Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NPHD506	LASER PHYSICS AND TECHNOLOGY	3	0	0	3

Prerequisite: Optics, Electrodynamics, Spectroscopy.

Course Objective

Laser, the light extraordinary, has so many applications in various field even having further potential and hence it has urgent need to familiarize lasers & their technical advances to the students so that students be ready to apply coherent light to solve various problems in areas such as scientific, industrial, healthcare etc.

Learning Outcomes

Through this course student will learn following:

- Fundamental principles of stimulated emission and how to convert it into coherent light emission.
- The manipulation of light i. e. mode selection, continuous and pulsed generation, spectral narrowing etc.
- Applications of various lasers in various fields including scientific research to common use.

Unit No.	Topics	Lecture Hours	Learning Outcome
1	Overview: Gaussian beam, Monochromaticity, Directionality, Coherence; Atomic energy levels.	5	In this section students will learn about fundamental properties of laser light.
2	Energy distributions and laser design: Einstein's quantum theory of radiation; Boltzmann distribution, Population inversion, Rate equations, Stability conditions, Three level and four level lasers; Issues in designing a laser; Pumping mechanisms; Stable and unstable resonators, Laser Cavity, Longitudinal and Transverse Modes, Mode Selection, Gain in a Regenerative Laser Cavity; Q-switching, Mode locking, Laser amplification, Frequency conversion, Pulse expansion, Pulse shortening – Pico-second and Femto-second operations, Spectral narrowing and Stabilization.	15	In this section students will learn basic principles of lasers, requirements for production of laser beams, pumping mechanism, modes and mode selection technique etc. Students will also learn laser pulse generation techniques.
3	Laser systems: Basics of tunable, ultrafast and power lasers; Gas lasers: He-Ne, He-Cd, Ar, Kr ion, CO2, Excimer lasers; Solid state lasers: Diode pumped solid state lasers, Lamp pumping and thermal issues; Ruby, Nd-YAG, Fibre lasers; Semiconductor lasers: Laser materials, Laser structure, Frequency control of laser output, Modern diode laser, Quantum cascade lasers, p-Ge lasers, Vertical-cavity surface-emitting laser.	14	In this section students will learn working of various important laser systems including semiconductor lasers
4	Applications of laser: Laser cooling; Laser barcode scanner, Laser trimming, Cutting, Welding, Drilling and Tracking, Pattern formation by laser etching; LIDAR; Laser-tissue interaction, Laser surgery; Holography, Interferometry, Microscopy.	8	In this section students will learn applications of lasers in various important fields
	Total	**42**	

Text Books:

1. Laser Fundamentals, William T. Silfvast, Cambridge University Press, 2008.
2. Principles of Lasers, Orazio Svelto; Springer, 2009.
3. Lasers – Theory and Applications, K. Thyagarajan and A. K. Ghatak; Macmillan India, Delhi, 1981.

Reference Books:

1. Laser Physics, Simon Hooker and Colin Webb; Oxford, 2010.
2. Lasers, A. E. Siegman; University Science Books, 1986.
3. Laser Application in Surface Science and Technology, H. G. Rubahn; John Wiley and Sons, 1999.
4. Laser Physics, P. W. Milonni, J. W. Eberly; John Wiley and Sons, 2010.
5. Laser Cutting: Guide for manufacturing, C. L. Caristan; Society of Manufacturing Engineers, 2004.
6. Optical Electronics, Ghatakand Thyagarajan, Cambridge.
7. Essentials of Optoelectronics, A. Rogers, Chapman Hall.
8. Lasers and Non-Linear Optics, B. B. Laud; New Age International, New Delhi, 1991.
9. Laser Spectroscopy: Basic Concepts and Instrumentation, Demtroder; Springer, 2004.