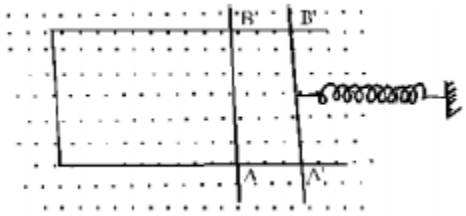
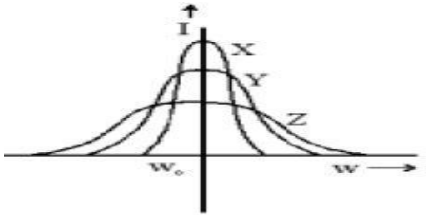
1. In a series LCR circuit the voltage across inductor, a capacitor and a resistor are 30 V, 30 V and 60 V respectively. What is the phase difference between applied voltage and current in the circuit?
2. What is the power factor of an LCR series circuit at resonance?
3. On what conservation law is Lenz's law based ?
4. Define coefficient of mutual inductance for a pair of coils.
5. the power factor of an a.c circuit is .5 what will be the phase difference between voltage and current in this circuit.
6. A household circuit has a fuse of 5A rating. Calculate the number of bulbs of rating 60W-220V each which can be connected in this circuit.
7. Distinguish between resistance, reactance and impedance for an AC circuit.
8. A rectangular current loop is in an arbitrary orientation in an external uniform magnetic field. Is any work required to rotate the loop about an axis perpendicular to its plane? Explain.
9. What do we mean by the term phasors? Draw a phasor diagram for an AC circuit with a capacitor.
10. Give two advantages of eddy currents in electrical appliances.
11. A lamp is connected in series with an inductor to a d.c. source. What will happen to its glow, when it is connected directly to the same source?
12. A sinusoidal voltage V=200sin 314t is applied to a resistor of 10 ohm resistance. Calculate
    a. Rms value of voltage
    b. Rms value of current
    c. Power dissipated as heat in watt
13. A rectangular wire frame, shown below, is placed in a uniform magnetic field directed upward and normal to the plane of the paper. The part AB is connected to a spring. The spring is stretched and released when the wire AB has come to the position $A^{\backslash}B^{\backslash}$ (t=0). How would the induced emf vary with time? Neglect damping

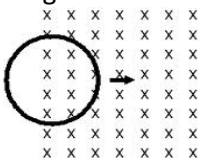


14. A bulb and a capacitor are connected in series to an a.c. source of variable frequency. How will the brightness of the bulb change on increasing the frequency of the a.c. source? Give reason.
15. the power factor of an a.c circuit is .5 what will be the phase difference between voltage and current in this circuit.
16. If the number of turns of a solenoid is doubled, keeping the other factors constant, how does the self-inductance of the solenoid change?
17. IN INDIA, domestic power supply is at 220 volt, 50 Hz, while in U.S.A. it is 110 volt, 50 Hz. Give one advantage and disadvantage of 220 volt supply over 110 V supply ?Ca lculate the power developed in an ideal inductor of L = 4H and ω = 100 rad/sec.
18. Obtain the resonant frequency ω_r of a series LCR circuit with L=2.0 H, C = 32μ F and R=10Ω. What is the Q value of the circuit.
19. An a.c. voltage of 100 V 50Hz is connected across a 20Ω resistor and 2mH inductor in series . Calculate (i) Impendence of the circuit (ii) r.m.s. current in the circuit.
20. A sinusoidal voltage of peak value 283 V and frequency 50 Hz is applied to a series LCR circuit in which R = 3Ω, l = 25.48 mH and C = 796 μ. Find the impedance of the circuit the power dissipated in the circuit.

21. State the condition under which the phenomenon of resonance occurs in a series LCR circuit. Plot a graph showing variation of current with frequency of a.c. source in a series LCR circuit.
22. The instantaneous value of voltage from an a.c. Source is given by E=300 Sin 314t. What is the r.m.s. voltage of the source?
23. A bulb and a capacitor are connected in series to an a.c. source of variable frequency. How will the brightness of the bulb change on increasing the frequency of the a.c. source? Give reason.
24. State the condition under which the phenomenon of resonance occurs in a series LCR circuit. Plot a graph showing variation of current with frequency of a.c. source in a series LCR circuit.
25. "The oscillations in copper disc in a magnetic field are highly damped." Why? Where does the vibrational kinetic energy of the copper disc disappear?
26. The above graph shows the variation of current amplitude vs angular frequency (ω) for a series LCR a.c. circuit obtained for different values of resistances X,Y,Z . Arrange the resistances in increasing order.

