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)

P.T.O.

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 ?

SN – 329

III Semester B.Sc. Examination, November/December 2017
(CBCS) (2017 – 18 and Onwards) (Fresh)
PHYSICS – III
Electricity and Magnetism

Time : 3 Hours

Max. Marks : 70

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

PART – A

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

1. a) Define an ideal voltage source and current source.

   b) State and prove maximum power transfer theorem. (2+6)

2. Obtain an expression for decay of charge in series LCR circuit and mention its special cases. 172 8

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

   b) Obtain an expression for the field on the axis of a Solenoid carrying current. (3+5)

4. a) Obtain with necessary theory an expression for the current through the Helmholtz galvanometer.

   b) Using Ampere's circuitar law obtain an expression for the magnetic field due to a straight conductor carrying conductor. (5+3)

5. a) State and explain Divergence theorem. 209

   b) Derive Maxwell's Equation $\nabla.D = \rho$ and discuss its physical significance. 217 & 221 (2+6)

6. a) Obtain an expression for velocity of electromagnetic waves in free space.

   b) State poynting theorem. 235 (6+2)

P.T.O.

7. a) Derive with a diagram an expression for self inductance of a coil using Maxwell's Bridge. 279

b) What is Q-factor ? Explain its significance. 266 (5+3)

8. a) Distinguish between Seebeck effect and Peltier effect.

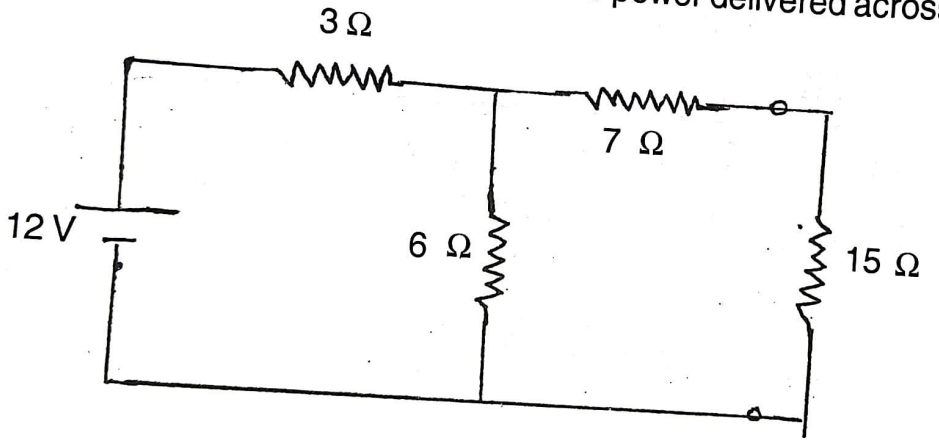
b) What is meant by Thermo electric diagrams ? Discuss in detail any two of its applications. 318 (2+6)

PART – B

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

[Permeability of free space $\mu_0 = 4\pi \times 10^{-7} H\,m^{-1}$
Permittivity of free space $t_0 = 8.8 \times 10^{-12} Fm^{-1}$]

9. Using Thevenin's theorem calculate the power delivered across 15 Ω.



$P = \frac{V_{th}^2}{4R_{th}}$

$V_{th} = \frac{E R_3}{R_3 + R_1}$

$R_{th} = R_2 + \frac{R_1 R_3}{R_1 + R_3}$

10. A 0.5 m long solenoid having 500 turns and radius 0.02 m is wound on an iron core of relative permeability 800. What will be the average emf induced in the solenoid if the current in it changes from 0 to 2 amp. in 0.05 sec.

Given $\mu_0 = 4\pi \times 10^{-7} H\,m^{-1}$.

11. A uniform magnetic field of magnitude 1.5 Tesla points horizontally from south to north. A proton of energy 5 MeV moves vertically downward through this field. Calculate the force on it.

Given mass of proton = 1.7×10^{-27} kg

Charge = 1.6×10^{-19} C.

