FORMULA AT A GLANCE

Static Charge

$B = 0$;

$\phi = 0$;

Induced EMF, $e = 0$

Charge in uniform motion

$B = \text{Constant } (\mu_0 N I)$;

$\phi = \text{Constant}$;

$e = 0$

Accelerating charge

$B = \text{Varying}$;

$\phi = \text{Varying}$;

$e = \text{Non-Zero}$

Inductance {Henry (H)}

Self: (Long solenoid)

$L = \mu_0 n^2 l A$

Mutual (Two long solenoids)

$M_{12} = M_{21} = M = \mu_0 n_1 n_2 Al$

Factors affecting Mutual Inductance,

$$K = \sqrt{\frac{M}{L_1 L_2}}$$

Induced EMF

$$e = -N\frac{d\phi}{dt} = Blv = -L\frac{dI}{dt}$$

Power produced due to induced EMF

$$P = \frac{B^2 l^2 v^2}{r}$$

$$F = \frac{B^2 l^2 v}{r}$$

$$I = \frac{Blv}{r}$$

Induced EMF

$$e = -N\frac{d\phi}{dt}$$

Energy of the oscillator

Total energy is stored in the inductor (Purely magnetic)

$$U = \frac{1}{2} L I_0^2$$

Total energy is stored in the capacitor (Purely electrical)

$$U = \frac{1}{2}\frac{q_0^2}{C}$$

For LC oscillator,

$$U = \frac{1}{2} L I^2 + \frac{1}{2}\frac{q^2}{C}$$

LC Oscillator Loop (Kirchhoff's Law)

$$\frac{q}{C} - L\frac{dI}{dt} = 0$$

Alternating current, $I = I_0 \sin \omega t$

Alternating EMF, $E = E_0 \sin \omega t$

RMS current, $I_v = \frac{I_0}{\sqrt{2}} = 0.707\, I_0$

RMS EMF, $E_v = \frac{E_0}{\sqrt{2}} = 0.707\, E_0$

AC through an Inductor

$$I = \frac{E_0}{\omega L}\sin\left(\omega t - \frac{\pi}{2}\right)$$

Inductive reactance, $X_L = \omega L$

AC through a capacitor

$$I = \omega C E_0 \sin\left(\omega t + \frac{\pi}{2}\right) = I_0 \cos \omega t$$

Capacitive reactance, $X_C = \frac{1}{\omega C}$

LCR Series circuit

$$I = \frac{E}{\sqrt{R^2 + (X_C - X_L)^2}}$$

Impedance,

$$Z = \sqrt{\{R^2 + (X_C - X_L)^2\}}$$

At resonance, $X_L = X_C$

$$\tan \phi = \frac{X_C - X_L}{R} = \frac{\frac{1}{\omega C} - \omega L}{R};$$

$$\cos \phi = \frac{R}{Z}$$

Magnetic Flux

(Tm^2 or Weber)

$\phi = \vec{B}.\vec{A} = B A \cos \theta$

Due to self-induction, $\phi = L I$

Due to mutual-induction, $\phi = M I$

$\phi_{21} = \mu_0 n_1 n_2 A l\, I_1 = M I_1$

$\phi_{12} = \mu_0 n_1 n_2 A l\, I_2 = M I_2$

Transformer

Transformation ratio

$$\frac{N_s}{N_p} = K$$

EMF ratio Vs Current ratio

$$\frac{E_S}{E_P} = \frac{I_P}{I_S} = \frac{N_s}{N_p}$$

Efficiency of the transformer

$$\eta = \frac{I_S E_S}{I_P E_P}$$

Resonant Frequency,

$$\nu_0 = \frac{1}{2\pi}\frac{1}{\sqrt{LC}}$$

Quality factor,

$$Q = \frac{\omega_0}{2\Delta\omega} = \frac{\omega_0 L}{R} = \frac{1}{\omega_0 CR}$$

Total bandwidth, $2\Delta\omega = \frac{R}{L} = \frac{1}{RC}$

Power factor $= \cos \phi$

Average power, $P_{av} = E_v I_v \cos \phi$

$= I_v^2 Z \cos \phi$

Wattless current

$I_v = \sin \phi$

SYNOPSIS

Faraday's laws of electromagnetic induction.

Whenever the magnetic flux linked with the closed coil changes, an induced e. m. f is produced, and it lasts as long as there is a change in magnetic flux.

The magnitude of induced e. m. f is directly proportional to the rate of change of magnetic flux linked with the coil. Let Φ_1 be the initial flux and Φ_2 is the flux after a time t, then induced em f.

$E \propto (\Phi_2 - \Phi_1)/t$ OR $E \propto (d\Phi / dt)$

Lenz's Law states that the direction of induced e. m. f or induced current is such that it opposes the change in magnetic flux that is producing it.

