



**WEST BENGAL STATE UNIVERSITY**  
B.Sc. Honours 6th Semester Examination, 2022

**PHSACOR13T-PHYSICS (CC13)**

Time Allotted: 2 Hours

Full Marks: 40

*The figures in the margin indicate full marks.  
Candidates should answer in their own words and adhere to the word limit as practicable.  
All symbols are of usual significance.*

**Question No. 1 is compulsory and any *two* questions from the rest**

1. Answer any **ten** questions from the following: 2×10 = 20
- (a) Show that for a good conductor, the phase lag of  $\vec{H}$  behind  $\vec{E}$  is  $\frac{\pi}{4}$ .
  - (b) The intensity of the sunlight reaching the earth's surface is about  $1300 \text{ W/m}^2$ . Calculate the strength of the electric field of the incoming sunlight.
  - (c) Find out the dimension of Poynting Vector  $\vec{S}$ .
  - (d) Show that TEM waves cannot occur in hollow wave guide.
  - (e) What are the differences between single mode and multimode fibers?
  - (f) What are positive and negative crystals?
  - (g) The conductivity of silver is  $3 \times 10^7 \text{ mho.m}^{-1}$ . Calculate its skin depth at a frequency of 9.5 Hz.
  - (h) Calculate the thickness of half-wave plate of wavelength  $5893 \text{ \AA}$ , Given  $n_o = 1.544$  and  $n_e = 1.553$ .
  - (i) The refractive index of the core of an optical fibre is 1.55. What should be the refractive index of the cladding for an acceptance angle of  $25^\circ$ ?
  - (j) A 20 cm long tube containing sugar solution given a rotation of  $10.6^\circ$  of the plane of vibration of a plane polarised light. Find the strength of the solution. Given the specific rotation of sugar =  $66.5 \text{ dm}^{-1}\text{g}^{-1}\text{.cm}^{-3}$ .
  - (k) Show that for electromagnetic waves in free space, energy is equally shared between electric and magnetic fields.
  - (l) Show that the frequency of an electromagnetic wave remains unchanged upon reflection or refraction.
  - (m) Describe the state of polarization of the electromagnetic wave represented by  $\vec{E}(z,t) = \hat{i} E_0 \cos(kz - \omega t) - \hat{j} E_0 \cos(kz - \omega t)$ .
  - (n) Explain the concept of displacement current.

2. (a) What is Babinet's compensator? Explain, how it can be used to analyse circularly polarized light. 1+3
- (b) When do Maxwell's equation become uncoupled? What is the consequence? 2+1
- (c) Write that the Maxwells' equations for plane polarised electromagnetic waves in a dielectric medium having finite values of  $\mu$  and  $\epsilon$  but  $\sigma = 0$  and derive its solution. 3
3. (a) Establish the boundary conditions that must be satisfied by the field vectors. when an electromagnetic wave is incident at the interface between two dielectric media. 3
- (b) Show that the Maxwell's equations are Lorentz invariant. 4
- (c) Define optic axis of a crystal. What is principal section of a crystal? 2+1
4. (a) Write Fresnel's theory of rotation of the plane of polarisation by an optically active substance. 4
- (b) What are H-polaroid and K-polaroid? 3
- (c) An electromagnetic wave polarized perpendicularly to the plane of incidence impinges at  $30^\circ$  on a glass slab having refractive index 1.5. Find the amplitude reflection and transmission coefficients. 3
5. (a) Show that average energy density in a harmonic electromagnetic field is 4
- $$\langle u \rangle = \frac{1}{4} \text{Re}[\vec{E} \cdot \vec{D}^* + \vec{H} \cdot \vec{B}^*],$$
- where  $\vec{D}^*$  and  $\vec{B}^*$  are complex conjugates of  $\vec{D}$  and  $\vec{B}$ .
- (b) Light is incident from air on a glass of refractive index 1.5. Calculate Brewster's angle. 2
- (c) Compute the thickness of quarter wave plate for negative crystal. 2
- (d) Describe with necessary diagram, the step index and graded index optical fibre. 2

**N.B. :** Students have to complete submission of their Answer Scripts through E-mail / Whatsapp to their own respective colleges on the same day / date of examination within 1 hour after end of exam. University / College authorities will not be held responsible for wrong submission (at in proper address). Students are strongly advised not to submit multiple copies of the same answer script.

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