Code No: R19ES1217 **R19** SET - 1

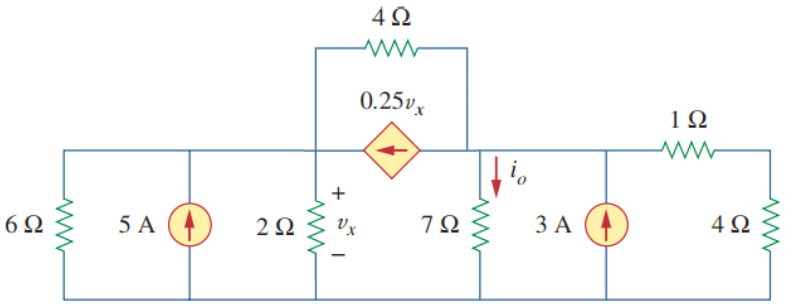
I B. Tech II Semester Regular Examinations, December - 2020
ELECTRICAL CIRCUIT ANALYSIS-I
(Electrical and Electronics Engineering)

Time: 3 hours Max. Marks: 75

Answer any five Questions one Question from Each Unit
All Questions Carry Equal Marks

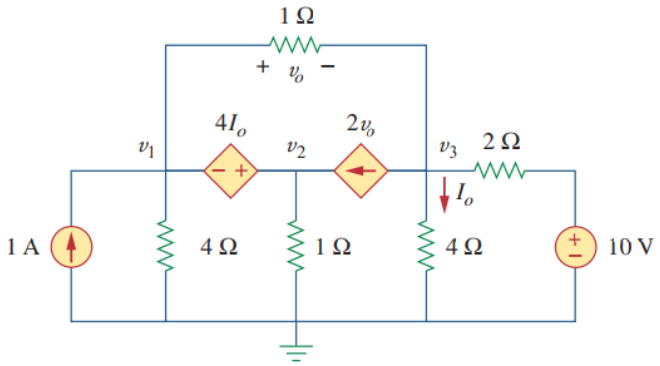
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1. a) Find i_0 in the circuit of figure by using source transformation method. (8M)



Figure

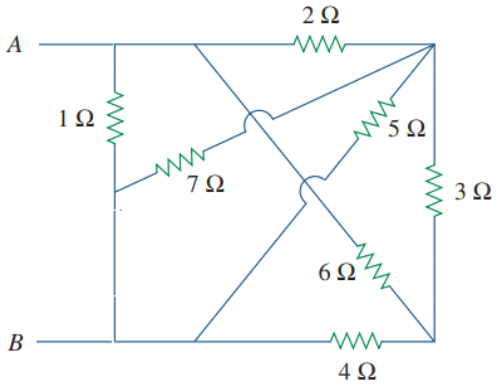
b) By using nodal analysis, find all the node voltages of the circuit of figure. (7M)



Figure

Or

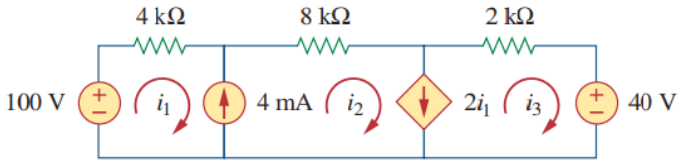
2. a) What is the equivalent resistance between the terminals AB of the figure? (8M)



Figure

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b) Find the mesh currents i_1, i_2, and i_3 in the network of figure. (7M)



Figure

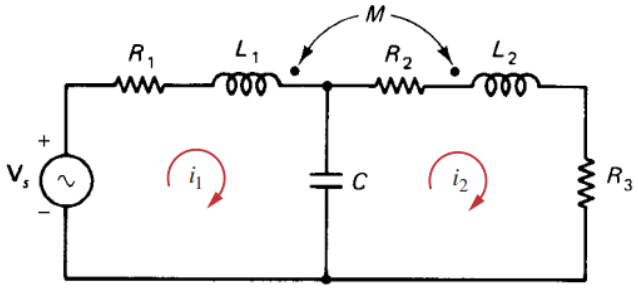
3. a) Two identical coupled coils have an equivalent inductance of 80 mH when connected series aiding and 35 mH in series opposing. Find L_1, L_2, M and K. (7M)

b) A teroidal core made of cast steel has a mean circumference of 1.2 m and cross sectional area of $4x10^{-4}$ m^2. A coil of 600 turns is wound on the core and the current in the coil is 6A. (i) determine the flux in the core (ii) calculate the width of an air gap to be cut radially in the core if it is desired to limit the flux in the core to 0.4 mWb. (8M)

Or

4. a) Explain self and mutual inductance in coupled magnetic circuits. (8M)

b) Calculate the phasor currents i_1 and i_2 in the circuit of figure, assume R_1=10 Ω, R_2=15 Ω, L_1 = 0.1 H, L_2=0.5 H, M=0.12, ω=100 rad/sec, Vs=120 V$\angle 0^0$ and $1/j\omega C = -j50$ Ω. (7M)



Figure

5. a) Three circuit elements are connected in series and the voltages across them are given byv_1 = 50 sin ωt; v_2=40 sin (ωt+60^0) and v_3=60 sin (ωt – 30^0). Determine the total voltage across the series combination and its phase angle with respect to v_1. (8M)

b) A capacitor of 80 μF capacitance takes a current of 1 A when supplied with 250 V (rms). Determine (i) the frequency of the supply, and (ii) the resistance which must be connected in series with this capacitor in order to reduce the current to 0.5 A at this frequency. (7M)

