CIRCUIT THEORY & NETWORK ANALYSIS
(AEIE 2103)

Time Allotted : 3 hrs **Full Marks : 70**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 5 (five) from Group B to E, taking at least one from each group.

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

Group – A
(Multiple Choice Type Questions)

1. Choose the correct alternative for the following: **10 × 1 = 10**

(i) A current dependent current source is realized using a/an
(a) inductor (b) bipolar junction transistor
(c) field effect transistor (d) diode

(ii) A reciprocal circuit should have
(a) only one independent source (b) at least two independent sources
(c) one dependent source (d) independent and dependent sources

(iii) Superposition theorem is not applicable for
(a) voltage calculations (b) current calculations
(c) power calculations (d) none of the above

(iv) In a series RL circuit, voltages across the resistor and the inductor are 3 V and 4 V respectively, then the applied voltage is
(a) 3V (b) 4V (c) 5V (d) 7V

(v) Two ideal current sources of $I_1 = 2$ A and $I_2 = 3$ A are connected in series as show in the Fig.1.

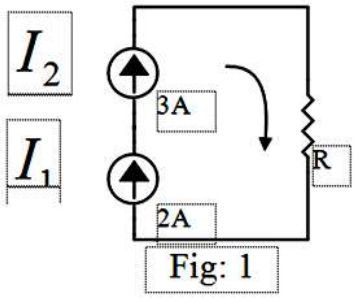

Fig: 1

The current through R will be
(a) 2A (b) 3A (c) $\sqrt{3^2 + 2^2}$ (d) cannot be determined

(vi) Which of the followings is correct for Z_{21} in a two-port network?

(a) $\frac{Y_{11}}{\det Y}$ (b) $\frac{-Y_{21}}{\det Y}$ (c) $-\frac{Y_{21}}{\det Y}$ (d) $\frac{Y_{22}}{\det Y}$

(vii) An active low pass filter with RC passive components has the cut-off frequency

(a) $\frac{1}{2\pi RC}$ (b) $2\pi RC$ (c) $2\pi\sqrt{RC}$ (d) $\frac{1}{2\pi\sqrt{RC}}$

(viii) The function of an Inductor is to oppose any change in_____.

(a) current (b) voltage

(c) voltage and current. (d) neither voltage nor current.

(ix) The voltage and current in a circuit are given by $v(t)=10\sin(t+30°)$ and $i(t)=10\sin(t-30°)$. The power consumed in the circuit is

(a) 25 W (b) 50 W (c) 100 W (d) 12.5 W

(x) If R and L are connected to a supply voltage (v) through an initially open toggle switch, the value of the currents at t=0 and infinity through the inductor after the closure of the switch will be respectively

(a) V/R, 0 (b) 0, V/R (c) ∞, 0 (d) 0, ∞

Group – B

2. (a) Find the current through the resistor R in the circuit shown in Fig. 2.

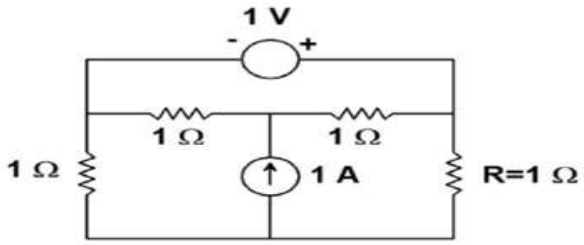

Fig. 2

(b) Find the potential difference across the 2Ω resistor in the circuit of Fig.3.

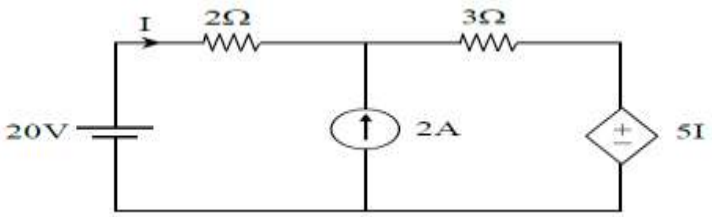

Fig. 3

6 + 6 = 12

3. (a) State and proof Maximum power transfer theorem for a DC circuit.

(b) For the circuit shown in Fig.4, use superposition theorem to compute current I.

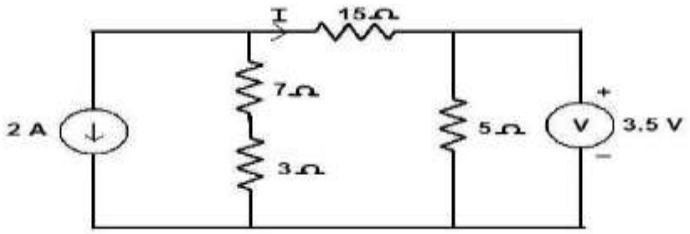

Fig.4

6 + 6 = 12

Group – C

4. (a) Derive the condition of resonance of a series RLC circuit. If the resistance in that circuit is doubled then what change in the resonating frequency will be observed? Justify.

(b) An RLC circuit, connected to a sinusoidal current source as shown in the Fig. 5, is under resonance. Find the ratio of the magnitudes of the I_L and I_R.

