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(FOR THE CANDIDATES ADMITTED DURING THE ACADEMIC YEAR 2023-24 ONLY)

SUBJECT CODE 23 PPS 411

REG.NO.

N.G.M.COLLEGE (AUTONOMOUS) : POLLACHI

END-OF-SEMESTER EXAMINATIONS : MAY– 2025

M.Sc. – PHYSICS **MAXIMUM MARKS: 75**

IV SEMESTER **TIME : 3 HOURS**

LASERS AND NON-LINEAR OPTICS

SECTION – A (10 X 1 = 10 MARKS)

ANSWER THE FOLLOWING QUESTIONS.

1. The condition for light amplification in the view of the population of energy level is…….

   a) N1=N2 b) N1>N2 c) N2<N1 d) N2>N1

2. The output Wave length of Nd -YAG laser is ……

   a) 1064 A^o b) 532 A^o c) 6943A^o d) 6928 A^o

3. Piezoelectric transducer is used in……..

   a) Rotating mirror b) Acousto-optic shutter

   c) Electro-optic shutter d) saturable absorbers

4. Identify the non-linear effect…….

   a) Wavelength doubling b) simple harmonic generation

   c) second harmonic generation d) Acousto-optic effect

5. CARS is……

   a) Collimated anti-Stokes Raman scattering
   b) Coherent and Stoke Raman scattering
   c) Coherent anti-Stokes Raman scattering
   d) Coherent anti-Stokes Rayeligh scattering

ANSWER THE FOLLOWING IN ONE (OR) TWO SENTENCES (K2)

6. Write a laser rate equation for two-level laser systems.
7. List any four characteristics of a laser beam,
8. Define the term Q-factor.
9. Which type of crystals generally produces second harmonic generation?
10. What is known as multi photon ionization?

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SECTION – B (5 X 5 = 25 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.

(K3)

11. a) Write a note on Line brodening.

(OR)

b) What are optical resonators? Describe the role of optical resonator in a laser unit,

12. a) What is known as laser action? Explain the various processes involved in laser action

(OR)

b) Explain the construction and working of Fiber optic laser with schematic diagram.

13. a) Derive the expression for Q factor.

(OR)

b) What is known as isotope separation? Explain

14. a) What is parametric amplification of light? Explain the role of pump frequency and idler frequency in this phenomenon.

(OR)

b) Give a note on frequency upconversion.

15. a) Explain the process of Photo Acoustic Raman effect.

(OR)

b) Discuss the process of laser cooling and trapping of neutral atoms.

SECTION – C (5 X 8 = 40 MARKS)

ANSWER EITHER (a) OR (b) IN EACH OF THE FOLLOWING QUESTIONS.

(K4 (Or) K5)

16. a) What is Einestein coefficients? Deduce the expression for the ratio between the stimulated and spontaneous emission processes.

(OR)

b) Construct Laser rate equation for three level laser systems and attain the condition for population inversion.

17. a) Describe the working of the He-Ne laser with construction details. Elaborate the laser activity of Helium and neon atoms in the active medium with a neat energy level diagram.

(OR)

b) Describe working of the following with their applications

i) Excimer laser

ii) Free electron laser

18. a) What are the methods of Q switching? Explain the electro optic shutter and Acousto optic shutter Q-switching with appropriate diagrams.

(OR)

b) List some of the applications of lasers in industries. Explain their uses and functions.

19. a) What is known as phase matching? Arrive at the phase matching criterion for frequency doubling process in crystals.

(OR)

b) Describe the construction and working of an experiment that exhibits a two-photon process.

20. a) Elaborate the Doppler-free two-photon spectroscopy with essentials.

(OR)

b) Explain the process of the Raman effect through classical and quantum mechanical treatment.

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