

Unit-1&2

- 1) What is Compton effect? Derive the equation for Compton effect.
- 2) Derive de Broglie's wave length for He atom.
- 3) What is Heisenberg's uncertainty principle? Explain.
- 4) What is photo electric effect? Explain
- 5) What do you mean by group velocity, Phase velocity and particle velocity?
- 6) What are the conditions for well behaved wave function?
- 7) Calculate the energy of Neutron whose de-Broglie's wave length is 10 \AA
- 8) A fast moving neutron is found to have an associated with de broglie wave length of $2 \times 10^{12} \text{ m}$. Find the kinetic energy, phase velocity and group velocity of de broglie waves.
- 9) In Compton's scattering the incident photons have wave length $3 \times 10^{10} \text{ m}$. Calculate the wave length of scattered radiation if they are viewed at an angle of 60° to the direction of incidence.
- 10) a) Calculate the de broglie wave length associated with a photon moving with a velocity equal to $1/20$ of the velocity of light.
b) Calculate the wave length of emission of Ga-As semiconductor Laser, whose band gap energy is 1.44 eV .

Unit-3&4

- 11) a) What is optical gain?
b) What is optical resonator?
c) What population inversion?
d) What is photo electric effect?
e) What is spontaneous emission?
f) Write short notes on Absorption, spontaneous and Stimulated emission.
- 12) a) Why optical cavity is required? Explain about different types (plane parallel mirror, concentric, confocal, ring) of optical cavity?
b) What is Q-switch laser? How Q-switching of laser is obtained?
c) Explain any liquid(dyes) laser?
d) Describe Ruby laser?
e) Explain Alexandrite Laser?
f) Write short notes on optical gain?
- 13) a) Derive Schrodinger time dependent wave equation.
b) Describe about any ion(Argon) laser?
c) Describe about any metal vapour laser(copper vapor laser and gold vapor laser)?
- 14) a) Explain Laser application in medical science and Ophthalmology?
b) Explain Laser application in military field? What is LIDAR?
c) Explain Laser application in Industry?
d) What is holography? Explain recording and reconstruction of hologram.
- 15) a) Describe CW laser and pulsed laser?
b) Explain Excimer Laser.
- 16) Derive Schrodinger time independent wave equation.
- 17) Derive the total energy for a particle of mass 'm' in a 1-D box, moving along X-axis.
- 18) Derive the wave function for a particle of mass 'm' in a 1-D box, moving along X-axis.

- 19) Derive the expression of group velocity.
- 20) Establish the relation between group velocity and particle velocity.
- 21) Establish the relation between wave velocity and wave length.
- 22) What do you understand by coherence and correlation? Explain it in brief.
- 23) Explain spontaneous emission and stimulated emission. Describe coherent absorption.
- 24) What are the properties of matter waves?
- 25) What are Einstein A and B coefficient? Establish a relation between them.
- 26 a) What is 2 level, 3 level and 4 level laser?
- b) What is absorption?
- c) What is spontaneous and stimulated emission?
- d) What is pumping process? What are the different types of pumping process?
- e) Write some important factors for LASER generation **or** characteristics of laser?
27. a) classify the different types of Laser. Also give the example of excitation (Pumping) Mechanism used in various lasers?
- b) How many methods do you know for optical pumping? Discuss with examples.
- c) What are the main components of Laser? Describe each.
- d) What is Q switching of Laser? What is the method of Q switching?
- e) Explain Carbon Di oxide Laser?
- f) Explain Nitrogen Laser?
- 28 a) Explain Helium-Cadmium laser?
- b) Explain Hydrogen Laser?
- c) What do you understand by couplers? Explain the types of couplers.
- 29 a) Explain semi conductor laser and its operation.
- a) Discuss the application of laser in welding, drilling and cutting, and hardening.
- b) Discuss the difference between the emission of radiation in LED and LASER.
- 30 a) What do you understand by METASTABLE STATE? Discuss their role in Laser action.
- b) What do you understand by coherence and correlation, explain in brief?

Unit-5

31. a) Explain LIDAR with neat sketch.
- b) Explain Holography and reconstruction on hologram.
32. a) Explain Industrial application of laser.
- b) Explain Military application of laser.
- c) Explain Laser application in Medical science.
- d) Write short notes on Optical fibers and couplers

or

Explain, how Laser is used in Optical communication process?

33. Explain He-Ne Laser.
- 34) Explain Semiconductor laser.
- 35) Explain Nd: YAG and Nd: Glass laser.

QUESTION PAPER:

Printed Pages : 2

EOE043

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

PAPER ID : 0929

Roll No. 1122531047

B.Tech.

(SEMESTER-IV) THEORY EXAMINATION, 2012-13

LASER SYSTEMS AND APPLICATIONS

Time : 3 Hours]

[Total Marks : 100

SECTION - A

1. Attempt **all** question parts. $10 \times 2 = 20$
- (a) What is the role of optical cavity in a laser ?
 - (b) How do you define gain of laser activity ?
 - (c) What do you mean by coefficient of gain ? Find the expression for it.
 - (d) How do you generate short pulse of laser ?
 - (e) What is dye laser ?
 - (f) Why laser light is monochromatic ?
 - (g) How do you define coherence property of laser light ?
 - (h) List out the features of materials used for laser action.
 - (i) Why a pulse laser is generally used for material processing ?
 - (j) Define Stimulated Emission of Radiation.

SECTION - B

2. Attempt any **three** question parts : $10 \times 3 = 30$
- (a) Prove that larger the energy difference between two states, much more likely is spontaneous emission compared to stimulated emission.
 - (b) Discuss briefly the different configurations of optical cavities.
 - (c) What is LIDAR ? Discuss its components and their role.
 - (d) Enlist the conditions in which a laser will work in cw/pulse mode. Show that a cw laser is suitable for time measurement.
 - (e) How communication gets facilitated using laser and fibre ? Estimate the number of telephone channels possible to have an optical fibre network using laser of wavelength $1.55 \mu\text{m}$.

0929

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SECTION - C

Attempt all questions :

10 × 5 = 50

3. Attempt any two parts :

5 × 2 = 10

- (a) Explain necessary condition for Laser Action.
- (b) Explain four characteristics of Laser Light.
- (c) Define Q-factor of an optical resonator. Show that $Q = \nu_0 / \Delta\nu$, where ν_0 – resonant frequency and $\Delta\nu$ – full width at half maximum.

4. Attempt any one part :

10 × 1 = 10

- (a) How is hologram different from photograph ? Discuss the method used to record and reduce a hologram.
- (b) Describe spontaneous and stimulated emission of radiation and establish a relation between transition probabilities of spontaneous and stimulated emissions.

5. Attempt any one part :

10 × 1 = 10

- (a) Explain the construction, working and application of excimer laser.
- (b) What do you mean by Q switching ? Describe various methods of Q switching.

6. Attempt any one part :

10 × 1 = 10

- (a) Describe the working of He-Ne laser with a neat diagram. What are the characteristics of output laser beam from He-Ne laser ?
- (b) With necessary diagram, explain the construction and working of Nd-YAG laser.

7. Attempt any two parts :

5 × 2 = 10

- (a) Explain the use of laser for construction and reconstruction of image in holography.
- (b) What are the components of optical communication ? Explain how laser becomes important for optical communication.
- (c) Which are the lasers suitable for surgical operations and list out their merits and demerits ?