Or

6. a) A circuit consists of a 100 Ω resistance in parallel with a 25 μF capacitor connected to a 250V, 50Hz supply. Calculate (i) the current flowing in each branch, (ii) the total current drawn from the supply, (iii) the impedance of the circuit, and (iv) the phase angle of the circuit. (8M)

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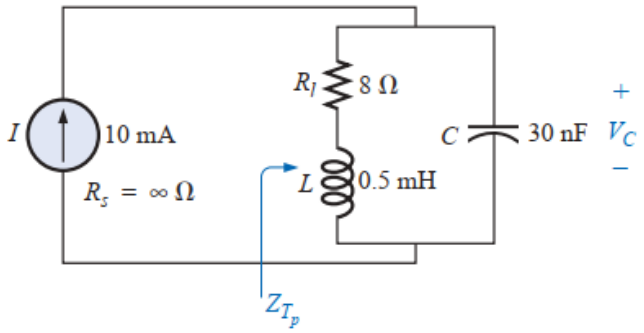
b) Three coils are connected in parallel across a 250V supply. Their impedances are (10+j30) Ω, (20+j0) Ω and (1–j20) Ω. Determine (i) the current drawn from the supply and (ii) the power factor of the circuit. (7M)

7. a) A coil of inductance L and resistance R in series with a capacitor is supplied at a constant voltage from a variable frequency source. If the frequency is ω_r, find in terms of L, R and ω_r the values of those frequencies at which the circuit current would be half as much as that at resonance and determine the bandwidth and selectivity of the circuit. (8M)

b) The impedance $Z_1 = (5 + j3)$ Ω and $Z_2 = (10 – j30)$ Ω are connected in parallel. This parallel branch is connected in series with impedance of $(R_3 – jX_3)$ Ω. Find the value of X_3 which will produce resonance. (7M)

Or

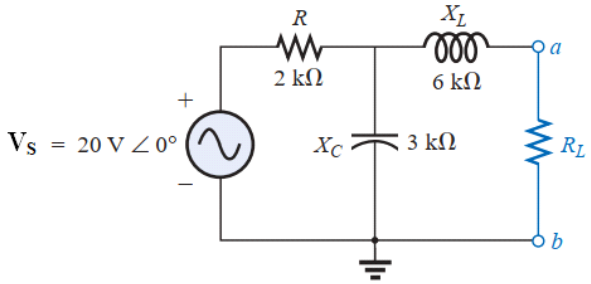
8. a) For the parallel resonant network of figure (i) Determine the resonant frequency f_p. (ii) Find the total impedance at resonance. (iii) Calculate the quality factor, bandwidth, and cutoff frequencies f_1 and f_2 of the system. (8M)



Figure

b) Given a series RLC circuit resonant at 250 kHz with $R = 10^4$ Ω and L = 200 mH. (i) Calculate the value of C, (ii) band width (iii) half power frequencies (iv) the frequency at which the impedance has an angle of $+30^0$. (7M)

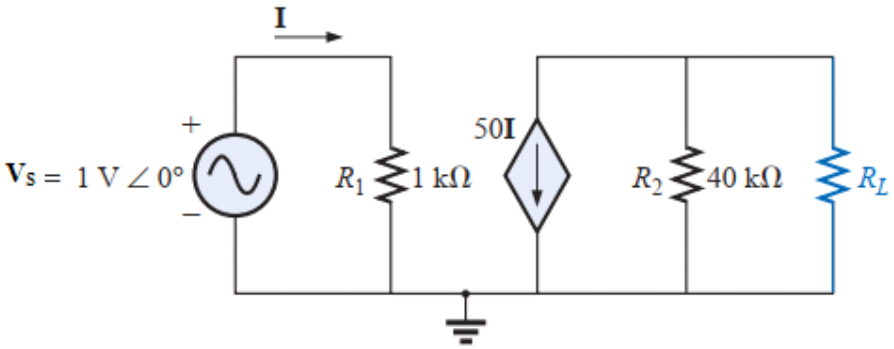
9. a) Find the Norton's equivalent circuit for the network external to the elements between *a* and *b* for the network of figure. (8M)



Figure

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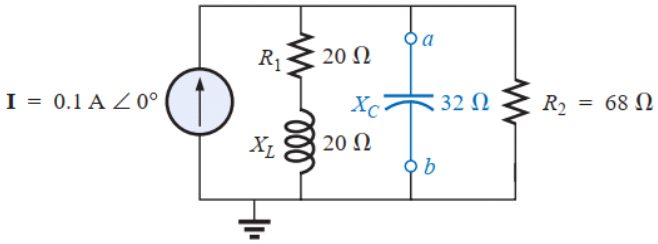
b) Find the load impedance R_L for the network of figure for maximum power to the load, and find the maximum power to the load. (7M)



Figure

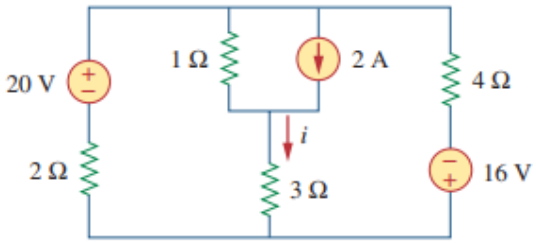
Or

10. a) Find the Thevenin's equivalent circuit for the portions of the networks of figure. external to the elements between points *a* and *b* (8M)



