2 SEM TDC PHYH (CBCS) C 3

2024

(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}

(Turn Over)

(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

(3)

(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
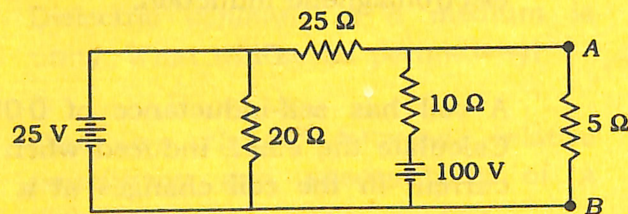
Or

Find the current in a circuit having a capacity of 10 µF 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 :

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.

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