NS – 286

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 $+2\mu c$ and $-2\ \mu c$ 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 $10\mu F$ 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°. ($B_H = 0.32\times10^{-4}$ T)

12) The magnetic flux linked with a coil of resistance 10Ω at any instant is given by $\phi = 6\ t^2 + 1.2\ t + 4$ where ϕ 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 Ω 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. ($c = 3\times10^8\ ms^{-1}$, $\mu_0 = 4\pi\times10^{-7}\ Hm^{-1}$).

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 $e = -15\theta + 0.025\theta^2$ (μV). Cold junction is maintained at 0°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 $\nabla.\vec{A} = 0$, 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 ?