Methods of producing the induced e. m. f:-

a)By changing the magnetic field (B

b) By changing the area of the coil (A)

c) By changing the relative orientation of the coil in magnetic field

Self induction is the process of inducing an e. m. f in a circuit due to the variation of current in the circuit itself.Le t I be the current flowing through a coil and Φ the magnetic flux associated with it at any instant,

$\Phi \propto I$, $\Phi = LI$

Mutual induction is the process of inducing an e. m. f in a circuit due to the variation of current in the neighbouring circuit. $\Phi \propto I$, $\boldsymbol{\Phi = MI}$

Eddy currents is defined as the currents induced in the body of a thick conductor (lamina or cylinder) when the magnetic flux linked with it changes. ***These currents are induced in the form of concentric circles.***

The direction of current in these circles is given by Lenz's law.

Application of eddy currents:-

Dead beat galvanometer ,Induction furnace, Electric brakes

Alternating current:-

AC through a resistor (R) The current (I) is in phase with the voltage (E) .

AC through an ideal inductor (L) The current (I) lags the voltage (E) by a phase of 90□ or □/2.

AC through a capacitor (C) The current (I) leads the voltage (E) by a phase of 90□ or □/2.

AC through a LR series circuit:-

Magnitude of the resultant voltage is given by $E = \square\, V_L^2 + V_R^2$ Impedance $Z = \square\, X_L^2 + R^2$

AC through a CR series circuit:-

Magnitude of the resultant voltage is given by $E = □\ V_C^2 + V_R^2$

Impedance $Z = □\ X_c^2 + R^2$

AC through a LCR series circuit:-

Magnitude of the resultant voltage is given by $E = □\ V_R^2 + (V_L □\ V_C)^2$

Impedance $Z = □\ R^2 + (X_L □\ X_C)^2$

Power associated with an ideal inductor and ideal capacitor in an AC circuit is zero.

Average Power associated with a LCR series circuit $P_{av} = E_{rms}\ I_{rms}$ Cos□

Power factor ***Cos□=R/Z***

For a LCR resonance series circuit: Z = R Cos□ = R/R = 1(maximum power is dissipated in a circuit at resonance)

For a purely resistive circuit: □ = 0 Cos□ = 1
(maximum power is dissipated in a purely resistive circuit)

For a purely inductive or capacitive circuit: □ = □/2 Cos□ = 0
(no power is dissipated in a purely inductive or capacitive circuit)

Wattless current is the current in a ideal inductor or ideal capacitor connected to an ac source at which the average power dissipated over one complete cycle is zero.

Transformer is a device which converts low voltage AC to high voltage AC and vice-versa.

Principle: It is based on the phenomenon of mutual induction, $E_S / E_P = N_S / N_P = K$

Where K is transformer ratio

Step up transformer converts low voltage ac to high voltage ac .

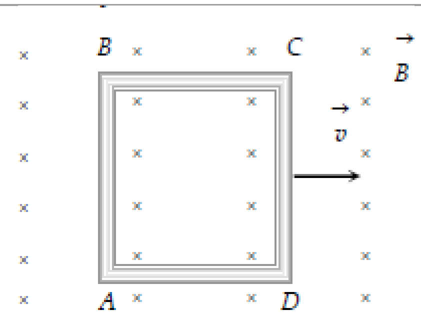
Conditions: K □ 1, N_S □ N_P

Step down transformer converts high voltage ac to low voltage ac.

Conditions: K □ 1, N_S □ N_P

S.No.	**Question Details**				**Marks**
	MULTIPLE CHOICE QUESTIONS				
1.	If both the number of turns and core length of an inductor is doubled keeping other factors constant, then its self-inductance will be-				**1**
	A	Unaffected	**C**	doubled	
	B	quadrupled	**D**	halved	
2.	Oscillating metallic pendulum in a uniform magnetic field directed Perpendicular to the plane of oscillation-				**1**
	A	Slows down	**C**	becomes faster	
	B	remains unaffected	**D**	oscillates with changing frequency	
3.	A metallic cylinder is held vertically and then or small magnet is dropped along its axis. It will fall with-				**1**
	A	acceleration a>g	**C**	acceleration a<g	
	B	acceleration a=g	**D**	constant velocity a=0	
4.	A conducting circular ring is placed in a uniform magnetic field B with its plane Perpendicular to the field. The radius of the ring starts shrinking at the rate (da/dt). Then induced-emf at the instant when the radius is *a* is-				**1**
	A	$(\pi a^2/2)^2 B(da/dt)$	**C**	$\pi a^2 (dB/dt)$	
	B	$\pi a B(da/dt)$	**D**	$2\pi a B(da/dt)$ □ □	
5.	The magnetic flux through a circuit of resistance *R* changes by an amount □ in time *t* , Then the total quantity of electric charge *Q* , which passing during this time through any point of the circuit is given by				**1**
	A	$Q = \frac{\Delta\phi}{\Delta t}$	**C**	$Q = \frac{\Delta\phi}{\Delta t} \times R$	
	B	$Q = -\frac{\Delta\phi}{\Delta t} + R$	**D**	$Q = \frac{\Delta\phi}{R}$	
6.	The energy stored in coil carrying current I is u. If current is halved, then energy stored in the coil will be				**1**
	A	U/2	**C**	U/4	
	B	2U	**D**	4U	
7.	A coil having an area A_0 is placed in a magnetic field which changes from B_0 to $4B_0$ to in atime interval *t*. The e.m.f. induced in the coil will be				**1**
	A	$\frac{3A_0B_0}{t}$	**C**	$\frac{3B_0}{A_0 t}$	
	B		**D**		

