Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.Tech (EIE)/SEM-3/EE-301(EI)/2010-11

2010-11

CIRCUIT THEORY & NETWORKS

Time Allotted : 3 Hours | *Full Marks* : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

GROUP – A

(Multiple Choice Type Questions)

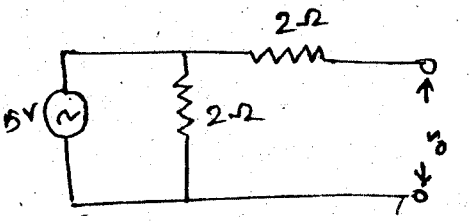
1. Choose the correct alternatives for any *ten* of the following : $10 \times 1 = 10$

   i) Which of the following represents the Laplace transform of an impulse function of strength A ?

   a) A b) A/S

   c) AS d) none of these.

   ii) Thevenin's equivalent resistance of the given circuit is



   a) 2 Ω b) 0 Ω

   c) 1 Ω d) 3 Ω

iii) A series resonant circuit at resonance is called

a) an acceptor circuit

b) a rejecter circuit

c) an oscillator circuit

d) none of these.

iv) An impedance (3 + j5) ohm is connected in series with a 10 V, 50 Hz source. What is the real power drawn by the impedance ?

a) 8·83 W b) 14·7 W

c) 17·15 W d) 13·27 W.

v) When a series R-C circuit is connected to a constant voltage at t = 0, the current passing through the circuit at t = 0+ is

a) infinite b) zero

c) V/R d) V/ωC.

vi) When two coils having self-inductance of L_1 & L_2 are coupled through a mutual inductance M, the coefficient of coupling, K is given by

a) $K = \frac{M}{\sqrt{2 L_1 L_2}}$ b) $K = \frac{M}{\sqrt{L_1 L_2}}$

c) $K = \frac{2M}{\sqrt{L_1 L_2}}$ d) $K = \frac{L_1 L_2}{M}$.

vii) Two wattmeter method of power measurement can be used to measure power in

a) balanced circuit b) unbalanced circuit

c) both (a) & (b) d) none of these.

viii) An RLC series circuit consists of a resistance 1 k. ohm, an inductance of 0·1 H and a capacitance of 10. The Q factor of the circuit will be

a) 100 b) 50

c) 10 d) 1/100.

ix) A resistor carries simultaneously a DC of 10 A and a sinusoidal AC peak value of 10 A. The rms value of the current will be

a) 20 A b) 17.08 A

c) 14.14 A d) 12.24 A

x) Two equal impedances $10 \angle 60^\circ$ are connected in parallel. Their equivalent impedance will be

a) $20 \angle 60^\circ$ b) $10 \angle 120^\circ$

c) $15 \angle 120^\circ$ d) $5 \angle 60^\circ$.

xi) Norton's equivalent circuit consists of

a) voltage source in parallel with impedance

b) voltage source in series with impedance

c) current source in series with impedance

d) current source in parallel with impedance.

xii) The principles of homogeneity and superposition are applied to

a) linear time variant systems

b) non-linear time variant systems

c) linear time invariant systems

d) non-linear time invariant systems.

GROUP – B

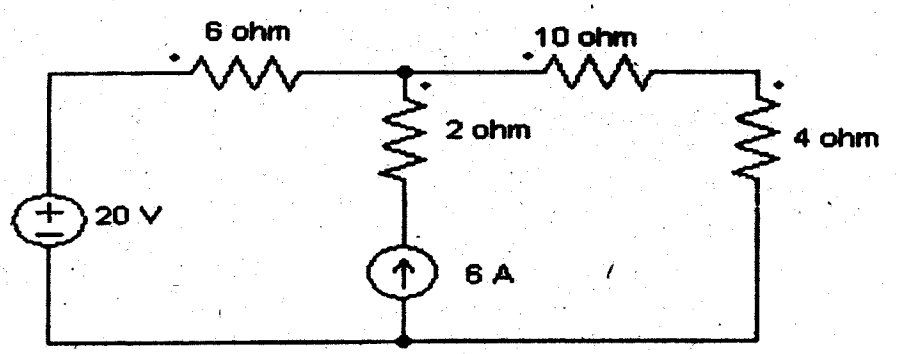
(Short Answer Type Questions)

