

Name : .....

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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

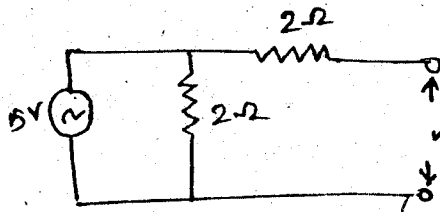
*The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.***GROUP - A****( Multiple Choice Type Questions )**

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 |

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- 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)  $V/\omega C$ .
- 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)  $K = \frac{L_1 L_2}{M}$ .

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- 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.

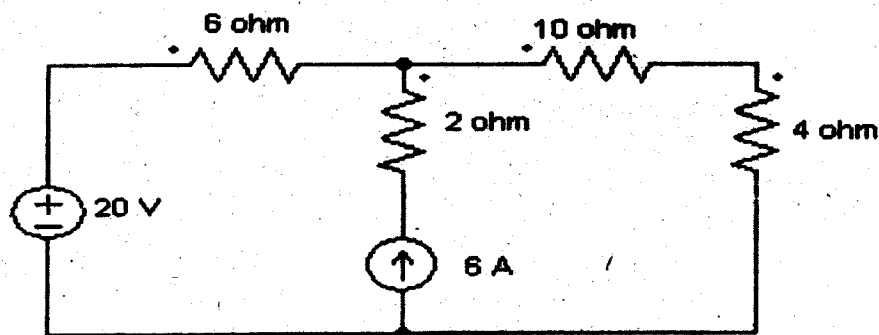
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xii) The principles of homogeneity and superposition are applied to

- a) linear time variant systems
- b) non-linear time variant systems
- c) linear time invariant systems
- d) non-linear time invariant systems.

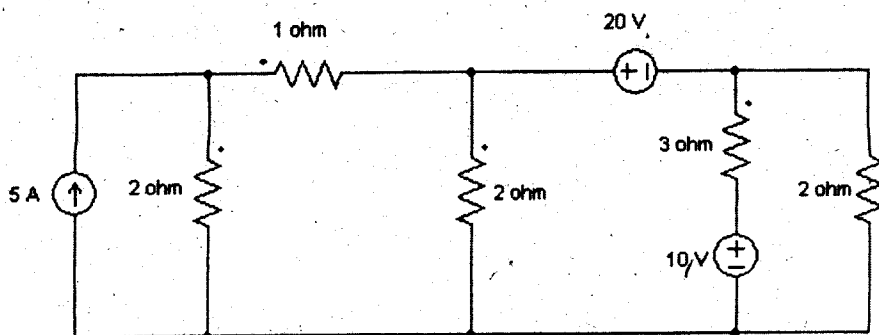
**GROUP - B****( Short Answer Type Questions )**Answer any *three* of the following. $3 \times 5 = 15$ 

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  $4 \Omega$  resistance for the circuit as shown in figure.



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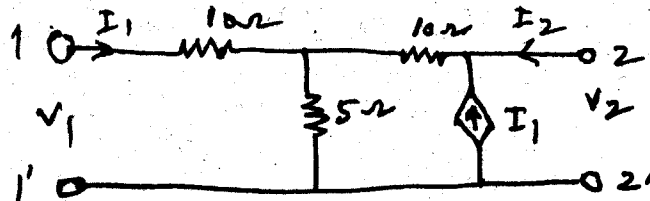
4. A voltage  $v(t) = 100 \sin 10t$  is applied to series RLC circuit where,  $R = 40 \text{ ohm}$ ,  $L = 13\text{H}$ ,  $C = 10\text{F}$ . Find
- the power supplied by the source
  - the reactive power supplied by the source
  - the reactive power of the capacitor
  - the power factor of the circuit.
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  $L_1$ ,  $C_1$ ,  $R_1$  and  $L_2$ ,  $C_2$ ,  $R_2$  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  $3 \Omega$  resistance by Nodal analysis for the circuit shown in figure.



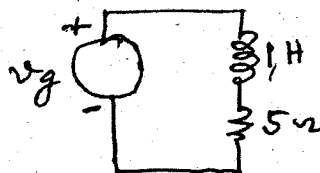
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**GROUP - C****( Long Answer Type Questions )**Answer any *three* of the following.  $3 \times 15 = 45$ 

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



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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

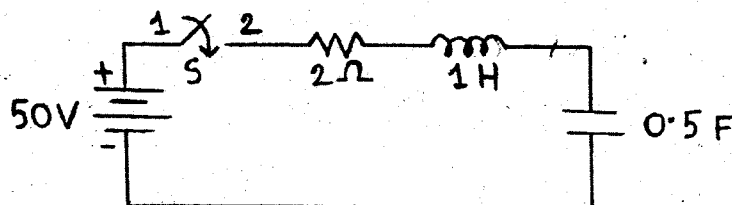
- b) Two coils  $L_1 = 400 \mu H$  and  $L_2 = 100 \mu H$  are magnetically coupled. The coefficient of coupling between two coils is 0.1. Calculate effective inductance if two coils are connected in

i) series adding

ii) series opposing. 7

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



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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.

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