Figure

b) For the circuit in figure use super position theorem to find i, Calculate power delivered to the 3 Ω resistor. (7M)



Figure

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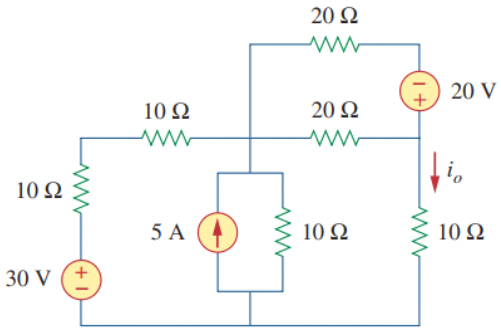
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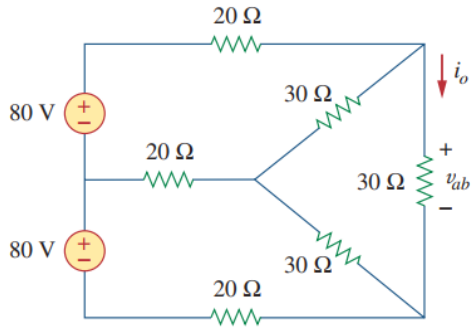
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1. a) Find i_0 in the circuit of figure by using source transformation method. (8M)



Figure

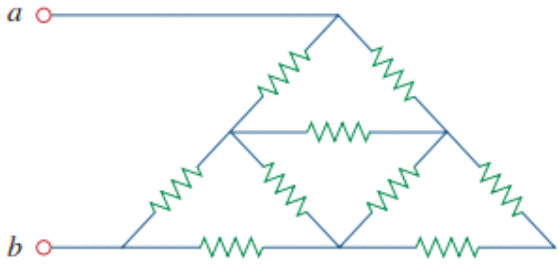
b) By using mesh analysis find i_0 and v_{ab} in the circuit of figure. (7M)



Figure

Or

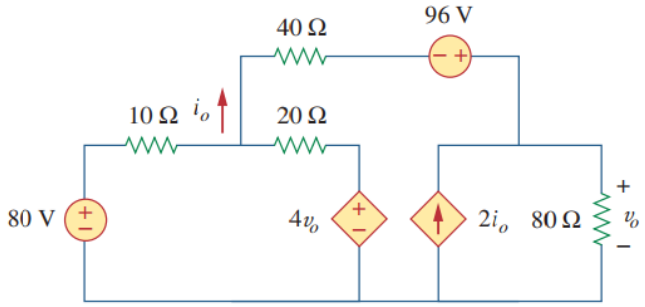
2. a) Determine equivalent resistance R_{ab} in the circuit shown in figure all resistors have a value of 30 Ω. (8M)



Figure

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b) By using nodal analysis, find v_0 and i_0 in the circuit of figure. (7M)



Figure

3. a) Two coupled coils have these data: L_1 = 0.1 H, L_2=0.4 H, M=0.15 H (coupling additive) ω=100 rad/sec, when V_1=1000 V$\angle 0^0$, I_1=50 $\angle 36.9^0$ A. Calculate V_2. (7M)

b) A magnetic circuit consists of an iron ring of mean circumference 80 cm with cross-sectional area of 12 cm^2 throughout. A current of 2A in the magnetizing coil of 200 turns produce a total flux of 1.2 mWb in the iron. Calculate: (i) the flux density in the iron (ii) the absolute and relative permeability of iron. (iii) the reluctance of the circuit. (8M)

Or

4. a) Derive the expression for equivalent inductance of a magnetically coupled two coils connected in series, when two coils are (i) aiding each other (ii) Opposing each other. (8M)

b) Two coils have a mutual inductance of 0.5 H. if the current in one coil is varied from 4A to 2A in 0.4 sec, calculate (i) The average e.m.f. induced in the second coil (ii) The rate of change of flux linked with the second coil assuming that it is wound with 400 turns. (7M)

5. a) A coil of inductance 15.9 mH and resistance 9 Ω is connected in parallel with a coil of inductance 38.2 mH and resistance 6 Ω across a 250 V, 50 Hz supply. Determine (i) the conductance, susceptance and admittance of the circuit, (ii) the current drawn from the supply and (iii) the total power consumed in kW. (8M)

b) Two coils A and B are connected in series across a 250 V, 50 Hz supply. The resistance of coil A is 10 Ω and inductance of coil B is 0.015 H. If input from the supply is 3 kW and 2 kVAR, find the resistance of coil B and inductance of coil A. Also calculate voltage across each coil. (7M)

Or

6. a) A coil of inductance 0.08 H takes a current of 5 A when connected in series with a 50 μF loss-free capacitor across a 250 V, 50 Hz supply. Calculate (i) resistance of the coil (ii) power factor of the coil (iii) the overall power factor. Sketch the phasor diagram. (8M)