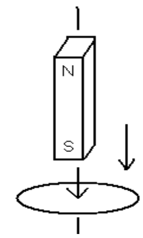
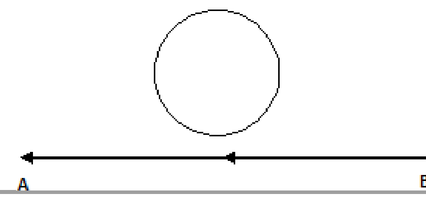
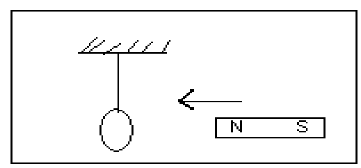
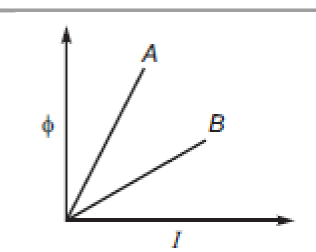
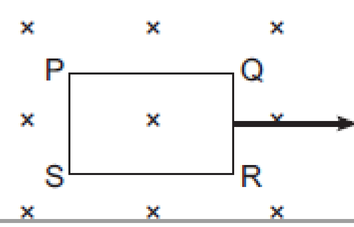
		$\frac{4A_0B_0}{t}$		$\frac{4B_0}{A_0 t}$	

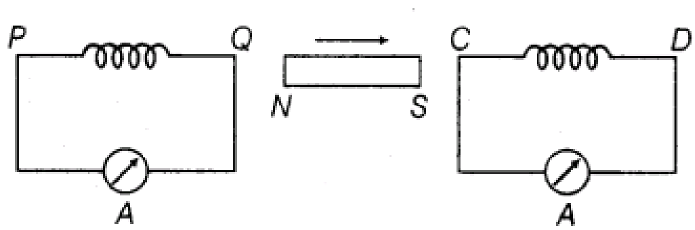
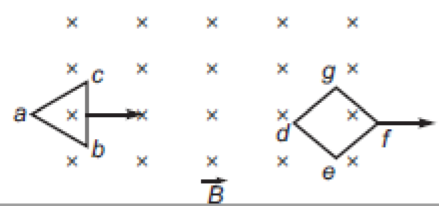
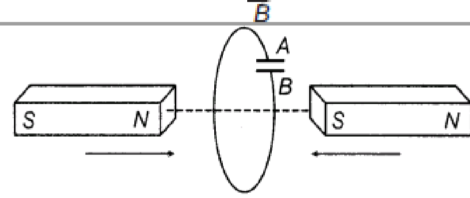
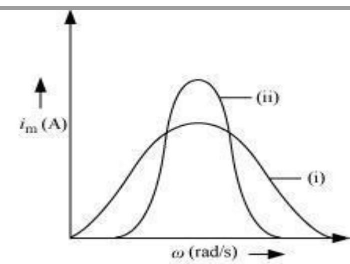
8.	Due to relative motion of a magnet with respect to a coil, an emf is induced in the Coil, identify the Principle involved-				**1**
	A	Ampere’s circuital law	**C**	Faraday's law	
	B	Biot-Savart law	**D**	Gauss law	
9.	A conducting square loop of side *L* and resistance *R* moves in its plane with a uniform velocity *v* perpendicular to one of its sides. A magnetic induction *B* constant in time and space, pointing perpendicular and into the plane of the loop exists everywhere. The current induced in the loop is				**1**
	A	BLv/R clockwise	**C**	BLv/R antoclockwise	
	B	2BLv/R anticlockwise	**D**	Zero	
10.	S.I unit of mutual inductance is				**1**
	A	Henry	**C**	Tesla	
	B	Weber	**D**	No unit	
11.	In a pure capacitive circuit if the supply frequency is reduced to 1/2, the current will				**1**
	A	Be reduced by half	**C**	Be doubled	
	B	Be reduced to one fourth	**D**	Be four times at high	
12.	In R-L-C series resonant circuit magnitude of resonance frequency can be changed by changing the value of				**1**
	A	R only	**C**	C only	
	B	L only	**D**	L or C	
13.	The core of a transformer is laminated, so as to				**1**
	A	make it light weight	**C**	make it robust and strong	
	B	increase the secondary voltage	**D**	reduce energy loss due to eddy current	
14.	The average value of a 12 V peak sine wave over one complete cycle is				**1**
	A	7.64 V	**C**	1.27 V	
	B	6.37 V	**D**	0 V	