12. A condenser of 1000 PF is charged to a potential difference of 1 volt and then discharged through a BG. The first throw on a scale placed away is 0.62 m. If the time period is 10 sec and logarithmic decrement is 0.02, calculate the ballistic constant of the galvanometer.

13. An ac voltage is applied directly across a 10 μ F capacitor. The frequency of the source is 3 kHz and the voltage amplitude is 30 V. Find the displacement current between the plates of the capacitor.

14. Calculate the skin depth in copper of conductivity 5.8×10^7 S m^{-1} for the electromagnetic waves of frequency 1 m Hz.

Given $\mu = \mu_0 = 4\pi \times 10^{-7}$ H m^{-1}

15. A circuit consists of a non inductive resistance of 50 Ω, an inductance of 0.3 H and resistance of 2 Ω, a capacitor of 40 μF in series and is supplied with 200 V at 50 Hz. Find the impedance, I_{rms} and I_{max} in the circuit.

16. Calculate the neutral temperature, temperature of inversion and the total emf of a thermo couple between 0°C and 100°C for which the Seebeck coefficients are a = 10 μv/°C and b = – 0.025 μv/°C^2.

PART – C

(5×2=10)

17. Answer **any five** questions. **Each** question carries **two** marks.

a) Can super position theorem be applied to non linear networks ? Explain.

b) Is there any loss of energy due to the production of back emf in an LR circuit ? Explain.

c) Does a current loop behave as a magnetic dipole ? Explain.

d) Is the field produced in a toroid uniform ? Explain.

e) Do magnetic monopoles exist ? Explain.

f) Is it possible to have only electric wave or magnetic wave alone propagating through space ? Explain.

g) What is the phase difference between the applied voltage and current in an LCR series ac circuit at resonance ? Explain.

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

SS – 320

III Semester B.Sc. Examination, Nov./Dec. 2018
(CBCS) (2017-18 and Onwards)
(Fresh + Repeaters)
PHYSICS – III
Electricity and Magnetism

Time : 3 Hours

Max. Marks : 70

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

PART – A

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

1. a) What is an ideal voltage source ? Represent V-I characteristics of ideal and practical voltage sources.

   b) State and explain Norton's theorem. **(3+5)**

2. a) Derive an expression for the self inductance of a solenoid.

   b) Derive an expression for the growth of current in LR circuit connected to a d.c. source. **(3+5)**

3. a) Mention the conditions for a moving coil galvanometer to be dead beat.

   b) Explain with a neat diagram the experimental determination of high resistance by leakage using ballistic galvanometer. **(3+5)**

4. a) State and prove Ampere's circuital law.

   b) Using Ampere's circuital law obtain an expression for magnetic field at a point inside a long solenoid carrying current. **(4+4)**

5. a) Write the equation of continuity. What is its physical significance ?

   b) Write the four Maxwell's field equations. Derive $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$. **(2+6)**

6. a) Derive $\nabla^2 E = \mu_0 \varepsilon_0 \frac{\partial^2 E}{\partial t^2}$.

   b) State poynting theorem. **(6+2)**

P.T.O.

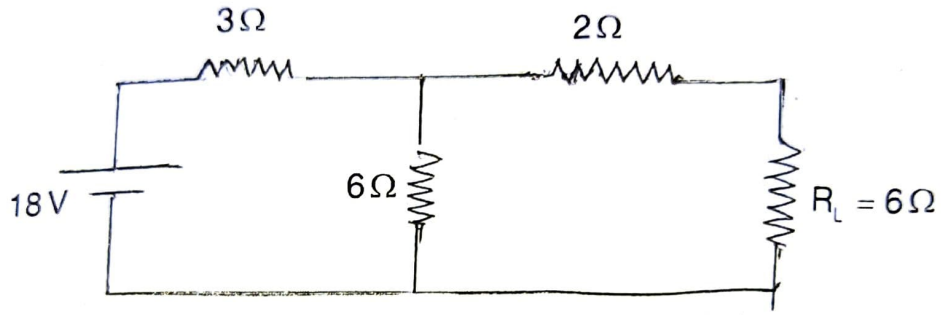
7. Derive expressions with diagram for impedance, current and phase angle of a series CR ac circuit by j operator method. 8

