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

Time: 3 Hours ***Total Marks: 70***

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

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a. What was Planck's revolutionary idea to explain black body radiation spectrum.
b. What do you mean by quantum mechanical tunneling? Give example.
c. Laser beam has a band width of 2500Hz. What are the values of coherence length and coherence time?
d. Why population inversion state is a known as a negative temperature state?
e. What are metastable states? Explain their role to get laser action.
f. Explain the role of nitrogen and helium gas in carbon dioxide laser.
g. List the difference between holography and ordinary photography.

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a. A particle is confined to move in a one dimensional infinite potential box of width 'a'. Write down Schrodinger's wave equation and solve it to find energy eigen values and eigen functions.
b. Explain Einstein's *A* and *B* coefficients. Derive a relation between them and explain the significance of this equation.
c. What do you mean by Q-switching? Describe various methods to achieve this.
d. What are Neodymium lasers? Explain construction, working, energy level diagram and applications of Nd-YAG lasers.
e. What is the difference between LIDAR and RADAR? Discuss its components and their role. Explain the principle of operation of LIDAR.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a) Explain spectral series of hydrogen atom with a suitable diagram. Calculate the series limit of all the series.
(b) An electron is bound by a potential which closely approaches square well of width $2.5X10^{-10}$m. Calculate the lowest three permissible quantum energies the electron can have.

4. Attempt any *one* part of the following: 7 x 1 = 7

(a) What do you mean by coherence? Explain temporal and spatial coherence. Derive an expression for temporal and spatial coherence length.
(b) Ruby laser has two states at 27ºC. If it emits radiation of wavelength 7000Å, then calculate relative population (N_2/N_1).

5. Attempt any *one* part of the following: 7 x 1 = 7

(a) Describe the essential components of a laser system with the help of suitable diagram. Describe various pumping mechanism used in different laser systems.

(b) What do you mean by loop gain in a laser system? Derive an expression for loop gain. Describe the threshold condition for laser oscillation.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a) Why excimer laser is known as self-illuminating laser? Explain the excitation mechanism of excimer laser with suitable energy level diagram. Give some output wavelengths of excimer laser.

(b) Discuss the excitation mechanism of semiconductor diode laser. What is the difference between LED and LASER?

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

(a) Explain the principle of holography and discuss its applications. Describe construction and reconstruction of holograms.

(b) Discuss the applications of lasers in material processing. What advantages are there in processing materials using lasers?

Physical Constants:

Mass of electron :$m_0 = 9.1X10^{-31}kg$
Speed of light :$c = 3X10^8 m/s$
Planck's constant :$h = 6.62X10^{-34}J - s$
Boltzmann's constant: $k = 8.6X10^{-5}eV/K$
Rydberg's constant:$R_H = 1.0973X10^7 m^{-1}$
Wein's constant:$b = 0.2896X\ 10^{-2}mK$