

CBCS Scheme

15PHY561

Model Question Paper – 1

Fifth Semester B.E. Degree Examination – Dec-2017

Laser Physics and Non-Linear Optics(Open elective)

Time : 3 hrs

Max. Marks: 80

Note: 1. Answer FIVE full questions, choosing one full question from each module.

2. Physical constants: Velocity of light $c = 3 \times 10^8$ m/s; $h = 6.625 \times 10^{-34}$ JS; $k = 1.38 \times 10^{-23}$ J/K; $N_A = 6.02 \times 10^{23}$ /K mole; $m_e = 9.1 \times 10^{-31}$ kg; $e = 1.6 \times 10^{-19}$ C.

Module – 1

- 1 a. What are free and damped vibrations? Give the theory of Damped vibrations (8 marks)
- b. Discuss the case of under damping (4 marks)
- c. A spring undergoes an extension of 5cm for a load of 50gm. It is set in vertical oscillation with a load attached at the bottom. If the angular frequency is 9.8 rad/s calculate the load attached and time period of the oscillations (4 marks)

OR

- 2 a. Give the theory of forced vibrations and deduce the condition for amplitude resonance (10 marks)
- b. Describe cavity resonance in Laser (4 marks)
- c. Evaluate the resonance frequency of a spring of force constant 1974N/m carrying mass of 2kg. (2 marks)

Module-2

- 3 a. Define the terms spontaneous emission, stimulated emission, meta stable state and population inversion. (4 marks)
- b. With a proper energy level diagram explain the working of Nd-YAG laser. Mention any two applications of Nd-YAG laser (8 marks)
- c. Calculate on the basis of Einstein's theory, the number of photons emitted per second by laser source emitting light of wavelength 6328\AA with an optical power output 10mW (4 marks)

OR

- 4 a. Give the theory of Einstein's A and B coefficients and discuss the conclusions of the theory (8 marks)
- b. Write a note on Excimer laser (4 marks)
- c. The ratio of population of two energy levels is 1.059×10^{-30} . Find the wavelength of light emitted at 330K (4 marks)

Module-3

- 5 a. What is a Laser Range Finder (LRF)? Give a qualitative explanation of working of LRF. Mention the factors affecting the range finder (10 marks)
- b. Briefly explain the three different types of missile guiding (6 marks)

OR

- 6 a. Explain the mechanism of optical data storage using low power laser beam. What are the advantages of optical storage? (8 marks)
- b. Mention different types of laser eye surgery. Explain the procedure of laser eye surgery using LASIK (8 marks)

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Model Question Paper – 2

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Module – 1

- 1 a. Define simple harmonic motion. Derive the equation for simple harmonic motion and hence arrive at the solution using Hooke's law. (10 marks)
 - b. What are free and damped vibrations? (2 marks)
 - c. A spring undergoes an extension of 5 cm for a load of 50 g. Find its force constant, angular frequency and frequency of oscillation, if it is set for vertical oscillations with a load of 200 g, attached to its bottom. Ignore the mass of the spring. (4 marks)
- OR**
- 2 a. Discuss the theory of forced vibrations and explain the different cases. (8 marks)
 - b. Describe Helmholtz volume resonator briefly. (4 marks)
 - c. A free particle is executing simple harmonic motion in a straight line with a period of 25 seconds. 5 seconds after it has crossed the equilibrium point, the velocity is found to be 0.7 m/s. Calculate the displacement at the end of 10 seconds, and also the amplitude of oscillation. (4 marks)

Module-2

- 3 a. Briefly explain laser pumping and population inversion. (4 marks)
 - b. Explain the construction and working of rhodamine 6G dye laser, with schematic diagram and energy level diagram. (8 marks)
 - c. A medium in thermal equilibrium at temperature of 300 K has two energy levels with a wavelength separation of 1 μ m. Find the ratio of population densities of the upper and lower energy levels. (4 marks)
- OR**
- 4 a. Starting from absorption and emission processes, obtain the relation between Einstein's A and B co-efficients. (7 marks)
 - b. Explain the working of a laser amplifier with a suitable diagram. (5 marks)
 - c. A laser operating at 632.8 nm emits 3.182×10^{16} photons per second. Calculate the output power of the laser if the input power is 100 watt. Also, find the percentage power converted into coherent light energy. (4 marks)

Module-3

- 5 a. Give a brief explanation of anti-tank missile and its working. (6 marks)
- b. Explain the construction and working of a laser printer with the diagram. (6 marks)
- c. Briefly explain the application of lasers in isotope separation. (4 marks)

OR

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- 4 a. Starting from absorption and emission processes, obtain the relation between Einstein's A and B co-efficients. (7 marks)
- b. Explain the working of a laser amplifier with a suitable diagram. (5 marks)
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- 5 a. Give a brief explanation of anti-tank missile and its working. (6 marks)
- b. Explain the construction and working of a laser printer with the diagram. (6 marks)
- c. Briefly explain the application of lasers in isotope separation. (4 marks)

OR

- 6 a. Give a brief description of laser range finder and its working. (6 marks)
b. Define endoscopy. Explain the procedure involved in endoscopy with the block diagram. (6 marks)
c. Write a short note on data storage using lasers. (4 marks)

Module – 4

- 7 a. Explain OVD technique of fiber fabrication with a neat sketch. (6 marks)
b. Define fiber splicing. Explain different types of fiber splicing. (7 marks)
c. Calculate the attenuation in an optical fiber of length 500 m, when a light signal of power 100 mW emerges out of the fiber with a power of 90 mW. (3 marks)

OR

- 8 a. Explain two fiber cable design and six fiber cable design. (6 marks)
b. What is attenuation? Mention the different types of attenuation and obtain the expression for attenuation coefficient. (6 marks)
c. Explain point to point communication with block diagram. (4 marks)

Module – 5

- 9 a. What is nonlinear optics? Briefly discuss its importance. (3 marks)
b. What is second harmonic generation in a nonlinear system? Explain. Mention its limitation. (7 marks)
c. Discuss the theory of parametric amplification of light. (6 marks)

OR

- 10 a. Write a note on phase matching and sum-frequency generation. (6 marks)
b. What is nonlinear susceptibility? Mention its properties. (4 marks)
c. What is an optical parametric oscillator? Describe its construction and working. (6 marks)