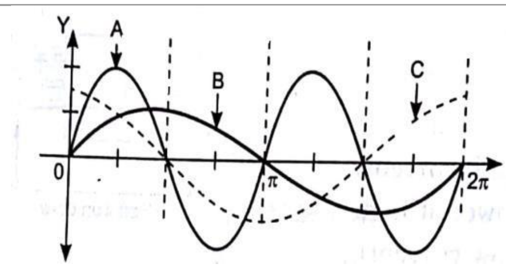
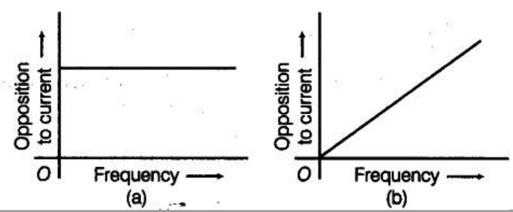
15.	If a secondary coil has 40 turns, and, a primary coil with 20 turns is charged with 50 V of potential difference, then potential difference in secondary coil would be				**1**
	A	50 V in secondary coil	**C**	60 V in secondary coil	
	B	25 V in secondary coil	**D**	100 V in secondary coil	
16.	In a series LR-circuit, the inductive reactance is equal to the resistance R of the circuit. An emf E = E0cos (ωt) is applied to the circuit. The power consumed in the circuit is				**1**
	A	$\frac{E_0^2}{R}$	**C**	$\frac{E_0^2}{4R}$	
	B	$\frac{E_0^2}{2R}$	**D**	$\frac{E_0^2}{8R}$	
17.	An AC voltage source of variable angular frequency ω and fixed amplitude V connected in series with a capacitance C and an electric bulb of resistance R (inductance zero). When ω is increased				**1**
	A	The bulb glows dimmer	**C**	Net impedance of circuit is unchanged	
	B	The bulb glows brighter	**D**	Total impedance of the circuit increases	
18.	In electric arc furnace Cu or Iron is melted due to variation of				**1**
	A	current	**C**	voltage	
	B	magnetic field	**D**	electric field	
19.	In series R-L-C circuit, quality factor can be improved by				**1**
	A	decreasing L	**C**	increasing C	
	B	decreasing R	**D**	decreasing R & L	
20.	A capacitor of capacitance C has reactance X. If capacitance and frequency become double, then the capacitive reactance will be				**1**
	A	2X	**C**	4X	
	B	X/2	**D**	X/4	
	ASSERTION & REASON (a) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion. (b) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion. (c) If the Assertion is correct but Reason is incorrect.				

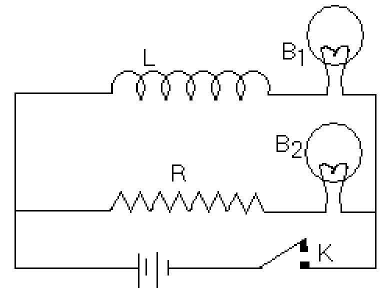
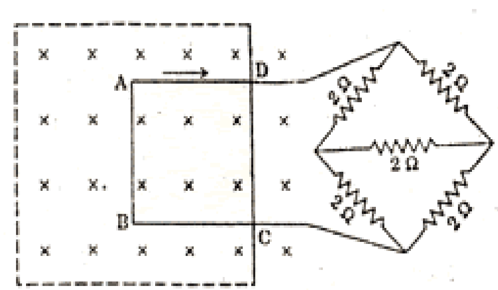
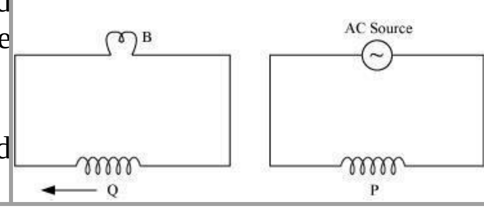
	(d) If both the Assertion and Reason are incorrect.	
21.	**Assertion :** Induced emf will always occur whenever there is change in magnetic flux. **Reason :** Current always induces whenever there is change in magnetic flux.	**1**
22.	**Assertion :** Lenz's law violates the principle of conservation of energy. **Reason :** Induced emf always opposes the change in magnetic flux responsible for its production.	**1**

