

**SECOND YEAR B.Sc. DEGREE EXAMINATION
MARCH/APRIL 2005**

Part III—Group II Physics

Paper II — ELECTRICITY AND MAGNETISM

(Prior to 2003 Admissions)

Time : Three Hours

Maximum : 50 Marks

Section A

*Answer any two questions.
Each question carries 6 marks.*

1. Describe a quadrant electrometer and give the theory of its action. Explain how it can be used to measure ionisation current.
2. What is meant by Peltier effect ? Define Peltier coefficient. Prove that the Peltire coefficient of a pair of metals is the product of absolute temperature and thermoelectric power.
3. Give the theory of oscillatory discharge of a capacitor through an inductance and a resistor. Deduce the condition under which the discharge is oscillatory.
4. Describe a method of tracing the hysteresis curve for a sample of iron. What is the importance of hysteresis curve ?

(2 × 6 = 12 marks)

Section B

*Answer any four questions.
Each question carries 3 marks.*

5. Define electric field intensity. Derive an expression for the electric field due to a finite line of charge.
6. What are dielectrics ? Derive Gauss's law in a dielectric medium.
7. Explain the principle of a capacitor. Derive an expression for the capacitance of a parallel plate capacitor.
8. State and prove Ampere's circuital law in magnetostatics. Use it do derive the magnetic field due to a long solenoid.
9. What are the different types of self excited dynamos ? Explain their characteristics and uses.
10. What is a choke coil ? Give its theory of action. Why is it considered superior to a rheostat ?

(4 × 3 =12 marks)

Section C

*Answer any seven questions.
Each question carries 2 marks.*

11. What do you mean by electric potential energy ?
12. What are ferroelectric crystals ? Mention their uses.
13. Define electric current and current density. Establish the relation between the current density and the velocity of charge carriers.
14. What is meant by damping in a ballistic galvanometer ? Explain how damping correction is applied in the galvanometer.
15. What is the principle of an induction coil ? Mention its any four important uses.
16. What are eddy currents ? Give their practical applications.
17. What is a series resonance circuit ? Explain its important application.
18. Describe the various losses occurring in a transformer.
19. Explain the principle of an ac induction motor.
20. Mention the important properties of ferromagnetic materials.
21. What is a magnetic circuit ? Explain the terms magnetomotive force and reluctance.

(7 × 2 = 14 marks)

Section D

*Answer any four questions.
Each question carries 3 marks.*

22. An electric dipole of moment 3×10^{-8} cm is placed in a uniform field of intensity 2×10^5 NC⁻¹. Find the maximum torque exerted by the field on the dipole and the work done on turning the dipole end to end.
23. A parallel plate capacitor consists of two plates of area 100 sq.cm. each and separated by a distance of 1cm. A square glass slab of thickness 1cm and side 5 cm is placed between the plates. Find the capacitance of the capacitor. Relative permittivity of glass = 10.
24. A current of 200A exists in a copper wire whose diameter is 1cm. find the current density and the electron drift speed. Given that there are 8.5×10^{28} free electrons per cubic metre of the metal.
25. A fully charged $1 \mu\text{F}$ capacitor produces a throw of 20 cm when it is discharged through a ballistic galvanometer. If the charged capacitor is first short-circuited through a resistance R for 20 seconds and then discharged, the throw reduces to 15 cm. Calculate the value of R.
26. A step-up transformer operates on a 200V line and supplies a current of 2A. The ratio of primary and secondary winding is 1:25. Determine the secondary voltage, primary current and output power. Assume 100% efficiency.
27. An AC supply 220V and 50Hz is joined to a circuit containing an inductance of 100mH and a resistance of 20 ohms in series. Calculate the power consumed.
28. A solenoid has a length of 1 metre. The number of turns per metre is 5×10^4 . Calculate the self inductance of the coil if its diameter is 0.05m. Find the magnetic flux when a current of 2A passes through the solenoid.

(4 × 3 = 12 marks)