OS – 195

III Semester B.Sc. Examination, October/November 2012
(NS) (2012-2013 and Onwards)
PHYSICS – III
Electricity and Magnetism

Time : 3 Hours Max. Marks : 70

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

PART – A

Answer **any five** of the following questions. **Each** question carries **eight** marks. **(5×8=40)**

1. a) Derive the relation between electric field and potential.

   b) Derive an expression for electric potential at a point due to an electric dipole. **(4+4)**

2. State and prove Thevenin's theorem. **8**

3. a) State and explain Biot-Savart's law.

   b) Derive an expression for the force between two parallel current carrying conductors. Hence define ampere. **(3+5)**

4. a) What is toroid ? Using Ampere's circuital law, deduce an expression for the magnetic field inside a toroid carrying current.

   b) State Faraday's laws of electromagnetic induction. What are eddy currents ? Mention any one application of eddy currents. **(4+4)**

5. a) Derive an expression for growth of current in series LR circuit connected to DC source. Indicate the growth of current graphically. Define time constant of the circuit.

   b) State and explain divergence theorem. **(6+2)**

P.T.O.

6. a) Derive Maxwell's field equations :

$$\vec{\nabla}.\vec{D} = 0 \text{ and } \vec{\nabla}\times\vec{E} = -\frac{\partial\vec{B}}{\partial t}.$$

b) Write an expressions for speed of electromagnetic waves in free space and explain the terms in it. **(6+2)**

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

b) Derive expressions for impedance, current and phase angle of a series LCR circuit connected to ac source by vector method. **(2+6)**

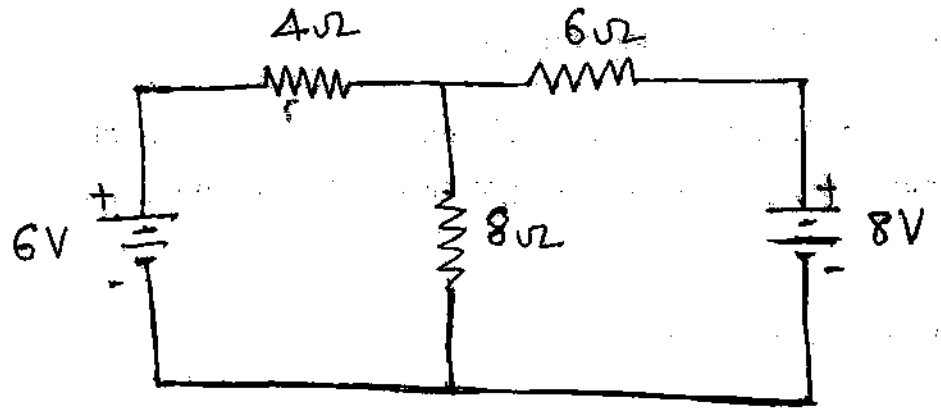
8. a) What are thermo-electric diagrams ? To construct the thermoelectric diagram for any metal, name the second metal for thermo-couple.

b) Explain methods of finding Peltier coefficient and Thomson coefficient using thermo-electric diagrams. **(2+6)**

PART – B

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

9. Find the current through 8 Ω resistance using superposition theorem in the given circuit.



10. A capacitor of capacitance 1 μ F is discharged through a resistance. Time taken for half the charge on the capacitor to leak is found to be 10 seconds. Calculate the value of resistance.

11. A Helmholtz tangent galvanometer has coils of radius 0.077 m each and number of turns 110. Calculate the current through the coils which produces a deflection of 45°, $B_H = 0.34\times10^{-4}$ T.

12. The magnetic flux linked with a coil of resistance 10 Ω at any instant is given by $\phi = 5t^2 + 2t + 3$. Calculate the magnitude of induced emf and current in a time interval of 0.5 seconds.

13. A coil of self-inductance 1 henry and having 100 turns carries a current of 5 ampere. Calculate the induced emf in it if the current changes at the rate of $2As^{-1}$.

14. A plane electromagnetic wave in the visible region is moving along the X-direction. The frequency of the wave is 0.5×10^{15} Hertz and the electric field at any point is varying sinusoidally with time with an amplitude 1 V m^{-1}. Calculate the instantaneous values of the densities of the electric and magnetic fields.
$\varepsilon_0 = 8.854\times10^{-12}$ Fm^{-1} $\quad \mu_0 = 4\pi\times10^{-7}$ Hm^{-1}

15. A resistance of 2 Ω and an inductance of 10 mH are connected in series with an ac source of 50 Hertz. Calculate the power factor of the circuit.

