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06ES34

Third Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Network Analysis

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions.***

1 a. Calculate the current through 2 ohm resistor in the network shown in figure Q1(a) by source transformation method. **(06 Marks)**

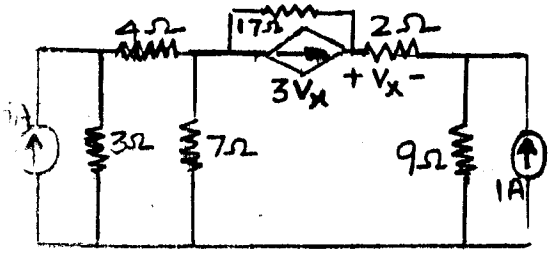

Fig. Q1 (a)

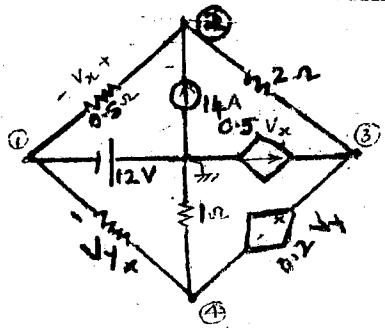

Fig. Q1 (b)

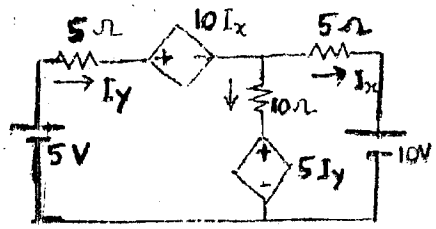

Fig. Q1 (c)

b. Find the voltages at nodes 1, 2, 3, 4 for the network shown in figure Q1 (b) using nodal analysis. **(07 Marks)**

c. Using mesh analysis find the current through 10 ohm resistor in the network shown in figure Q1 (c). **(07 Marks)**

2 a. Find the maximum possible number of trees for the network shown in figure Q2 (a).

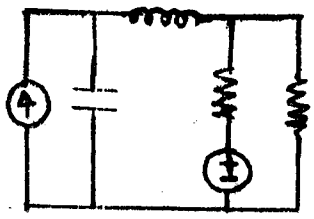

Fig. Q2 (a)

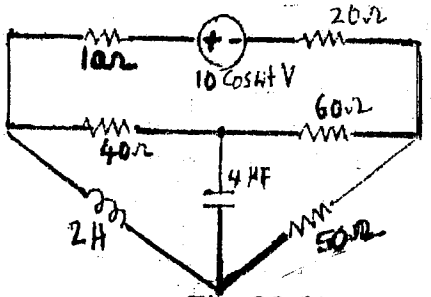

Fig. Q2 (b)

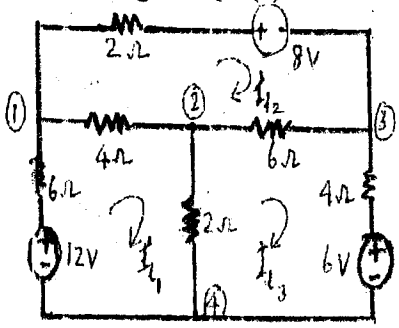

Fig Q 2(c)

b. Draw the dual of the network shown in figure Q2 (b). **(06 Marks)**

c. For the network shown in figure Q2 (c), calculate I_{l_1}, I_{l_2}, I_{l_3} using graph theory and network equilibrium equation based on KVL. **(10 Marks)**

3 a. Using superposition principle, find the current in 6 ohm resistor in the network shown in figure Q3 (a). **(06 Marks)**

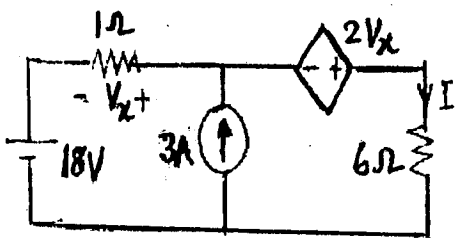

Fig. Q3 (a)

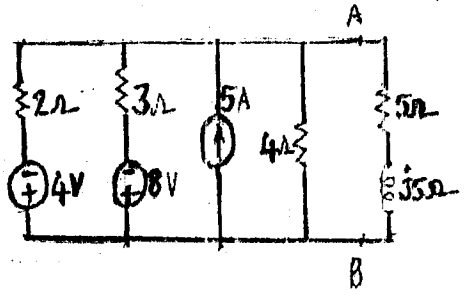

Fig. Q3 (c)

b. State and explain reciprocity theorem. **(07 Marks)**

c. Find Thevenin's equivalent circuit across AB using Millman's theorem and find the current through the load (5+J5)Ω shown in figure Q3 (c). **(07 Marks)**

4 a. Calculate Thevenin's equivalent circuit across AB for the network shown in figure Q4 (a). **(07 Marks)**

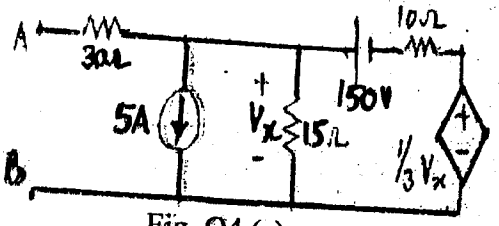

Fig. Q4 (a)

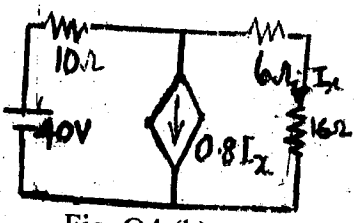

Fig. Q4 (b)

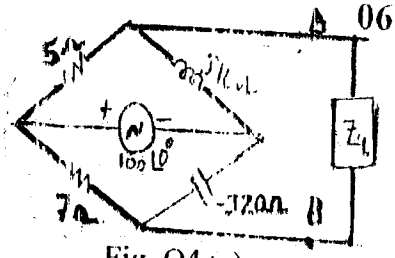

Fig. Q4 (c)

b. State Norton's theorem and find the current through 16 ohm resistor using Norton's theorem in figure Q4 (b). (07 Marks)

c. Find the value of Z_L for which maximum power is transferred to the load Z_L from the network in figure Q4 (c). (06 Marks)

5 a. A series RLC circuit has R = 50 Ω, L = 0.01 H and C = 0.04 μF and is connected to ac source of 100 V. Find the i) resonant frequency ii) Circuit impedance at resonant frequency iii) Maximum value of voltage across capacitance and the frequency at which it occurs iv) Voltage across inductance at resonance. (06 Marks)

b. For the network shown in figure Q5 (b) determine the following: i) f_r ii) Q iii) half power frequencies iv) Band width. (07 Marks)

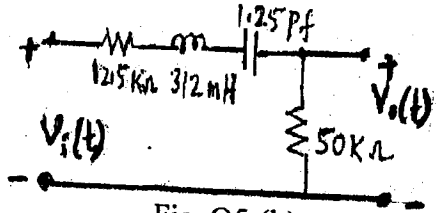

Fig. Q5 (b)