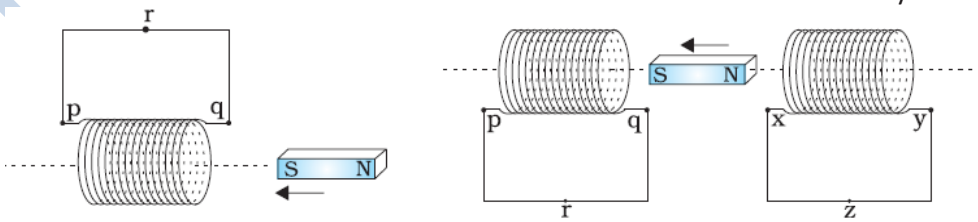


27.
28. A metallic rod of length 'l' and resistance 'R' is moving normal to a uniform magnetic field 'B' with a velocity 'V' . Deduce expressions for (i) the emf induced (n) the induced current in the metallic rod.
29. If a rate of change of current of 2 A/s induces an e.m.f.of 10mV in a solenoid, what is the self -inductance of the solenoid?
30. Show that Lenz's law is in accordance with the law of conservation of energy.
31. Define mutual inductance. State two factors on which the mutual inductance between a given pair of coils depends.
32. What are eddy currents? How are they produced? Give two applications of eddy currents.
33. An armature coil consists of 20 turns of wire, each of area A = 0.09m^2 and total resistance15Ω .It rotates in a magnetic field of 0.5T at a constant frequency of 150/π Hz. Calculate the value of (i) maximum (ii) average induced emf produced in the coil
34. : A conducting loop is pulled in and taken out with a constant velocity in a region of constant (steady) magnetic field of induction B as shown in the figure.



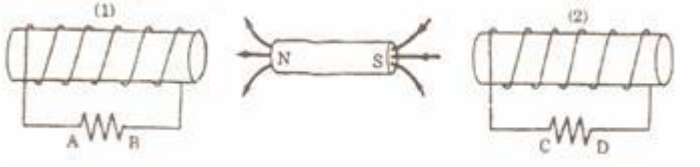
When will the current in the loop flow in (a) Clockwise direction (b) become zero.

35. The coefficient of mutual induction of the two coils is 0.5 H. If the current is increased from 2 to 3 A in 0.1 seconds in one of them, then find the induced EMF in the second coil.
36. State Lenz's law. Predict the direction of induced current in the situations described by the following Figs.



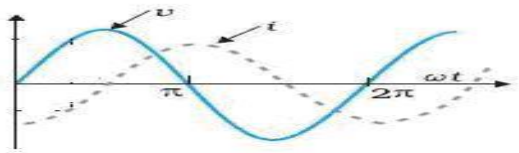
37. When 100 volts d.c is applied across an inductor, a current of 1A flows through it. If the same inductor is connected across 100 v a.c. source, a current reduces to 0.5 A. Why is the current reduced in later case? Calculate the reactance.

38. Write two characteristics of a transformer. Diagrammatically represent step-up and step-down transformer.
39. In the figure given below, a bar magnet moving towards the right or left induces an e.m.f. in the coils (1) and (2). Find giving reason, the directions of the direction of the induced currents through the resistors AB and CD when the magnet is moving (a) towards the right, and (b) towards the left.

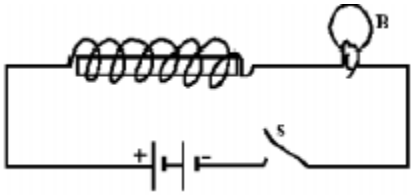


40. An a.c. voltage $E = E_0 \sin \omega t$ is applied across an inductor L. Obtain an expression for current I.

41. When a circuit element 'X' is connected across an a.c. source, a current of A flows through it and this current is in phase with the applied voltage. When another element 'Y' is connected across the same a.c. source, the same current flows in the circuit but it leads the voltage by $\pi/2$ radians. (i) Name the circuit elements X and Y.(ii) Find the current that flows in the circuit when the series combination of X and Y is connected across the same a.c.voltage.(iii) Plot a graph showing variation of the net impedance of this series combination of X and Y as a function of the angular frequency of the applied voltage.
42. The fig. shows the variation of v and i vs ωt for a circuit element connected to A.C mains. Name the. circuit