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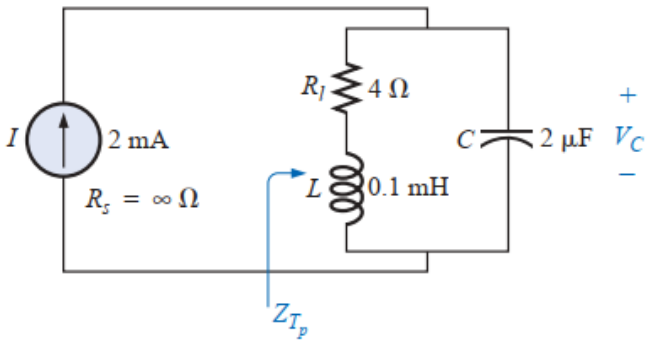
b) Three impedances (2+j4) Ω, (3–j5) Ω and (1–j3)Ω are connected in parallel. The combination is in series with a coil of resistance 3 Ω and inductance 0.02H to 250V, 50Hz supply. Find (i) The complex expression for the total impedance of the circuit. (ii) Current taken from the supply. (7M)

7. a) Show that resonant frequency ω_r of RLC series circuit is geometric mean of lower and upper half-frequencies ω_1 and ω_2. (8M)

b) A series circuit consists of a 40Ω resistor, a 0.5 H inductor and a variable capacitor connected across a 100 V, 50 Hz supply. Calculate (i) the value of the capacitance required to give resonance, (ii) the voltages across the resistor, the inductor and the capacitor at resonance, and (iii) the Q-factor of the circuit. (7M)

Or

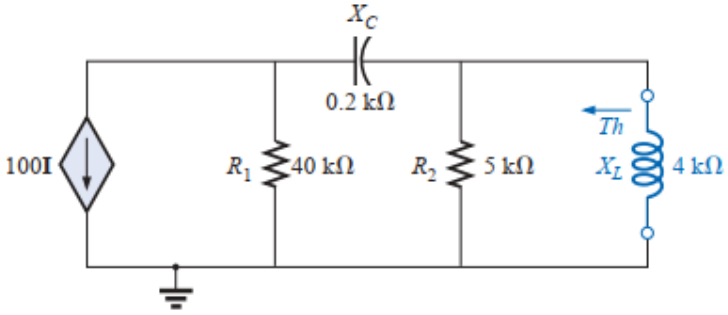
8. a) For the parallel resonant network of figure. (i) Determine the resonant frequency, f_p. (ii) Find the total impedance at resonance. (iii) Calculate the quality factor, bandwidth, and cutoff frequencies f_1 and f_2 of the system. (8M)



Figure

b) A series RC circuit having variable R and C= 15 μF is supplied from AC source having voltage V=250 V at ω=1000 rad/sec. Draw current locus for sample values of R=0,5, 15, 25, 35, 50Ω. (7M)

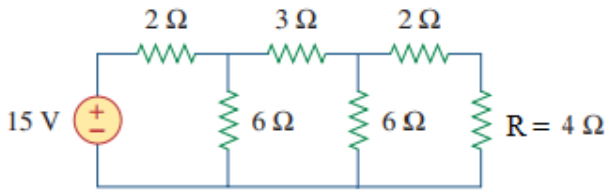
9. a) Determine the Thevenin's equivalent circuit for the network external to the 4-kΩ inductive reactance of figure (in terms of I). (8M)



Figure

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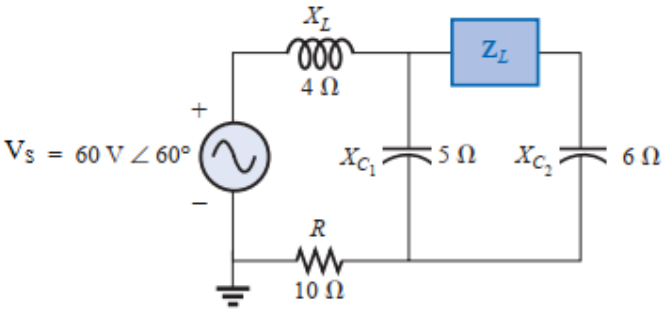
b) Verify the compensation theorem of the circuit in figure, when resistance, R is changed from 4 Ω to 2 Ω. (7M)



Figure

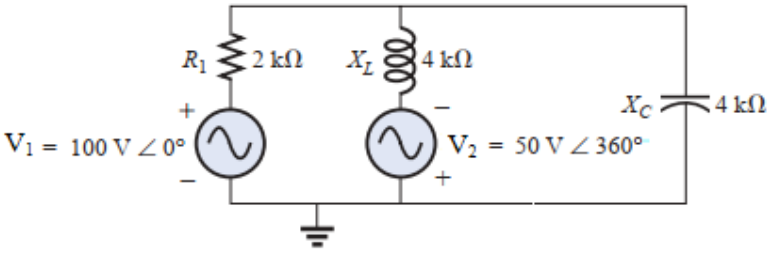
Or

10. a) Find the load impedance Z_L for the networks of figure for maximum power to the load, and find the maximum power to the load. (8M)



Figure

b) Using Millman's theorem, determine the current through the 4-kΩ capacitive reactance of figure. (7M)



