Name : .....

Roll No. : .....

Invigilator's Signature : .....

CS/B.TECH (BME)/SEM-7/BME-704A/2009-10

2009

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) The basic principle of fibre optics is
   a) Reflection
   b) Refraction
   c) Total internal reflection
   d) none of these.

ii) Thermal effect of Laser on tissue is normaly a
   a) 4-step process b) 3-step process
   c) 1-step process d) 2-step process.

iii) Dispersion problem of optical fibre can be overcome by using
   a) Cylindrical fibre b) Graded index fibre
   c) None of these d) All of these.

iv) The term 'single frequency operation' of Laser is related to the property of Laser

a) Monochromaticity b) Coherency

c) Directionality d) None of these.

v) Laser light travels in a fibre optic at $3{\cdot}2 \times 10^8$ m/s. What is the refractive index of the fibre ?

a) 1·55 b) 1·67

c) 2·89 d) None of these.

vi) In population inversion

a) no atoms are excited

b) more atoms are excited

c) less atoms are excited

d) all atoms are excited.

vii) Electromagnetic field and optical fibre do not show any interference because of their

a) transparency b) non-conductivity

c) conductivity d) none of these.

viii) Nd-YAG Laser finds application in

a) Neuro-surgery b) Dermatology

c) Gynaecology d) all of these.

ix) Which one of the following 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 & cladding μ are equal to each other

d) None of these.

x) He-Ne Laser shows

a) Two-step emission b) Three-step emission

c) Four-step emission d) none of these.

GROUP – B

(Short Answer Type Questions)

Answer any *three* from the following. 3 × 5 = 15

2. Write the basic working principle of Gas Laser action with proper diagram.

3. How Laser is used in dermatology ?

4. Write the basic working principle of 'Optical fibre' with diagram. What are the advantages of optical fibre ? 3 + 2

5. How are continuous wave (CW) and pulsed wave laser formed ? Why Ruby Source is not used for CW laser production ?

6. What are the safety precautions to be taken during laser operation as well as laser surgery ? Why wavelength selection is so important in laser surgery ? 3 + 2

7. What do you mean by 'Population Inversion' in Laser production ? Explain with different energy state diagrams.

GROUP – C

(Long Answer Type Questions)

Answer any *three* of the following. 3 × 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) Write down the construction details of optical fibre. 3

b) How is the signal transmitted through it ? 4

c) A silica optical fibre with a core diameter large enough to be considered by ray theory to analysis which has core refractive index of 1·67 and cladding refractive index of 1·52. Determine,

i) the critical angle (θ_c) at core cladding interface

ii) numerical aperture of the fibre

iii) the acceptance angle of the fibre. 8

10. a) Briefly discuss about the coherency, directionality and monochromaticity of Laser. 4

b) Find out the ratio between spontaneous and stimulated emission discovered by Albert Einstein. 8

c) What do you mean by polarization of Laser emission ? 3

11. a) Write the operation details of Nd-YAG Laser production. 5

b) What is the full form of PDT ? Write down the basic principle of it. 1 + 4

c) What is selective photothermolysis ? How it is performed ? 1 + 4

12. a) Briefly discuss the *Q*-switching technique in Laser application. 5

b) Write basic principle of Laser by showing different energy level diagram. 10

13. a) Explain photoablative and photodynamic effects of Laser. 5

b) With a suitable schematic diagram, discuss the working principle of CO_2 laser. 5

c) Discuss briefly about Laser flow cytometry. 5