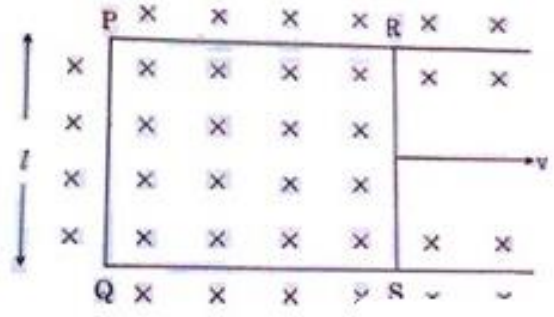


element and the phase relation between current and voltage
43. Define self-inductance and give its S. I . unit. Derive an expression for self- inductance of a long, air-cored solenoid of length *l,* radius r, and having N number of turns.
44. with the help of a neat labeled diagram , explain the principle ,construction & working of an a.c generator.
45. a rectangular coil of area A , having number of turns N is rotated at ƒ revolutions /second in a uniform magnetic field B ,the field being perpendicular to the coil. Prove that maximum emf induced in the coil is $2\pi f NBA$.
46. A coil with an average diameter of 0.02m is placed perpendicular to a magnetic field of 6000T. If the induced emf is 11V when the magnetic field is changed to 1000T in 4 seconds. What is the number of turns in the coil?
47. In a series L-R circuit $X_L = R$, power factor is P_1. When a capacitor having capacitance such that $X_C = X_L$ connected in series, power factor become P_2. Find the ratio P_1/P_2.
48. Fig. Shows a light bulb (B) and iron-cored inductor connected to a DC battery through a switch (S).



What will one observe when switch (S) is closed?How will the glow of the bulb change when the battery is replaced by an ac source of rms voltage equal to the Voltage of DC battery? Justify your answer in each case.'
49. An electric heater and an electric bulb are rated 500 W, 220 V and 100 W, 220 V respectively. Both are connected in series to a 220 V a.c. mains. Calculate the power consumed by (i) the heater and (ii) electric bulb.

50. Draw the curves showing the variation of inductive reactance and capacitive reactance with applied frequency of an a.c source. A capacitor, a resistor of 5 ohm, and an inductor of 50 mH are in series with an a.c. source marked 100 V, 50 Hz. It is found that voltage is in phase with the current. Calculate the capacitance of the capacitor and the impedance of the circuit.
51. Write Faraday's laws of electromagnetic induction. How will you find the direction of induced emf ? find an expression for induced emf in a rod of length *l* moving with velocity V perpendicular to a magnetic field of induction B.
52. With the help of a labeled diagram explain the construction and working of an a.c. generator. Deduce the expression for emf induced. What is average and root mean square value of emf induced ?
53. In L-R series circuit, the potential difference across the inductor 'L' and the resistor 'R' are 120 V and 90 V respectively and rms value of current is 3 A (1) calculate r.m.s voltage across the circuit. (2) Is the algebraic sum of the voltage across two components more than the applied voltage? If yes, explain the reason (3) Calculate the phase angle between the voltage and current
54. A resistor of resistance 400Ω, and a capacitor of reactance 200Ω,are connected in series to a 220V,50Hz a.c. source .If the current in the circuit is 0.49 ampere find the (i) voltage across the resistor and capacitor(ii) value of inductance required so that voltage and current are in same phase.
55. A sinusoidal voltage of peak value 283V and frequency 50Hz is applied to a series LCR circuit in which R = 3Ω, L = 25.48mH and C = 796 μF. Find (a)the impedance of the circuit (b)the phase difference between the voltage across the source and the current (c)the power dissipated and the circuit
56. Give principle, construction and working of Transformer.
57. Figure shows a rectangular conducting loop PQSR in which arm RS of length 'l' is movable. The loop is kept in a uniform magnetic field 'B' directed downward perpendicular to the plane of the loop. The arm RS is moved with a speed 'v'. (a) the emf induced across the arm RS (ii) the external force required to move the arm, and (iii) the power dissipated as heat.
58. Define self-inductance and give its S. I . unit. Derive an expression for self- inductance of a long, air-cored solenoid of length *l,* radius r, and having N number of turns.