8. a) State and explain the laws of thermo-electricity.
   b) Explain with a neat diagram Thermopile. (4+4)

PART – B

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

9. In the given circuit find the current through R_L using Thevenin's theorem.



10. How many time constants will be taken by a condenser to gain 99% of its steady state charges in a CR circuit ?

11. Two parallel wires each of length 3 m kept 20 cm apart carry currents of 20 A and 30 A respectively in the same direction. Calculate the force acting. What is the nature of this force ? Given $\mu_0 = 4\pi \times 10^{-7}$ Hm^{-1}.

12. An electric current I is flowing in a circular wire of radius $\sqrt{3}$ m. At what distance from the centre on the axis of circular wire will the magnetic field be $1/8^{th}$ of its value at the centre ?

13. Yellow light of frequency 5.09×10^{14} Hz enters diamond. Calculate the wavelength and speed of wave propagation in diamond. At this frequency diamond has $\varepsilon_r = 5.84$ and $\mu_r = 1$. Given $C = 3 \times 10^8 ms^{-1}$.

14. An electromagnetic wave of frequency 2 MHz is propagating in a conducting medium. The medium is silver for which conductivity is 6.8×10^7 Sm^{-1} and $\mu_r = 1$. Calculate the skin depth. Given $\mu_0 = 4\pi \times 10^{-7}$ Hm^{-1}.

15. An alternating voltage of 110 V, 50 Hz is applied to a circuit containing a resistance of 200 Ω, an inductance of 5 H and a capacitance of 2 μF connected in series. Calculate the impedance and the current in the circuit.

16. The emf of a certain thermocouple varies with temperature θ of the hot junction when the cold junction is kept at 0°C as $e = 40\ \theta - \frac{\theta^2}{20}$. Find the neutral temperature and the temperature of inversion.

PART – C

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

a) Self inductance is called electrical inertia. Justify.

b) What does a small value of time constant in a LR circuit represent ? Explain.

c) Is the direction of displacement current same as that of conduction current ? Explain.

d) Does a current carrying conductor kept parallel to the direction of a magnetic field get deflected ? Explain.

e) Do magnetic monopoles exist ? Explain.

f) Does the skin depth for a good conductor increase with increasing wave frequency ? Explain.

g) What is a rejector circuit ? Why is it so called ?

h) Is Peltier effect reversible ? Explain.

61321

Third Semester B.Sc. Degree Examination, November/December 2019

(CBCS - Freshers Scheme)

Physics

Paper 301 – ELECTRICITY AND MAGNETISM

Time : 3 Hours] *[Max. Marks : 70*

*Instructions to Candidates : Answer any **FIVE** questions from each Part.*

PART – A

Answer any **FIVE** questions. Each question carries **8** marks : **(5 × 8 = 40)**

1. (a) What are ideal voltage and current sources?

   (b) State Thevenin's theorem. With a suitable network of resistances explain the determination of Thevenin's voltage and Thevenin's resistance. **(2 + 6)**

2. (a) Derive an expression for energy stored in an inductor.

   (b) Derive an expression for the decay of charge in a series CR circuit. **(3 + 5)**

3. Derive an expression for magnetic field at a point on the axis of a current carrying solenoid and hence show that field at one end of the solenoid of infinite length is half that at the centre. **(8)**

4. (a) Give the theory of moving coil ballistic galvanometer and hence obtain an expression for charge flowing through it.

   (b) Mention any three applications of ballistic galvanometer. **(5 + 3)**

5. (a) What is displacement current? Mention any two properties of displacement current.

   (b) Derive the Maxwell's equation $\nabla \cdot \vec{B} = 0$. What is its physical significance? **(3 + 5)**

6. (a) State and explain Poynting theorem.

