

Reg. No. :

Name :

Second Semester M.Sc. Degree Examination, July 2019

Physics

PH 221 : MODERN OPTICS AND ELECTROMAGNETIC THEORY

(2014 - 2017 admns)

Time : 3 Hours

Max. Marks : 75

PART – A

Answer **any five** questions (Each question carries 3 marks)

- I. 1. Distinguish between Fraunhofer and Fresnel diffraction.
2. Write a note on 'transfer function' $T(\mu, \nu)$ of an optical system.
3. Write a note on second harmonic generation.
4. Differentiate between transmission lines and ordinary electric network circuits.
5. Define power gain and radiation efficiency of an antenna.
6. Explain why magnetic field vector lags behind the electric field vector when EM waves propagate in a conducting media.
7. What are four vector potentials?
8. Explain the method of wave front construction.

(5 × 3 = 15 Marks)

P.T.O.



PART – B

Answer **all** questions (Each question carries 15 marks).

- II. A. (i) Discuss the theory of multilayer films.
(ii) What are anti-reflection and high reflection films?
(iii) Write a note on Fabry-Perot interference filter.

OR

- B. With necessary theory explain the construction and reconstruction of holograms.

- III. A. Discuss all the optical laws when EM waves are obliquely incident on a dielectric interface and derive the coefficients of reflection and transmission.

OR

- B. Obtain the transformation equations for electric and magnetic fields in a frame S' moving with a velocity \mathbf{v} with respect a stationery frame S .

- IV. A. What are transmission line parameters? Derive the general transmission line equations.

OR

- B. What are wave guides? Discuss the behaviour of TM waves in a rectangular wave guide and also derive an equation for the cut-off frequency of the guide.

(3 × 15 = 45 Marks)

PART – C

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

- V. (a) When a spacecraft re-enters the earth atmosphere, its speed and temperature ionize the surrounding atoms and molecules and create a plasma. It has been estimated that electron density is in the neighbourhood of 2×10^8 per cm^3 . Discuss the plasma's effect on the frequency of usage in radio communication between the spacecraft and the mission controller on the earth.



- (b) In free space ($z < 0$), a plane wave with $H = 10 \cos(10^7 t - \beta z) \hat{a}_x$ mA/m is incident normally on a lossless medium ($\epsilon = 2\epsilon_0, \mu = 8\mu_0$) in a region $z > 0$. Determine the reflected and transmitted components of electric and magnetic waves.
- (c) In a satellite communication system, free space condition may be assumed. The satellite is at a height of 36,000 km above the earth. the frequency used is 4000 MHz, the transmitting antenna gain is 15 dB and the receiving antenna gain is 45 dB. Calculate
- the free space transmission loss and
 - the receiving power when transmitted power is 200 watts.
- (d) An airline has characteristic impedance of 70Ω and phase constant of 3 rad/m at 100 MHz. Calculate the inductance per meter and capacitance per meter of the line.
- (e) Write the general instantaneous expressions for TE mode and deduce the field expressions for TE_{01} mode.
- (f) Show that the equation $\frac{\partial G^x}{\partial x} = 0$ represents $\nabla \cdot B = 0$ and $\nabla \times E = -\frac{\partial B}{\partial t}$.

(3 × 5 = 15 Marks)

