SN – 236

III Semester B.Sc. Examination, November/December 2014
(N.S.) (Semester Scheme) (2012 – 13 and Onwards)
PHYSICS – III
Electricity and Magnetism

Time : 3 Hours Max. Marks : 70

Instruction : *Answer* ***five*** *questions from* ***each*** *of Part* ***A****, Part* ***B*** *and Part* ***C****.*

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks.

(5×8=40)

1. State and prove super position theorem. **8**

2. a) Obtain an expression for the torque acting on a current loop placed in a magnetic field.

   b) Mention the conditions for a moving coil galvanometer to be ballistic and dead beat. **(6+2)**

3. Derive an expression for the magnetic field at any point on the axis of a circular loop carrying current. **8**

4. State and prove Ampere's circuital law. Obtain an expression for magnetic field due to a long solenoid using Ampere's law. **8**

5. Define self inductance of a coil. Obtain an expression for energy stored in an inductor. **8**

6. a) Define Poynting vector. Write an expression for velocity of e.m. wave in vacuum.

   b) Show that the electromagnetic waves are transverse in nature. **(3+5)**

P.T.O.

7. a) Define rms and average values of an alternating current.

   b) Derive an expression for current in an a.c. circuit containing LCR in series. **(2+6)**

8. a) Distinguish between Peltier and Thomson effects.

   b) Apply the principles of thermodynamics and arrive at the relation $\pi = T\left[\frac{dE}{dT}\right]$. **(4+4)**

PART – B

Solve **any five** of the following problems. **Each** problem carries **four** marks. **(5×4=20)**

9. Two point charges ± 10 μ C are placed 5 mm apart. Determine the electric field at a point 0.15 m from the mid point of two charges along their axis.

10. An electron is projected into a magnetic field of flux density 10 T with a velocity 3×10^7 ms^{-1} perpendicular to the field. Calculate the magnetic force on the electron and compare it with the weight of the electron.

11. A Helmholtz galvanometer has coils of circumference 0.49 m each and the number of turns 50. Calculate the current flowing through the coils, which produce a deflection of 45°. $B_H = 3.6 \times 10^{-5}$ T.

12. A coil of 50 turns and area 0.02 m^2 is kept in a uniform magnetic field of flux density 10^{-2} T, so that the flux passes normally through it. Calculate the induced emf in the coil when it is suddenly removed from the field in 0.1S.

13. A 10 μ F capacitor is charged and then discharged through a resistance of 10 MΩ. Calculate the time in which the charge on the capacitor decreases to half of its initial value.

14. Find the divergence of a vector $\vec{A} = \hat{i}x^2z + \hat{j}\,2y^3z^2 + \hat{k}\,xy^2z$ at a point (1, –1, 1).

15. A resistance of $2\,\Omega$ and an inductance of 10 mH are connected in series with an ac source of 50 Hz. Calculate power factor of the circuit.

16. Calculate the total emf and neutral temperature of a thermocouple between 0°C and 100°C for which seeback coefficients are

$a = 10\,\mu V/°C$ and

$b = -0.025\ \mu V/°C^2$.

PART – C

Answer **any five** of the following questions. Each question carries **two** marks. **(5×2=10)**

17. a) An electrical charge is kept near a magnet. Will it experience a force ? Explain.

b) A solenoid tends to contract when a current is passed through it. Why ?

c) Why two coils are used in Helmholtz galvanometer instead of single coil ?

d) Ampere's circuital law is valid only for steady state phenomenon and not for changing fields. Why ?

e) If the divergence of the vector field is zero, the field is called solenoidal. Explain.

f) Can resonance be achieved without changing the supply frequency ? Explain.

g) When is power delivered to the load maximum ?

h) Is seeback effect reversible ? Explain.