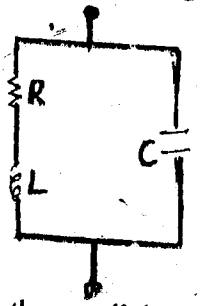

Fig. Q5 (c)

c. Derive the expression for resonant frequency for the parallel resonant circuit shown in figure Q5 (c). If R =25 Ω, L =0.5 H and C = 5μF, find W_0, Q and bandwidth for the circuit. (07 Marks)

6 a. For the network shown in figure Q6 (a), find i_1, i_2, $\frac{di_1}{dt}$, $\frac{di_2}{dt}$, $\frac{d^2i_2}{dt^2}$ at $t = 0^+$. The circuit was in steady state before the closure of the switch. Assume all initial conditions zero. (10 Marks)

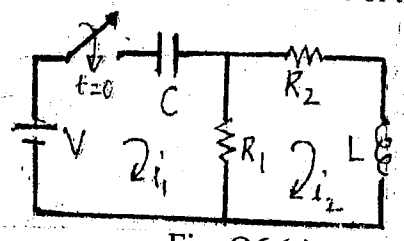

Fig. Q6 (a)

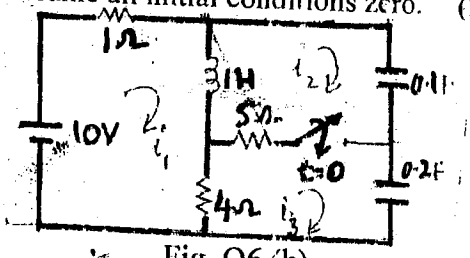

Fig. Q6 (b)

b. The network shown in figure Q6 (b) was in steady state before t = 0. The switch is closed at t = 0. Determine the three mesh currents i_1, i_2, i_3 at $t = 0^+$. (10 Marks)

7 a. The network shown in figure Q7 (a) was in steady state before t = 0. The switch is opened at t = 0. Find i(t) for t > 0 using Laplace transform. (10 Marks)

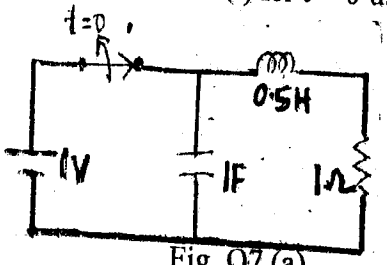

Fig. Q7 (a)

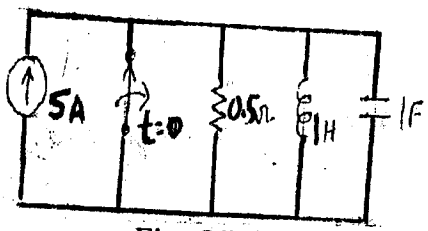

Fig. Q7 (b)

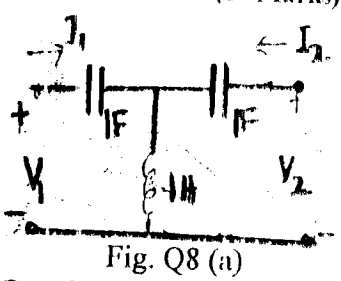

Fig. Q8 (a)

b. For the network shown in figure Q7 (b) find the voltage across 0.5 Ω resistor, when the switch is opened at t = 0. Assume all initial conditions zero. (10 Marks)

8 a. Determine the h-parameters for the network shown in figure Q8 (a). (10 Marks)

b. Z – parameters of a network are obtained from an experiment. Explain how Y-parameters and transmission parameters can be computed from the experimental data. (10 Marks)

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06ES34

Third Semester B.E. Degree Examination, June / July 08
Network Analysis

Time: 3 hrs. Max. Marks:100

Note : ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART - A

1 a. Explain mesh method of analysis. **(06 Marks)**

b. Calculate the power delivered by the source in the circuit, shown in Fig. Q 1(b) using node method. **(14 Marks)**

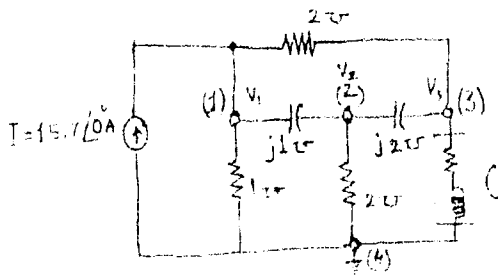

Fig. Q 1(b)

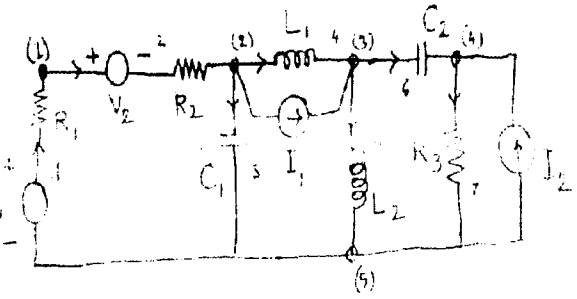

Fig. Q 2(a)

2 a. Obtain the complete incidence matrix for the network shown in Fig. Q 2(a) after writing its graph and oriented graph. **(05 Marks)**

b. For the network shown in Fig. Q 2(b) write the tie set schedule, tie set matrix and obtain equilibrium equation in matrix form using KVL, calculate loop currents. Follow the same orientation and branch numbering as shown in Fig. Q 2(b). Use branches 4, 5 and 6 as tree branches. **(15 Marks)**

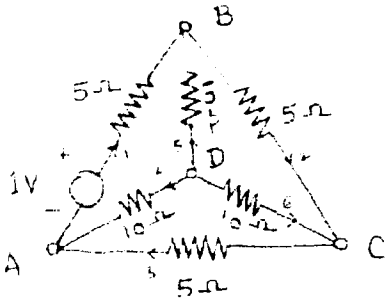

Fig. Q 2(b)

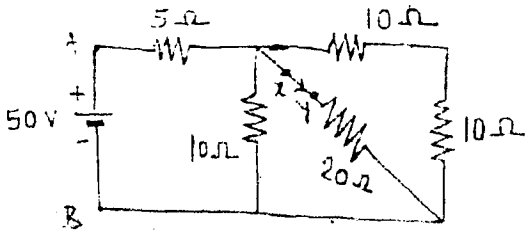

Fig. Q 3(c)

3 a. Define the following theorems.

i) Super position theorem ii) Reciprocity theorem. **(04 Marks)**

b. State and prove Millman's theorem. **(06 Marks)**

c. Show the validity of reciprocity theorem for the following circuit given in Fig. Q 3(c) for AB and XY ports. **(10 Marks)**

4 a. State the following theorems –

i) Norton's theorem ii) Maximum power transfer theorem. **(04 Marks)**

b. State and prove Thevenin's theorem. **(07 Marks)**

c. Find the Thevenin's equivalent circuit of the network shown in Fig. Q 4(b) across load.