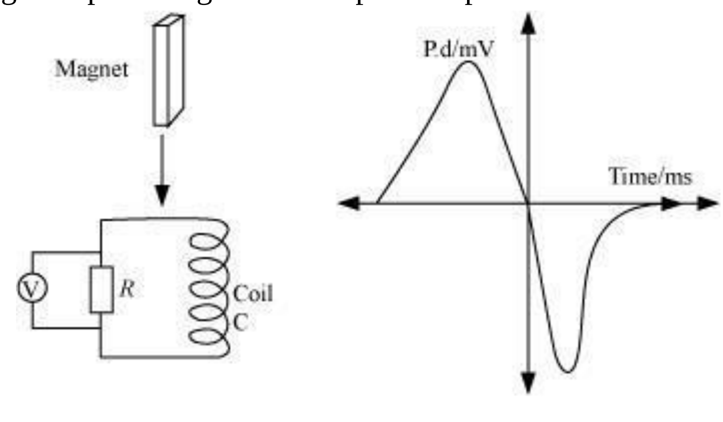
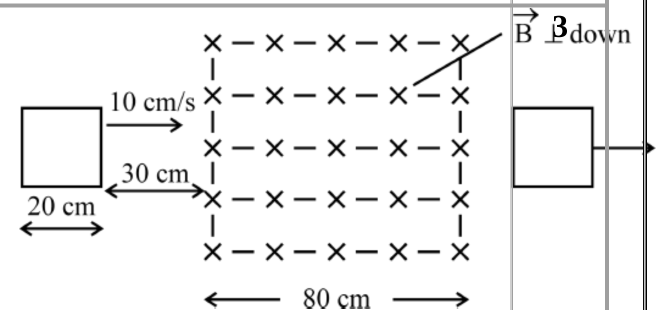
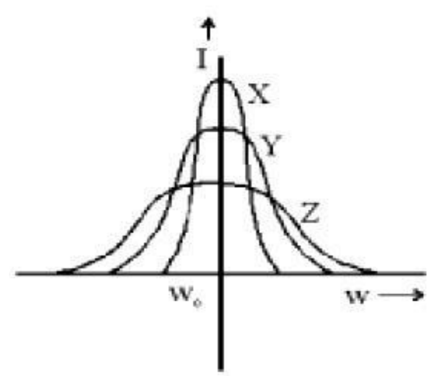
23.	**Assertion :** Average value of ac over a complete cycle is always zero. **Reason:** Average value of ac is always defined over half cycle.	**1**
24	**Assertion :** The power is produced when a transformer steps up the voltage. **Reason :** In an ideal transformer VI = constant.	**1**
25	**Assertion :** The alternating current lags behind the emf by a phase angle of, $\pi/2$ when AC flows through an inductor. **Reason :** The inductive reactance increases as the frequency of AC source increases.	**1**

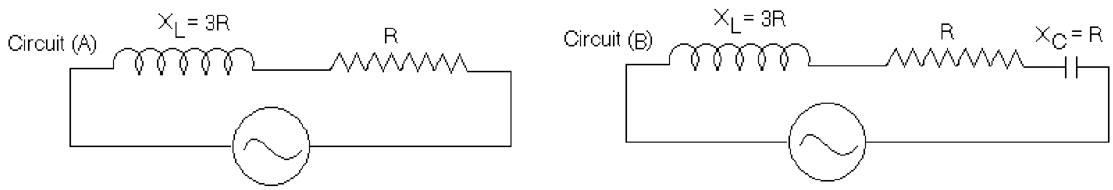
	VERY SHORT ANSWER QUESTIONS		
26.	A copper ring is held horizontally, and bar magnet is dropped through the ring with its length along the axis of the ring. Will the acceleration of the falling magnet be equal to, greater than or less than that due to gravity? Give reason?		**1**
27.	The electric current in the direction B to A is decreasing. What is the direction of induced current in the loop kept above the wire?		**1**
28.	Give the direction in which the induced current flows in the wire loop, when the magnet moves towards it as shown in the figure.		**1**
29.	A metallic disc on the top of an electro magnet is thrown up as the current is switched on. Why? Give reason		**1**
30.	A plot of magnetic flux (Ø) versus current (I) is shown in the figure for two inductors A and B. Which of the two has larger value of self inductance ?		**1**
31.	The closed loop (PQRS) of wire is moved out of a uniform magnetic field at right angles to the plane of the paper as shown in the figure. Predict the direction of the induced current in the loop.		**1**
32.	Obtain the condition in a LCR series circuit under which wattles current flows in the circuit?		**1**
33.	The power factor in an AC circuit is 0.5. What is the phase difference between voltage and current in this circuit?		**1**

