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NY—161—2023

FACULTY OF SCIENCE

M.Sc. (Second Year) (Third Semester) EXAMINATION

NOVEMBER/DECEMBER, 2023

(CBCS/New Pattern)

PHYSICS

PHY-303

(Basics of Lasers and Devices)

(Saturday, 9-12-2023)

Time : 2.00 p.m. to 5.00 p.m.

Time—3 Hours

Maximum Marks—75

N.B. :— All questions are compulsory and carry equal marks.

1. Define Pumping. Describe in detail the following : 15

- (i) Two level pumping scheme.
- (ii) Three level pumping scheme.
- (iii) Four level pumping scheme.

Or

(a) As long as the material is in the thermal equilibrium, the population inversion of the higher state cannot exceed the population of the lower state." Explain. 8

(b) Derive an expression for the condition for amplification

$$r = (N_2 - N_1) \frac{B_{12} h\nu}{v}. \quad 7$$

2. Derive Laser Rate Equations for three and four level laser system. 15

P.T.O.

Or

- (a) Derive an expression for the threshold condition for lasing : 8
- $$v_{th} = \alpha_s + \frac{1}{2L} \ln \frac{1}{r_1 r_2}$$
- (b) Derive expression for critical population inversion. 7
3. Describe the general description, structure and working of Ruby Laser with neat diagrams. 15
- Or
- (a) Explain the structure and working of He-Ne Laser. 8
- (b) Discuss in detail Diode Laser operation. 7
4. Describe the use of lasers in isotope separation, nuclear fusion and nuclear fission. 15
- Or
- (a) Explain the working of optical disc as a data storage device. 8
- (b) Discuss cutting process with laser. 7
5. Write short notes on (any *three*) : 15
- (a) CO₂ laser
- (b) Active medium and metastable states
- (c) Doppler Broadening
- (d) Advantages and disadvantages of Laser diodes over LED.