   (b) Show that in an electromagnetic field energy is equally shared between electric and magnetic fields. **(6 + 2)**

7. (a) What is the condition for resonance of a series LCR circuit and hence obtain the expression for resonant frequency?

   (b) For a series resonant circuit, define (i) quality factor (ii) band width. Also write the expressions for them. (4 + 4)

8. (a) State the laws of thermoelectricity.

   (b) Applying the principle of thermodynamics arrive at the relation $\pi = T\left(\frac{dE}{dT}\right)$. (4 + 4)

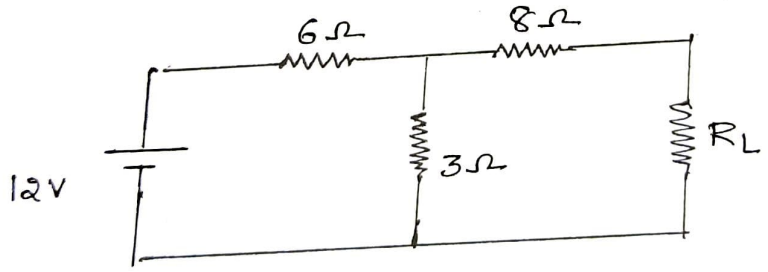
PART – B

Solve any **FIVE** questions. Each problem carries **4** marks : (5 × 4 = 20)

(permeability of free space = $\mu_0 = 4\pi \times 10^{-7} Hm^{-1}$)

(permittivity of free space = $t_0 = 8.85 \times 10^{-12} Fm^{-1}$)

9. Find the value of R_L in the given network to obtain maximum power in it. Also find the maximum power.



10. In an LR circuit the current attains $\frac{1}{3}$rd of its final steady value in 1s after the circuit is closed. What is the time constant of the circuit?

11. An electron experiences greatest force as it travels $3.9 \times 10^5 ms^{-1}$ in a magnetic field when it is moving westwards. The force is upward and is of magnitude $8.2 \times 10^{-13} N$. What is the magnitude and direction of the magnetic field? (Given electron charge = $1.6 \times 10^{-19} C$)

12. A Helmholtz galvanometer has coils of circumference 0.49 m each and number of turns 50. Calculate the current through the coils which produces a deflection of 45^0 (Given $B_H = 0.38 \times 10^{-4} T$)

13. A plane wave travelling in a loss less medium has a wavelength of 0.25 m and its velocity of propagation is $1.5\times10^{8}\,ms^{-1}$. Find the frequency and permittivity of the medium.

14. An electromagnetic wave of frequency $1.6\times10^{6}Hz$ propagating in a conducting medium has the conductivity of $38.2\times10^{6}Sm^{-1}$, calculate the skin depth Given $\mu_r = 1$.

15. A condenser of capacitance $2\mu F$ is connected in series with a resistor to a 220 V, 50 Hz ac supply. If the potential difference across the condenser and resistor are equal in magnitude, calculate the resistance and phase current in the circuit.

16. The temperature of cold junction of a thermocouple is 0^0C and the temperature of the hot junction is θ^0C. The thermo emf is given by $E = 16\theta - 0.04\theta^2\,\mu v$. Find (a) neutral temperature (b) temperature of inversion.

PART – C

17. Answer any **FIVE** questions. Each question carries **2** marks : **(5 × 2 = 10)**

(a) Is there any loss of energy due to the production of back emf in a LR circuit? Explain.

(b) An α-particle and a β-particle are projected with the same velocity perpendicular to the magnetic field. Do they experience the same force? Explain.

(c) Is the field produced in a toroid uniform? Explain.

(d) In a ballistic galvanometer the leakage method is suitable to determine high resistance only. Why? Explain.

(e) What does the small value of quality factor indicate? Explain.

(f) Does the skin depth for a good conductor depend on the wave frequency? Explain.

(g) A series resonance circuit is called an acceptor circuit. Why? Explain.

(h) Does the thermo electric effect obey the law of conservation of energy? Explain.