Ω and an inductive reactance of 15Ω are star connected across a $400V$, three phase supply. Calculate 6

(i) The line current

(ii) The power factor

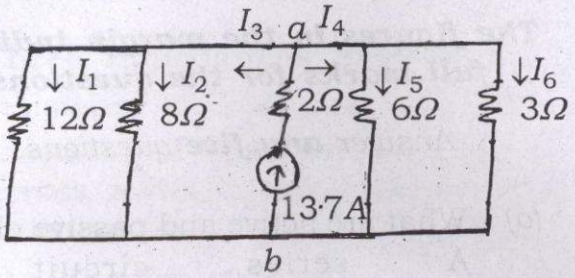
(iii) The total power in kW.

(b)



find V_3 and its polarity if the current I in the circuit is 0·40A. 4

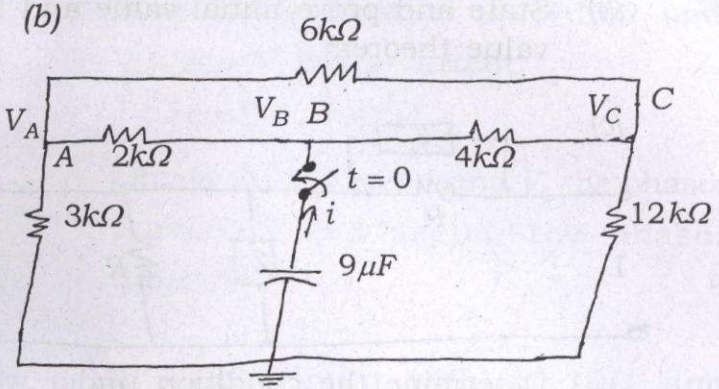
(c)



Find all branch currents in the network. 7

2. *(a)* A 4μF capacitor with an initial voltage of $V(O^-)=2V$ is connected to a $12V$ battery through a resistor $R=5k\Omega$ at $t=0$. Find the voltage across and current through the capacitor for $t>0$. 5

(b)

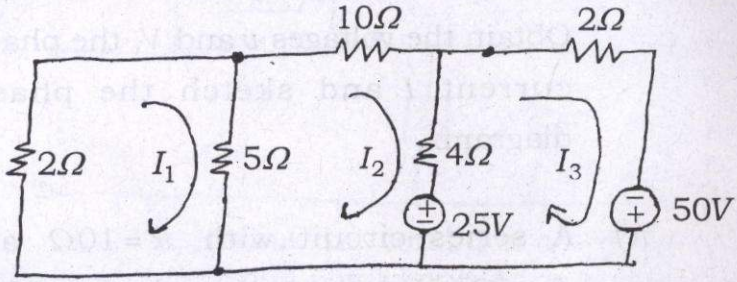


The $9\mu F$ capacitor is connected to the circuit at $t=0$. At this time capacitor voltage is $V_0=17V$. Find $V_A, V_B, V_C, i_{AB}, i_{AC}, i_{BC}$ for $t>0$. 12

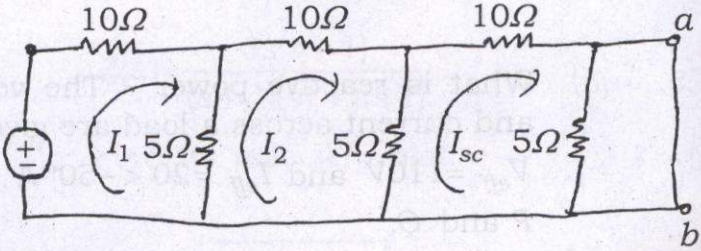
(c) Obtain the current $i(t)$ in *RL* circuit for unit impulse input. 3

3. (a) A series RLC circuit with $R=200\Omega$, $L=0{\cdot}1H$ and $C=13{\cdot}33\mu F$, has an initial charge on the capacitor of $Q_0=2{\cdot}67\times10^{-3}C$. A switch is closed at $t=0$, allowing the capacitor to discharge. Obtain the current transient. 6