Answer any *three* of the following. 3 × 5 = 15

2. a) State & prove the maximum power transfer theorem. 3

b) Show that the efficiency for maximum power transfer theorem is 50%. 2

3. Using Mesh analysis, find the current through 4 Ω resistance for the circuit as shown in figure.



4. A voltage $v(t) = 100 \sin 10t$ is applied to series RLC circuit where, R = 40 ohm, L = 13H, C = 10F. Find

   a) the power supplied by the source

   b) the reactive power supplied by the source

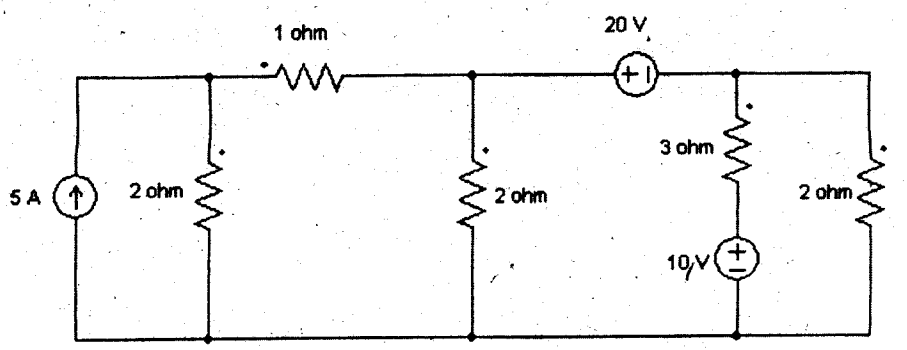
   c) the reactive power of the capacitor

   d) the power factor of the circuit.

5. a) Two refrigerators are supplied from same *a.c.* mains. The first refrigerator draws a current of 2A at a power factor of 0·70 and the two together draw a current of 5A at a power factor of 0·64. Assuming that the current lags in both the cases, calculate the current drawn by the second refrigerator and power factor. 2

   b) Two series R-L-C circuits consist of $L1$, $C1$, $R1$ and $L2$, $C2$, $R2$ respectively having same resonate frequency. Show that if the two circuits are joined in series, the combined circuit will also resonate at the same frequency. 3

6. Calculate the current in 3 Ω resistance by Nodal analysis for the circuit shown in figure.



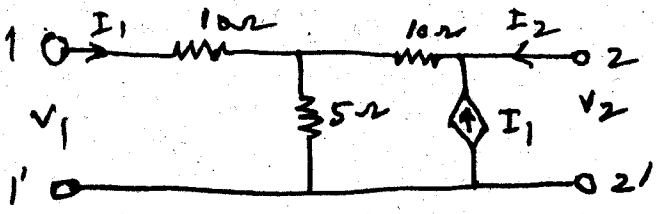
GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. $3 \times 15 = 45$

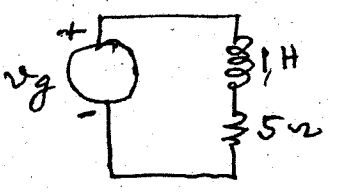
7. a) What are Z parameters of a 2-port network ? Express them in terms of h-parameters.

   b) Determine the Z-parameters of the network shown and thus show that the circuit is neither reciprocal nor symmetrical.



8. a) A voltage of 125 V at 60 Hz is applied across a non-inductive resistor connected in series with a capacitor. The current is 2·2 A. The power loss in the resistor is 96·8 W and that in the capacitor is negligible. Calculate the resistance and capacitance. 5

   b) In the circuit shown by $V_g = 10 + 2 \sin 4t + \sin 10t$, determine the power consumed by and the p.f. of the circuit. 10



9. a) Find the expression of mutual inductance in the series connection of two mutually coupled coils, when the two coils assist each other, the effective inductance is L_A and when the two coils oppose each other, the effective inductance is L_B. 8

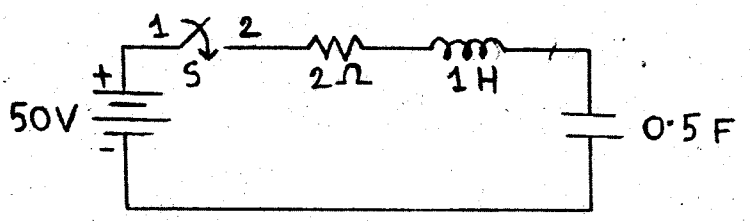
b) Two coils $L_1 = 400\,\mu H$ and $L_2 = 100\,\mu H$ are magnetically coupled. The coefficient of coupling between two coils is 0·1. Calculate effective inductance if two coils are connected in

i) series adding

ii) series opposing. 7

10. a) Determine the Laplace transform of $F(t) = \left[2 - 2e^{\wedge}(-t)\right]/t$. 6

b) In the series R-L-C circuit as shown, there is no initial charge on the capacitor. If the switch is closed at t = 0, determine the resulting current at i (t). 9



11. a) Two coils $L_1 = 2H$ and $L_2 = 4H$ are magnetically coupled. The coefficient of coupling between two coils is 0·3535. Calculate effective inductance if two coils when connected in

i) series adding

ii) series opposing. 6

b) A balanced delta-connected load having an impedance $Z_L = (300 + j210)$ ohm in each phase is supplied from a 400 V, 3-phase supply through a 3-phase line having an impedance of $Z_S = (4 + j8)$ ohm in each phase. Find the total power supplied to the load as well as the current and voltage in each phase of the load. 9