CHEMISTRY AND BIOCHEMISTRY

LASER: FUNDAMENTALS AND APPLICATIONS

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TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 8 weeks (28 Jan'19 - 22 Mar'19)
INTENDED AUDIENCE : Senior UG and PG students
EXAM DATE : 31 Mar 2019
PRE-REQUISITES : Basic knowledge of quantum mechanics and optics would be helpful

COURSE OUTLINE :

A Laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. Because of its extremely high degree of monochromaticity, coherence, directionality, polarization, and power, etc., laser radiation or light has been widely used in high resolution spectroscopy and imaging, chemistry, optical communications, biomedicine, defense industries, etc. This course is intended for students who need to understand the basic principles of how lasers work and their main properties. This course provides the students a thorough understanding of the fundamentals of lasers: their unique properties, their operations and their applications. It will equip the students with the knowledge of how a coherent light is generated and amplified, the techniques behind different lasers' design, and applications of lasers in spectroscopy, chemistry, medicine, biology, military and other areas.

ABOUT INSTRUCTOR :

Dr. Manabendra Chandra is an Assistant Professor in the Department of Chemistry at IIT Kanpur. His area of specialization is experimental physical chemistry.

COURSE PLAN :

Week 01 : Introduction; Importance: why laser?, unique properties of lasers; Brief history of laser development ; Laser basics

Week 02 : Concept of stimulated emission; Einstein's coefficients; Population inversion; Amplification of stimulated emission; Laser instrumentation fundamentals: Cavity, resonator and pumping processes; Gain medium

Week 03 : Coherent radiation, standing waves and modes; The kinetics of laser emission; Rate equations; Threshold conditions; Pulsed and continuous wave laser emission; Various pulsing techniques: cavity dumping, Q-switching and mode-locking

Week 04 : Transitions, lifetimes and linewidths: Three level laser, Four-level laser, emission linewidth; Properties of laser light: monochromaticity, spatial and temporal coherence, intensity, beam-width Similarity transforms.

Week 05 : Laser sources; different types of lasers; Laser instrumentation details

Week 06 -08 : Applications of lasers in spectroscopy, chemistry, biology, medical sciences and other fields