Reg. No. : ....

Name : ....

Second Semester M.Sc. Degree Examination, May 2020

Physics

PH 221 : MODERN OPTICS AND ELECTROMAGNETIC THEORY

(2014-2017 Admission)

Time : 3 Hours   Max. Marks : 75

PART – A

Answer **any five** questions, each question carries **3** marks.

1. (a) Explain the construction of Fabry-Perot interferometer.

   (b) What is the difference between Raman-Nath diffraction and Bragg diffraction?

   (c) Explain Faraday rotation in solids.

   (d) Explain how the phase matching for second harmonic generation can be achieved.

   (e) Deduce the expression for radiation pressure when light falls on a perfect absorber.

   (f) Explain the concept of radio horizon.

   (g) Why TEM wave cannot be transmitted through a hollow waveguide of any shape?

   (h) What is an antenna array? Distinguish between broadside array and end-fire array.

(5 × 3 = 15 Marks)

P.T.O.

PART – B

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

2. (a) Derive Fresnal Kirchhoff inegral formula and hence explain the Fraunhofer diffraction by a single slit.

OR

(b) Explain the electrooptic amplitude and phase modulation using KDP crystal.

3. (a) (i) Explain the reflection and transmission of plane electromagnetic wave incident obliquely at the boundary between two liner media. **10**

(ii) Discuss the radio wave propagation through ionosphere. **5**

OR

(b) (i) Show that magnetism is a relativistic phenomenon. **8**

(ii) Express electromagnetic field tensor in terms of 4-vector potential and obtain Maxwell's equations as a four vector equation. **7**

4. (a) (i) Derive the expressions for input impedance, reflection coefficient and standing wave ratio for a transmission line terminated by a load. **9**

(ii) Explain the construction of Smith chart. **6**

OR

(b) (i) Explain the propagation of TE waves through a rectangular waveguide and obtain the expression for cut-off frequency of TE_{mn} mode. **10**

(ii) Sketch the field pattern for TE_{10} mode in a rectangular waveguide. **5**

(3 × 15 = 45 Marks)

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PART – C

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

5. (a) A 400 $\overset{\circ}{A}$ thick film of $ZrO_2(n = 2.1)$ is deposited on glass $(n = 1.5)$. Determine the normal reflectance for sodium light $(\lambda = 589.3\,nm)$.

   (b) The electric field of a plane electromagnetic wave propagating in vacuum is given by $\vec{E} = E_0(\hat{x} - i\hat{y}e)e^{i(kz-wt)}$. Determine the magnetic field $\vec{B}$ and the time average poynting vector.

   (c) Prove that $(E^2 - c^2B^2)$ is relativistically invariant.

   (d) A lossless transmission line has characteristic impedance of 70Ω. If the phase constant of the wave is 3rad/m at 100 MHz, calculate the inductance per meter and the capacitance per meter.

   (e) An air filled rectangular waveguide of dimensions 5 cm and 2 cm operates at a frequency of 1 GHz. Show that TM_{21} mode cannot propagate at this frequency.

   (f) A half wave dipole antenna radiates 10 kw at a frequency of 100 MHz. A short dipole antenna situated at a distance of 25 km is used as receiving antenna. If both the antennas are placed symmetrically in the xy plane and the medium is free space, determine the power absorbed by the receiving antenna.

   (3 × 5 = 15 Marks)

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