53 (IE 301) NWTH

2015

NETWORK THEORY

Paper : IE 301

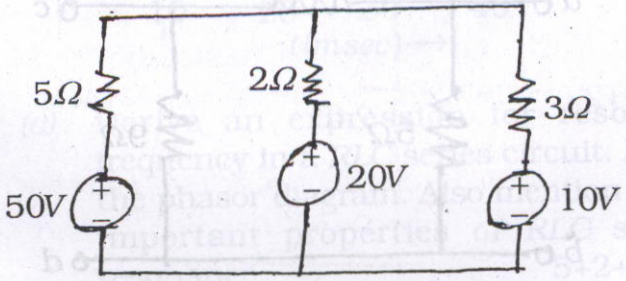
Full Marks : 100

Time : Three hours

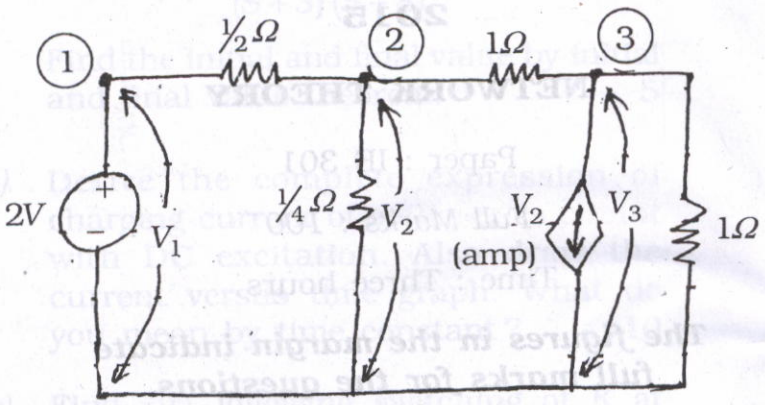
The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

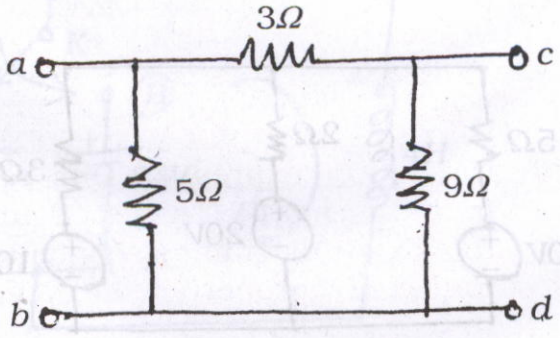
1. *(a)* Using Mesh analysis, find the current flow through the 5Ω resistance in the given network. 10



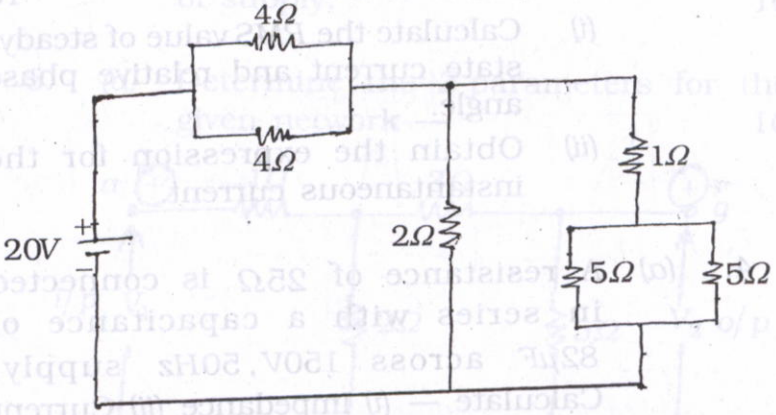
(b) In the network given below, find V_1, V_2 and V_3 by nodal analysis. 10