Figure

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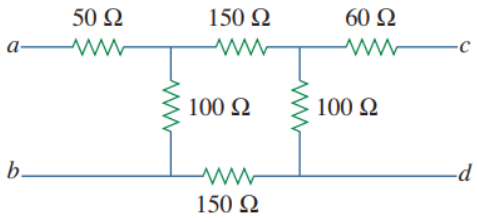
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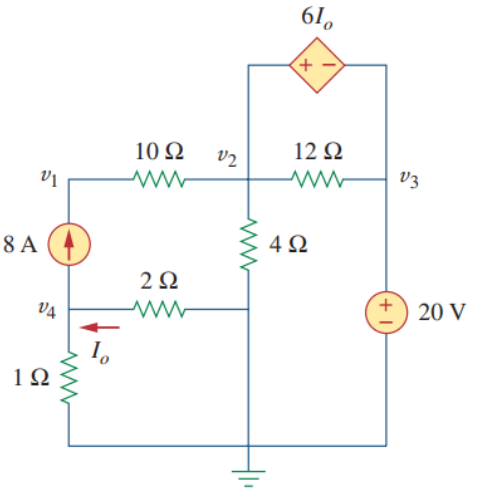
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1. a) Consider the circuit in figure, find the equivalent resistance across the terminals: (i) a-b and (ii) c-d. (8M)



Figure

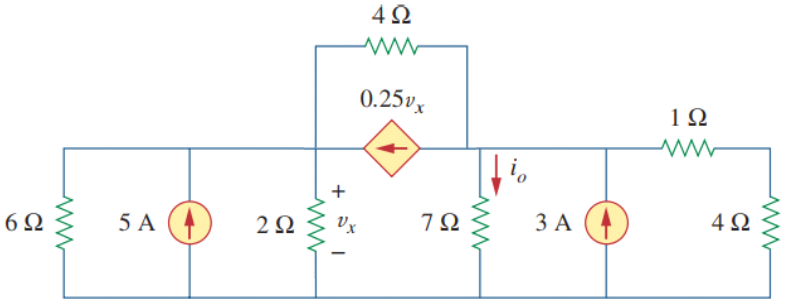
b) By using node analysis, find all the node voltages of the circuit of figure. (7M)



Figure

Or

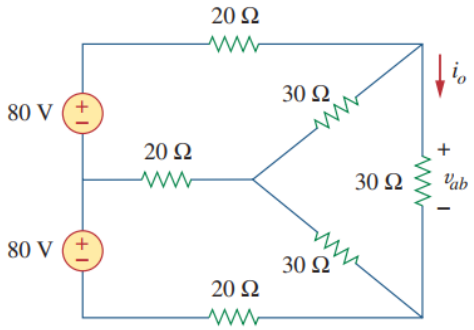
2. a) Find i_0 in the circuit of figure by using source transformation method. (8M)



Figure

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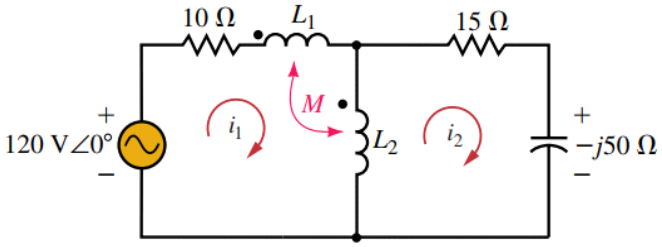
b) By using mesh analysis find i_0 and v_{ab} in the circuit of figure. (7M)



Figure

3. a) The total inductance of two coils is measured to be 13 mH. If one of the coil is reversed total inductance is found to be 8 mH. If inductance of one coil is known to be 5 mH, calculate inductance of the other coil, the mutual inductance, and the coefficient of coupling between the two coils. (8M)

b) Calculate the phasor currents i_1 and i_2 in the circuit of figure. (7M)



$L_1 = 0.1$ H $\quad M = 0.12$ H
$L_2 = 0.5$ H $\quad \omega = 100$ rad/s

Figure

Or

4. a) Derive the expression for equivalent inductance of a magnetically coupled two coils connected in parallel, when the two coils are (i) Aiding each other (ii) Opposing each other. (8M)

b) Two coupled coils have self-inductances L_1=15mH and L_2=25mH.The coefficient of coupling (K) being 0.8 in the air, find voltage in the second coil and the flux of first coil provided the second coil has 500 turns and the circuit current is given by i_1= 10 sin 314t A. (7M)

5. a) A resistance of 50 Ω is connected in series with a variable capacitor across a 200 V, 50 Hz supply. (8M)
(a) When the capacitance is set to 50 μF calculate (i) the current drawn from the supply, (ii) the voltage across the two elements and (iii) the power factor.
(b) Find the value of the capacitance when the current is 2 A.
(c) Determine the value of the capacitance required to give a power factor of 0.866 leading.

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b) A resistance R, L=0.02H and capacitance C are connected in series. When a voltage V=200 cos(2000t–20^0) V is applied to the series combination, the current flowing is $5\sqrt{2}$ cos(2000t – 65^0) A, find R & C. (7M)

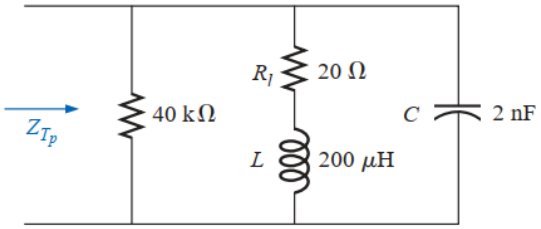
Or

6. a) A series circuit consisting of a 10 Ω resistor, 100mH inductance is driven by a 50 Hz. AC voltage source of maximum value 100V. Calculate the equivalent impedance, rms value of the voltage, form factor of the voltage, current in the circuit, the power factor and power dissipated in the circuit. (5M)

b) A capacitor having a reactance of 5 Ω is connected in series with a resistor of 10 Ω. This circuit is then connected (a) in series and (b) in parallel with a coil of impedance (5+j7) Ω. Calculate for each case (i) the current drawn from the supply, (ii) the power supplied, and (iii) the power factor of the whole circuit. (10M)