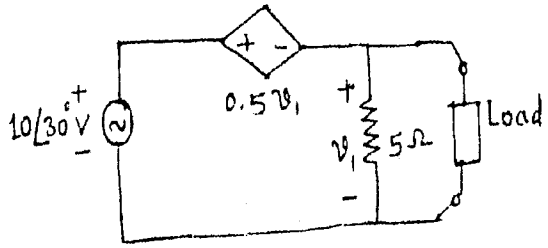

Fig. Q 4(c) **(09 Marks)**

PART - B

5 a. Define the following terms – i) Resonance, ii) A – factor, iii) Selectivity, iv) Band Width. (04 Marks)

b. Derive the expression for parallel resonance circuit. Containing resistance in both the branches. (06 Marks)

c. A series R L C circuit has R = 10 Ω, L = 0.01 H and C = 0.01 μ F and it is connected across 10 mV supply. Calculate – i) f_0 ii) Q_0 iii) Band Width iv) f_1 and f_2, v) Io. (10 Marks)

6 a. Why to study initial conditions? (03 Marks)

b. For the network diagram shown in Fig. Q6 (b) find out $i(0^+)$, $\frac{di(0^+)}{dt}$ and $\frac{d^2i(0^+)}{dt^2}$, take $V_c(0) = 0$ if K is closed at t = 0. (07 Marks)

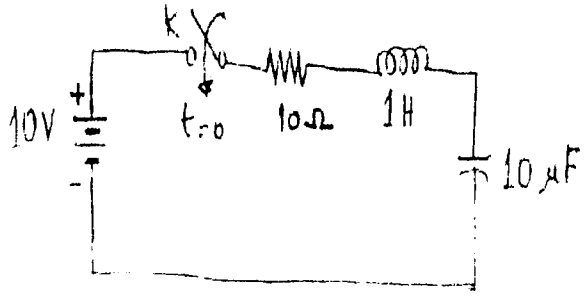

Fig. Q 6(b)

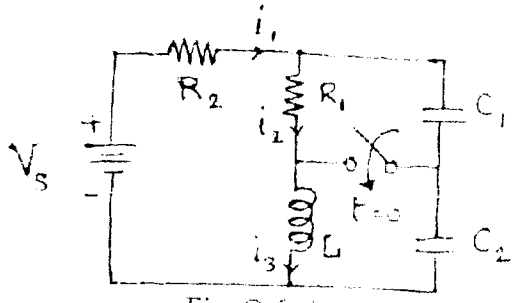

Fig. Q 6(c)

c. Determine the currents at t = (0^+) for the circuit shown in Fig. Q 6(c). (10 Marks)

7 a. Define impulse function. Draw diagram of approximate impulse function. Obtain L. T of impulse function. (05 Marks)

b. For the circuit shown in Fig. Q 7(b) find out the current i(t) if K is closed at t = 0. use L. T. method. (05 Marks)

c. Find the equivalent impedance for the circuit, shown in Fig. Q 7(c) L. T. (10 Marks)

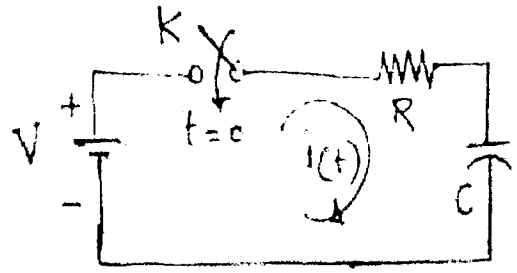

Fig. Q 7(b)

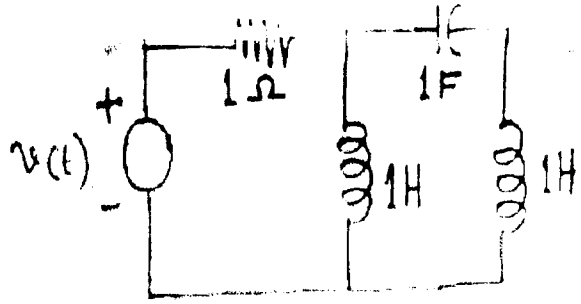

Fig. Q 7(c)

8 a. What is the use of hybrid parameters? Define hybrid parameters. (05 Marks)

b. Derive expressions for Y – parameters in terms transmission parameters. (05 Marks)

c. For the network shown in Fig. Q 8 (c) obtain the O.C. impedance parameters.

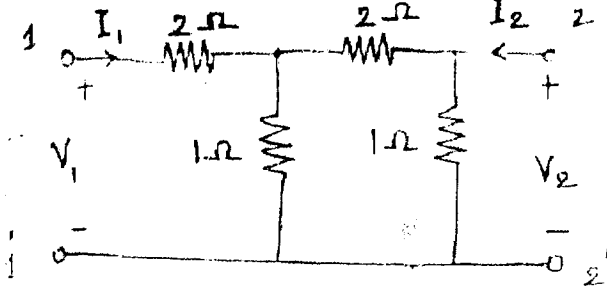

Fig. Q 8(c) (10 Marks)

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06ES34

Third Semester B.E. Degree Examination, Dec.08/Jan.09
Network Analysis

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Explain the node method of analysis. **(04 Marks)**

b. Determine the current through load resistor, R for the network shown in Fig.1(b), using mesh method. **(06 Marks)**

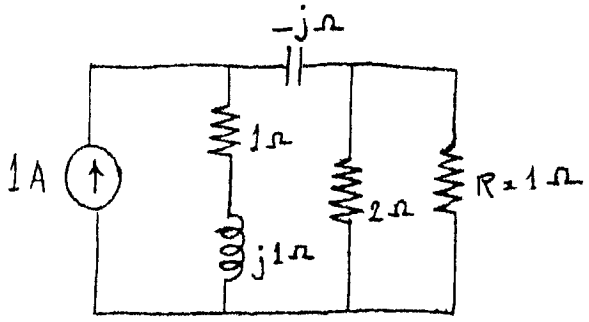

Fig.1(b)

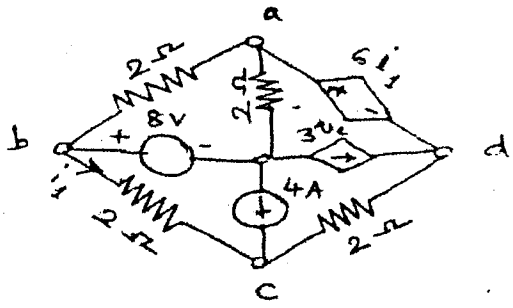

Fig.1(c)

c. For the network shown in Fig.1(c), find the node voltages v_d & v_c. **(10 Marks)**