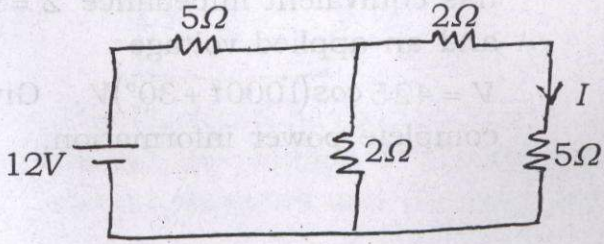
(c) Write the mesh current matrix equation for the network by inspection and solve for the currents. 5



(d) Obtain the Thevenin's equivalent for the circuit to the left of terminal *ab*. 5

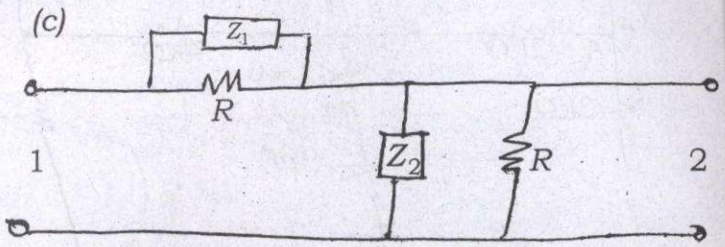


6. (a) Determine the current I in the circuit by using the Norton's theorem 5



(b) State and prove initial value and final value theorem. 6

(c)



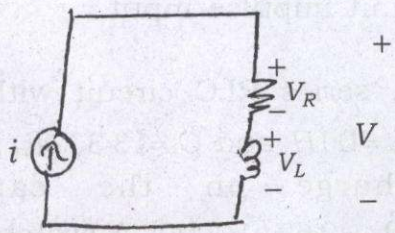
Determine the condition under which the driving point impedance at port 1 of the network is R. 4

(d) A transfer function is given as,

$$Z(s)=\frac{3s(s+4)}{(s+2)(s^2+s+1)}$$

Find its pole-zero plot. 4

4. (a)



The RL circuit has a current $i = I \sin \omega t$ obtain the voltage V across the two circuit elements and sketch V and i. 8

(b) A series combination of $R = 10\Omega$ and $L = 20mH$ has a current $i = 5\cos(500t + 10^{o})A$.

Obtain the voltages v and V_1 the phasor current I and sketch the phasor diagram. 8

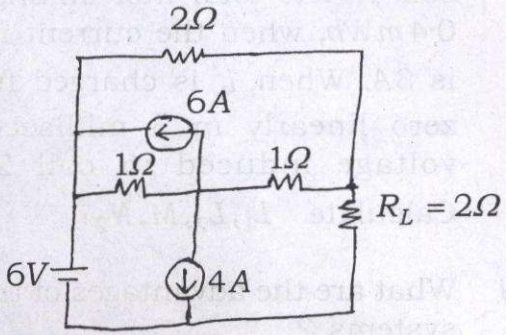
(c) A series circuit with $R = 10\Omega$ and $L = 20mH$, has a current $i = 2\sin 500t$. Obtain total voltage V and the angle by which i lags V. 4

5. (a) What is reactive power ? The voltage and current across a load are given by $V_{eff} = 110V$ and $I_{eff} = 20 < -50^{o} A$. Find P and Q. 5

(b) A certain passive network has equivalent impedance $Z = 3 + j4\Omega$ and an applied voltage $V = 42{\cdot}5\cos(1000t + 30^{o})V$. Give complete power information. 5

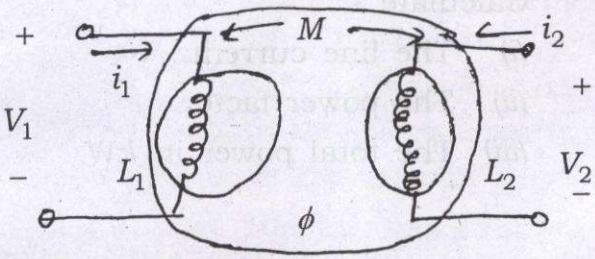
(b) State and explain the compensation theorem and Tellegen's theorem. 10

(c)



Determine the current through R_L in the circuit using super position theorem. 5

7. (a) What is mutual inductance ? 5



In the circuit $L_1 = 0{\cdot}1H$ $L_2 = 0{\cdot}5H$ and $i_1(t) = i_2(t) = \sin wt$. Find $V_1(t)$ and $V_2(t)$ for (a) $M = 0{\cdot}01H$ (b) $M = 0{\cdot}2H$ (iii) $M = -0{\cdot}2H$.