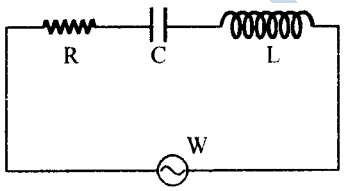


59. Describe briefly with the help of a labeled diagram, the working of a step up transformer. Since the transformer increase the voltage, does it violate the principle of conservation of energy?
60. Derive a relation between peak value and rms value of ac.
61. A rectangular coil of N turns and area A is rotated in a uniform magnetic field of intensity B with an angular velocity ω. Obtain an expression for the maximum induced emf in the coil. What would be flux linked with the coil at the instant when the induced emf is maximum?
62. Two coils are being moved out of magnetic field- one coil is moved rapidly and the other slowly. In which case is more work done and why?
63. A bar magnet M is dropped so that it falls vertically through the coil C. The graph obtained for voltage produced across the coil vs time is shown in figure (b). (i) Explain the shape of the graph. (ii) Why is the negative peak longer than the positive peak?
64. How does the self inductance of an air core coil change, when (i) the number of turns in the coil is decreased, (ii) an iron rod is introduced in the coil? A copper coil L wound on a soft iron core and a lamp B

are connected to a battery E through a tapping key K. When the key is suddenly opened, the lamp flashes for an instant to much greater brightness. Explain.

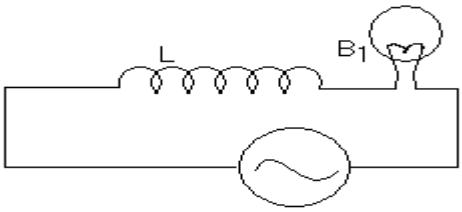
65. How is the mutual inductance of a pair of coils affected when separation between the coils is increased? The number of turns of each coil is increased? A thin iron sheet is placed between the two coils, other factors remaining the same? Explain your answer in each case.
66. Why does metallic piece become very hot when it is surrounded by coil carrying high frequency alternating current?
67. When a circuit element 'X' is connected across an a.c. source, a current of √2A flows through it and this current is in phase with the applied voltage. When another element 'Y' is connected across the same a.c. source, the same current flows in the circuit but it leads the voltage by π/2 radians.(i) Name the circuit elements X and Y. (ii) Find the current that flows in the circuit when the series combination of X and Y is connected across the same a.c. voltage.
68. A circuit containing a 80 mH inductor and a 60 µF capacitor in series is connected to a 230 V, 50 Hz supply. The resistance of the circuit is negligible. (a) Obtain the current amplitude and rms values. (b) Obtain the rms values of potential drops across each element. (c) What is the average power transferred to the inductor? (d) What is the average power transferred to the capacitor? (e) What is the total average power absorbed by the circuit?
69. A series LCR-circuit with L = 0.12 H, C = 480 nF, R = 23 Ω is connected to a 230 V variable frequency supply. (a) What is the source frequency for which current amplitude is maximum? Obtain this maximum value. (b) What is the source frequency for which average power absorbed by the circuit is maximum? Obtain the value of this maximum power. (c) For which frequencies of the source is the power transferred to the circuit half the power at resonant frequency? What is the current amplitude at these frequencies? (d) What is the Qfactor of the given circuit?
70. An LC-circuit contains a 20 mH inductor and a 50 µF capacitor with an initial charge of 10 mC. The resistance of the circuit is negligible. Let the instant the circuit is closed be t = 0(a) what is the total energy stored initially. Is it conserved during the LC-oscillations? (b) What is the natural frequency of the circuit? (c) At what times is the energy stored (i) Completely electrical (i.e., stored in the capacitor)? (d) At what times is the total energy shared equally between the inductor and the capacitor? (e) If a resistor is inserted in the circuit, how much energy is eventually dissipated as heat?
71. Define self-inductance in terms of work done against the induced emf.
72. Draw the wave form of out put current. Substantiate your answer
73. An electron beam is deflected in a given field. Identify whether it is an electric field or a magnetic field in the following cases?
    (i) The trajectory of the beam is a parabola and its K.E changes.
    (ii) The trajectory of the beam is circular and its K.E. remains the same. Justify your answer.
74. A resting electron near a stationery bar magnet does not set into motion. But a moving magnet near an electron set it into motion. Why?
75. An irregularly shaped flexible current carrying loop when placed in an external magnetic field will assume a circular shape. Give reason
76. An electromagnet has stored 648 J of magnetic energy when a current of 9A exists in its coils. What average emf is induced if the current is reduced to zero in 0.45 s?
77. A 40 Ohm resistor is connected across a 15 V variable frequency electronic oscillator. Find the current through the resistor when the frequency is (a) 100 Hz and (b) 100 kHz. What is the current if the 40 Ohm resistor is replaced by a 2 mH inductor?
78. Two identical loops, one of copper and another of aluminum are rotated with the same speed in the same M.F.In which case, the induced (a) e.m.f (b) current will be more and why?
79. Why is spark produced in the switch of a fan, when it is switched off?
80. Coils in the resistance boxes are made from doubled up-insulated wire. Why?
81. A galvanometer connected in an A.C. circuit does not show any deflection. Why?

