LIFS 3070 Introduction to Biophysical Instrumentation

Course Outline - Spring 2022/23

Instructors

Prof. ZHU, Guang (LIFS)

Prof. PARK, HyoKeun (LIFS & PHYS)

Prof. Huang Pinbo (LIFS)

Prof. DANG, Shangyu (LIFS)

Schedule

Tue: 10:30-11:50am, Thu: 10:30-11:50am

Venue

Rm:1409 (Lift:25/26)

Course description

LIFS3070 offers an introduction to principles and applications of a variety of modern biophysical experimental techniques for the structural and functional study of biological systems at the cellular and molecular levels. It is designed for students who seek a basic understanding of modern biophysical experimental methods to meet future challenges in biological science, synthetic biology, bio-technology, bioengineering and molecular medicine.

Topics include Light absorption, Fluorescence light spectroscopy, Circular dichroism (CD), Isothermal titration calorimetry (ITC), Surface plasmon resonance (SPR), Fluorescence resonance energy transfer (FRET), Multiphoton Microscopy, Total internal reflection microscopy (TIRF), Single Molecule Imaging, Analytical ultracentrifugation, Scintillation counters, X-ray crystallography, Cryo-EM, Atomic force microscopy, Biomolecular NMR spectroscopy, MRI, Mass spectrometry, Patch-clamp, Capacitance measurements, Amperometry, Flow cytometry and Optical tweezers.

Because its interdisciplinary nature and students will have diverse backgrounds, the course is designed to focus on qualitative understanding of principles and biological applications of modern biophysical techniques with minimal requirement of mathematics and physics. Some knowledge of physical chemistry, molecular and cell biology will be helpful.

Grading

Midterm Exam: 30%

Final Exam: 40%

Final project: 30%

Course Intended Learning Outcomes

On successful completion of this course, students are expected to be able to:

1. Understand the basic concepts of quantitative instrumentation.

2. Recognize how quantitative instrumentation can be built and contribute to modern complex equipment.

3. Evaluate and analyze the system of quantitative instrumentation related to biotechnology.

4. Communicate and explain issues and importance of quantitative instrumentation to general public.

5. Obtain a global perspective to analyze issues related to quantitative instrumentation and biotechnology.

Week	Date	Lecture Title	Lecturer
1	7 Feb	Course Outline and General Principles	G Zhu
	9 Feb	Centrifugation and its biological application	G Zhu
2	14 Feb	Radioisotopes and their application in biological science	G Zhu
	16 Feb	FRET/CD and their applications	G Zhu
3	21 Feb	SPR/ ITC/DSC and their applications	G Zhu
	23 Feb	SPR/ ITC/DSC and their applications	G Zhu
4	28 Feb	Flow cytometry/Mass spectrometry and their applications	G Zhu
	2 Mar	Lab visit	G Zhu
5	7 Mar	Basic principle of NMR spectroscopy	G Zhu
	9 Mar	Biomolecular NMR	G Zhu
6	14 Mar	Biomolecular NMR	G Zhu
	16 Mar	NMR Lab visit	G Zhu
7	21 Mar	Mid-term exam	
	23 Mar	Structure-function of Biomolecules	S Dang
8	28 Mar	Introduction to x-ray crystallography	S Dang
9	30 Mar	Introduction to single particle cryo-EM	S Dang
	4 Apr	EM-Lab visit	S Dang
	13 Apr	Optical microscopy	H Park
10	18 Apr	smFRET and its application	H Park
	20 Apr	Super-resolution microscopy (SRM), Optical and magnetic tweezers	H Park
11	25 Apr	Lab visit	H Park
	27 Apr	Ion channel biological physics	P Huang
12	2 May	Ion channel biological instrumentation	P Huang
	4 May	Ion channel biological instrumentation	P Huang
13	9 May	Lab visit	P Huang