## SEMESTER - I

**Paper - IV : Laser Physics**

**Max. Marks: 55**
**Time: 3 Hrs**

Note: Nine questions will be set and students will attempt 5 questions. Question No. 1 will be compulsory consisting of 4 parts based on the conceptual aspects of the whole syllabus. The answers should not be in yes/no. In addition to Question No. 1 there will be four Units in the question-paper each containing two questions belonging to four Units in the syllabus. Students will select one question from each unit.

### UNIT - I

Introduction to laser, Spontaneous transitions between atomic levels - Homogenous and Inhomogenous broadening, Induced transition, Absorption and Amplification. Einstein Coefficient, significance of Einstein coefficients. Active material, population inversion, Laser medium, Pumping. Properties of laser – Coherence, Spatial coherence, Temporal coherence, Directionality, Monochromaticity, Focusability. Origin of the line shape function, Shape and width of the spectral lines, Spiking behaviour of the lasers

### UNIT - II

Laser rate equation, Fabry Perot Laser, Oscillations frequency, Three and Four levels Lasers, Power in laser Oscillation and Mode Locking. Q-switched lasers.
Curved Mirror Oscillator Theory: Optical Resonator with Spherical Mirrors, Mode stability criteria, Modes in generalised resonator, Resonance Frequencies of Optical resonators.

### UNIT - III

Laser System and Applications: Ruby Laser, $Nd^{3+}$ : YAG Laser. He-Ne Laser, $N_2$-Laser, $CO_2$ Laser, $Ar^+$ Laser, Excimer Laser, Semiconductor junction Laser and Organic-Dye Lasers, Free electron Laser and X-Ray Lasers.

## UNIT - IV

Spatial Frequency Filtering, Holography, Laser induced Fusion, Light wave communications, Lasers in Isotope Separation. Fundamental Characteristics of High energy density beams in materials processing. An oscillating Laser Beam. Hardfacing using a CW Laser. Applications of Laser Technology : Drilling, Cutting, Welding, Engraving, Stimulated Raman's Scattering and Self Focussing of Optical beams. Harmonic Generation, Second harmonic generation, Phase matching.

### References


1. Laser and Optical Engineering - P.Das, Narosa Publication.
2. Lasers and Nonlinear Optics - B.B. Land.
3. Optical Electronics - A Ghatak and K. Thyagarayan.
4. Introduction to Optical Electronics - A. Yariv, Holt, Rinehart and Winston.