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G – 4473

Reg. No. :

Name :

Second Semester M.Sc. Degree Examination, July 2019

Branch : Physics

PH 221 : MODERN OPTICS AND ELECTROMAGNETIC THEORY

(2018 Admission)

Time : 3 Hours

Max. Marks : 75

PART – A

Answer any **five** questions. **Each** question carries **3** marks.

- I. (a) Explain briefly the phenomenon of Faraday rotation in optically active crystals.
- (b) What is second harmonic generation? Give one example.
- (c) Write down the expression for the propagation of plane electromagnetic waves in a conducting medium. Explain the concept of skin depth.
- (d) Show how magnetism is explained as a relativistic phenomenon.
- (e) What is an electric dipole? What are the characteristics of electric dipole radiation?
- (f) Explain the characteristic impedance of a transmission line. Give an expression for the same in terms of the properties of the line.
- (g) What is a TEM wave? Explain why such waves cannot pass through rectangular wave guides.
- (h) Briefly describe a half wave dipole antenna.

(5 × 3 = 15 Marks)

P.T.O.



PART – B

Answer (A) OR (B) part of **all** question from II to IV. **Each** question carries **15** marks.

- II. (A) (a) Describe the theory of multi layer films.
(b) What are anti reflection films? How do they function?

OR

- (B) (a) Discuss third harmonic generation, giving an example.
(b) Briefly explain paramagnetization of light.
- III. (A) Give the mathematical theory of reflection and transmission of electromagnetic waves at oblique incidence from one dielectric medium to another and hence verify Snell's laws of reflection and refraction.

OR

- (B) (a) What are scalar and vector potentials? Are they unique? Comment.
(b) Explain gauge transformation. Describe in detail the coulomb gauge.
- IV. (A) (a) Elaborate on the propagation of TE waves in a rectangular wave guide.
(b) Obtain an expression for the cut off frequency in the above case.

OR

- (B) (a) Obtain the electric and magnetic fields of an oscillating electric dipole. Calculate the time averaged power radiated per unit solid angle.
(b) Explain radiation reaction.

(3 × 15 = 45 Marks)



PART – C

Answer any **three** questions. **Each** question carries **5** marks.

- V. (a) Define Fourier transform. Show how Fourier transforms are useful for the explanation of diffraction phenomenon.
- (b) The lowest cut off frequency of a wave guide of square cross section is fixed at 3000 MHz. What should be the dimension of the wave guide and the corresponding mode of propagation.
- (c) Obtain a relation between the reflection coefficient R and the standing wave ratio of a transmission line.
- (d) The vector potential due to a certain current distribution is

$$\vec{A} = x^2y \vec{i} + y^2x \vec{j} - 4xyz \vec{k}$$

Find the magnetic field \vec{B} .

- (e) The electric field amplitude of a certain plane wave propagating in the Z direction is 250 V/m. If $\omega = 1 \mu\text{rad/s}$, find the frequency and amplitude of the H-wave and the power.
- (f) Write down the basic condition for phase matching in non-linear optics in terms of wave vector. Convert it into a form involving refractive indices.

(3 × 5 = 15 Marks)

