

**Division of Life Science**  
**The Hong Kong University of Science & Technology**  
**LIFS 4540 Structure and Function of Proteins**  
(2016/2017 Spring Semester)

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**Date/Time:** Tuesdays and Thursdays. 16:30-17:50

**Venue:** Room 2504

**Instructors:** Prof. Chun LIANG (**Course Coordinator**), 2358-7296, Rm 5524; [bccliang@ust.hk](mailto:bccliang@ust.hk)  
Prof. Mingjie ZHANG, 2358-8709, Rm 5532; [mzhang@ust.hk](mailto:mzhang@ust.hk)

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

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**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 history and scientific thinking behind the discoveries of biological principles and theories.
3. Utilize the strategies, ideas and methodologies used in current biological research.
4. Self-study biological topics related to proteins
5. Appreciate biological sciences and research

**Course Contents:**

First half (Prof. C. Liang)

Biogenesis of proteins and protein engineering

Approaches for studying protein functions, interactions and regulation in budding yeast

Literature search and protein and DNA sequence analysis

Activities and regulation of protein enzymes

Biochemical methods for studying protein-protein and protein-DNA interactions

Proteolysis and cellular regulation

Second half (Prof. M. Zhang)

Chemical and physical characterization of proteins

Chemical modification of proteins

Post-translational modification of proteins

Forces that determine protein structures

Secondary and tertiary structures of proteins

**Course Topics and Schedule:**

**Second Half (Prof. C. Liang)** 02 Feb.- 14 Mar. (12 lectures to cover 19 topics in 6 areas)

**I. Biogenesis of Proteins and Protein Engineering**

1. General Introduction, Gene Structure and DNA Replication (Textbook section 2.1)

2. Transcription, Splicing and Translation (Textbook section 2.1)
3. Protein Engineering: Cloning, Expression and Mutagenesis of Genes (Textbook section 2.3)

## **II. Approaches to Study Protein Functions and Regulation in Budding Yeast**

4. Introduction to Budding Yeast
5. Gene Disruption and Tetrad Analysis
6. Random Mutagenesis and Making Yeast Mutants
7. Characterization of Proteins in the Cell Cycle
8. DNA and Chromatin Association of Proteins
9. Identification and Characterization of Interacting Proteins by Using Interaction Screens
10. Phenotypic Screens: Finding Genes Involved in Particular Cellular Functions or Pathways
11. Using Budding Yeast to Study Proteins of Other Eukaryotes and Two-hybrid System to Study Protein-Protein Interactions

## **III. Literature Search and Protein and DNA Sequence Analysis**

12. Web-based Literature Search, Sequence Retrieval and Sequence Analysis

## **IV. Activities and Regulation of Protein Enzymes**

13. Functions and Regulation of Enzymes (Textbook section 9.4)
14. Regulation of the Activities of Enzymes and Other Proteins by Phosphorylation and Dephosphorylation

## **V. Protein-Protein and Protein-DNA Interactions**

15. Biochemical Methods to Study Protein-Protein Interactions
16. Biochemical Methods to Study Protein-DNA Interactions
17. Case study: Protein-Protein and Protein-DNA Interactions in the Initiation of DNA Replication in Budding Yeast

## **VI. Protein-Protein and Protein-DNA Interactions**

18. Mechanism of Protein Degradation and Proteolysis Pathways (Textbook sections 10.2-10.3)
19. Case study: Proteolysis in Cell Cycle Control

## **Midterm Exam on 16 March 2017, or to be arranged**

(Covers the lectures by Prof. C. Liang; counts as 50% of the course together with homework)

**Second Half (Prof. M. Zhang)**      21 Mar.– 09 May (12 lectures to cover 7 topics in 5 areas)

## **I. Chemical and physical characterization of proteins**

- Properties of amino acids, peptides, and proteins (Textbook Chapter 1)
- Working with proteins----- purification and characterization of proteins

## **II. Chemical modification of proteins**

Methods and applications

## **III. Post-translational modification of proteins**

Structural and functional effects (Textbook Section 2.4)

## **IV. Forces that determine protein structures**

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

## **V. Secondary and tertiary structures of proteins**

Protein folding patterns (Textbook Chapter 5, 6.4)

Protein modules

**Final Exam:** covers the lectures by Prof. C. Liang; counts as 50% of the course]