SC513T					Laser Physics and Spectroscopy					
Teaching Scheme					Examination Scheme					
L	T	P	C	Hrs/Week	Theory			Practical		Total Marks
					MS	ES	IA	LW	LE/Viva	
3	0	0	3	3	25	50	25	--	--	100

COURSE OBJECTIVES

- To understand the fundamental concepts of Laser principles.
- To provide the knowledge of Laser beam properties and methods of Laser pulse generation
- To provide knowledge of various Laser spectroscopic techniques
- To introduce some advanced Laser spectroscopic techniques

UNIT 1 Introduction to Lasers **10 Hrs.**

History of Laser; Classical absorption of light; Quantum absorption of light; Interaction of Light with matter: Absorption and Emission processes; Light Source; Properties of Laser, Einstein Coefficients and Light Amplification; Population Inversion; Pumping; Gain.

UNIT 2 Laser Fundamentals **12 Hrs.**

Laser rate equations; Three & four level Lasers; Laser beam propagation; Properties of Gaussian beam; Resonator; Various types of resonators; Resonator for high gain and high energy Lasers; Gaussian beam focusing; General lasers and their types: CW and pulsed Lasers; Laser pulse generation: Q-switching and mode locking; ultra-short (nanosecond, picosecond and femtosecond) laser pulse generation.

UNIT 3 Introduction to Laser Spectroscopic techniques **10 Hrs.**

Laser systems for spectroscopy; Instrumentation for detection of optical signals and time-resolved measurements; Pump and probe techniques; Absorption and fluorescence spectroscopy; Raman spectroscopy: basics and instrumentation.

UNIT 4 Applications of Lasers in spectroscopy **12 Hrs.**

Laser-induced breakdown spectroscopy; Nonlinear spectroscopy: linear and nonlinear absorption; Terahertz spectroscopy; Special applications of laser spectroscopy: Single molecule detection, trace level detection of explosives and hazardous gases; Future of laser spectroscopy.

Max. <44> Hrs.

COURSE OUTCOMES

On completion of the course, student will be able to

CO1 - Acquire basic knowledge about the fundamental processes associated with lasers and spectroscopy

CO2 - Analyze the properties of the Laser beam and solve related problems

CO3 - Comprehend the significance of Lasers in spectroscopy

CO4 - Understand and learn the principles involved in various laser and spectroscopic systems

CO5 - Correlate the laser properties with the spectroscopic techniques

CO6 - Develop the skills needed to solve various problems in applications related to laser and spectroscopy

TEXT/REFERENCE BOOKS

1. O Svelto, Principles of lasers, 5th edition, Springer (2010).
2. W. T. Silfvast, Laser Fundamentals, 2nd Edition, Cambridge University Press (2004).
3. K. Thyagrajan and Ajoy Ghatak, LASER fundamentals and its applications, 2nd edition, Springer (2010).
4. Andrews and Demidov, An introduction to Laser Spectroscopy, 2nd edition, Springer (2002).
5. Demtroder W, Laser Spectroscopy: Basic Concepts and Instrumentation, 3rd edition, Springer (2004)
6. Radziemski L J, Solarz R W, Paisner J A, Laser Spectroscopy and its Applications, Marcel Dekker (1987)
7. M. S. Feld and V. S. Lethokov, Nonlinear laser Spectroscopy, Springer (1980).
8. Stenholm, Foundations of laser spectroscopy, Wiley (1999).

END SEMESTER EXAMINATION QUESTION PAPER PATTERN

Max. Marks: 100	**Exam Duration: 3 Hrs**
Part A/Question: 3 Questions from each unit, each carrying 3 marks	36 Marks
Part B/Question: 2 Questions from each unit, each carrying 8 marks	64 Marks