Optical Spectroscopy and Microscopy

A Graduate course in Chemical Sciences, Tata Institute of Fundamental Research
Spring 2023

Teacher: Sudipta Maiti (maiti@tifr.res.in)

Schedule

Monday, Wednesday, Friday 10:00 AM in AG 80

First Lecture: Monday, January 23, 2023, Final Exam: Monday, May 22, 2023

Syllabus

PART I: INTRODUCTION

A) Molecular Spectroscopy: What it can tell us, its limitations, basic introduction to various forms of optical spectroscopy

B) Microscopy: What it can tell us, its limitations, basic introduction to Optics and Imaging

PART II: OPTICS, LASERS AND MICROSCOPY

A) Lasers and amplifiers, non-linear optics
B) Ultrafast spectroscopy
C) Properties of light, Maxwell's equations, fiber optics
D) Diffraction theory
E) Microscopy: Theory of Image formation, Confocal and multiphoton microscopy
F) Super-resolution microscopy
G) Single molecule microscopy

PART III: OPTICAL SPECTROSCOPY

A) Light matter interactions: perturbation theory
B) Two level systems: Density matrix formalism, Concepts of weak/strong perturbation, dephasing and Coherence.
C) Molecular spectroscopy: Born Oppenheimer approximation, motion on potential energy surfaces, non-radiative decay
D) Brief introduction to UV/VIS, Vibrational, Raman and Circular Dichroism spectroscopy
E) Fluorescence spectroscopy
F) Fluorescence lifetime, TCSPC technique, Quenching, , FRET, Anisotropy
G) Fluorescence correlation spectroscopy