2 a. Define the following and give one example of each:
(i) Network graph (ii) Tree (iii) Tie set (iv) Cut set. **(06 Marks)**

b. For the circuit diagram shown in Fig.2(b), write the f-cut set matrix & hence obtain the equilibrium equation on node basis & obtain tree branch voltages. Take tree of the graph containing branches (1) & (3) and same orientation as shown in figure. **(14 Marks)**

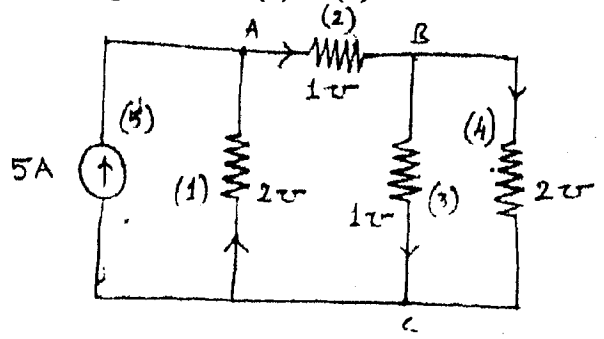

Fig.2(b)

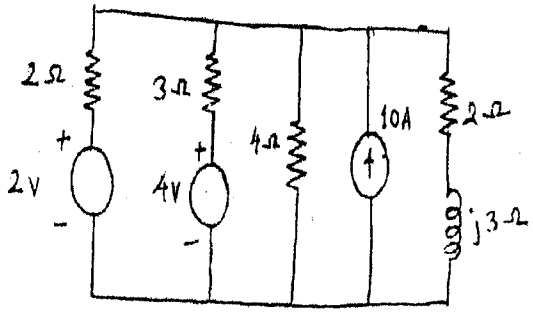

Fig.4(c)

3 a. State the superposition theorem. **(02 Marks)**

b. State and prove the reciprocity theorem. **(06 Marks)**

c. A source of 100V feeds a load impedance Z_L through a series impedance $Z_s = (25 + j40)\Omega$. (i) Determine the load impedance for maximum power transfer & the value of the max. power. (ii) If the load consists of a purely resistance R_L, find the value of R_L for which the maximum power is transferred & max. power transfer. **(12 Marks)**

4 a. State the Norton's theorem. **(02 Marks)**

b. State & prove Thevenin's theorem. **(06 Marks)**

c. Use Millman's theorem to find current flowing through $(2 + j3)\Omega$ impedance, for circuit given in Fig.4(c). **(12 Marks)**

PART – B

5 a. Define the following terms: (04 Marks)
(i) Resonance (ii) Selectivity (iii) B. W. (iv) Q-factor.

b. Derive the expression for a resonant frequency for a parallel circuit having R in series with L only. (06 Marks)

c. Two coils; one of R_1=0.51Ω, L_1= 32mH & other coil of R_2=1.3Ω, L_2= 15mH are in series and are in series with a capacitor of 25 μF & 62 μF and a series resistor of resistance 0.24 Ω. Determine the following:
(i) Resonant frequency (ii) Q-factor of the circuit (iii) B.W.
(iv) Power dissipated in the circuit at resonant frequency (10 Marks)

6 a. For the network shown in Fig.6(a), the switch is moved from position 1 to position 2 at t=0 the steady state has been reached before switching. Calculate i, di/dt, d^2i/dt^2 at $t=0^+$ (10 Marks)

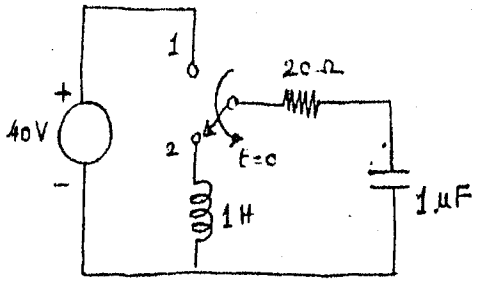

Fig.6(a)

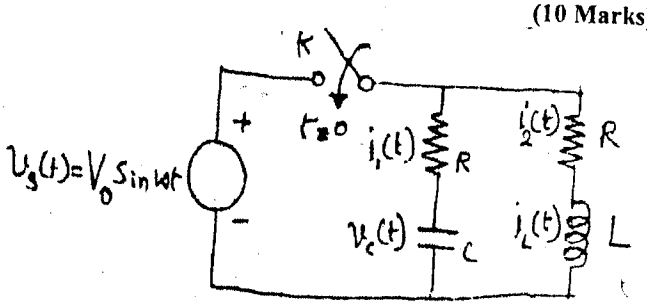

Fig.6(b)

b. For the network shown in Fig.6(b), find out $\frac{di_1(o^+)}{dt}$ & $\frac{di_2(o^+)}{dt}$ when the switch K is closed at t=0. Assume the circuit was not activated before t=0. (10 Marks)

7 a. Define the impulse function & obtain its L.T. (04 Marks)

b. For a series RL circuit shown in Fig.7(b), the switch K is closed at time t=0, find the current i(t) using Laplace transform. (06 Marks)

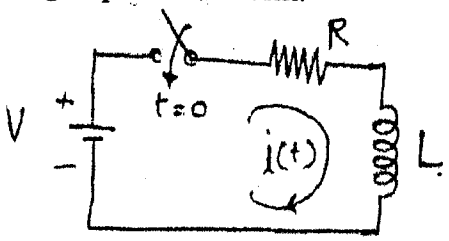

Fig.7(b)

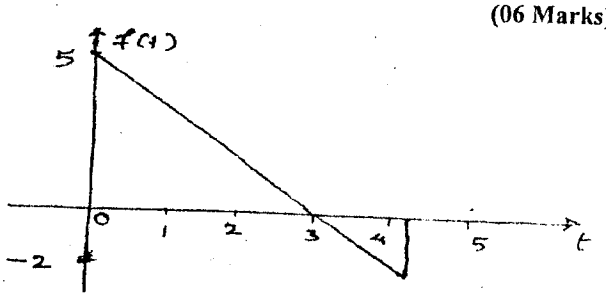

Fig.7(c)

c. Obtain the Laplace transform of F(t) for the waveform shown in Fig.7(c). (10 Marks)

8 a. Define Z-parameters. (04 Marks)

b. Obtain the relationship between T & h parameters i.e. T parameters in terms of h parameters. (06 Marks)

c. Obtain the Y-parameters of the two port network shown in Fig.8(c). (10 Marks)

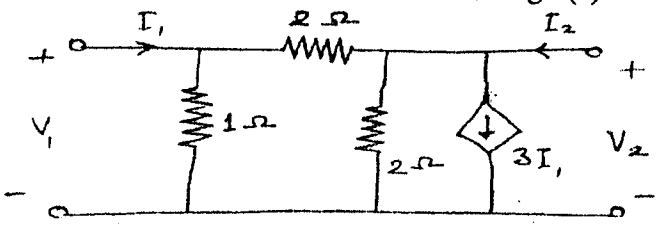

Fig.8(c)

