City College

Internal Examination 2020-2021

Physics (Hons.) CBCS Semester 5

Paper: PHSA DSE A1 (b)

Topic: Laser and Fiber Optics

Full Marks: 20; Time: 1 Hour

Answer any ten questions from the following: [2 × 10 = 20]

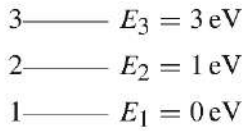
1. What is spatial and temporal coherence?

2. A LASER beam of wavelength 740 nm has coherence time 4 x 10^{-5} s. Deduce the order of magnitude of its coherence length and spectral half width.

3. An optical amplifier of length 10cm amplifies an input power 1 Watt to 1.1 Watt. Calculate the gain coefficient.

4. Calculate the ratio of stimulated to spontaneous for the wavelength 5893 A at 27 ^{0}C, k_bT=0.025 ev.

5. Calculate the spontaneous lifetime of level 3 for the atomic system as shown below:



The A coefficient of the various transitions are given by $A_{32} = 7 \times 10^7\ s^{-1}$, $A_{31} = 10^7\ s^{-1}$ and $A_{21} = 10^8\ s^{-1}$

6. State whether resonators made with the following mirror pairs are stable or not?
   a. $R_1 = \infty$, R_2 = 20 cm, d = 25 cm
   b. R_1 = 20 cm, R_2 = 20 cm, d = 40 cm
   c. R_1 = 20 cm, R_2 = −20 cm, d = 15 cm.

7. Define Q factor and cavity lifetime.

8. What is numerical aperture of an optical fibre? Write its value in terms of fractional refractive index change.

9. A step-index fibre is made with a core of refractive index 1.5, a diameter of 29.5 μm and a fractional difference index of 0.0007. When it is operated at a wavelength of 1.3 μm find the V-number and the number of modes that the fibre will support.

10. Explain the basic principle of point holography.

11. What is nonlinear frequency mixing and frequency doubling?

12. What is active and passive nonlinear optics?

Answer scripts must be emailed to sem5hcityphysics@gmail.com within 15 minutes of the end of the examination