B.TECH
(SEM III) THEORY EXAMINATION 2018-19
LASER SYSTEMS AND APPLICATIONS

Time: 3 Hours   *Total Marks: 100*

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1.   **Attempt *all* questions in brief.**   **2 x 10 = 20**

   a. Heisenberg's principle of uncertainty is outcome of description of particle
    Comment on this statement.
   b. Define photoelectric effect with Einstein photoelectric equation.
   c. Define the expression for quality factor
   d. Why is a four level laser more efficient than a three level laser?
   e. Show that electron cannot exists in the nucleus by uncertainty principal.
   f. What is metastable state? Discuss their role in laser action.
   g. Why is a pulse laser generally used for material processing?
   h. Show that laser light of even 1mW power is brighter than sun.
   i. Why laser light is monochromatic? What is the smallest width which could be
   achieved using low power cw laser?
   j. Why are near infrared lasers preferred for optical communication?

SECTION B

2.   **Attempt any *three* of the following:**   **10 x 3 = 30**

   a. Find the expression for the energy state of particle in one dimensional box.
      Calculate the energy difference between the ground state and first excited state for
      an electron in one dimensional rigid box of length $1A^0$. Mass of electron = $9.1×10^{-31}$kg and h=$6.63×10^{-34}$ J-S.
   b. What are characteristic inlaser beam? Explain in details?
   c. Explain the physical significance of the wave function and established time
      dependent Schrodinger equation wave equation.
   d. Write the significance of Einstein's coefficient and explain the relation between
      Einstein's A and B coefficients.
   e. Whycannot achieved population inversion in two level energy scheme. Ratio of
      population of two energy levels out of which upper one corresponds to a metastable
      state is 1.059×10^{-30}. Find the wavelength of light emitted at a temperature
      T=330K. (h=$6.63×10^{-34}$ J-S,K=$1.38×10^{-23}$J/K)

SECTION C

3.   **Attempt any *one*part of the following:**   **10 x 1 = 10**

   a) Derive the expression for the Compton-shift and direction of recoil electron.
      Why Compton Effect is not observed in case of visible light?
   b) What is optical activity? Describe various types of optical cavities.

4. **Attempt any _one_ part of the following:** 10 x 1 = 10

   a) What do you mean by Coherence? Explain temporal coherence and spatial coherence. Laser produced plasma consisting of a 100 μm diameter radiates very strongly to a wavelength 10 nm. Calculate the value of spatial coherence length at a distance 0.5 from the source.

   b) Discuss the different types of pumping used in laser. What is the advantage of using lasers at place of flash lamp in optical pumping?

5. **Attempt any _one_ part of the following:** 10 x 1 = 10

   a) What do you understand by laser gain? Derive an expression for the loop gain.

   b) Mode- locking and Q-switching are two important phenomena's for producing powerful laser.

6. **Attempt any _one_ part of the following:** 10 x 1 = 10

   a) Write short note on following: - (i) CO_2 laser (ii) Excimer laser.

   b) Discuss about semiconductor lasers. Give relevant resin behind the statement "Semiconductor lasers are most useful lasers".

7. **Attempt any _one_ part of the following:** 10 x 1 = 10

   a) What is LIDAR? Write various application of laser in LIDAR.

   b) Explain the following industrials applications of laser: cutting, welding, melting, photolithography, 3-d measurements.