B.Sc. III Semester Degree Examination, Oct./Nov. - 2018
PHYSICS
Optical Instruments, Laser And Electrodynamics
Paper-3.1

Time : 3 Hours

Maximum Marks : 80

Instructions to Candidates:

1. Section-I is compulsory.

2. Answer any **FOUR** questions from Section-II and **FOUR** questions from Section-III

SECTION - I

1. Answer any **Twelve** of the following.   (12×1=12)

   A. Choose the correct answer.

   (i) Resolving power of microscope increases with

      a) Increase of numerical aperture.

      b) Decrease of numerical aperture.

      c) Increase of wavelength.

      d) None of the above.

   (ii) Population inversion means

      a) Atoms in the ground state are more than atoms in the excited state.

      b) Atoms in the ground state are less than atoms in the excited state.

      c) Atoms in the ground state equal to the atoms in the excited state.

      d) No atoms in the excited state.

   (iii) Divergence of any vector is

      a) Vector   b) Scalar

      c) both (a) and (b)   d) None of the above

   (iv) A stationary charge produces

      a) An electric field   b) Magnetic field

      c) both (a) and (b)   d) No field

[P.T.O.

B. Fill in the blanks.

    (i) Chromatic aberration in Ramsden eyepiece is _____.

    (ii) Curl of a vector is _____.

    (iii) A coil wounded in the form of cylinder is called _____.

    (iv) Charge density in free space is _____.

C. State **TRUE** or **FALSE**.

    (i) Chromatic aberration arises due to the change in refractive index with the colour of light.

    (ii) Maxwell introduced the concept of displacement current.

    (iii) Distribution of temperature is a vector field.

D. Answer the following in one or two sentences.

    (i) What is an optical instrument?

    (ii) State Biot- Savart law.

    (iii) State Ampere's law.

    (iv) Write equation of continuity.

SECTION - II

(4×4=16)

2. Derive an expression for resolving power of microscope.

3. Explain spontaneous and stimulated emission of radiation.

4. Prove that curl grad S = 0 where S is scalar function.

5. Derive Poisson's equation and Laplace equation. Mention their importance.

6. Write the Maxwell's equations in differential and integral form.

7. Explain production and detection of electromagnetic waves by Hertz experiment.

SECTION - III

8. a) Give the construction and theory of Huygen's eyepiece.   (9+4=13)

    b) The lenses in a Huygen's eyepiece have the focal lengths of 0.02 metre and 0.04 metre. Find the distance between the lenses.

9. a) What is holography? Explain how hologram is recorded and reconstructed. (9+4=13)

    b) Mention the applications of laser.

10. a) State and prove Gauss divergence theorem. Prove that $\nabla(\phi+\psi)=\nabla\phi+\nabla\psi$.

    (9+4=13)

    b) Explain physical significance of divergence.

11. a) Obtain an expression for magnetic field at a point on the axis of a circular coil carrying a current.

    (9+4=13)

    b) A solenoid of 1200 turns is wound uniformly in a single layer on a glass tube 2 metre long and 0.2 metre in diameter. Find the magnetic field on the axis well inside the solenoid. When a current of 2 amperes flows through it.

12. a) Derive an expression for equation of electromagnetic waves in isotropic non-conducting medium.

    (9+4=13)

    b) Obtain an expression for torque on a current loop kept in a magnetic field.

13. a) State and prove the poynting theorem and give the physical significance of poynting vector.

    (9+4=13)

    b) Estimate the value of permittivity of free space from the knowledge of velocity of electromagnetic waves in free space. Given $\mu_0=4\pi\times10^{-7}$ H/m.