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06ES34

Third Semester B.E. Degree Examination, June-July 2009
Network Analysis

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full question, selecting atleast two question from each part.***

Part A

1 a. Three impedances are connected in star. Obtain expressions for their delta connected equivalent. Also find the star equivalent of the following circuit shown in figure Q1 (b). **(09 Marks)**

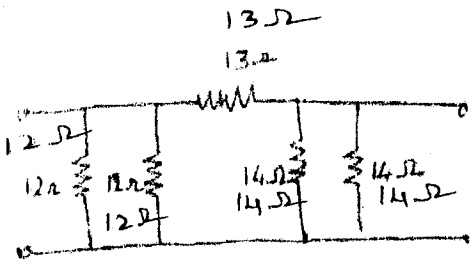


Fig. Q1 (a)

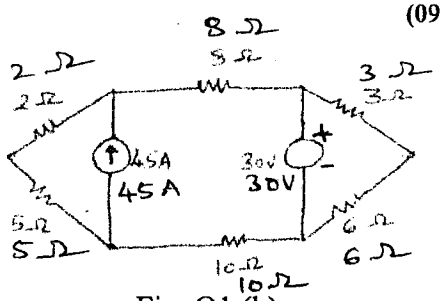


Fig. Q1 (b)

b. Reduce the network shown in figure Q1 (c) to a single voltage source in series with a resistance using source shift and source transformation. **(06 Marks)**

c. Solve for $i_0(t)$ using mesh analysis in the network shown in figure Q1 (c). **(05 Marks)**

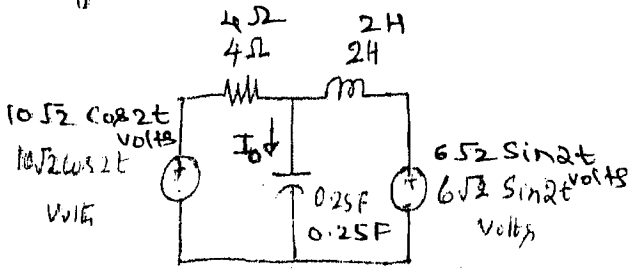


Fig. Q1 (c)

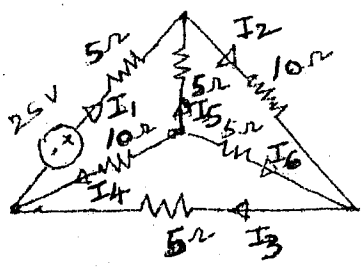


Fig. Q2 (c)

2 a. Define the following terms as applied to network topology with suitable examples,
i) tree and co-tree. ii) Planar and non-planar graphs. **(04 Marks)**

b. The reduced incidence matrix of a graph is given below. Draw the oriented graph corresponding to the same. **(03 Marks)**

$$\begin{bmatrix} -1 & 1 & 0 & 0 & 0 & -1 \\ 0 & -1 & -1 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & -1 & 1 \end{bmatrix}$$

c. For the network shown in figure Q2 (c), write the tie-set schedule selecting center star as tree and find all branch currents by solving equilibrium equation. **(09 Marks)**

d. Define the term duality as applied to networks. Give suitable example. **(04 Marks)**

3 a. State and explain reciprocity theorem. **(06 Marks)**

b. Find the current through load impedance $Z_L = 15\angle -30\Omega$ using Millmans theorem in the circuit shown in figure Q3 (b). **(06 Marks)**

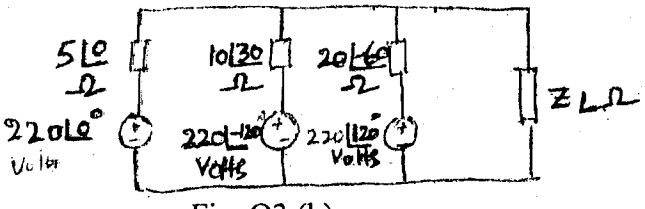


Fig. Q3 (b)

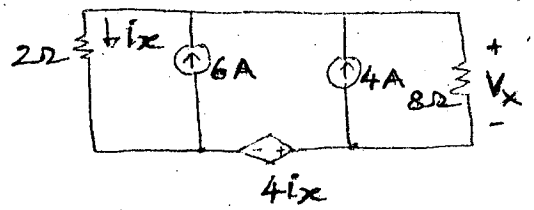


Fig. Q3 (c)

c. Use Superposition theorem to find Vx in the circuit shown in figure Q3 (c). **(08 Marks)**

4 a. State and prove Thevenins theorem. Show that Thevenins equivalent circuit is the dual of Nortons equivalent circuit. (10 Marks)

b. Find the value of R_L for which power transferred to the load is maximum and maximum power. Also establish the condition for maximum power transfer. (10 Marks)

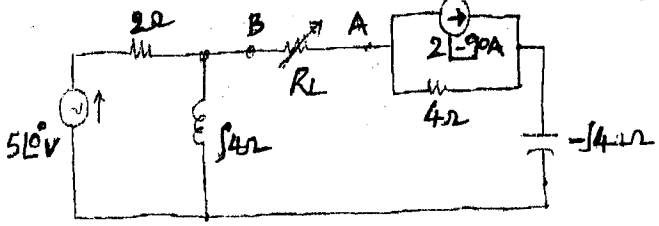


Fig. Q4 (b)

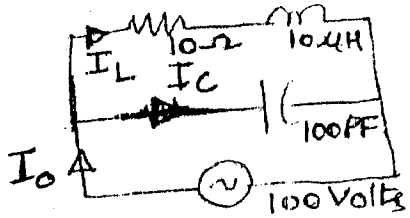


Fig. Q5 (c)

Part B

5 a. Explain the following terms with respect to series resonant circuit i) Selectivity and Band width ii) Q-factor. (05 Marks)

b. In a series resonant circuit, show that resonant frequency is equal to the geometric mean of half power frequencies. (07 Marks)

c. For the parallel resonant circuit shown in figure Q5 (c), find I_O, I_L, I_C, f_O and dynamic resistance. (08 Marks)

6 a. Explain the transient behaviour of the resistance, inductance and capacitance. Also explain the procedure for evaluating transient behaviour. (08 Marks)

b. For the circuit shown in figure Q6 (b), the switch 'K' is changed from position 1 to position 2 at t = 0, steady state condition having been reached in position 1. Find the values of i, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at t = 0. (07 Marks)

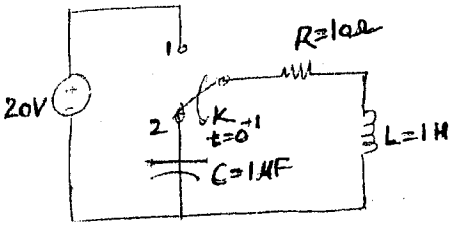


Fig. Q6 (b)