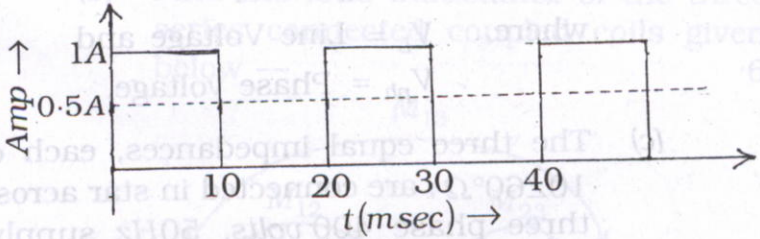
2. (a) Convert the following delta to equivalent star — 4



(b) Find the voltage drop across 1Ω resistor and power loss across 2Ω resistor in the following circuit — 10



(c) A non-alternating periodic wave-form has been shown below. Find its form factor. 6



3. (a) Derive an expression for resonant frequency in a *RLC* series circuit. Draw the phasor diagram. Also mention *three* important properties of *RLC* series resonance. 5+2+3=10

(b) A 50*Hz* sinusoidal voltage $v = 311 \sin \omega t$ is applied to a *RL* series circuit. If the magnitude of resistance is 5Ω and inductance is 0·02*H*. 10

(i) Calculate the *RMS* value of steady-state current and relative phase angle.

(ii) Obtain the expression for the instantaneous current.

4. (a) A resistance of 25Ω is connected in series with a capacitance of $82\mu F$ across $150V, 50Hz$ supply. Calculate — (i) Impedance (ii) Current (iii) Phase angle. 5

(b) Prove that in a balance star-connected 3-ϕ system, $V_L = \sqrt{3}Vph$

where, V_L = Line Voltage and

V_{ph} = Phase voltage. 5

(c) The three equal impedances, each of $10\angle 60°\Omega$, are connected in star across three phase 400 *volts*, 50*Hz* supply. Calculate

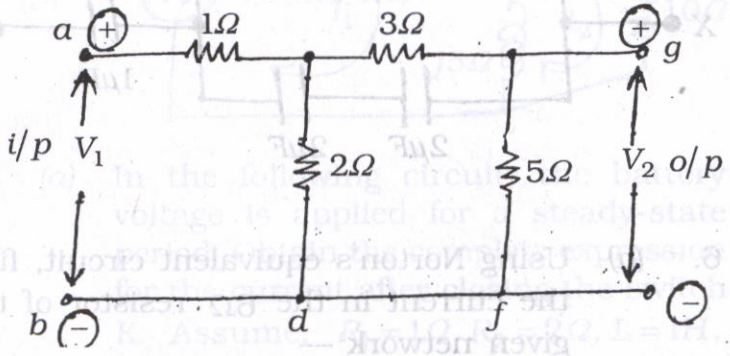
(i) Line voltage and phase voltage

(ii) Line current and phase current

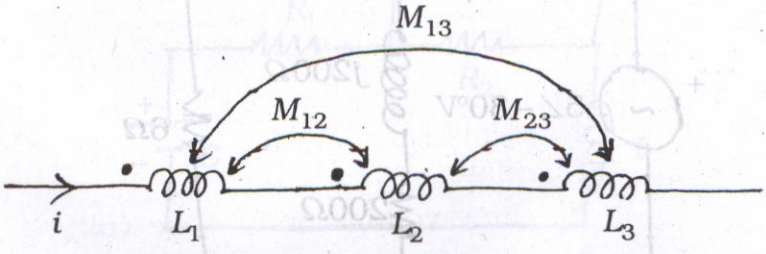
(iii) Power factor and active power consumed.

