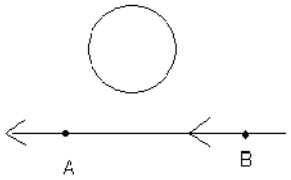
	UNIT 4	
	ELECTROMAGNETIC INDUCTION AND ALTERNATING CURRENT	
	PART A	
1	Define magnetic flux. What is its SI unit?	1
2	Define Power factor.	1
3	State Faraday's Laws of EMI.	1
4	State Lenz's Law. On which law of conservation it is based?	1
5	State the principle of a Transformer.	1
6	A wire cuts across a flux of 0.2×10^{-2} Wb in 0.12 s. What is the emf induced in the wire?	2
7	What are eddy currents? Write two applications of eddy currents.	2
8	Write one disadvantage of eddy currents. How can we reduce eddy currents?	2
9	State Fleming's Right Hand Rule.	2
10	220V a.c. is more dangerous than 220V d.c. Why?	2
11	Define mutual-inductance. Write its SI unit. Give the factors on which mutual inductance between a pair of coils depend.	3
12	An a.c. source generating a voltage $V = V_m \sin \omega t$ is connected to a capacitor of capacitance C. Find the expression for the current I flowing through it.	3
13	Plot a graph of V and I versus ωt to show that the current is $\pi/2$ ahead of the voltage.	3
14	What are the energy losses in a transformer?	3
15	State the condition for resonance to occur in a series LCR circuit and derive an expression for resonant frequency and impedance using phasor diagram.	3
16	The frequency of a.c. is doubled. How do R, X_L and X_C get affected?	3
17	Distinguish between resistance, reactance and impedance of an a.c. circuit.	3
18	Draw a plot showing the variation of peak current and the frequency of the a.c. source used. Define the Quality Factor Q of the circuit.	5

19	With the help of a labeled diagram explain the underlying principle, construction and working of an a.c. generator. Derive the expression for induced emf. Show graphical representation of induced emf with time.	5
20	With the help a labeled diagram, describe the principle, construction and working of a transformer.	5
	PART B	
1	In which a.c.circuit, current lags behind the voltage by π/ 2?	1
2	Show graphical variation of X_L with frequency of alternating current.	1
3	What is Wattless current?	1
4	Show the graphical variation of X_C with angular frequency of alternating current.	1
5	What is the phase angle between current and voltage in a.c. circuit containing R only?	1
6	When is Magnetic Flux linked with surface: (i) maximum (ii) minimum?	2
7	In an a.c. circuit, there is no power consumption in an ideal inductor. Why?	2
8	Why does the metallic piece become very hot when it is surrounded by a coil carrying high frequency ac?	2
9	Define self-inductance. Write its SI unit. Give two factors on which self inductance of an air core coil depends.	2
10	Give the phase difference between applied a.c. voltage and current in LCR circuit at resonance.	2
11	In India the domestic power supply is at 220V, 50 Hz while in USA it is 110V, 50 Hz. Give one advantage and one disadvantage of 220V supply over 110V supply.	3
12	How is the transformer used in large scale transmission and distribution of electrical energy over long distances?	3
13	A transformer is used to step- down a.c. voltage. Which appliance will you use to step-down d.c voltage?	3
14	A step-up transformer converts a low input voltage into a high output voltage. Does it violate the law of conservation of energy? Explain.	3
15	A magnetic field of 0.200 T exists within a solenoid of500 turns and a diameter of 10.0 cm. How rapidly (that is, within what period of time) must the field be reduced tozero, if the average induced emf within the coil during thistime interval is to be 10.0 kV?	3

16	As soon as the current is switched on in a high voltage wire, the bird sitting on it flies away, Why?	3
17	Two circular coils, one of radius r and the other R are placed coaxially with their centre coinciding. For R>>r, obtain an expression for the mutual inductance of the arrangement.	3
18	Derive an expression for the induced emf produced by changing the area of a rectangular coil placed perpendicular to a magnetic field.	3
19	Derive expression for self-inductance of a long air-cored solenoid of length l, radius r and having number of turns N.	5
20	An inductor 200mH, capacitor 500 μF, and resistor 10 Ω are connected in series with a 100V, variable frequency a.c. source. Calculate the (i) frequency at which power factor of the circuit is unity (ii) current amplitude at this frequency (iii) Q-factor.	5
	PART C	
1	The current in the direction from B-A is decreasing, what is the direction of induced current in the Metallic loop kept above the wire? 	1
2	A coil has an inductance of 0.03 H. Determine the emf induced in the coil if current changes at the rate of 150 A/s.	1
3	How does Self Inductance of a coil change when an iron rod is introduced in it?	1
4	When are the voltage and current in LCR series a.c. circuit in phase?	1
5	The instantaneous current from an a.c. source I = 5 sin 314t.What is the rms value of the current?	1
6	The magnetic flux through a coil perpendicular to the plane is varying according to the relation $\phi = (5t^3 + 4t^2 + 2t-5)$ Wb Calculate the induced current through the coil at t= 2s, if the resistance of the coil is 5Ω.	2
8	A jet plane is travelling west at 450 ms^{-1}. If the horizontal component of earth's magnetic field at that place is 4×10^{-4} T and the angle of dip is 30°, find the emf induced between the ends of wings having a span of 30 m.	2
9	A capacitor blocks d.c. and allows a.c to flow through it. Explain.	2
10	You are given an air core coil, a bulb and an iron rod and a source of electricity. Suggest a method to find whether the given source is d.c. or a.c. Explain your answer.	2

11	Prove that an ideal inductor (or ideal capacitor) does not dissipate power in an a.c. circuit.	3
12	Why can't a transformer be used to step-up d.c. voltage?	3
13	Obtain the expression for the mutual inductance of a two long co-axial solenoids but having different radii and different number of turns.	3
14	How does the mutual inductance of a pair of coils change when a) The distance between the coils is increased. b) the number of turns in each coil is decreased c) a thin iron sheet is placed between the two coils, Other factors remaining the same. Justify your answer in each case.	3
15	An average induced emf of 0.4 V appears in a coil when the current in it is changed from 10A in one direction to a 10A in opposite in 0.40s.Find the coefficient of self-induction of the coil.	3
16	A metallic rodof length l is rotated at an angular speed ω normal to a uniform magnetic field B. Derive expressions for the (i) emf induced in the rod (ii) heat dissipated if the resistance of the rod is R.	3
17	A sinusoidal emf E=200 sin 314t is applied to a resistor of 10 Ω resistance; calculate Rms value of voltage rms value of current (iii) Power dissipated as heat in watt.	3
18	Does the current in an a.c. circuit lag, lead or remain in phase with the voltage of frequency applied to the circuit when (i) $f = f_r$ (ii) $f < f_r$ (iii) $f > f_r$, where f_r is the resonant frequency.	3
19	A series LCR circuit with L = 4.0 H, C = 100μF and R = 60Ω is connected to a variable frequency 240V source. Calculate (i) the angular frequency of the source which drives the circuit at resonance. (ii) The current at resonance (ii) the rms potential drop across the inductor at resonance.	3
20	A resistor of 200 Ω and a capacitor of 15 μF are connected in series t a 220 V, 50 Hz a.c. source. Calculate the current in the circuit and the rms voltage across the resistor and the capacitor. Is the algebraic sum of these voltages more than the source voltage? If yes, resolve the paradox.	3