

BSE/ChE 4544 Prot. Sep. Eng.  
BSE/ChE 5444 Adv. Protein Sep. Eng.  
Course syllabus and outline  
Fall 2016

**Instructor:** Mike Zhang, 210 Seitz Hall, 231-7601, [cmzhang@vt.edu](mailto:cmzhang@vt.edu)

**Teaching Assistant:** Yi Lu

**Location:** Seitz 313, Tue, Thu, 9:30 – 10:45 a.m.

**Office Hours:**

M. Zhang: Tuesday and Thursday, 10:45-12:15 pm, or by email or appointment.

Yi Lu: TBD.

**Text:** Roger G. Harrison, Paul Todd, Scott R. Rudge, and Demetri P. Petrides.  
Bioseparations science and engineering. Oxford University Press. ISBN: 0-19-512340-9.

During the semester, handouts of journal articles and online materials may also be used.

**Description**

Concepts, principles and applications of various unit operations used in protein separations. Properties of biological materials, such as cells and proteins, and their influences on process design. Design of processes for protein purification based on the impurities to be eliminated. Concepts and principles of scale-up of unit operations. Case studies in practical protein recovery and purification issues, with a focus on enhanced protein purification by genetic engineering.

**Prerequisites:** BSE 3504 Transport Processes in Biological Systems, or CHE 3144 Mass Transfer

**Learning Objectives**

Upon successful completion of this course, students shall be able to:

1. Discuss strengths and weaknesses of different techniques for a selected unit operation for protein recovery and purification;
2. Identify the unusual physicochemical properties of a product;
3. Describe basic concepts and issues in bioseparation unit operations: removal of insolubles, isolation, product purification, and polishing;
4. Describe how each unit operation can improve the product quality;
5. Identify where the product and impurities are present in each process stream;
6. Identify the key parameters and dimensionless groups of process scale-up;
7. Evaluate the economic feasibility of a purification process for proteins and other biological materials;
8. Write scientific reports (only for graduate students).

**Syllabus:**

	<u>Percent of Course</u>
Introduction to biological materials, molecular biology, protein biochemistry, and expression systems	20%
Cell lysis and flocculation	15%
Filtration and membrane separation	15%
Sedimentation and centrifuge	20%
Adsorption and liquid chromatography	25%
Case study	<u>5%</u>
	100%

**Tentative course outline: (the scheduled topics are subject to change)**

<u>Meeting</u>	<u>Topic</u>	<u>Readings</u>
1. Aug. 23	Introduction to course	
2. Aug. 25	Introduction to molecular biology	
3. Aug. 30	Intro. to protein biochemistry (I)	
4. Sept. 1	Intro. to protein biochemistry (II)	
5. Sept. 6	Expression systems	
6. Sept. 8	Nature of Bioseparation	
7. Sept. 13	Cell disruption (I)	Chapter 3
8. Sept. 15	Cell disruption (II)	
9. Sept. 20	Filtration (I)	Chapter 4
10. Sept. 22	Filtration (II)	
11. Sept. 27	Membrane separation	Supplementary
12. Sept. 29	Membrane separation	
13. Oct. 4	Exam I	
14. Oct. 6	Sedimentation and Centrifugation (I)	Chapter 5
15. Oct. 11	Sedimentation and Centrifugation (II)	
16. Oct. 13	Sedimentation and Centrifugation (III)	
17. Oct. 18	Adsorption (I)	Chapter 7
18. Oct. 20	Adsorption (II)	
19. Oct. 25	Adsorption (III)	
20. Oct. 27	Adsorption (IV)	
21. Nov. 1	Adsorption (V)	
22. Nov. 3	Exam II	
23. Nov. 8	Chromatography (I)	Chapter 7
24. Nov. 10	Chromatography (II)	
25. Nov. 15	Chromatography (III)	
26. Nov. 17	Chromatography (IV)	
27. Nov. 22	Thanksgiving week	
28. Nov. 24	Thanksgiving week	
29. Nov. 29	Chromatography (V)	

30. Dec. 1	Case studies
31. Dec. 6	Case studies
32. Dec. 8	Reading day (no class)
Dec. 15	Final Exam 10:05am -12:05pm, Seitz 313

In addition to regular lectures, there will be a couple of sessions of recitation to go over assigned homework problems (after grading) by Mr. Lu. Attendance is optional but highly recommended. Time is to be determined.

**Grading:**

	BSE/ChE 4544	BSE/ChE 5544
Homework (5-7)	20%	20%
First exam	25%	20%
Second exam	25%	20%
Final exam	30%	30%
Writing assignment	-	10%

All of your turned in works will be graded. The final course grade will be decided based on the above scheme. I may curve the grades or exam scores if necessary.

**Homework:** Discussion is allowed, but individual has to complete the assignments independently. Copying homework will be considered as plagiarism, which will lead to an automatic fail for this course (see Honor Code). No late homework will be accepted unless delay has been granted ahead of time.

**Exams:** Exams will be cumulative.

**Honor Code:** The Honor Code will be STRICTLY enforced in this course.

The Undergraduate Honor Code pledge that each member of the university community agrees to abide by states:

“As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do.”

Students enrolled in this course are responsible for abiding by the Honor Code. A student who has doubts about how the Honor Code applies to any assignment is responsible for obtaining specific guidance from the course instructor before submitting the assignment for evaluation. Ignorance of the rules does not exclude any member of the University community from the requirements and expectations of the Honor Code. For additional information about the Honor Code, please visit: <https://www.honorsystem.vt.edu/>

All assignments submitted shall be considered "graded work". All aspects of your coursework are covered by the honor system. All projects and homework assignments are to be completed individually unless otherwise specified.

**Students with disabilities:** If you need adaptations or accommodations because of a disability (learning disability, attention deficit disorder psychological, physical, etc.); if you have emergency medical information to share with me; or if you need special arrangements in case the building must be evacuated please make an appointment with me as soon as possible.

**Attendance policy:** Attendance to the classes is enforced. Late or no show to the classes will be penalized with deduction to the final cumulative grade. Email me if you will be late or absent due to emergency.