7. a) A coil of inductance 80 mH and negligible resistance is connected in series with a capacitance of 0.25 μF and a resistor of resistance 12.5Ω across a 100V, variable frequency supply. Determine (a) the resonant frequency, and (b) the current at resonance. How many times greater than the supply voltage is the voltage across the reactances at resonance? (8M)

b) For the parallel resonant circuit of figure, (i) Determine the resonant frequency, (ii)Find the total impedance at resonance, (iii) Find quality factor, and (iv) Calculate the band width. (7M)



Figure

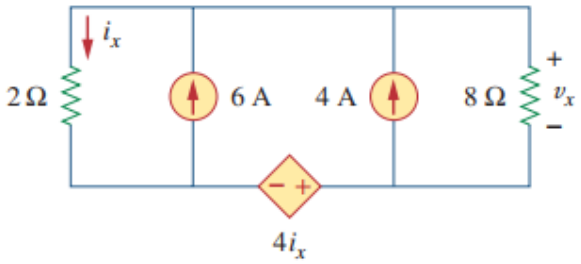
Or

8. a) A circuit consisting of a coil of inductance 250 mH, having a resistance of 20 Ω, in parallel with a variable capacitor C is connected to a 200 V, 50 Hz supply. Determine (i) the value of C required for the circuit to resonate, (ii) the power absorbed at resonance, and (iii) the ratio of the current through the capacitor to the supply current at resonance. (8M)

b) A series circuit consisting of an inductance of 0.3 H, having a resistance of 10 Ω, and a variable capacitor C_1 is supplied from a 100 V, variable frequency source. (i) Determine the value of C_1 necessary for the circuit to operate resonantly at 50 Hz. (ii) A second variable capacitor, C_2, is now connected in parallel with the original circuit and the supply frequency is adjusted to 60 Hz. Determine the value of C_2 in order that the circuit still operates with minimum current. (7M)

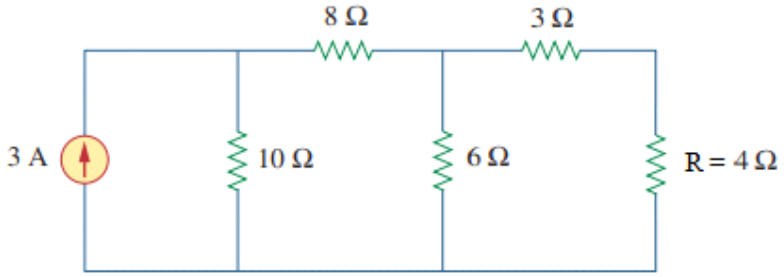
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9. a) Use superposition theorem to solve for v_x in the circuit of figure. (8M)



Figure

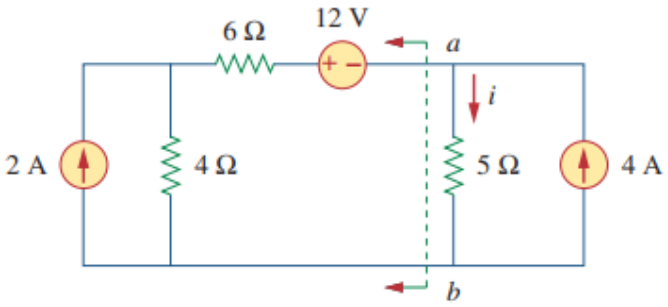
b) Verify the compensation theorem of the circuit in figure, when resistance, R is changed from 4 Ω to 2 Ω. (7M)



Figure

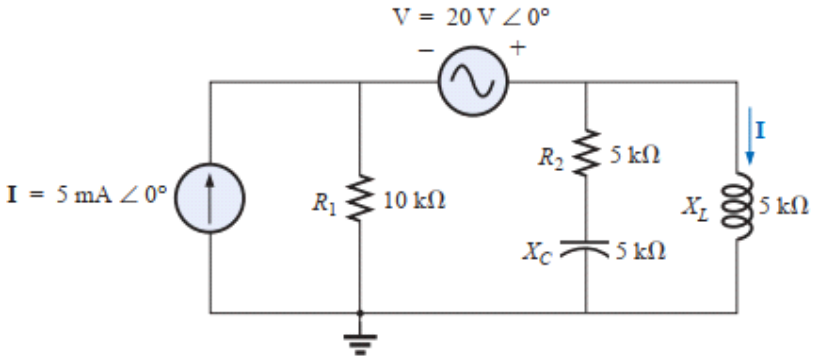
Or

10. a) Obtain Norton's equivalent of the circuit in figure to the left of terminals *a-b*. Use the result to find *i*. (8M)



Figure

b) Determine the load impedance to replace the inductor, X_L of figure to ensure maximum power to the load. Using the results, determine the maximum power to the load. (7M)



Figure

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Code No: R19ES1217 **R19** SET - 4

