

Division of Life Science
The Hong Kong University of Science & Technology
LIFS 4540 Structure and Function of Proteins
(2022/2023 Spring Semester)

Date/Time: 1:30 pm -2:50 pm (Tuesday and Thursday)

Venue: Lecture Theatre H

Instructors: Prof. Shangyu Dang, (Tel: 2358 5944, Email: sdang@ust.hk, Room 5507)

Course website: CELT (<https://canvas.ust.hk>) for lecture slides and course materials.

Textbook/Reference: T.E. Creighton “*Protein: Structure and Molecular Properties*” 2nd Ed.
W.H. Freeman and Company; plus reading materials in handouts

Course Objectives (Intended Learning Outcome):

After completion of the course, students are expected to be able to

1. Comprehend the knowledge, theories and principles of protein structure, functions, regulation and biological processes.
2. Describe the most up-to-date methods (including X-ray crystallography and cryo-EM) utilized to characterize protein structures at atomic resolution.
3. Describe the history and scientific thinking behind the discoveries of biological principles and theories.
4. Utilize the strategies, ideas and methodologies used in current biological research.
5. Self-study biological topics related to proteins
6. Appreciate biological sciences and research

Course Contents:

- I. Chemical and physical characterization of proteins
- II. Secondary and tertiary structures of proteins
- III. Chemical modification of proteins
- IV. Post-translational modification of proteins
- V. Protein purification
- VI. Protein structure prediction
- VII. Protein structural determination (X-ray crystallography and cryo-EM)
- VIII. Tools to analyze protein sequence and structures
- IX. Structural and function of membrane proteins
- X. Protein and diseases

Exams and Grading:

Mid-term examination (30%), Final Examination (30%), Homework or Presentation (40%)

Grading A⁺ to F

Course Topics and Schedule:

I. Chemical and physical characterization of proteins

Properties of amino acids, peptides, and proteins (Textbook Chapter 1)

II. Secondary and tertiary structures of proteins

Protein folding patterns (Textbook Chapter 5, 6.4)

Protein modules

How to keep a protein folded properly (Textbook Chapter 4)

III. Chemical modification of proteins

Methods and applications

IV. Post-translational modification of proteins

Structural and functional effects (Textbook Section 2.4)

Methods for detection of protein PTM

V. Protein purification

Methods for protein expression and purification

Methods for characterization of protein

Methods for evaluation of protein behavior

VI. Protein structure prediction

Secondary protein structure prediction

Tertiary Protein structure prediction

VII. Protein structural determination (X-ray crystallography and cryo-EM)

X-ray crystallography (Textbook Chapter 10.1, 10.3)

Resolution revolution of cryo-EM (Textbook Chapter 10.5)

VIII. Tools to analyze protein sequence and structures

Protein sequence analysis (Textbook Chapter 6.3)

Protein structural visualization and analysis (Textbook Chapter 6.6)

IX. Structural and function of membrane proteins

Physiological functions of membrane proteins (Textbook Chapter 5)

Structural and mechanistic studies of membrane proteins

X. Protein and diseases

Relationship of protein and diseases (Textbook Chapter 12)

Structural based drug development