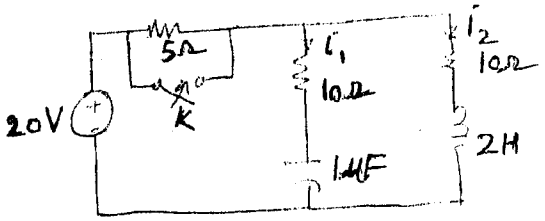


Fig. Q6 (c)

c. In the network shown in figure Q6 (c), the switch 'K' is opened at t = 0 after the network has attained steady state the switch is closed. Find i_1, i_2 at t = 0+ (05 Marks)

7 a. State and prove initial and final value theorem with suitable examples. (08 Marks)

b. Find the Laplace transform of the waveform shown in Fig. Q7 (b). (06 Marks)

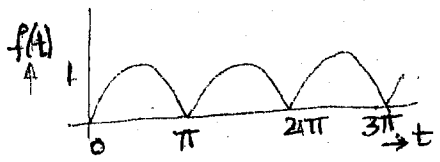
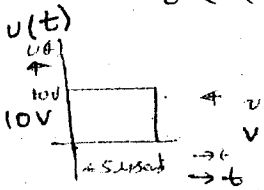


Fig. Q7 (b)



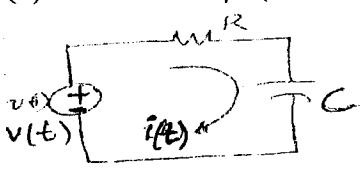


Fig. Q7 (c)

c. A voltage pulse of 10 V magnitude is applied to RC network shown in figure Q7 (c). Find the current i(t) of R = 10 Ω and C = 0.05 μF for the circuit. (06 Marks)

8 a. Express h – parameters in terms of z-parameters and establish the same. (08 Marks)

b. Explain symmetry and reciprocity property of two port networks. (04 Marks)

c. Find the z-parameters of the network shown in figure Q8 (c). (08 Marks)

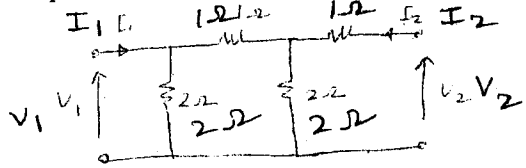


Fig. Q8 (c)

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06ES34

Third Semester B.E. Degree Examination, Dec.09/Jan.10
Network Analysis

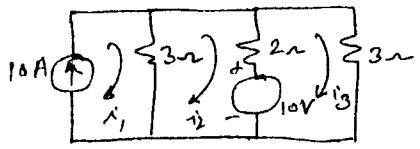
Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Write the mesh equations for the circuit shown in Fig.1 and solve for currents i_1, i_2 and i_3. **(10 Marks)**

Fig.1(a)



b. The node voltage equations of a network are

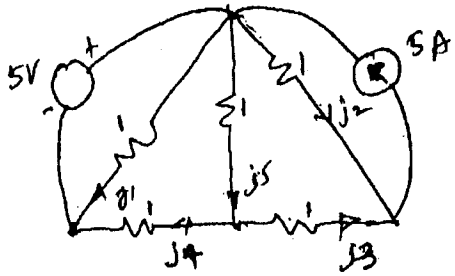
$$\left(\frac{1}{5}+\frac{1}{2}j+\frac{1}{4}\right)v_1-\frac{1}{4}v_2=\frac{50\angle 0^\circ}{5} \text{ and } -\frac{1}{4}v_1+\left(\frac{1}{4}-\frac{1}{j2}+\frac{1}{2}\right)v_2=\frac{50\angle 90^\circ}{2}$$

. Derive the network. **(10 Marks)**

2 a. Define the following terms with respect to the network topology. Give examples.
i) Tree ; ii) Graph ; iii) Sub graph ; iv) Tieset ; v) Cutset. **(08 Marks)**

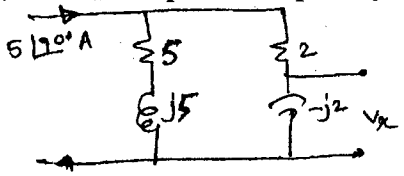
b. For the network shown in Fig.2(b), write the graph and obtain the tieset schedule considering j_1, j_2, j_5 as tree branches. Also calculate all branch currents. **(12 Marks)**

Fig.2(b)



3 a. In the circuit shown in Fig.3(a), find v_x and prove reciprocity theorem. **(10 Marks)**

Fig.3(a)



b. State and explain super position theorem with a suitable example. **(10 Marks)**

4 a. Obtain the Thevenin's equivalent network for the circuit in Fig.4(a) between the terminals X and Y. **(10 Marks)**

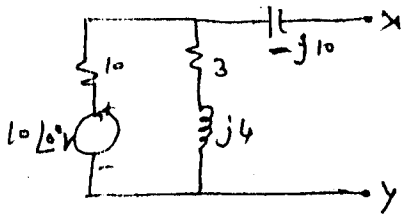


Fig.4(a).

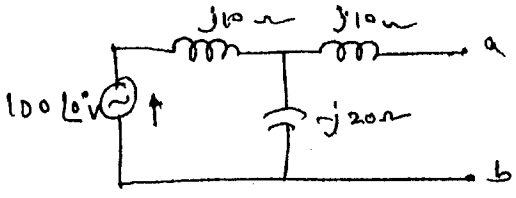


Fig.4(b).

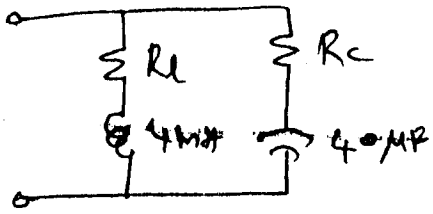
b. What should be the value of pure resistive load to be connected across the terminals a and b in the network shown in Fig. 4(b), so that maximum power is transferred to the load? Calculate the maximum power. **(10 Marks)**

PART – B

5 a. Show that for a series RLC resonant circuit the selectivity $\varphi = \frac{f0}{f2-f1}$, where fo: resonate frequency f1 and f2 are half power frequency. (08 Marks)

b. Determine R_L and R_C for which the circuit shown in Fig.6 resonates at all frequencies. (06 Marks)

Fig.5(b)



c. It is required that a series RLC circuit should resonate at 1 MHz. Determine values of R, L and C if bandwidth of the circuit is 5 kHz and its impedance is 50 Ω at resonance. (06 Marks)

6 a. Explain the importance of study of initial conditions in electric circuit analysis. (06 Marks)

b. Explain the behaviour of R, L and C elements for transients. Mention their representation at the instant of switching. (06 Marks)

c. In the circuit shown in Fig.6(c), the switch is moved from 'a' to 'b' at t = 0. Find the values of i, $\frac{di}{dt}, \frac{d^2i}{dt^2}$ at $t = 0^+$, if R = 1 Ω, L = 1 H, C = 0.1 μF and V = 100 V. Assume steady state is achieved when k is at 'a'. (08 Marks)

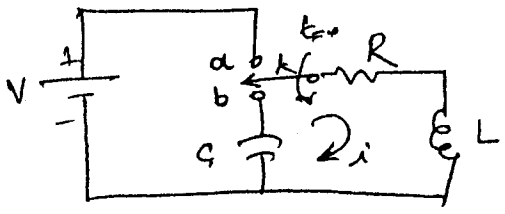


Fig.6(c).

