

Name :

Roll No. :

Invigilator's Signature :

CS/B.Tech(BME)/SEM-7/BME-704A/2011-12

2011

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 × 1 = 10

i) He-Ne Laser shows

- a) two-step emission b) three-step emission
c) four-step emission d) none of these.

ii) Biological chromophores are

- a) haemoglobin (Hb) and water (H₂ O)
b) water and melanin
c) Hb, (H₂ O) and melanin
d) none of these.



iii) Laser light energy can be calculated by using the equation

- a) $E = h.(c/\lambda)$
- b) $E = mc^2$
- c) $E = (1/2) CV^2$
- d) none of these.

iv) Which one is most appropriate ?

- a) Core refractive index (μ) of fibre optic is more than cladding μ
- b) Core μ is less than cladding μ
- c) Core μ and cladding μ are equal to each other
- d) None of these.

v) Laser light travels in a fibre optic at 2.5×10^8 m/sec. What is the refractive index of fibre ?

- a) 1.52
- b) 1.37
- c) 1.2
- d) 2.5.

vi) Thermal effect of LASER on tissue is normally

- a) one-step process
- b) two-step process
- c) three-step process
- d) four-step process.



- vii) Dispersion problems can be overcome by using
- a) Cylindrical fibre
 - b) Graded Index fibre
 - c) Step-Index fibre
 - d) None of these.
- viii) Optical fibre does not show any interference by Electromagnetic field because of its
- a) conductivity
 - b) non-conductivity
 - c) transparency
 - d) none of these.
- ix) The power of He-Ne Gas Laser is
- a) 100 – 1000 W
 - b) 0.1 – 500 MW
 - c) 0.001 – 0.01 MW
 - d) 100 – 1000 kW.



- x) In population inversion
- a) no atom is excited
 - b) more atoms are excited
 - c) less atoms are excited
 - d) all atoms are excited.

GROUP – B

(Short Answer Type Questions)

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

2. What are the fundamental characteristics of LASER light ?
Explain with proper diagram.
3. Briefly describe the Nd-YAG Laser production technique.
4. How is Ruby laser produced ? Why Ruby source is not used for CW Laser production ?
5. Briefly discuss about the coherency and monochromaticity of the LASER.
6. Write the different advantages of Optical fibre used in Medical field.
7. Discuss the mechanical effect produced by the interaction of LASER with living tissue.

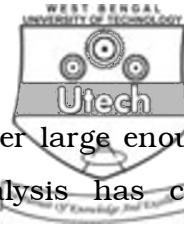


GROUP – C

(Long Answer Type Questions)

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

8. a) What are the optical properties of living tissues ? Briefly explain the Laser-tissue interaction by considering the terms 'thermal effect' and 'photo-thermal ablation'. 8
- b) Write the names of at least five different Lasers with specification (λ) and their applications in medical field. 7
9. a) Briefly discuss the working principle of Gas Laser action with proper diagram. 6
- b) How is Argon Ion Laser used to control the Gastric haemorrhage by photo-coagulation ? 5
- c) What precautions you must take for surgical use of Laser ? 4
10. a) Briefly discuss the Q-Switching technique in Laser operation. 5
- b) How is CO_2 Laser with He-Ne Laser used in medical surgery ? What is the main function of He-Ne Laser in this application ? 4 + 3
- c) What do you mean by polarization of Laser emission ? 3
11. a) Write the basic working principle of 'Optical Fibre' with diagram. 5



- b) A silica optical fibre with a core diameter large enough to be considered by ray theory analysis has core refractive index of 1.5 and cladding refractive index of 1.47.

Determine :

- i) The critical angle at the core-cladding interface
- ii) Numerical aperture of the fibre
- iii) The acceptance angle in air for the fibre

$$\text{Given : } \phi_c = \sin^{-1} \left(\frac{n_2}{n_1} \right) = 78.5^\circ$$

$$NA = \left(n_1^2 - n_2^2 \right)^{1/2} = 0.30$$

$$\theta_a = \sin^{-1} (NA) = 17.4^\circ. \quad 2 + 2 + 2$$

- c) Write the different uses of Optical fibre in Biomedical field. 4
12. a) Write the basic concepts of LASER by showing different energy state diagrams. 5
- b) Find out the relation between "Stimulated Emission Rate" and " Spontaneous Emission Rate" by using Einstein equation and Boltzman statistics. 5
- c) Briefly discuss the term "Population Inversion" by showing different energy level diagrams. 5



13. Write short notes on any *three* of the following : 3 × 5

- a) Laser flow Cytometry
 - b) Factors influencing the properties of Laser lights
 - c) Continuous wave and Pulsed Laser operation
 - d) Laser in Ophthalmology
 - e) Laser in Dentistry.
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