

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0929

Roll No.

--	--	--	--	--	--	--	--	--	--

B. Tech.

(Sem. III) Theory Examination, 2011-12

LASER SYSTEMS AND APPLICATIONS

Time : 3 Hours

Total Marks : 100

Note : Attempt questions from each Section as indicated.

Section-A

Attempt *all* parts of this question. Each part carries 2 marks. $2 \times 10 = 20$

- (a) Show that population inversion is a condition of negative temperature.
- (b) What is the role of optical cavity in a laser?
- (c) How do you define gain of a laser cavity?
- (d) Define Einstein's coefficients A and B.
- (e) How do you generate short pulse of laser?
- (f) A pulse laser is generally used for material processing. Give the reason.

- (g) The diameter of the discharge tube in a helium neon laser is kept narrow. Give the reasons.
- (h) Even a small piece of hologram can give complete information about the object. How?
- (i) How do you define coherence property of laser light?
- (j) Why near infrared laser are preferred for optical communication?

Section-B

Attempt any *three* parts out of five. Each part carries 10 marks. 10×3=30

2. (a) Explain the phenomenon of induced emission indicating the features which differentiate it from spontaneous emission.
- (b) Discuss in brief the basic idea of elementary quantum theory and some observed experimental phenomena which could not be understood on this basis.
- (c) Write down the rate equation for a four level laser and obtain the threshold condition for lasing.
- (d) Discuss the working of an excimer laser. Why excimer lasers have high efficiency?
- (e) How eye surgery is made using lasers? Discuss its advantage over other kind of surgery.

Section-C

Attempt *all* questions of this Section. Each question carries 10 marks. $10 \times 5 = 50$

3. How is hologram different from photograph? Discuss the method used to record and reproduce a hologram. Can we get hologram with ordinary light?

Or

How communication gets facilitated using laser and fiber? Estimate the number of telephone channels possible to have an optical fiber network using laser of wavelength $1.55 \mu\text{m}$.

4. What is LIDAR? Discuss its components and their role. How atmospheric pollutants are measured using LIDAR?

Or

What is dye laser? Explain the working of dye laser on the basis of Jablonskii diagram. Show that a dye laser works as a four level laser.

5. Discuss the conditions in which a laser will work in cw/pulse mode. Name some lasers which works in cw as well as pulsed mode. Show that a cw laser is suitable for time measurements.

Or

Discuss the characteristics of a solid laser. With a neat energy level diagram explain the working of a ruby laser. A Ruby laser generally works in pulsed mode. Give the reason.

6. What do you understand by the term light amplification and how is it achieved in the case of laser?

Or

Answer the following :

- (i) Why laser light is monochromatic? What is the smallest width which could be achieved using low power cw laser?
- (ii) Show that laser light of even 1 mW power is brighter than sun.
7. Derive an expression for the resonance frequency in a resonator cavity with two mirrors of radius r_1 and r_2 separated by a distance d .

Or

Discuss the different types of pumping used in laser. What is the advantage of using lasers at the place of flash lamp in optical pumping? What type of pumping is suitable for HF, HCl lasers?