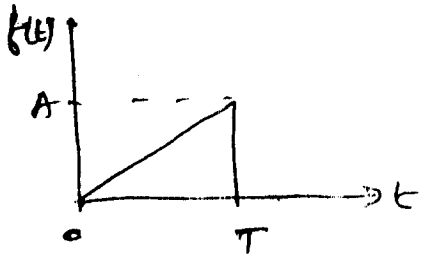


Fig.7(a).

7 a. Obtain the Laplace transform of saw took waveform shown in Fig.7(a). (06 Marks)

b. Find the Laplace transform of i) δ (t) ; ii) t ; iii) e^{-at}. (06 Marks)

c. Find f (o) and f (∞) using initial value and final value theorem for the function given below.

$$F(s) = \frac{s^3 + 7s^2 + 5}{s(s^3 + 3s^2 + 4s + 2)}.$$ (08 Marks)

8 a. Find y parameters for the network shown in Fig.8(a). (08 Marks)

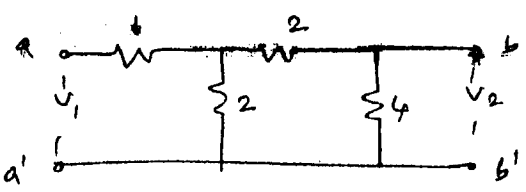


Fig.8(a).

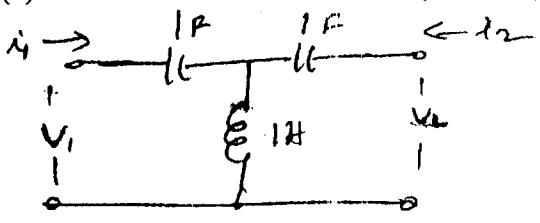


Fig.8(b)

b. Determine the 'h' parameters for the network shown in Fig.8(b). (08 Marks)

c. Mention the application of
i) Transmission parameters ; ii) 'h' parameters ; iii) 'z' parameters. (04 Marks)

* * * * *

6 b. The network shown in Fig.Q6(b), has two independent node pairs; of the switch K is opened at t = 0, find the following quantities at t = 0+.
i) v_1 ii) v_2 iii) dv_1/dt iv) dv_2/dt v) di_L/dt **(10 Marks)**

7 a. In the network shown in Fig.Q7(a), the switch 'K' is closed and the steady state is reached. At t = 0, the switch is opened. Find the expression for the current in the inductor using Laplace transform. **(10 Marks)**

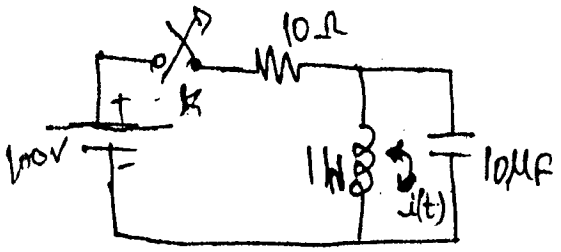


Fig.Q7(a)

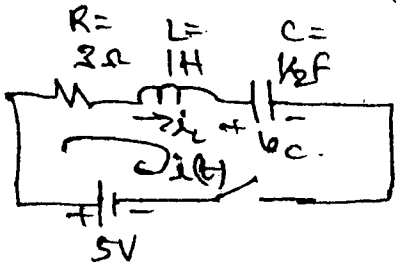


Fig.Q7(b)

b. For the series RLC circuit shown in Fig.Q7(b), the initial conditions are i_{Lo} = 2A and v_{c_o} = 2V. It is connected to a DC voltage of 5V at t = 0. Find the current i(t) after the switching action, using Laplace transform. **(10 Marks)**

8 a. The bridged T-RC network is shown in Fig.Q8(a). For the values given, find the Y and Z parameters. **(10 Marks)**

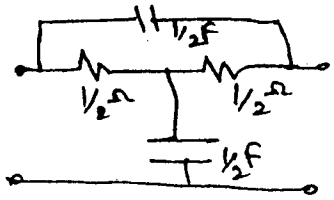


Fig.Q8(a)

b. For the network shown in Fig.Q8(b), determine the ABCD parameters. **(10 Marks)**

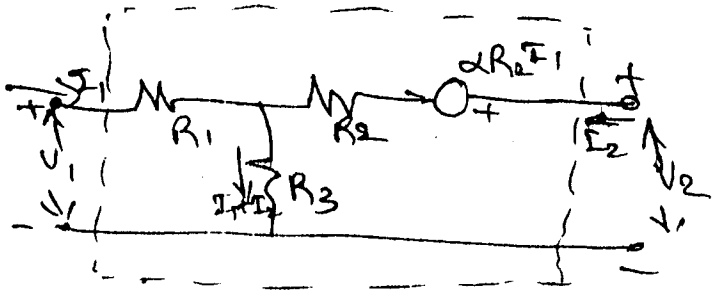


Fig.Q8(b)

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06ES34

Third Semester B.E. Degree Examination, May/June 2010
Network Analysis

Time: 3 hrs Max. Marks:100

Note: ***Answer any FIVE full questions, selecting at least TWO questions from each part.***

PART – A

1 a. Using Y-Δ transformation, find an equivalent resistance between A and B for the network shown in Fig.Q1(a). **(06 Marks)**

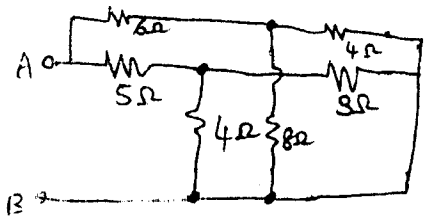

Fig.Q1(a)

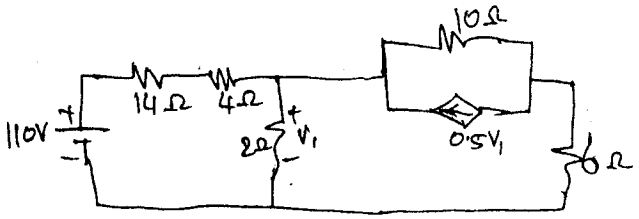

Fig.Q1(b)

b. For the network shown in Fig.Q1(b), find the current through 4Ω and 6Ω resistors. (Use mesh analysis) **(07 Marks)**

c. By using the nodal analysis, find the voltage V_{AB} for the network shown in Fig.Q1(c).

