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2 SEM TDC PHYH (CBCS) C 3

2026

(May/June)

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) Potential difference is analogous to

(i) mass

(ii) pressure

(iii) energy

(iv) inertia

(b) The net charge inside a polarised dielectric is

(i) positive

(ii) negative

(iii) zero

(iv) either positive or negative

(2)

- (c) Steady magnetic fields are governed by
- (i) Biot-Savart law
 - (ii) Ampere's circuital law
 - (iii) Both (i) and (ii)
 - (iv) None of the above
- (d) Two coils have the mutual inductance 0.05 henry. The current changes in the first coil as $I = I_0 \sin \omega t$ where $I_0 = 1$ A and $\omega = 100\pi$ rad s⁻¹. The maximum e.m.f. induced in the secondary coil is
- (i) 6π V
 - (ii) 2.5 V
 - (iii) 5π V
 - (iv) 10 V
- (e) In an AC circuit the e.m.f. leads the current by a phase of $\frac{\pi}{2}$ radian. The circuit contains only
- (i) resistance
 - (ii) inductance
 - (iii) capacitance
 - (iv) None of the above

(3)

2. (a) Define electric field and electric lines of force. 2
- (b) What is a conservative field? Show that the curl of such a field is zero. 1+2=3
- (c) Show that in a uniform electric field, an electric dipole experiences only a torque but no net force. Derive an expression for the torque. 2+2=4
3. (a) Derive the expression for force per unit area on surface of a charged conductor in terms of surface charge density. 4
- (b) Define capacitance of a capacitor. Prove that the total electrostatic energy stored in a parallel plate capacitor is $\frac{1}{2}CV^2$. 1+3=4
- Or
- A charged spherical conductor has a surface density of 0.07 C-cm⁻². When the charge is increased by 4.4 C, the surface density changes to 0.084 C-cm⁻². Find the initial charge and capacitance of the spherical conductor. 4
4. (a) Define electrical susceptibility. What is the significance of electric susceptibility for a dielectric? 1+1=2
- (b) Derive $\vec{D} = \epsilon_0 \vec{E} + \vec{P}$, where symbols have their usual meanings. 4

(4)

5. (a) Derive an expression for the force acting on a current carrying conductor placed inside a uniform magnetic field. Name the rule which gives the direction of this force. 3+1=4

- (b) Define vector potential and hence derive an expression for the vector potential. 1+2=3

Or

A current is flowing in a circular coil of radius r and the magnetic field strength at the centre is $8T$. At what distance from the centre on the axis of the coil, the magnetic field strength will be $1T$? 3

6. Define magnetic induction ($\vec{B}$), magnetic intensity ($\vec{H}$) and magnetization vector. State the relation among $\vec{B}$, $\vec{H}$ and $\vec{M}$. 1+1+1+1=4

Or

What is hysteresis? Derive an expression for the work done per unit volume during cycles of magnetization. 4

7. (a) State the Faraday's laws of electro-magnetic induction. 2

(5)

- (b) The self-inductance of a coil having 200 turns is 100 millihenry. Calculate the magnetic flux through the cross-section of coil in which current of 2 mA is passing. Also, compute the total magnetic flux linked with the coil. 3

Or

Derive the expression for the magnetic potential energy stored in an inductor.

8. (a) What do you mean by sharpness of resonance, bandwidth and quality factor in L - C - R series resonant circuit? 3

Or

A core has an inductance of $\frac{4}{\pi}$ henry and is joined in series with a resistance of 30 ohm. Calculate the current flowing in the circuit, when connected to AC mains of 200 volt and of frequency 50 hertz.

- (b) State Norton's theorem. Mention the steps for solving a network utilizing Norton's theorem. 1+2=3

Or

State and explain reciprocity theorem. 3

9. Derive an expression for the torque on a rectangular coil of N turns each of area A carrying a current I placed in a uniform magnetic field B . The angle between the direction of B and the vector perpendicular to the plane of the coil is θ .

3

Or

What are meant by sensitivity, charge sensitivity and current sensitivity of the ballistic galvanometer?
