



Name : .....

Roll No. : .....

Invigilator's Signature : .....

**CS/B.Tech (BME)/SEM-7/BME-704A/2010-11**

**2010-11**

**LASERS AND FIBRE OPTICS IN MEDICINE**

Time Allotted : 3 Hours

Full Marks : 70

*The figures in the margin indicate full marks.*

*Candidates are required to give their answers in their own words as far as practicable.*

**GROUP – A**

**( Multiple Choice Type Questions )**

1. Choose the correct alternatives for the following :  $10 \times 1 = 10$

i) If  $c$  be the velocity of light, which one of the following is correct ?

a)  $\mu_0 \epsilon_0 = c$

b)  $\mu_0 \epsilon_0 = c^2$

c)  $\mu_0 \epsilon_0 = \frac{1}{c}$

d)  $\mu_0 \epsilon_0 = \frac{1}{c^2}$

ii) If the frequencies and wavelengths of photons in transitions from excited to ground, excited to metastable and metastable to ground for a laser emitting atom are  $f_1, f_2, f_3$  and  $\lambda_1, \lambda_2$  and  $\lambda_3$  respectively, then which one of the following is true ?

a)  $\lambda_3 = \lambda_1 + \lambda_2$

b)  $f_3 = f_1 - f_2$

c)  $\lambda_3 = \frac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$

d)  $f_3 = \frac{f_1}{f_1 + f_2}$



- iii) Fundamental characteristics of Laser light is/are
- a) Coherency and Monochromaticity
  - b) Coherence only
  - c) Coherency and Transparency
  - d) none of these.
- iv) Refractive index of core and cladding of an optical fibre are 1.5 and 1.47 respectively. What is the critical angle ( $\theta_c$ ) at core-cladding interface ?
- a)  $86^\circ$
  - b)  $71^\circ$
  - c)  $48^\circ$
  - d)  $78.5^\circ$ .
- v) Principal optical properties of biological tissues are
- a) reflection
  - b) absorption
  - c) scattering
  - d) all of these.
- vi) Commonly used laser photo-coagulator for G.I. tract is
- a) Ar-ion laser
  - b) Ruby laser
  - c)  $\text{CO}_2$  laser
  - d) none of these.
- vii) What is not the principle characteristic of laser light ?
- a) Coherency
  - b) Monochromaticity
  - c) Low dispersion
  - d) Destructive interference.
- viii) He-Ne laser is a/an
- a) Atomic laser
  - b) Ionic laser
  - c) Molecular laser
  - d) Solid laser.
- ix) Ruby LASER shows
- a) four-level system
  - b) three-level system
  - c) two-level system
  - d) none of these.
- x) One of the metal cutting LASERS is
- a)  $\text{CO}_2$  LASER
  - b) He-Ne LASER
  - c) Argon LASER
  - d) None of these.



**GROUP – B**

**( Short Answer Type Questions )**

Answer any *three* of the following.  $3 \times 5 = 15$

2. Write the basic working principle of “Optical Fibre” with diagram. 5
3. Write the basic concepts of LASER by showing different energy state diagrams. 5
4. Briefly describe the technique of ‘Laser Holography’. What is its primary application ? 1 + 4
5. How can the pumping requirements be greatly reduced by using the 4-level scheme instead of 3-level system ? 5
6. Briefly discuss about the energy level diagram of He-Ne Laser. 5
7. How is Laser use in ophthalmology ? 5

**GROUP – C**

**( Long Answer Type Questions )**

Answer any *three* of the following.  $3 \times 15 = 45$

8. a) Define the term Laser.  
b) Derive the relation between “Spontaneous Emission Rate” and “Stimulated Emission Rate” by using Einstein equation and Boltzmann statistics.  
c) Discuss about the thermal effect and non-thermal effect of Laser with living tissue. 1 + 6 + 8
9. Name the different types of reaction occurred when Laser light is absorbed by tissue. Explain any one of them. Write down the application of that effect in biology and explain the mechanism of that application. What is the full form of LASIK ? What is done by it ? 3 + 3 + 2 + 3 + 1 + 3



10. a) Define "Population Inversion" and discuss the same using energy level diagram.
- b) Discuss the basic working of Gas Lasers.
- c) With a suitable schematic diagram, discuss the working principle of CO<sub>2</sub> Laser. 5 + 6 + 4
11. a) Write the working principle of Laser light signal transmission through optical fibre with proper construction details. 6
- b) What are the advantages of optical fibre in signal transmission over conventional copper wire? 4
- c) A quartz optical fibre with core diameter large enough to be considered by ray theory analysis has core refractive index of 1.43 and cladding refractive index of 1.39. Find the following :
- i) The critical angle ( $\theta_c$ ) at the core-cladding interface
- ii) Numerical aperture of the fibre
- iii) The acceptance angle in air for fibre. 2 + 2 + 1
12. a) Write the different advantages of optical fibre used in medical field.
- b) How is 'Argon Ion Laser' used to control the Gastric haemorrhage by photocoagulation?
- c) What precautions you must take for surgical use of Laser? 5 + 5 + 5
13. Write notes on any *three* of the following : 3 × 5
- a) LASER in Ophthalmology
- b) LASER in Dentistry
- c) LASER in Dermatology
- d) LASER flow Cytometry
- e) Formation of 'Argon Ion Laser'.
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