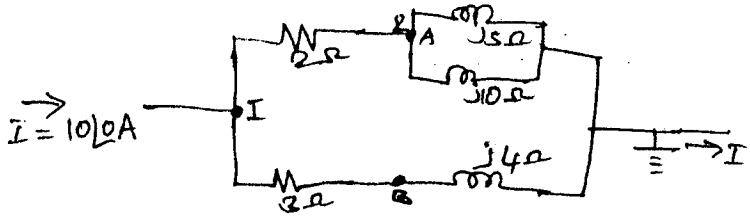

Fig.Q1(c)

(07 Marks)

2 a. For the network shown in Fig.Q2(a), write the Tie set matrix and obtain the network equilibrium equations in matrix form, using KVL. Calculate the loop currents and branch voltages. Choose AD, BD and CD as tree branches (4, 5, 6 branches). **(08 Marks)**

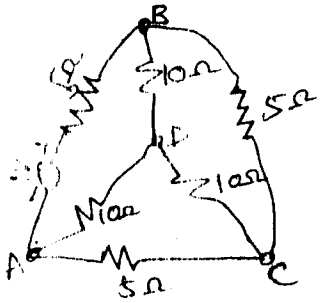

Fig.Q2(a)

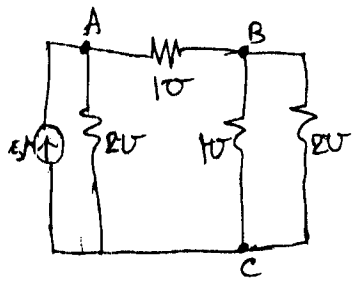

Fig.Q2(b)

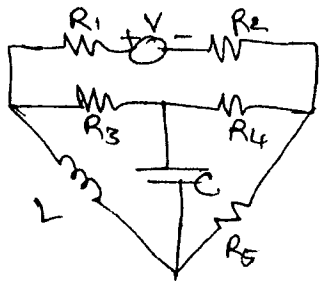

Fig.Q2(c)

b. For the network shown in Fig.Q2(b), write the f-cutset matrix and hence obtain the equilibrium equations on node basis. Choose AC and BC as twigs. **(08 Marks)**

c. For the network shown in Fig.Q2(c), draw the dual network. **(04 Marks)**

3 a. State and explain (i) Reciprocity theorem (ii) Millman's theorem as applied to electrical circuits. **(10 Marks)**

b. By using superposition principle, find the current through the (4+j3) impedance as shown in Fig.Q3(b). **(10 Marks)**

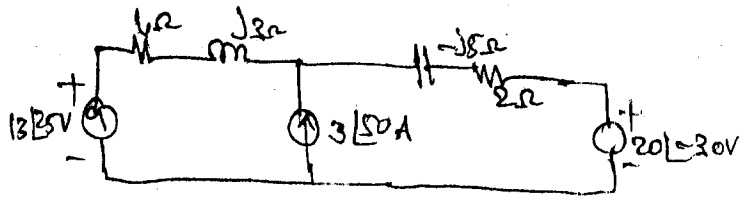

Fig.Q3(b)

4 a. Find the current in the 10Ω resistor in the network shown in Fig.Q4(a), by using Thevenin's theorem. **(06 Marks)**

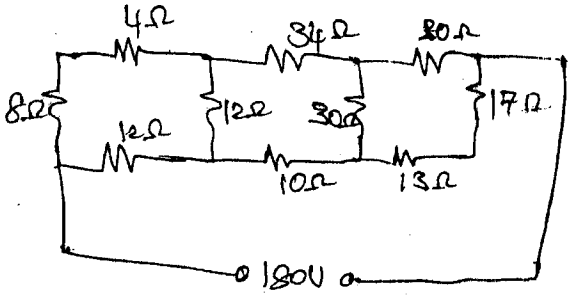

Fig.Q4(a)

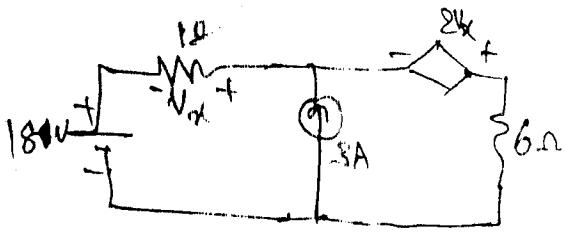

Fig.Q4(b)

b. For the network shown in Fig.Q4(b), find the Thevenin's voltage, short circuit current and determine the actual current flowing through the 6Ω resistor. **(07 Marks)**

c. Find the maximum power transferred to the load Z_L of the network shown in Fig.Q4(c).

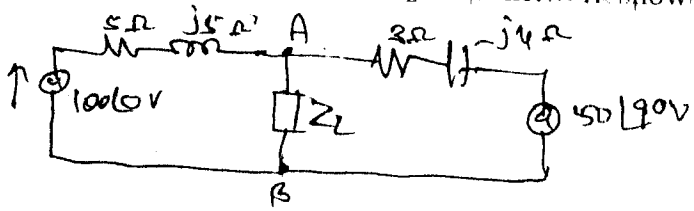

Fig.Q4(c)

(07 Marks)

PART – B

5 a. Determine i) the line current, ii) the power factor and iii) the voltage across the coil, when a coil of resistance 40Ω and inductance of 0.75H forms a part of a series circuit for which the resonant frequency is 55Hz, if the supply is 250V, 50Hz. **(08 Marks)**

b. Give the comparison between the series resonance and parallel resonance. **(04 Marks)**

c. Derive an expression for the resonance frequency of a resonant circuit consisting of $R_L L$ in parallel with $R_C C$. Draw the frequency response curve of the above circuit, indicating the half power frequencies. **(08 Marks)**

6 a. In the network shown in Fig.Q6(a), K is changed from position a to b, at t = 0. Solve for i, $\frac{di}{dt}$ and $\frac{d^2i}{dt^2}$ at t = 0+, if R = 1000Ω, L = 1 H, C = 0.1 μF and V = 100V Assume that the capacitor is initially uncharged. **(10 Marks)**

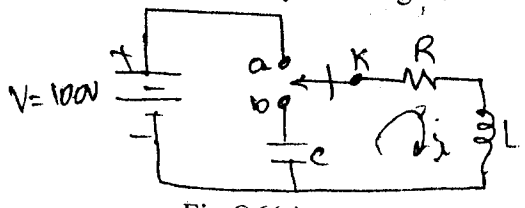

Fig.Q6(a)

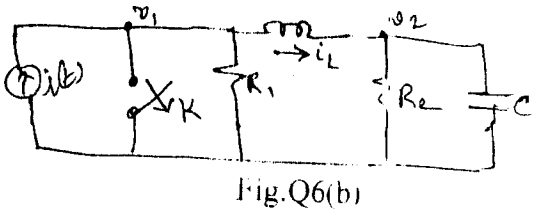

Fig.Q6(b)