K20P 0121

Reg. No. : ....

Name : ....

IV Semester M.Sc. Degree (CBSS-Reg./Suppl./Imp.)
Examination, April 2020
(2014 Admission Onwards)
PHYSICS
PHY4C14 : Optics

Time : 3 Hours   Max. Marks : 60

SECTION – A

Answer **both** questions (Either **a)** or **b)**).

1. a) i) What is population inversion ? Why a four level laser system is better than 3 level laser system ?

   ii) Explain the rate equation for a three level laser system.

   OR

   b) i) Discuss the electro-optic effect in Lithium Niobate crystals.

   ii) Derive the Einstein coefficients in the theory of laser.

2. a) i) Give an account of Stimulated Raman Gain Spectroscopy.

   ii) Explain the quantum picture of the sum frequency generation.

   OR

   b) i) Describe different signal degradation in optical fibres.

   ii) Briefly discuss pulse broadening in optical fibers.   **(2×12=24)**

SECTION – B

Answer **any four**. (**1** mark for Part **a**), **3** marks for Part **b**), **5** marks for Part **c**)).

3. a) A two level pumping scheme cannot be used for lasing. Explain.

   b) Briefly explain the principle of an optical resonator.

   c) With the help of an energy level diagram, explain the principle and working of a He-Ne laser.

4. a) What is meant by magneto-optic effect ?

   b) Briefly explain principle and operation of a Pockels cell modulator.

   c) Sketch and explain an electro-optic amplitude modulator using KDP crystal.

5. a) What is meant by harmonic generation ?

   b) Write a short note on spatial solitons.

   c) Describe the theory of inverse Raman scattering.

6. a) What is meant by material dispersion ?

   b) The numerical aperture of an optical fibre is 0.24. If the refractive index of the core is 1.48, calculate the refractive index of the cladding.

   c) Explain what is meant by :

      a) Fiber birefringence

      b) Fiber beat length in single mode fibers.

7. a) What are leaky modes in optical fibers ?

   b) Find the relative population of the two states in a ruby laser that produces a light beam of wavelength 6943 Å at 300 K and 500 K.

   c) Briefly discuss the nonlinearity in the polarization of the medium.

8. a) What is meant by phase matching ?

   b) Explain what is meant by self-focusing of light.

   c) With an energy level diagram, explain the working of a Carbon dioxide laser.

   $(4 \times 9 = 36)$