16. The thermo-emf of a thermo-couple in microvolt is given by the equation $e = 16.3\,\theta - 0.021\,\theta^2$ when the junctions are at 0°C and θ°C. Calculate neutral temperature and the temperature of inversion.

PART – C

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

17. a) Is the electrostatic potential necessarily be zero at a point where the electric field intensity is zero ?

    b) Does electric charge kept near a powerful magnet experience a force ? Explain.

    c) What is the force experienced by a conductor carrying current placed along the magnetic field ? Explain.

    d) Induced emf during break of the circuit is greater than that during make of the circuit. Why ? Explain.

    e) When does an LCR circuit get critically damped ?

    f) Is electromagnetic wave transverse ? Explain.

    g) Why is a choke preferred to a rheostat in controlling the current in an ac circuit ?

    h) Does thermoelectric effect obey the law of conservation of energy ? Explain.

OS – 195

III Semester B.Sc. Examination, October/November 2012
(OS)(Semester Scheme) (Prior to 2012-2013)
PHYSICS – III
Electricity, Magnetism and Radiation

Time : 3 Hours | Max. Marks : 60

Instruction : *Answer* ***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. a) State Thevenin's theorem.

   b) What is dipole moment ? Derive an expression for the dipole moment of a current carrying coil in a magnetic field. **(2+4)**

2. Derive an expression for the charge flowing through a ballistic galvanometer. **6**

3. Obtain an expression for the magnetic field at a point on the axis of a circular coil carrying a current. **6**

4. a) State and explain Gauss's theorem.

   b) Write down Maxwell's equations. **(2+4)**

5. Derive an expression for the growth of current in an L-R circuit connected to a dc source. **6**

6. Derive an expression for resonant frequency in a series R-L-C ac circuit. Why is it called an acceptor circuit ? **6**

7. a) What is Seebeck effect ? Is Seebeck effect reversible ?

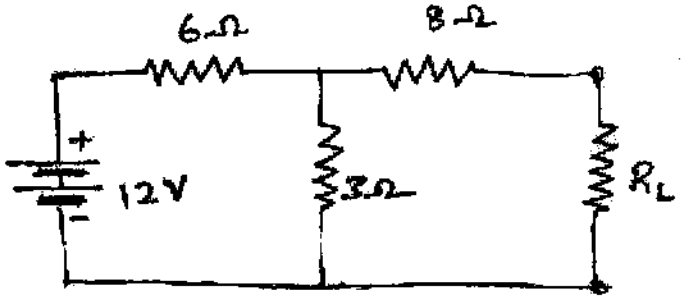
   b) State and explain the two laws of thermoelectricity. **(2+4)**

8. Derive Planck's law of distribution of energy in the spectrum of a black body. **6**

PART – B

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

9. For the network shown in the figure, determine the value of R_{Th} for maximum power to R_L and calculate the power delivered under these conditions. **5**



10. A straight conductor 25 cm long carrying a current of 5 A is kept in a uniform magnetic field of 0.05 T. Find the force acting on the conductor when it is at

    a) right angles to the field and

    b) 30° to the field. **5**

11. 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 emf induced in it when the coil is suddenly removed from the field in 0.1 s. **5**

12. A capacitor of 1 μF is connected to a battery of 2 V through a resistance of 10 kΩ. Calculate the initial current and current after 0.02 s. **5**

13. A 100 μF capacitor in series with a 40 Ω resistance is connected to a 100 V, 60 Hz supply. What is the maximum current in the circuit ? **5**

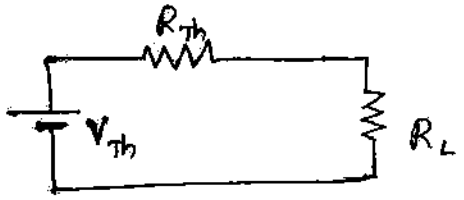
14. Calculate the surface temperature of the sun from the following data :

    $S = 1.330\ Js^{-1}\ m^{-2}$, $\sigma = 5.67\times10^{-8}\ Wm^{-2}\ K^{-2}$, radius of the sun = 6.95×10^{5} km and distance of the sun from the earth = 1.5×10^{8} km. **5**

PART – C

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

a) Is current in the circuit shown below maximum or minimum when the load resistance is short-circuited ? Explain.



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

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

d) A metal container is filled with water and is placed in a variable magnetic field. Can the water boil ? Explain.

e) What is the basic source of electromagnetic waves ? Explain.

f) Does the resonant frequency of a series R-L-C circuit depend on the resistance ? Explain.

g) Mention the factors on which the temperature of inversion depends.

h) The bottom of a cooking vessel should be dark and rough. Explain.