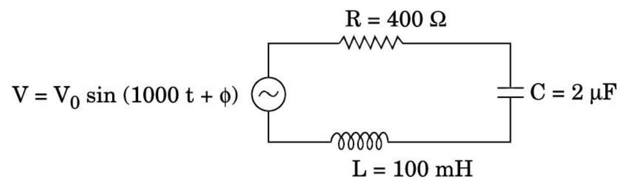
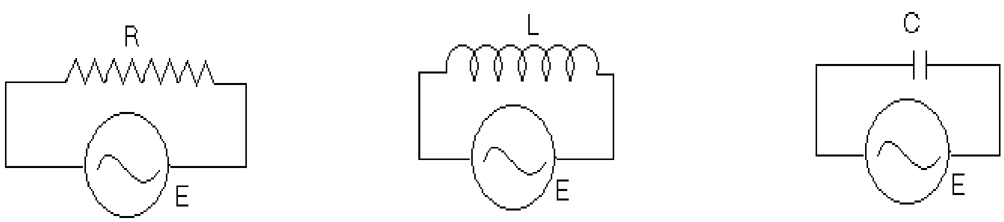
34.	A bar magnet is moved in the direction indicated by the arrow between two coils PQ and CD. Predict the direction of induced current in each coil. 	**1**
35.	What does the quality factor Q signify in a LCR circuit? What is its SI unit?	**1**
36.	Two loops of different shapes are moved in a region of uniform magnetic field in the directions marked by the arrows as shown in the figure. What is the direction of inducedcurrent in each loop? 	**1**
37.	Predict the polarity of the capacitor in the situation describes below: 	**1**
38.	The current vs. frequency plots of two circuits having the same inductance and capacitance, but different resistance is shown above. Which of the two circuits will have a higher resistance? 	**1**
39.	In an ac circuit, the instantaneous voltage and current are V= 200 Sin 300 t volt and I= 8 Cos 300 t ampere respectively. Is the nature of the circuit capacitive or inductive? Give reason.	**1**
	2 MARKER QUESTIONS	
40.	Why do metallic pieces become very hot when they are surrounded by a coil carrying high frequency AC? Why is spark produced in switch when the light is put off?	**2**
41.	A device X is connected to an ac source $V= V_0$ Sin ωt. The variation of voltage, current andpower in one cycle is shown in the following graph.	**2**

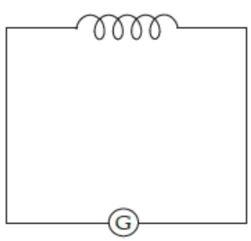
	 (a) Identify the device X. (b) Which of the curves A, B or C represent the current, voltage and power in the circuit?	
42.	How does the mutual inductance of a pair of coils change when (i) The distance between the coils is increased?(ii) The number of turns in each coil is decreased? Justify?	**2**
43.	A coil is mechanically rotated with constant angular speed w in a uniform magnetic field, which is perpendicular to the axis of rotation of the coil. The plane of the coil is initially held perpendicular to the field. Plot on the same graph the variation with **ωt** a) magnetic flux in the coil b) the induced emf in the coil	**2**
44.	The following graph (a) and (b) represent the variation of opposition offered by the circuit element to the flow of ac with frequency of applied emf. Identify the circuit element corresponding to each graph. 	**2**
45.	A rectangular coil of area A, having number of turns N, is rotated at 'f' revolutions per second in a uniform magnetic field B, the field being perpendicular to the coil. Prove that the maximum emf induced in the coil is $2\pi f\, NBA$.	**2**
46.	Show that Lenz's law is in accordance with law of conservation of energy?	**2**
47.	If the self-inductance of an air core inductor increases from 0.01mH to 10 mH on introducing an iron core into it, what is the relative permeability of the core used?	**2**
48.	Write the principle of a transformer? Mention 2 losses in a transformer and how are they minimized?	**2**
49.	a) What are eddy currents? b) Write any two applications of eddy currents.	**2**
50.	The current flowing through an inductor of self-inductance L is continuously increasing. Plot a graph showing the variation of a) Magnetic flux versus the current. b) Induced emf versus *dI/dt*. c) Stored magnetic potential energy versus current.	**2**