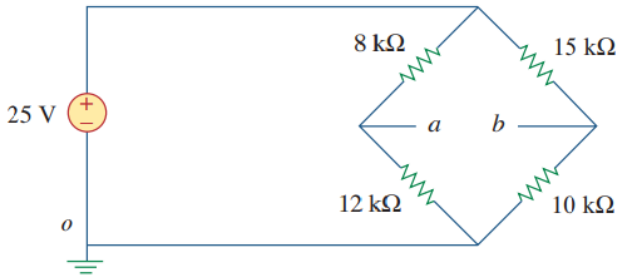
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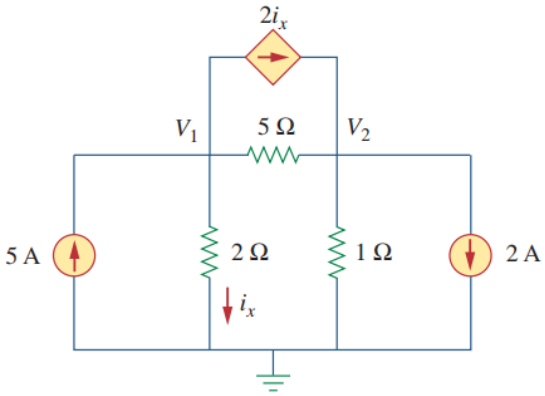
1. a) (i) Consider the circuit shown in figure, calculate v_a, v_b and v_{ab}. (10M)



Figure

(ii) If the ground is placed at 'a' instead of 'o' again calculate v_a, v_b and v_{ab}.

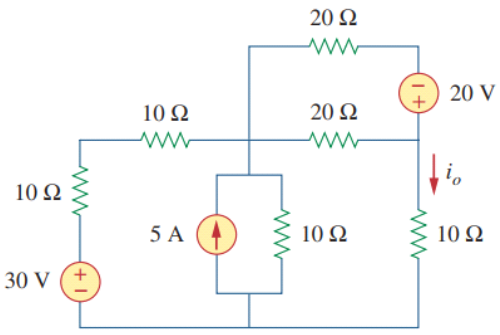
b) Solve for V_1 and V_2 in the circuit of figure. (5M)



Figure

Or

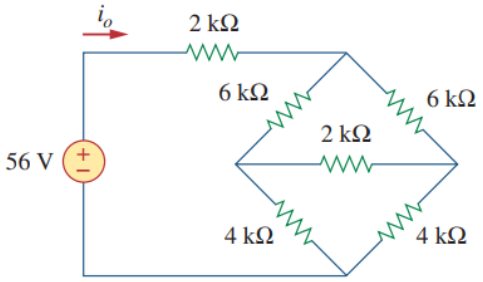
2. a) Find i_0 in the circuit of figure by using source transformation method. (8M)



Figure

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b) For the bridge network in figure, find i_0 using mesh analysis. (7M)



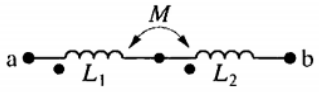
Figure

3. a) Define coefficient of coupling and derive its expression. (7M)

b) A ring has a mean diameter of 21 cm and cross sectional area of 10 cm^2. The ring is made up of semi-circular sections of cast iron and cast steel with each joint having reluctance equal to an air gap of 0.2 mm. Find the ampere turns required to produce a flux of 0.8 mWb. The relative permeability of cast steel and cast iron are 800 & 166 respectively. Neglect fringing and leakage effects. (8M)

Or

4. a) Show that the two coupled coils in figure can be replaced by a single coil having an inductance of $L_{ab} = L_1 + L_2 + 2M$. (8M)



Figure

b) Two magnetically coupled coils have self-inductances of 60 mH and 9.6 mH, respectively. The mutual inductance between the coils is 22.8 mH. (7M)

(i) What is the coefficient of coupling? (ii) For these two coils, what is the largest value that Mutual inductance can have?

5. a) A circuit is supplied from 50Hz mains whose voltage has a maximum value of 250V and takes a current whose maximum value is 5A. At a particular instant (t = 0) the voltage has a value of 200V and the current is then 2A. Obtain expressions for the instantaneous values of voltage and current as functions of time and determine their values at an instant t = 0.015 s. Determine also the phase difference between them. (7M)

b) A coil of inductance 15.9 mH and resistance 9 Ω is connected in parallel with a coil of inductance 38.2 mH and resistance 6 Ω across a 250 V, 50 Hz supply. Determine (i) the conductance, susceptance and admittance of the circuit, (ii) the current drawn from the supply and (iii) the total power consumed in kW. (8M)

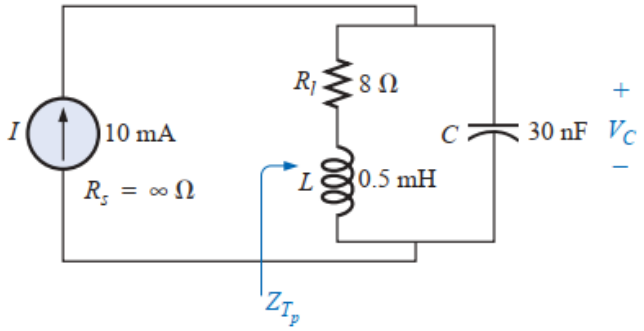
Or

6. a) A coil is connected in series with a 20 μF capacitor across 250 V, 50 Hz supply. The current drawn by the circuit is 8A and power consumed is 200W. Calculate inductance of the coil if power factor is (i) lagging and (ii) leading. (8M)

||''|''||''||''''''|

b) Two coils A and B are connected in series across a 250 V, 50 Hz supply. The resistance of coil A is 10 Ω and inductance of coil B is 0.015 H. If input from the supply is 3 kW and 2 kVAR, find the resistance of coil B and inductance of coil A. Also calculate voltage across each coil. (7M)

