Roll No. | | | | | | | | | | | | |

Total No. of Pages : 02

Total No. of Questions : 09

M.Sc.(Physics) (2015 to 2017) (Sem.–2)

OPTOELECTRONICS, LASERS AND ITS APPLICATIONS

Subject Code : MPH-202

Paper ID : [A2816]

Time : 3 Hrs. Max. Marks : 100

INSTRUCTION TO CANDIDATES :

1. Attempt any FIVE questions including the compulsory question no. 9.
2. Each question carries TWENTY marks.
3. Symbols used have their usual meanings.

Q1. a) What is the working principle of an optical fibre? (3)

b) What are its different parts and their role? (5)

c) What are different types of an optical fibre? Give their advantages and disadvantages. (5)

d) Define numerical aperture of an optical fibre. What is its role? Do we prefer a fibre with a small or a large numerical aperture? (4)

e) If a graded-index fibre has radius of 30μm, numerical aperture 0.15, calculate the total number of modes propagating through the fibre operating at wavelength of 0.85μm. (3)

Q2. a) Explain the principle of laser. (3)

b) What are Einstein's coefficients and derive Einstein relation. (6)

c) What is the energy level diagram of a laser? Explain different types of lasers on the basis of energy levels. (6)

d) What is three-level laser system? Using laser rate equations, derive the expression for its population inversion. (5)

Q3. a) Explain the laser propagation in open planer resonator and derive the expression for allowed frequencies of oscillation of the field in the resonator. (8)

b) What are different techniques for Q-switching in a pulsed operation of lasers? (6)

c) Write a short note on mode selection for laser propagation in a resonator. (6)

Q4. a) With the help of a neat energy-level diagram, explain the construction, working and advantages and disadvantages of Ruby laser. (10)

b) Make a comparison between solid lasers, gas lasers and semiconductor lasers. (6)

c) A certain Ruby laser emits 1.00 J pulses of light whose wavelength is 6940 A^0. What is the minimum number of Cr^{3+} ions in the ruby? (4)

Q5. a) With the help of a neat energy-level diagram, explain the construction, working and advantages and disadvantages of liquid dye laser. (10)

b) Make a comparison between atomic lasers, ion lasers and molecular lasers. (6)

c) A laser beam can be focused on an area equal to the square of its wavelength. For a He-He laser $\lambda = 6328A^0$. If the laser radiates energy at the rate of 1mW, find out the intensity of focused beam. (4)

Q6. a) Explain the basic principle and working of a laser tracking system based on interferometry. (8)

b) Discuss the principle, working and applications of a LIDAR. (6)

c) Explain the principle and working of a laser system in information storage. (6)

Q7. a) What is holography? What is the difference between holography and photography? (5)

b) Give briefly the requirements for holography and mention the various properties of a hologram. (5)

c) Explain in detail about holographic interferometry and its different forms: double exposure, real time and time average. (10)

Q8. Write short-notes on the following : (5×4=20)

a) Distance measurement with laser.

b) Laser in material processing.

c) Laser-induced fusion.

d) Laser heat treatment.

Q9. Answer briefly :

a) Explain briefly the working principle of a LED.

b) What do you understand by dispersion in an optical fibre?

c) Give the working principle of optical resonators.

d) What is mode locking in a pulsed operation of lasers?

e) What is the ultimate length of a laser?

f) Draw the energy level diagram for Carbon Dioxide laser.

g) Give some examples for applications/uses of laser interferometric methods.

h) Construction of a hologram.

i) Explain briefly the laser cooling.

j) On what principle a bar code scanner works? (2×10=20)