SN – 236

III Semester B.Sc. Examination, November/December 2014

(O.S.) (Semester Scheme) (Prior to 2012 – 13)

PHYSICS – III

Electricity, Magnetism and Radiation

Time : 3 Hours Max. Marks : 80

Instruction : *Answer* ***any five*** *in Part* ***A****,* ***four*** *in Part* ***B*** *and* ***five*** *in Part* ***C****.*

PART – A

Answer **any five** questions. **Each** question carries **six** marks. **(5×6=30)**

1. State and prove superposition theorem. **6**

2. a) State Biot-Savart's law.

   b) Obtain an expression for the magnetic field due to current in a straight conductor of finite length. **(2+4)**

3. a) State Faraday's laws of electromagnetic induction.

   b) Deduce an expression for induced emf. **(2+4)**

4. a) Starting from Maxwell's equations set up differential equation for electromagnetic wave.

   b) Establish the relation between electric and magnetic vectors. **(4+2)**

5. Obtain an expression for growth of current in L-R circuit. Define time constant of L-R circuit. 6

6. Give the theory of series resonance circuit. Represent the variation of current with frequency. 6

7. a) State and explain the laws of thermoelectricity.

b) Applying the laws of thermodynamics to a thermocouple deduce $\pi = T\frac{dE}{dT}$, where the symbols have their usual meaning. (2+4)

8. State and explain :

i) Stefan's law

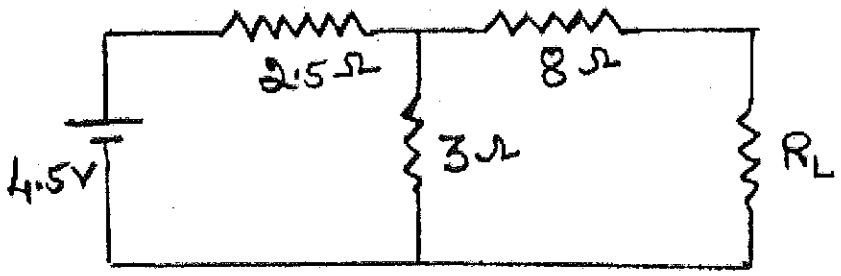
ii) Stefan-Boltzmann's law

iii) Wien's displacement law. 6

PART – B

Solve **any four** problems. **Each** problem carries **five** marks. (4×5=20)

9. In the network given below, find the current flowing through R_L using Thevenin's theorem if $R_L = 5\Omega$.



10. A Helmholtz galvanometer has coils of radius 0.08 m each and number of turns 100. Calculate the current flowing through the coils which produces a deflection of 50°. Given $B_H = 0.36 \times 10^{-4}$ T $\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$.

11. A closed coil having 50 turns area 0.03 m^2 and resistance 50 Ω is held at right angles to uniform field of 0.02 T is turned through an angle of 30° in 0.1S about an axis right angle to the field. Calculate induced current and charge.

12. A capacitor of capacitance 1 μ F is discharged through a high resistance. The time taken for half the charge of the capacitor to leak is 10 S. Find the value of resistance.

13. A coil of resistance 200 Ω , an inductance 0.75 H and a capacitor of 0.5 μ F are connected in series with 220 V – 50 Hz mains. Calculate the impedance of the circuit.

14. Calculate neutral temperature, temperature of inversion of a thermocouple between 0°C and 100°C for which seeback coefficients are a = 13.4 μ V/°C and b = – 0.02 μ V/°C^2.

PART – C

Answer **any five** of the following. **(5×2=10)**

15. a) Static magnetic fields cannot change the kinetic energy of moving charge. Explain.

    b) The moment of inertia of the suspension in BG is made large. Why ?

c) What is the physical significance of the equation $\vec{\nabla} \cdot \vec{B} = 0$?

d) A bar magnet is dropped along the axis of a solenoid placed with its axis vertical. Does it fall with an acceleration equal to g ? Explain.

e) When does an LCR get critically damped ?

f) Does thermo-electric effect obey the law of conservation of energy ? Explain.

g) What is average power dissipated by pure inductor ?

h) Animals curl their body when they feel cold. Explain.