Also calculate the active power consumed, if the three impedances are connected in delta to the same source of supply. 10

5. *(a)* Determine the *Z*-parameters for the given network — 10



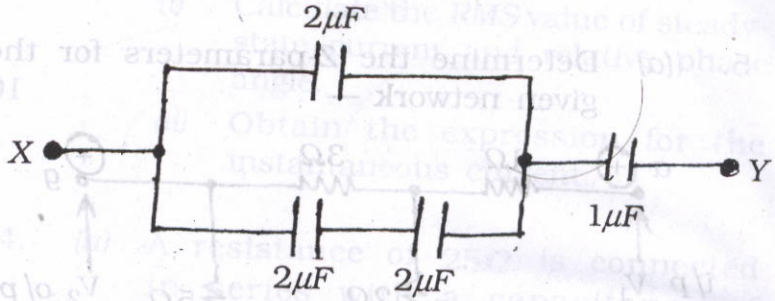
(b) Find the total inductance of the three series connected coupled coils given below — 6



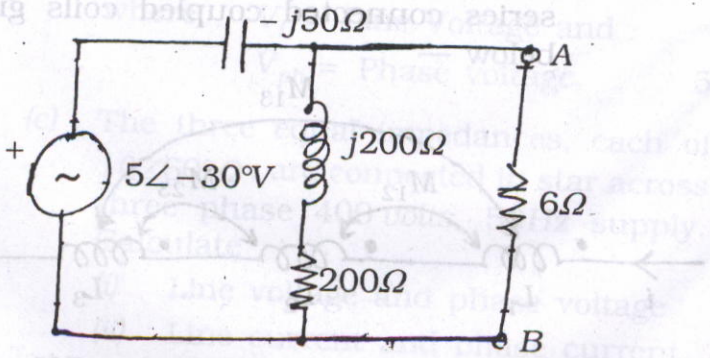
Given that, $L_1 = 1H, L_2 = 2H, L_3 = 5H$

$M_{12} = 0 \cdot 5H, M_{23} = 1H, M_{13} = 1H$

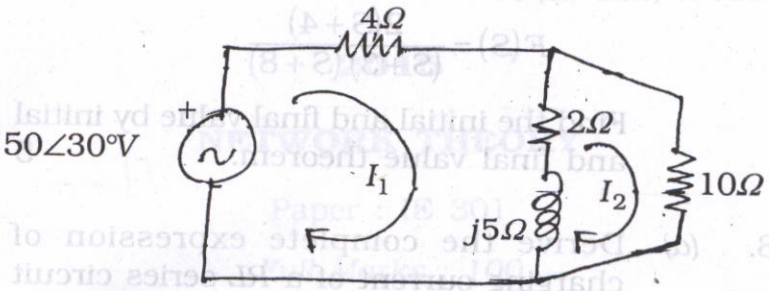
(c) For the following network capacitors, find the equivalent capacitance between terminals X and Y. 4



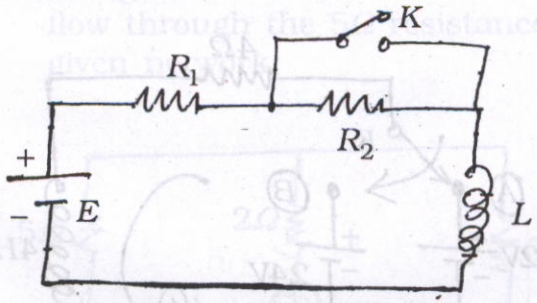
6. (a) Using Norton's equivalent circuit, find the current in the 6Ω resistor of the given network — 8



(b) Find the drop across 4Ω and 10Ω resistors using mesh analysis. 12



7. (a) In the following circuit, the battery voltage is applied for a steady-state period. Obtain the complete expression for the current after closing the switch K. Assume, $R_1 = 1\Omega$, $R_2 = 2\Omega$, $L = 1H$, $E = 10V$. Use Laplace Transform method. 10



(b) Find the inverse Laplace Transform of— 5

$$F(S) = \frac{S-1}{S(S+1)^3}$$

(c) A function in Laplace domain is given by

$$F(S) = \frac{2(S+4)}{(S+3)(S+8)}$$

Find the initial and final value by initial and final value theorem. 5

8. (a) Derive the complete expression of charging current of a *RL* series circuit with DC excitation. Also draw the current versus time graph. What do you mean by time constant? 10

(b) Find $i(t)$ following switching of K at $t = 0$ in the circuit shown below, from (A) to (B). 10