Bsc Physic Sem - I

Paper 2 (Electrostatics, Time varying fields & Electric Currents)

Question Bank

Unit 1

1. State and explain Coulomb's law in vacuum. Prove that Coulomb's law is in accordance with the Newton's third law of motion.
2. What do you mean by conservative field ? Show that electrostatic field is conservative
3. Derive an expression for electric field intensity at a point due to a point charge.
4. Derive the relation E = –grad V.
5. Define electric dipole and dipole moment. Obtain an expression for the electric potential at a far off point due to a short dipole. Hence, obtain an expression for the electric field at that point.
6. Obtain an expression for work done on a charge by an electric field, expressed as line integral of electric field.
7. State and explain Coulomb's Law in vector form. Give its limitations.
8. Derive an expression for electric field intensity at a point due to a point charge.
9. Derive the expression $E = -\nabla V$, for a conservative electrostatic field.
10. Four point charges of +4, –3, +2 and +3 C are placed at the corners of a square of side 1 m. Find the potential at the centre of the square.
11. Define electric dipole and dipole moment. Obtain an expression for electric field intensity at a point due to an electric dipole having polar co-ordinates (r, q).
12. Define Electric potential at a point and derive an expression for the potential at a point due to a point charge.
13. What do you mean by conservative field ? Show that electrostatic field is conservative.
14. What is Q-value of series LCR circuit ? How it signify the sharpness of resonance ? On what factor does it depends ?

Unit 2

1. Define Electric field intensity (E), Displacement density (D) and Polarization (P) and derive the relation between them.
2. Explain with examples polar and non-polar dielectrics.
3. A parallel plate condenser is partially filled with an ebonite plate of thickness 6 mm. If area of plates of condenser is 2×10^{-2} m2 , separation between the plates is 1 cm and dielectric constant of ebonite is 3, calculate capacity of the condenser.
4. Three parallel capacitor and three series capacitor are connected in parallel. If the capacity of each capacitor is 'C', find the capacitance of their combination.
5. Discuss different types of polarizability in dielectrics.

6. If the capacity of condenser changes from 1000 µF to 1500 µF when the dielectric is introduced. Find out the value of dielectric constant introduced
7. Explain the meaning of local electric field in a dielectric substance. Obtain an expression for local electric field at a point inside a dielectric.
8. What is polarization in dielectrics ? Explain its physical meaning.
9. Explain electronic, ionic and orientational polarizability
10. Show that the capacity of a parallel plate capacitor completely filled with a dielectric is given by
    $K = \frac{\epsilon A}{d}$
11. Discuss different types of polarizability in dielectrics.

Unit3

1. Describe the construction and theory of transformer with neat labelled diagram
2. What are the different types of losses associated with the transformer ? How can they be minimize ?
3. Derive equation of continuity for time varying currents.
4. Derive an expression for decay of charge in CR circuit.
5. State and explain Kirchoff's current and Voltage law
6. In an LR circuit, the current attains 1/3rd of its final steady value in 5 sec. What is the time constant of the circuit ?
7. Distinguish between current and current density. Derive equation of continuity.
8. What are the different types of losses associated with a transformer ? How can they be eliminated ?
9. A step down transformer converts a voltage of 2200 V into 220 V in the transmission line. Number of turns in primary coil is 5000. Efficiency of the transformer is 90% and its output power is 8 kW. Calculate :
    (a) Number of turns in secondary coil
    (b) Input power.
10. State and explain Kirchoff's current and voltage laws
11. Explain various parameters of a transformer
12. The current in LR circuit rises to half of its final value in 3 seconds. Find the time constant of the circuit
13. If the capacity of condenser changes from 1000 µF to 1500 µF N when the dielectric is introduced. Find out the value of dielectric constant introduced.
14. Prove Coulomb's law in accordance with Newton's third law of motion.
15. Write the unit of reactance and impedance.

Unit4

1. Explain the term impedance and reactance. Obtain an expression for the power consumed in an ac circuit ? What is Wattless current ?
2. What is Q-value of series LCR circuit ? How it signify the sharpness of resonance ? On what factor does it depends ?

3. Show that in a pure inductive circuit, the current lags behind the applied emf by 90º.
4. An electric lamp marked 100 Volts d.c. consumes a current of 10 A. It is connected to a 200 Volts, 50 cycles a.c. mains. Calculate the inductance of the required choke.
5. By j-operator method, obtain an expression for the current in an ac circuit containing capacitance and resistance.
6. How a.c. current and voltages are expressed in complex number form ? Explain.
7. Obtain an expression for the power consumed in an ac circuit. What is wattless current ?
8. What is resonance in series LCR ac circuit ? Obtain an expression for the resonant frequency in LCR circuit.
9. In a series resonant LCR circuit L = 4 H, C = 1 mF, R = 20 ohm. Calculate the resonant frequency.
10. By j-operator method obtain an expression for the current an ac circuit containing capacitance and resistance.
11. Explain how a.c. current and voltage are expressed in complex number form.
12. Using j-operator method show that in pure inductor, the current lags behind the emf by $\pi/2$.
13. A resistance of 10 ohms is in series with pure inductance of 0.01 H, a.c. voltage of 210 V (rms), 50 Hz is applied to this circuit. Calculate current and potential drop across resistance in the circuit
14. Explain the conservative nature of electrostatic field.
15. Show that : E = – grad v