האוניברסיטה העברית בירושלים
THE HEBREW UNIVERSITY OF JERUSALEM

Syllabus

Light Spectroscopy and its Application in Bilolgy - 93900

Last update 08-01-2019

HU Credits: *2*

Responsible Department: *Structural & Molecular Biochemistry*

Academic year: *0*

Semester: *2nd Semester*

Teaching Languages: *Hebrew*

Campus: *E. Safra*

Course/Module Coordinator: *Dr. Eitan Lerner*

Coordinator Email: *eitan.lerner@mail.huji.ac.il*

Coordinator Office Hours: *Sundays at 10:00-12:00*

Teaching Staff:
Dr. Eitan Lerner

Course/Module description:

Learning & understanding different spectroscopic techniques and their uses in biological measurements from proteins to tissue

<u>Course/Module aims:</u>

* To instill basic understanding of spectroscopy, that will enable any student to understand how he can use light (on its various types) to study many biological processes*
* To instill intellectual tools regarding spectroscopic techniques and regarding the ability to develop them and to fit them to their research needs*

<u>Learning outcomes - On successful completion of this module, students should be able to:</u>

* To understand the working principles of different spectroscopic measurements*
* To understand how to read & interpret data acquired from spectroscopic measurements*
* To understand what has already been achieved and what is expected to be the next pioneering achievement (regarding all subjects currently limited only by technology)*

<u>Attendance requirements(%):</u>

100

Teaching arrangement and method of instruction: Lectures + Seminars

<u>Course/Module Content:</u>

* Lecture 1 (2 hours). Introductory to the interaction of electromagnetic radiation with matter. Classical description a dipole and an oscillating electric field, resonance*
* Lecture 2 (2 hours). 1st hour: Elastic light scattering, small angle X-ray scattering (SAXS), dynamic light scattering (DLS). 2nd hour: introductory to electronic spectroscopy.*
* Lecture 3 (2 hours). Quantum description of light, matter & ther interaction. Plancks law, the photo-electric effect, electrons & photons are both waves & particles. Matter has discrete energetic levels, Heisenbergs uncertainty principle, atomic & molecular orbitals. Different energetic levels and the spectral ranges of light that interacts with them: electronic, vibrational, rotational levels & levels of electronic & nuclear spin.*
* Lecture 4 (2 hours). Electronic spectroscopy the processes the electron experiences excitation, spontaneous emission & stimulated emission, radiative &*

non-radiative processes, Fluorescence.
* *Lecture 5 (two hours). Different characteristics of fluorescence & their uses: wavelengths, lifetimes, yields & intensities. Stokes shift. Polarization of fluorescence. F¶rster resonance energy transfer (FRET).*
* *Lecture 6 (two hours). Vibrational spectroscopy and its uses. FTIR, Raman scattering.*
* *Lecture 7 (two hours). Nuclear magnetic resonance, Zeeman levels and their split with magnetic fields. Introductory to NMR, the chemical shift, spectral couplings, dynamic effects. Solving chemical structure using NMR.*
* *Lectures 8-14 (each is 2 hours). Each hour, a student will present a seminar he/she prepared based on research article he/she chose (so that in each meeting, 2 students will give a seminar; if the attendance will be low, one hour will be dedicated to the seminar and the other to thorough discussion). The papers will be chosen according to search keywords, according to one of the spectroscopies we studied and according to the innovation of the application of that specific spectroscopy. The seminar's aim is to bring the students to an independent level of understanding how to analyze papers reporting on advanced applications of spectroscopy. The students will be given a long list of up-to-date "hot" subject to choose relevant papers from. Additionally, only papers from Tier 2 journals, or better, should be chosen.*

Required Reading:

* *Review papers that will be given from time to time*
* *Articles, on which the seminarion will be based*

Additional Reading Material:

* *Modern Optical Spectroscopies (with exercises and examples from biophysics and biochemistry) – William W. Parson*
* *Principles of Fluorescence Spectroscopy – Joseph R. Lakowicz*
* *Molecular Fluorescence – Bernard Valeur*
* *Principles of NMR spectroscopy*

Course/Module evaluation:
End of year written/oral examination 0 %
Presentation 50 %
Participation in Tutorials 50 %
Project work 0 %
Assignments 0 %
Reports 0 %
Research project 0 %
Quizzes 0 %

Other 0 %

Additional information: