

## **M.Sc. Physics Semester IV Paper XXVI**

### **Physics of Laser and Laser Applications 23PHY24C1**

Theory Marks:80

Internal Assessment Marks:20

Time: 3 Hours

#### **COURSE OUTCOMES**

- CO1 Student would be able to understand the diversity of laser designs and various applications.
- CO2 Understand the basic concepts of most of the commercially available lasers.
- CO3 Student will get the knowledge about the basic principles which form the basis of nonlinear optics.

#### **Unit I**

Laser characteristics: Spontaneous and Stimulated Emission, Absorption, Einstein Coefficients and their relationship, Laser Idea, threshold condition for laser oscillations, Pumping Schemes, Properties of Laser Beams: Monochromativity, Coherence, Directionality, Brightness, Radiation Trapping Superradiance, Superfluorescence, Amplified Spontaneous Emission, Non-radiative delay.

#### **Unit II**

Pumping process: Optical pumping and pumping efficiency, Electrical pumping and pumping efficiency, Passive Optical Resonators, Types of Resonators, Stability Diagram, Different types of losses in optical Resonators. Rate Equations, Four-level Laser, Three-level Laser, Q Switching, Methods of Q-switching: Electro optical shutter, Kerr effect, Pockel effect in KDP crystal, mechanical shutter, Acousto - optic Q-switches, Mode locking, theory of mode locking, methods of mode locking (active & passive).

#### **Unit III**

Principle, working, characteristics and energy level diagram of various types of laser as Solid State Lasers; Ruby Laser, Neodymium laser, Gas lasers; Neutral Atom Gas Laser, Helium Neon Laser, Nitrogen Laser, Dye-Laser, Semiconductor Laser.

#### **Unit IV**

Multiphoton photo-electric effects, Two-photon, Three-photon and Multiphoton Processes Raman Scattering, Stimulated Raman Effect, Introduction to Applications of Lasers: Physics, Chemistry, Biology, Medicine, Material, working, optical communication, Thermonuclear Fusion, Holography, Military etc.

**Note:**The syllabus is divided into four units. Nine questions will be set in all. Question No.1 will be compulsory having four to eight parts covering the whole syllabus. In addition there will be two questions from each unit and the student is to answer one question from each unit. A student has to attempt five questions in all.

#### **Text and Reference Books**

- [1] Introduction to Atomic and Molecular Spectroscopy by V.K.Jain
- [2] Yariv Optical Electronics
- [3] Demtroder: Laser Spectroscopy
- [4] Letekhov : Non-Linear Spectroscopy
- [5] Principles of Lasers by O. Svelto
- [6] Lasers and Non-linear Optics by B.B. Laud.