RAN-2103000205021002

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T. Y. B. Sc. (Sem. - V) Examination March - 2023

Physics : Paper - VII

Electrodynamics and Optics (New Course)

[Total Marks: 50

સૂચના : / Instructions

(1)

નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.
Fill up strictly the details of ☛ signs on your answer book

Name of the Examination:

☛ **T. Y. B. Sc. (Sem. - V)**

Name of the Subject :

☛ **Physics : Paper - VII Electrodynamics and Optics (New Course)**

Subject Code No.: **2103000205021002**

Seat No.:

Student's Signature

(2) Figures on the right indicate the total marks carried by the question.
(3) Symbols used in the question paper have their usual meanings.
(4) Students are permitted to use non-programmable scientific calculator.

Q. 1. Answer the following questions in brief: (10)

1. Define: polar dielectric.
2. What do you mean by a polarized material?
3. State the unit and dimensional formula of volume charge density.
4. What are diamagnetic materials?
5. On which factor(s), does the value of relative permeability of a substance depend?
6. When a current carrying loop is placed in a magnetic field, the torque acting on it remains same irrespective of its orientation relative to the field. Agreed?
7. State condition for destructive interference in terms of phase difference.
8. Define the phenomenon on which an optical interferometer works.
9. What is the value of transmittivity of the Fabry-Perot etalon at FWHM?
10. What is coherence?

Q. 2. (A) Attempt any one of the following: **(7)**

(1) Explain the behavior of an electric dipole in the presence of uniform and non-uniform electric fields.

(2) What is a linear dielectric? Obtain the relationship between the electric susceptibility and the dielectric constant for a linear dielectric.

(B) Solve any one of the following: **(3)**

(1) What will be the magnitude of torque acting on an electric dipole having dipole moment 6.17×10^{-30} Cm when it is placed in a uniform electric field of intensity $4 \frac{mN}{c}$ making an angle of 30° with the field?

(2) Determine the electric permittivity and electric susceptibility of benzene if its dielectric constant is 2.28.

Q. 3. (A) Attempt any one of the following: **(7)**

(1) Derive an expression for the magnetic moment due to the orbital motion of electron assuming the orbit to be circular.

(2) Show and discuss hysteresis cycle for a ferromagnetic substance.

(B) Solve any one of the following: **(3)**

(1) Using the following data, calculate the magnitude of Bohr magneton.

$e = 1.6 \times 10^{-19}\ C$, $h = 6.626 \times 10^{-34}\ Js$ and

$m_e = 9.1 \times 10^{-31}\ kg$

(2) A square loop of side 4 *cm* is placed in a uniform magnetic field of 5 *mT*. If a current of 0.5 *A* is flowing through it, what will be the value of (i) its magnetic moment and (ii) torque acting on it?

Q. 4. (A) Attempt any one of the following: **(7)**

(1) Assume plane wave to be incident on a glass plate. Obtain the following expression for the resultant amplitude due to the waves obtained as a result of multiple reflections from the two surfaces of the plate.

$$A_r = A_0 \left[r_1 + \frac{t_1 r_2 t_2\ exp(i\delta)}{1 - r_2^2\ exp(i\delta)} \right]$$

(2) Explain the construction and working of Lummer-Gehrcke Plate.

(B) Solve any one of the following. **(3)**

(1) Consider a plane wave to be incident on a plate of thickness 2 *mm* and refractive index 1.5 at an angle of 15°. It experiences multiple reflections in the plate. Find the value of phase difference between two successive reflected waves.

(2) Consider a Fabry-Perot interferometer illuminated by collimated beam of white light normally. If the separation between the two plates is 6 μm and the refractive index of the medium between them is 1.5, (i) how many visible maxima, (ii) of what orders and (iii) of what wavelengths will be observed?

Q. 5. (A) Attempt any one of the following: **(7)**

(1) Explain the theory of recording of a hologram by assuming appropriate equations for the object wave and a reference wave and derive an expression for average intensity.

(2) Explain how double exposure holographic interferometry technique can be used for determining the Young's modulus of a cantilever.

(B) Solve any one of the following: **(3)**

(1) A plane monochromatic wave of wavelength 450 nm is propagating in the XZ plane at an angle of 30° with Z axis. Calculate the spatial frequency.

(2) The dimensions of the cross-section of a beam are 2.5 *cm* × 6 *mm* and it is supported on two knife edges kept at a separation of 60 *cm*. When it is loaded by 30 g at its center, the center depresses by 4 *mm*. Find the Young's modulus of the beam. ($g = 9.8\ \frac{m}{s^2}$).