7. a) For the parallel resonant network of figure. (i) Determine the resonant frequency, f_p. (ii) Find the total impedance at resonance. (iii) Calculate the quality factor, bandwidth, and cutoff frequencies f_1 and f_2 of the system. (8M)



Figure

b) A series circuit consisting of an inductance of 0.3 H, having a resistance of 10 Ω, and a variable capacitor C_1 is supplied from a 100 V, variable frequency source. (i) Determine the value of C_1 necessary for the circuit to operate resonantly at 50 Hz. (ii) A second variable capacitor, C_2, is now connected in parallel with the original circuit and the supply frequency is adjusted to 60 Hz. Determine the value of C_2 in order that the circuit still operates with minimum current. (7M)

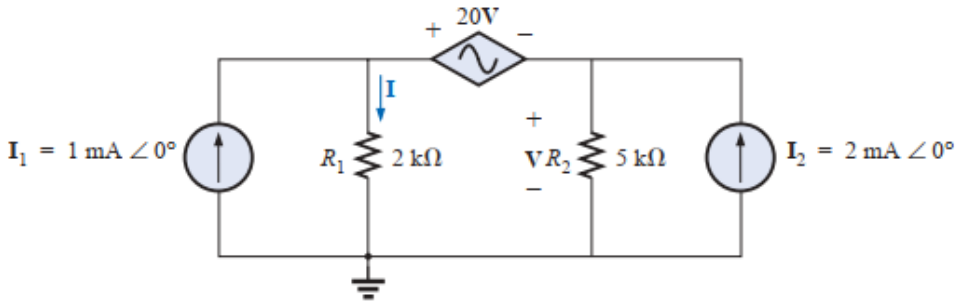
Or

8. a) A coil having a Q-factor of 100 is connected in parallel with a capacitor of 100 pF. The circuit resonates at a frequency of 5 MHz. Determine (i) the bandwidth of the circuit, (ii) the amount of resistance required to be placed in parallel with the capacitor in order to increase the bandwidth to 250 kHz, and (iii) the amount of resistance required to be placed in series with the inductor in order to produce the same bandwidth. (8M)

b) A resistor of 90 Ω resistance is connected in series with a coil of inductance 500mH, having a resistance of 10 Ω. This series circuit is connected in parallel with a 20 μF capacitance across a 250 V variable frequency supply. Determine (i) the resonant frequency of the circuit, (ii) the resonant frequency if the 90 Ω resistor is short circuited and (iii) the current drawn from the supply in each case. (7M)

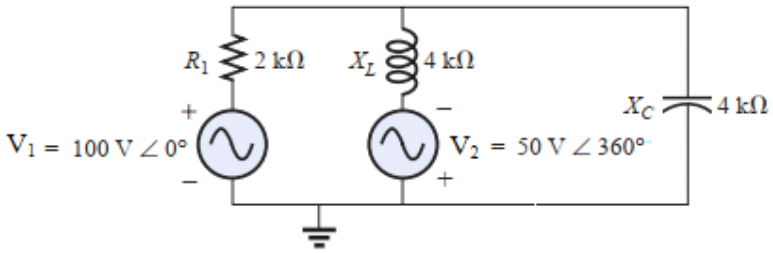
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9. a) Calculate the current, I for the network of figure by using superposition theorem. (8M)



Figure

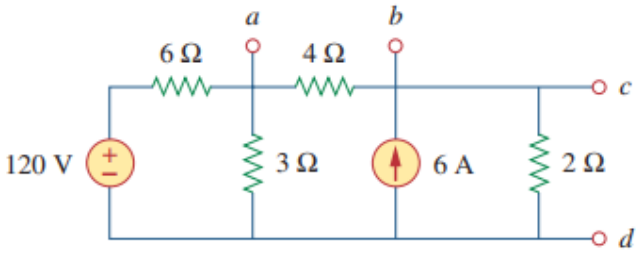
b) Using Millman's theorem, determine the current through the 4-kΩ capacitive reactance of figure. (7M)



Figure

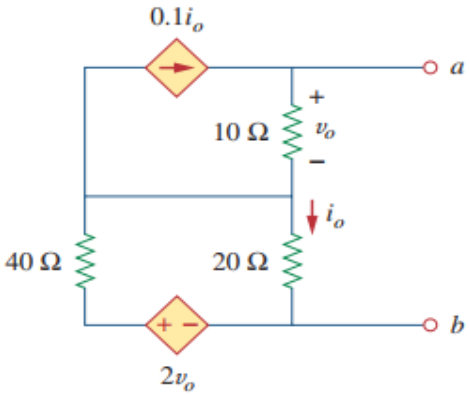
Or

10. a) Given the circuit in figure, Obtain Norton's equivalent circuit as viewed from (i) *a-b* (ii) *c-d*. (10M)



Figure

b) Find the Thevenin's equivalent circuit shown in figure. (5M)



Figure

||"|"||"||""""|