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

Paper ID : 2289415   Roll No. [ ][ ][ ][ ][ ][ ][ ][ ][ ]

B.TECH

Regular Theory Examination (Odd Sem - III), 2016-17

LASER SYSTEM AND APPLICATIONS

Time : 3 Hours   *Max. Marks : 100*

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

Section - A

1.   **Attempt all questions in brief.**   (10×2=20)

   a)   What do understand by Planck's Hypothesis?

   b)   Describe wave particle duality in short.

   c)   Explain the physical significance of wave function.

   d)   How is metastable state essential to achieve population inversion?

   e)   Describe the factors which cause losses in a laser.

   f)   Find the intensity of a laser beam of 100mW power and having a diameter of 1.3mm. Assume the intensity to be uniform.

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g) What is an active medium?

h) What are Dye Lasers?

i) Write few applications of Ruby laser.

j) What is hole-burning in laser gain curve?

Section - B

2. **Attempt any three of the following:** (3×10=30)

a) What is Compton Effect? Derive an expression for Compton shift. A photon of energy 1.02 MeV is scattered through 60^0 by a free electron. Calculate the energy of the photon and the electron after interaction.

b) What are the Einstein's coefficients? Establish a relation between them.

c) Why does a two-level laser not have any physical significance? Explain working of three and four level laser systems.

d) What are ionic lasers? Explain the construction and working of Argon ion laser.

e) Write a note on application of laser in medicine and surgery.

Section - C

3. **Attempt any one part of the following:** (1×10=10)

a) By using Heisenberg's uncertainty principle, show that an electron cannot exist inside the nucleus but proton can exist.

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b) Describe Davisson and Germer's electron diffraction experiment to demonstrate the wave character of electron.

4. **Attempt any one part of the following : (1×10=10)**

a) What is the concept of coherence in laser? Derive a relation between coherence length and line width.

b) What is an optical resonator and explain its various configurations.

5. **Attempt any one part of the following: (1×10=10)**

a) What do you mean by loop gain? If active medium gain in laser is 1.03 with length 30 cm. The loss coefficient is $\alpha = 1.35 \times 10^{-4}$ cm^{-1}. The reflection coefficients of the mirrors are 0.99 and 0.94 respectively. Calculate its loss factor, loop gain and gain coefficient.

b) What do you mean by Q-switching? Describe various methods of Q-switching in brief.

6. **Attempt any one part of the following: (1×10=10)**

a) Describe the construction and working of He-Ne laser. Compare it Ruby Laser.

b) Discuss the features, lasing transitions, operations of Nd^{3+}: YAG laser.

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7. **Attempt any one part of the following:** (1×10=10)

a) What do you mean by material processing? What are the various changes that can take place during material processing?

b) Discuss, how Laser can be used in Metrology?

Physical Constants

Rest mass of electron	m_o	$= 9.1 \times 10^{-31}$ kg
Rest Mass of Proton	m_p	$= 1.67 \times 10^{-27}$ kg
Speed of light	c	$= 3 \times 10^8$ m/s
Planck's Constant	h	$= 6.63 \times 10^{-34}$ J-s
Charge on electron	e	$= 1.6 \times 10^{-19}$ C
Boltzmann's Constant	k	$= 1.38 \times 10^{-23}$ J K^{-1}