82. A capacitor blocks D.C. but allows A.C to pass through it. Explain. Why?
83. Can we use transformer to step up D.C. voltage? If not, why?
84. The algebraic sum of potential drop across the various – elements in LCR circuit is not equal to the applied voltage. Why?
85. When a series combination of a coil of inductance L and a resistor of resistance R is connected across a 12 V-50 Hz supply, a current of 0.5.A flows through the circuit. The current differs in phase from applied voltage by $\pi / 3$ radian. Calculate the value of L and R.
86. An A.C. generator is connected to a sealed box through a pair of terminals. The box may contain R L C or the series combination of any two of the three elements. Measurements made outside the box reveal that: $E=75 \sin \omega t$ (in volt) and $I= 1.2 \sin (\omega t + \pi / 5)$ (in ampere) Name the circuit elements. What is the Power factor of the circuit? What is the rate, at which energy is delivered by the generator to the circuit?
87. 59. Does the current in an A.C. circuit lag, lead or remain in phase with the voltage of frequency u applied to the circuit when
    (i) $u = u_r$ (ii) $u < u_r$ (iii) $u > u_r$
    where u_r is the resonance frequency.
88. 60. Two different coils have self-inductance L1=8 mH and L2 = 2 mH. At a certain instant, the current in the two coils is increasing at the same constant rate and the power supplied to the two coils is same. Find the ratio of (a) induced voltage (b) current and (c) energy stored in the two coils at that instant?
89. In the circuit shown below, R represents an electric bulb. If the frequency v of the supply is doubled, how should the values of C and L be changed so that the glow in the bulb remains unchanged

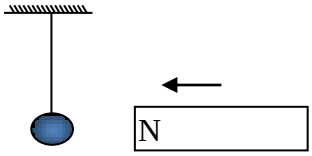


90. Give expression for the average value of the a c voltage $V = V0 \sin \omega t$ over the time interval t = 0 and t =T.
91. An inductor L of reactance XL is connected in series with a bulb B to an A.C. source as shown in the figure. Briefly explain how the brightness of the bulb changes when Number of turns of the inductor is reduced and A capacitor of reactance XC =XL is included in series in the same circuit.

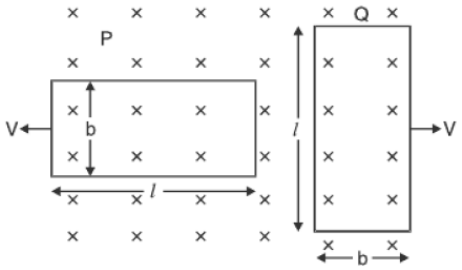
92. An armature coil consists of 20 turns of wire, each of area A = 0.09m2 and total resistance15Ω .It rotates in a magnetic field of 0.5T at a constant frequency of $150/\pi$ Hz. Calculate the value of (i) maximum (ii) average induced emf produced in the coil.



93. Give the direction in which induced current flows in the wire loop, when the magnet is moved towards the loop as shown.



94. Define self-inductance of a coil. Show that magnetic energy required to build up the current I in a coil of self-inductance L is given by ½ LI^2.
95. Show that an ideal inductor does not consume any power in an a.c. circuit.
96. In the figure shown coils P and Q are identical and moving apart with the same velocity V. Induced current in coils are



UNIT DERIVATIONS

1. Explain the concept of magnetic flux . discuss its units and dimension .
2. State and explain faraday ‘s law of electromagnetic induction.
3. State and explain lenz’s law . how will you verify its experimentally ? does it obey the principal of energy conservation/
4. What are the eddy currents ? discuss briefly any two application of eddy currents .
5. Explain the phenomenon of self induction . define the coefficient of self induction . calculate the self induction of long solenoid.
6. Derive the expression of mutual induction of two coaxial long solenoid.
7. What is meant by mean value of AC ? derive an expression for mean value of alternating current and emf.
8. What is meant by rms value of AC? Derive an expression for rms value of alternating current and emf.
9. An AC voltage is applied across an (i) resistor ,(ii) inductor (iii) capacitor then find the expression for current and also draw the phasor diagram
10. Explain the electrical oscillation with the help of diagram , prove that how energy is conserved
11. Explain the series resonant frequency . hence define the quality factor.
12. Derive an expression for the average power in LCR circuit connected to AC supply . hence definer power factor.
13. Explain the construction . principal and working of AC generator
14. Explain the construction principal and working of Transformer, explain the various loses of energy .

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