

Total No. of Printed Pages—7

2 SEM TDC PHYH (CBCS) C 3

2 0 2 4

(May)

PHYSICS

(Core)

Paper : C-3

(Electricity and Magnetism)

Full Marks : 53

Pass Marks : 21

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

1. Choose the correct option from the following :

1×5=5

(a) The unit of electric flux density is

(i) cm^{-2}

(ii) cm^2

(iii) c^2m

(iv) cm^{-3}

(2)

(b) Which of the following substances is dielectric?

(i) Copper

(ii) Mica

(iii) Germanium

(iv) Tungsten

(c) Which of the following does not have dimensions of time?

(i) CR

(ii) $\frac{L}{R}$

(iii) \sqrt{LC}

(iv) LC

(d) $\vec{\nabla} \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ represents

(i) Faraday's law

(ii) Ohm's law

(iii) Lenz's law

(iv) Ampere's law

(e) Bandwidth of a series resonance circuit is

(i) $Q_0 f_0$

(ii) $\frac{R}{2\pi L}$

(iii) $\frac{R}{4\pi L}$

(iv) None of the above

2. (a) Define electric lines of force. Do the two electric lines of force intersect each other? Give reason for your answer. 2

(b) Electric charge is uniformly distributed within an infinite cylinder of radius R . Use Gauss's theorem to calculate the electric field strength at any point distance r from the axis lying outside the cylindrical charge distribution. 3

(c) Prove the relation $\vec{E} = -\vec{\nabla}\phi$, where the symbols have their usual meanings. What is the significance of negative sign here? 3+1=4

3. (a) Define capacitance. Derive an expression for the capacitance of a parallel plate capacitor. 1+3=4

- (b) Using the method of electrical images, derive the expressions for electric field intensity and potential on the surface of an earth connected conducting sphere due to a point charge placed near the sphere. 4

Or

A point charge q is placed at a distance d from an infinite earthed plane conductor. Using the method of images, calculate—

- (i) total induced charge;
- (ii) force of attraction between the charge and the conductor;
- (iii) work done in remaining q to infinity. 2+1+1=4

4. (a) Dielectric constant of a medium is unity. What will be its permittivity? 1

- (b) Find a relation between relative permittivity and susceptibility of a dielectric. 2

- (c) State and prove the Gauss theorem in dielectric medium. 3
5. (a) State Biot-Savart law, use it to find the strength of magnetic field at the centre of a circular coil of radius R , number of turns N carrying a current I . 1+3=4

(b) Prove $\oint_C \vec{B} \cdot d\vec{l} = \mu_0 I$ 3

Or

Two straight wires are kept in air 2 m apart carrying currents of 80 A and 30 A in the same direction. Calculate the force between them and specify its nature.

6. Define permeability and magnetic susceptibility. Show that $\mu = \mu_0(1 + \chi_m)$. 2+2=4
7. (a) State and explain Faraday's law of electromagnetic induction. 2

Or

A coil has self-inductance of 0.05 H. Calculate the e.m.f. induced when the current in the coil changes at a rate of 120 A sec^{-1} .

- (b) Deduce the equations $\vec{\nabla} \cdot \vec{D} = \rho$, $\vec{\nabla} \cdot \vec{B} = 0$, where the symbols have their usual meanings.

3

8. (a) Explain the terms 'power factor' and 'wattless current' in an AC circuit. Derive the expression for power and power factor.

3

Or

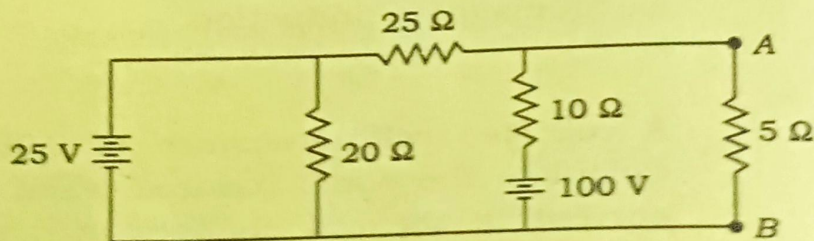
Find the current in a circuit having a capacity of $10 \mu\text{F}$ and resistance of 10 ohm when connected to a 250 volt , 50 Hz AC supply.

- (b) State and prove Thevenin's theorem for a network containing voltage generators and resistances.

3

Or

Find the voltage across points A and B in the network shown in the figure below, using Norton's theorem :



(7)

9. What are meant by sensitivity, charge sensitivity and current sensitivity of a ballistic galvanometer?

3

Or

Write the difference between a Ballistic Galvanometer and a Normal Galvanometer.

★ ★ ★