# 2 0 1 8

( November )

## PHYSICS

( Major )

Course : 502

### ( Electrodynamics )

*Full Marks* : 60

*Pass Marks* : 24 /18

*Time* : 3 hours

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

1. Choose the correct answer from the following : 1×6=6

   *(a)* The refractive indices of glass and water are 1·54 and 1·33 respectively. The polarizing angle for a beam incident from water to glass is

   *(i)* 33°

   *(ii)* 40°52′

   *(iii)* 49°8′

   *(iv)* 57°

*( Turn Over )*

*(b)* Which of the following statements is wrong?

   *(i)* The electromagnetic waves travel with the same speed in all media.

   *(ii)* The speed of the electromagnetic waves is independent of the wavelength in non-dispersive medium.

   *(iii)* In the electromagnetic waves, the electric and magnetic vectors oscillate perpendicularly to the direction of propagation of waves.

   *(iv)* The electromagnetic waves are produced by accelerated charged particles.

*(c)* The radiation zone of an oscillating dipole is

   *(i)* $r \gg c/w$

   *(ii)* $r \gg w/c$

   *(iii)* $\alpha = \beta$

   *(iv)* $\beta \gg \alpha$

*(d)* Which of the following statements is correct?

    *(i)* Dimensions perpendicular to velocity of moving frame are contracted.

    *(ii)* A moving clock runs fast.

    *(iii)* In every closed system, the total relativistic energy and momentum are conserved.

    *(iv)* All of the above

*(e)* In propagation of electromagnetic waves in a conducting medium, the skin depth depends on

    *(i)* frequency

    *(ii)* conductivity

    *(iii)* dielectric properties of conductor

    *(iv)* both frequency and conductivity

*( Turn Over )*

(f) In polarization for normal incidence, the sum of reflected coefficient and transmission coefficient is always equal to

    (i) zero

    (ii) 1

    (iii) 2

    (iv) $\pi / 2$

2. (a) What is displacement current? Explain Maxwell's postulates for displacement current.           1+4=5

(b) Discuss the propagation of plane electromagnetic wave in an isotropic dielectric medium and hence show that electric vector $\vec{E}$, magnetic vector $\vec{H}$ and propagation vector $\vec{K}$ are perpendicular to each other.     3

3. (a) Deduce an expression for magnetic scalar potential.     5

(b) Give the physical significance of Maxwell's fourth equation.     3

                               ( Continued )

**4.** Derive the expressions for electromagnetic fields of an oscillating dipole.    6

*Or*

Show the complete pattern of electric and magnetic lines from an oscillating electric dipole.    6

**5.** *(a)* Explain Brewster's law on the basis of electromagnetic theory.    3

    *(b)* A plane electromagnetic wave is incident obliquely at the boundary of two non-conducting media. Discuss the phenomena of reflection and refraction.    4

**6.** Show that the speed of electromagnetic wave in isotropic dielectric is less than the speed of electromagnetic wave in free space.    5

*Or*

Obtain boundary conditions satisfied by electromagnetic field vector $\vec{E}$ on the plane interface between the media.    5

**7.** Discuss the phenomenon of polarization of electromagnetic wave.    5

8. *(a)* Explain the twin paradox phenomenon. 5

*(b)* What are time dilation and improper length in relativistic mechanics? 2+2=4

9. *(a)* What is relativistic energy? Prove the relation $E^2 - p^2c^2 = m_0^2 c^4$.

4

*(b)* Find the relativistic mass of an electron moving with a speed of 0·8c. 2

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