



III Semester B.Sc. Examination, November/December 2016  
(CBCS/NS) (2012-13 & Onwards) (Freshers & Repeaters)

Physics – III  
ELECTRICITY & MAGNETISM



Time : 3 Hours

Max. Marks : 70

**Instruction :** Answer any five questions from each Part.

PART – A

I. Answer any five questions. Each question carries eight marks. (5×8=40)

- 1) a) Write an expression for electric field at a point due to a short dipole.  
Hence find the electric field at a point on the equatorial line of the dipole.
- b) State Thevenin's theorem. With a suitable network of resistances, explain the determination of Thevenin voltage and Thevenin resistance. (3+5)
- 2) a) Explain the theory of working of a moving coil ballistic galvanometer.
- b) Mention the conditions for a ballistic galvanometer to be dead beat. (5+3)
- 3) a) State and prove Ampere's circuital law.
- b) Using Ampere's circuital law, obtain an expression for magnetic field at the center of a long solenoid carrying current. (4+4)
- 4) a) Write the expression for magnetic field at a point due to an infinitely long straight conductor carrying current. State the Maxwell's cork screw rule to find the direction of the magnetic field.
- b) Obtain an expression for force between two long straight parallel conductors separated by a small distance. Hence, define Ampere. What is the nature of the force between the conductors when they carry currents in same direction and in opposite direction ? (2+6)

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- 5) a) Derive an expression for growth of charge in an RC circuit. Represent graphically the variation of charge with time. Define time constant of RC circuit.
- b) Mention the conditions to start or stop oscillations in a series LCR circuit. (6+2)
- 6) a) Obtain an expression for velocity of electromagnetic waves in free space using Maxwell's field equations.
- b) Mention the factors on which the refractive index of a material medium depend. (6+2)
- 7) a) Obtain an expression for impedance of series LCR circuit using phasor diagram. Also obtain an expression for the phase difference between voltage and current.
- b) What is resonance of series LCR circuit ? Mention the condition for resonance and write the expression for frequency at resonance. (5+3)
- 8) a) State the laws of thermoelectricity.
- b) Describe the determination of Thomson coefficient using thermoelectric diagram. (4+4)

### PART – B

II. Answer **any five** questions. **Each** question carries **four** marks. (5×4=20)

- 9) Two point charges of  $+2\mu\text{C}$  and  $-2\mu\text{C}$  are placed at the two corners of an equilateral triangle of side 20 cm. Find the direction and magnitude of the electric field at the third corner.
- 10) A capacitor of capacitance  $10\mu\text{F}$  is discharged through a high resistance. Time taken for one-third of the charge on the capacitor to leak is found to be 20 s. Calculate the value of the high resistance.
- 11) A Helmholtz tangent galvanometer has coils of radius 11 cm and 100 number of turns. Calculate the current through the coils which produces a deflection of  $45^\circ$ . ( $B_H = 0.32 \times 10^{-4} \text{ T}$ )
- 12) The magnetic flux linked with a coil of resistance  $10\Omega$  at any instant is given by  $\phi = 6t^2 + 1.2t + 4$  where  $\phi$  is in Wb and  $t$  in s. Find the magnitude of induced current at 0.4 s.



- 13) An inductance of 10 H and a resistance of  $0.5 \Omega$  are connected to a battery of emf 6 V. Calculate the time taken for the current to reach 6 A.
- 14) Evaluate the value of permittivity of free space from the standard value of speed of light in free space. ( $c = 3 \times 10^8 \text{ ms}^{-1}$ ,  $\mu_0 = 4\pi \times 10^{-7} \text{ Hm}^{-1}$ ).
- 15) A 60 V, 10 W lamp to be run on 100 V, 60 Hz ac mains. Calculate the inductance of the choke coil required.
- 16) Determine the neutral temperature and inversion temperature for a thermocouple in which emf is given by  $e = -15\theta + 0.025\theta^2$  ( $\mu\text{V}$ ). Cold junction is maintained at  $0^\circ\text{C}$ .

PART – C

- 17) Answer **any five** questions. **Each** question carries **two** marks. **(5×2=10)**
- a) Electric potential at a point due to a dipole is zero. Will electric intensity at that point be zero ? Explain.
  - b) A stationary electric charge of 10 nC is kept in a strong magnetic field of 40 T. What is the force on the charge ?
  - c) An aluminium bar falls much more slowly through a small region containing a magnetic field than a similar bar of an insulating material. Explain.
  - d) A conducting rod is moved with its length parallel to the magnetic field lines with a velocity  $v$ . What is the emf induced in the rod ?
  - e) The inductance of a series LR circuit is doubled. What happens to the time constant ?
  - f) If  $\vec{A}$  is such that  $\nabla \cdot \vec{A} = 0$ , then what is the vector field  $\vec{A}$  called ? Why ?
  - g) A capacitor blocks dc but allows ac. Why ?
  - h) Why is Sb-Bi thermocouple preferred to Fe-Cu thermocouple ?
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