



K21P 0244

Reg. No. :

Name :

**IV Semester M.Sc. Degree (C.B.S.S. – Reg./Suppl. (Including Mercy
Chance)/Imp.) Examination, April 2021
(2014 Admission Onwards)**

**PHYSICS
PHY 4C14 : Optics**

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **both** the questions (Either **a** or **b** or **c**) :

1. a) Explain the working of a He-Ne laser. Can we design it to operate at a wavelength other than the typical red emission ?

OR

b) Discuss the various dispersion mechanisms associated with an optical waveguide.

OR

c) What is electro optic effect ? With necessary theory explain the working of electro-optic amplitude and phase modulators.

2. a) What are optical parametric amplifiers ? Give the theory of sum frequency generation and difference frequency generation.

OR

b) What is an optical fiber ? Discuss the various loss mechanisms in an optical fiber cable.

OR

c) Based on Einstein coefficients, show that laser action is based on non-thermal equilibrium. **(2×12=24)**

SECTION – B

Answer **any four** questions (**One** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**) :

3. a) Can we have a two level laser system ?

b) Give a schematic of three level laser system (with actual energy levels, lifetimes etc.).

c) Give a schematic of a four level laser system and give the rate equations.

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K21P 0244



4. a) What is a laser amplifier ?
b) What are modes and free spectral range of a laser cavity ?
c) A laser cavity has a cavity length of 200 microns consisting of gain medium with refractive index 3.7 filling the entire cavity and a peak emission wavelength of 870 nm. Find the mode integer m of peak emission wavelength and the free spectral range of the cavity.
5. a) What is refractive index ellipsoid ?
b) What happens to the refractive index ellipsoid of a lithium niobate crystal, when an electric field is applied ? Explain.
c) Explain the working of a Faraday rotator.
6. a) What is self-focusing of light ?
b) Explain angle tuning and temperature tuning.
c) Give a brief description on CARS.
7. a) What is single mode cut-off wavelength of an optical fiber ?
b) Schematically represent the optical intensity distribution of first and second order modes of an optical fiber.
c) A typical single mode fiber has a core diameter of 8 microns and refractive index of 1.46. The normalized index difference is 0.3%. Cladding diameter is 125 microns. Calculate NA and the acceptance angle.
8. a) Show meridional rays and skew rays, graphically.
b) What are modes of an optical fiber ?
c) Plot the normalized propagation constant b Vs V number for a step index fiber for various modes.
9. a) What is optical nonlinearity ?
b) Explain optical rectification.
c) Give the theory of second harmonic generation.
10. a) Can we achieve cent per cent coupling of light into an optical fiber ?
b) Optical pulses, traversing through an optical fiber tend to change shape as it travels. Why ?
c) Make a note on power launching to an optical fiber, pointing out how to maximise coupling.

(9×4=36)