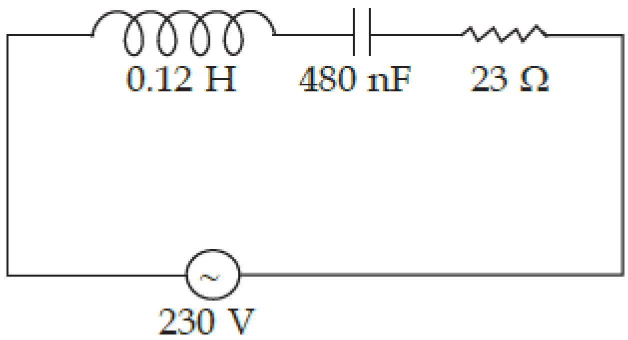
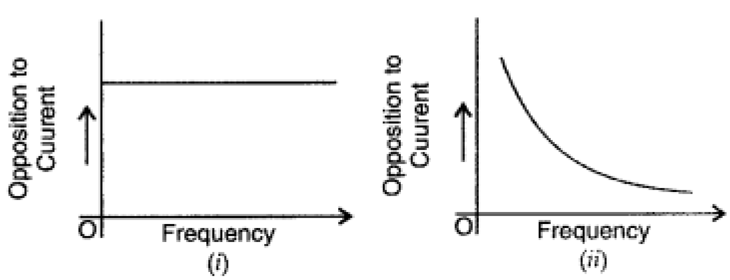
51.	Figure shows an inductor L and a resistance R connected in parallel to a battery through a switch. The resistance R is same as that of the coil that makes L. Two identical bulbs are put in each arm of the circuit. a) Which of the bulbs lights up earlier, when K is closed? b) Will the bulbs be equally bright after same ? 	**2**
52.	The currents flowing in the two coils of self inductance L1= 16mH and L2 = 12 mH are increasing at the same rate. If the power supplied to the two coils are equal, find the ratio of (i)Induced voltages, (ii)The currents and (iii)energy stored in the two coils at a given instant.	**2**
53.	Two identical loops, one of copper and the other of aluminium, are rotated with the same angular speed in the same magnetic field. Compare (i) the induced emf and (ii) the current produced in the two coils. Justify.	**2**
	3 MARKER QUESTIONS	
54.	A metallic square loop ABCD of size 15 cm and resistance $1.0\,\Omega$ is moved at a uniform velocity of v m/s, in a uniform magnetic field of 2 Tesla, the field lines being normal to the plane of the paper. The loop is connected to an electrical network of resistors, each of resistance $2\,\Omega$. Calculate the speed of the loop, for which 2 m A current flows in the loop. 	**3**
55.	Define mutual inductance between two long coaxial solenoids. Find out the expression for the mutual inductance of inner solenoid of length *l* having the radius r1 and the number of turns n1 per unit length due to the second outer solenoid same length and n2 number of turns per unit length	**3**
56.	Prove mathematically that the average power over a complete cycle of alternating current through an ideal inductor is zero.	**3**
57.	A coil Q is connected to low voltage bulb B andplaced near another coil P as shown in the figure.Give reasons to explain the following observations: (a) The bulb 'B' lights (b) (b) Bulb gets dimmer if the coil Q is moved towards left 	**3**
58.	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	**3**

	circuit.	
59.	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?  (a) (b)	**3**
60.	A square loop of side 20 cm is initially kept 30 cm away from a region of uniform magnetic field of 0.1 T as shown in the figure. It is then moved towards theright with a velocity of 10 cm s^{-1} till it goes out of the field. Plot a graph showing the variation of (i) magnetic flux (f) through the loop with time (t). (ii) induced emf (e) in the loop with time t. (iii) induced current in the loop if it has resistance of 0.1 W. 	**3**
61.	When an alternating voltage of 220V is applied across a device X, a current of 0.5 A flows through the circuit and is in phase with the applied voltage. When the same voltage is applied across another device Y, the same current again flows through the circuit but it lead the applied voltage by □/2 radians. (a) Name the device X and Y. (b) Calculate the current flowing in the circuit when same voltage is applied across the serious combination of X and Y . [I= 0.354A]	**3**
62.	Three students X, Y and Z performed an experiment for studying the variation of alternating currents with angular frequency in a series LCR circuit and obtained the graphs shown below. They all used a.c. sources of the same r.m.s value and inductances of the same value. a) What can we (qualitatively) conclude about the i. Capacitance value ii. Resistance values used by them? 	**3**

	b) In which case will the quality factor be maximum and Why? c) What can we conclude about nature of the impedance of the setup at frequency ω_0 ?		
63.	Figure shows two electric circuits A and B. Calculate the ratio of power factor of the circuit B to the Power factor of the circuit A.[$\sqrt{2}$]  		**3**
64.	A capacitor and a resistor are connected in series with an a.c. source. If the potential difference across C,R are 120V, 90 V respectively and if the r.m.s. current of the circuit is 3 A, calculate the (i) impedance,(ii) power factor of the circuit. [50Ω,0.6]		**3**
65.	A resistor of 100 Ω and a capacitor of 100/π μF are connected in series to a 220 V, 50 Hz a.c. supply. (a) Calculate the current in the circuit. (b) Calculate the (rms) voltage across the resistor and the capacitor. Do you find the algebraic sum of these voltages more than the source voltage? If yes, how do you resolve the paradox?		**3**
	5 MARKER QUESTIONS		
66.	You are given three circuit elements X, Y and Z. When the element X is connected across an a.c. source of a given voltage, the current and the voltage are in the same phase. When the element Y is connected in series with X across the source, voltage is ahead of the current in phase by π/4. But the current is ahead of the voltage in phase by π/4 when Z is connected in series with X across the source. Identify the circuit elements X, Y and Z. When all the three elements are connected in series across the same source, determine the impedance of the circuit. Draw a plot of the current versus the frequency of applied source and mention the significance of this plot.		**5**
67.	A capacitor of 50 micro farad, a resistor of 10 ohm and an inductor L are connected in series with an ac source of frequency 50 Hz. Calculate the value of L, if the phase angle between the current and voltage is zero. [0.2H]		**5**
68.	In a series LR circuit, X_L = R and the power factor of the circuit is P_1. When a capacitor with capacitance C such that X_C = XL is put in series, the power factor becomes P_2. Find out P_1 / P_2.		**5**