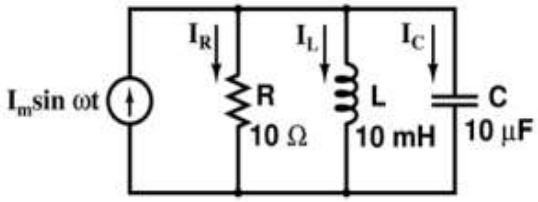

Fig.5

(4 + 2) + 6= 12

5. (a) What is the co-efficient of coupling in a magnetically coupled circuit? What is its practical range?
For the circuit in the Fig. 6, the following data are given:
(i) 45% of the primary flux gets linked with the secondary
(ii) $i_1(t) = 4 \sin 2t$ A
(iii) i_2=0 A.
Find
(A) the coefficient of coupling and
(B) v_2.

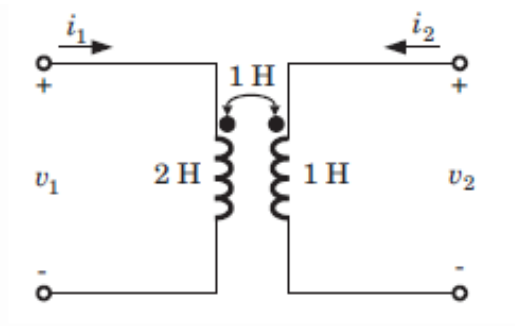

Fig. 6

(b) In a RLC Series resonance circuit, R = 10 Ω, L = 20 mH and C = 0.5 μF. Find (i) Quality factor and (ii) Bandwidth

(1 + 1 + 3 + 3) + (2 + 2) = 12

Group – D

6. (a) Derive Z-parameters of the network shown in the Fig.7.

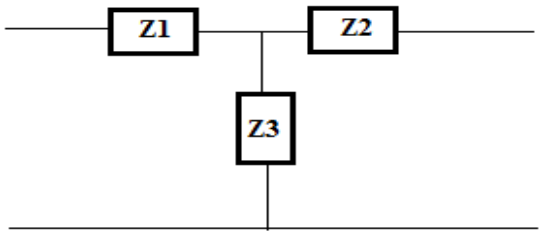

Fig. 7

Where, Z1= (3+j4) Ω, Z2= 3 Ω and Z3= (3-j4) Ω.
Justify the symmetry and Reciprocity of the network.

(b) Express Z- parameters in terms of h-parameters.

(4 + 2) + 6 = 12

7. (a) A 0.1 capacitor charged to 10 V is discharged through a 1KΩ resistor. Find the time required for the voltage across the capacitor to drop to 1V.

(b) In the circuit shown in the Fig.8, the initial charge on the capacitor is 0 (zero) coulomb. Find an expression of the rate of change of current through the capacitor for t >0 after the switch is closed at t=0 second.

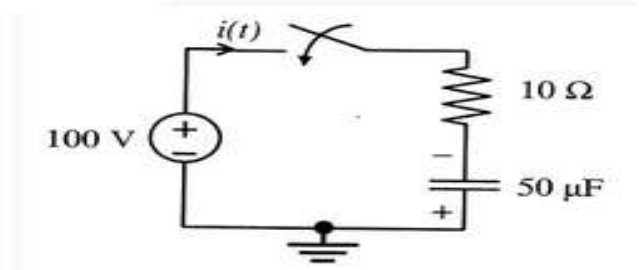

Fig. 8

5 + 7 = 12

Group – E

8. (a) Draw the scheme of realizing a band pass filter.

(b) Analyze the circuit in Fig. 9 to determine the type of the filter.

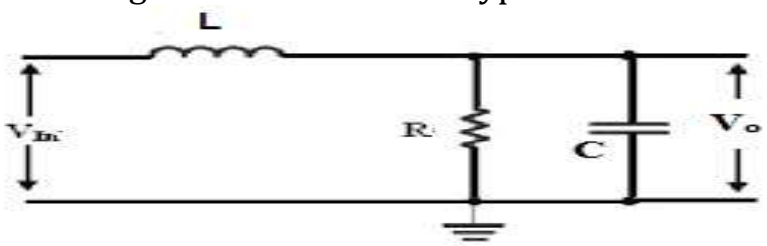

Fig. 9

If the components L and C in Fig. 9 are transposed then what type of filter may be realized?

4 + (4 + 4) = 12

9. (a) Find the Y-parameters for the circuit shown in Fig. 10.

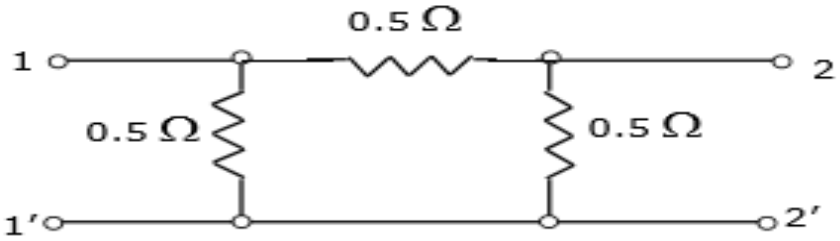

Fig. 10

(b) Find the Thevenin's equivalent resistance across the terminals a and b of the circuit in Fig. 11.

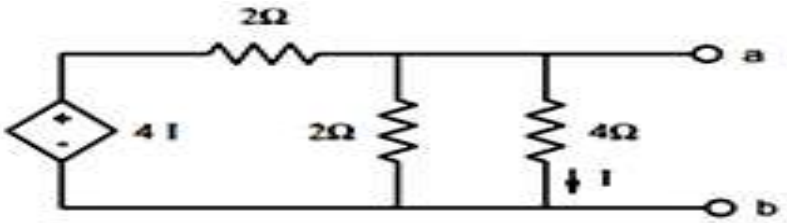

Fig. 11

6 + 6 = 12

Department & Section	Submission Link
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