69.	Determine the value of phase difference between the current and the voltage in the given series LCR circuit. Calculate the value of the additional capacitor which may be joined suitably to the capacitor C that would make the power factor of the circuit unity.  	**5**
70.	a) Explain, with the help, of a diagram, the principle and working of an a.c. generator. Write the expression for the emf generated in the coil in terms of its speed of rotation. b) 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 ωt (in volt) and I= 1.2 Sin (ωt+ $\frac{□}{5}$)(in ampere) i. Name the circuit elements ii. What is the Power factor of the circuit? iii. What is the rate, at which energy is delivered by the generator to the circuit? [(a). Series combination of a register and a capacitor.(b). Power factor = cosΦ = 0.81(c). P_{av} = $E_V I_V$CosΦ = 72.9W]	**5**
71.	A circular coil of radius r is placed coaxially with another coil of radius R, where R >> r, with the center of the two coils coinciding with each other. Obtain an expression for the mutual inductance M12 of the two coils. Further show that M_{12} = M_{21}.	**5**
72.	A) Figure (a), (b) and (c) Show three alternating circuits with equal currents. If frequency of alternating emf be increased, what will be the effect on currents In the three cases. Explain.  B) An a.c. source of frequency 50Hz is connected to 50mH inductor and a bulb. The bulb glows with some brightness. Calculate the capacitance of the capacitor to be connected in series with circuit, so that the bulb glows with maximum brightness.	**5**

73.	(a) State the principle in which AC generator works. Draw a labeled diagram and explain its working. (b) A conducting rod held horizontally along east west direction is dropped from rest from a certain height near the earth's surface. Why should there be an induced emf across the ends of the rod? Draw a plot showing the instantaneous variation of emf as a function of time from the instant it begins to fall.	**5**
74.	A 2μF capacitor, 100Ω resistor and 8H inductor are connected in series with an AC source. a) What should be the frequency of the source such that current drawn in the circuit is maximum.? What is this frequency called? b) If the peak value of emf of the source is 200V, find the maximum current? c) Draw a graph showing variation of amplitude of circuit current with changing frequency of applied voltage in a series LCR circuit for two different values of resistance R_1 and R_2($R_1 > R_2$) d) Define the term 'Sharpness of Resonance'. Under what condition. Does a circuit become more selective?	**5**
	CASE STUDY Self Induction. When a current I flows through a coil, flux linked with it is φ = LI, where L is a constant known as self inductance of the coil.  Any charge in current sets up an induced emf in the coil. Thus, self inductance of a coil is the induced emf set up in it when the current passing through it changes at the unit rate. It is a measure of the opposition to the growth or the decay of current flowing through the coil. Also, value of self inductance depends on the number of turns in the solenoid, its area of cross-section and the permeability of its core material.	
1	The inductance L of a solenoid depends upon its radius R as	1
2	The induced emf in a coil of 10 henry inductance in which current varies from 9 A to 4 A in 0.2 second is	1
3	**Determine the energy stored in an inductor of inductance 100mH when a current of 0.2A is passed through it.** **OR**	2

	A solenoid (air core) has 400 turns, is 20 cm long and has a cross-section of 4cm^2. Then find the coefficient of self-induction.	
	CASE STUDY 2 Resonant Series LCR Circuit. When the frequency of ac supply is such that the inductive reactance and capacitive reactance become equal, the impedance of the series LCR circuit is equal to the ohmic resistance in the circuit. Such a series LCR circuit is known as resonant series LCR circuit and the frequency of the ac supply is known as resonant frequency. Resonance phenomenon is exhibited by a circuit only if both L and C are present in the circuit. We cannot have resonance in a RL or RC circuit. A series LCR circuit with L = 0.12 H, C = 480 nF, R = 23 Ω is Connect to a 230 V variable frequency supply.  	
1	Plot a graph showing variation of capacitive reactance with the change in the frequency of the AC source.	1
2	**What is the principle of mutual induction?**	
3	A lamp is connected in series with a capacitor. Predict your observation when this combination is connected in turn across (i) ac source and (ii) a 'dc' battery. What change would you notice in each case if the capacitance of the capacitor is increased? OR The graph shown in the figure represent variation of opposition offered by the circuit elements, X and Y, respectively to the flow of alternating current vs. the frequency of the applied emf. Identify the elements X and Y.  	2

ANSWER KEY - MCQ

1	**2**	**3**	**4**	**5**
C	A	C	D	D
6	**7**	**8**	**9**	**10**
C	A	C	D	A
11	**12**	**13**	**14**	**15**
A	D	D	D	D
16	**17**	**18**	**19**	**20**
C	B	A	B	D