

**BSE 3524 Unit Operations in BSE**

CRN: 11483 11484 11485

Spring 2016 (01/19/15 - 05/11/15)

**Instructor:** Prof. Y-H Percival Zhang  
Office: 304 Seitz Hall  
Email: [ypzhang@vt.edu](mailto:ypzhang@vt.edu) phone: 231-7414 (Seitz)

**Lecture time:** Mon, Wed, 12:20–1:10 PM; (Fri, 12:20-1:10 PM 4 times)

**Lecture place:** Seitz 313

**Office hours:** Mon (1:30-3:00 PM), Wed (9:00-10:30 AM), 304 Seitz  
(Other time may be available, please make an appointment. Office 301A HABB I)

**Lab time:** Mon, Wed, Thur, 2:30 PM – 5:15 PM (check the lab manual)

**Lab place:** Agnew 100

**Lab manager:** Cora Chen, [ychen12@vt.edu](mailto:ychen12@vt.edu)

**Lab TAs:** Chaochen Wu, [wucc925@vt.edu](mailto:wucc925@vt.edu)  
Bill Carswell, [cypher@vt.edu](mailto:cypher@vt.edu)  
Daniel Wolozny, [dwoozn1@vt.edu](mailto:dwoozn1@vt.edu)  
Sravanthi Budaraju, [budaraju@vt.edu](mailto:budaraju@vt.edu)

**Lab safety instructor -- TBD**

**Textbook:** **Transport Processes and Unit Operations**, Christie J. Geankoplis, Prentice Hall, Inc., 4<sup>rd</sup> edition, ISBN: 0-13-101367-X.

**Reference:** Unit Operations of Chemical Engineering, Warren McCabe, et al. McGraw-Hill's. 7<sup>th</sup> edition, ISBN: 0-07-284823-5.

**Course description.** Description of unit operations for processing biological materials, including evaporation, heat exchange, drying, various membrane separations, fermentation, and mixing. Laboratory hands-on experience in various unit operations.

**Learning objectives**

1. Apply the knowledge gained from thermodynamics and transport phenomena to design various unit operations technologies in processing biological materials,
2. Design evaporation equipment in processing biological materials,
3. Design drying equipment used in processing biological materials,
4. Design and operate heat exchangers in processing biological materials,
5. Design various gas-liquid, vapor-liquid, liquid-liquid, and solid-liquid separation technologies in processing biological materials,
6. Operate various equipment commonly found in the bioprocessing industries, and
7. Obtain basic biotechnology lab skills.

**Co-requisites:** BSE 3504 Transport Processes in Biological Systems

**Grading:**

Lab report	16% (7 reports)
Homework	30%
Exam 1	17%
Exam 2	17%
Final exam	17%
Class participation	3%
<b>Total</b>	<b>100%</b>

**Final scores**

	A: 93-100	A-: 90-93 below
B+: 87-90 below	B: 83-87 below	B-: 80-83 below
C+: 77-80 below	C: 73-77 below	C-: 70-73 below
D+: 67-70 below	D: 63-67 below	D-: 60-63 below
F: 60 below		

**Lab session:** All labs will be conducted in five groups per session (three sessions per week; M, W or R). Due to the number of students enrolled, you may find yourself in a 3- or 4-member group. The groups will be pre-determined based on the name order by the instructor. Make sure that you actively participate in all related activities. Although one group will work together to finish the lab work, each group member will submit one group lab report. So, please read the lab manual in advance and carefully. All lab reports are submitted to your TAs the same day of Next WEEK when the experiment is completed. No late reports will be accepted. Lab report should be written based on Lab Report Template (available at Scholar website). Because the set-up of the course, you may not have learned the theory of a particular lab when you are doing it. (**Note:** Each group member will receive 80% credits based on the group report; another 20% credit will be given based on your team members' evaluation on your contribution to lab activities and final lab report.)

**Lab schedule:** Available based on the lab manual (see scholar website).

**Course Policies**

**Scholar:** The course syllabus, lectures, schedule, and other relevant materials will be placed on the Scholar website developed for this course. Students unable to access this website should contact the instructor immediately. <https://scholar.vt.edu/portal>

**Homework:** Assignments will be given in classroom and then will be posted on Scholar. Students are encouraged to work in teams and consult with classmates regarding homework problems. However, each student must submit his or her own homework assignments. Any assignment submitted with two or more names will not be graded. Even though teamwork is encouraged, all submitted homework assignments must be the student's own work. In other words, no two homework assignments should be identical. Homework is expected to be submitted on at the beginning of class on Wed in classroom. The solution will be posted in Scholar website after homework is submitted. **Late Assignments:** Homework assignments received one day after the due day will receive at 50% penalty. Homework assignments received two days after the due date will not be graded.

**Class Attendance:** It is strongly recommended that students attend all class periods and participate in class discussions. This will be reflected in the student's grade through better

performance on homework assignments and exams. Spontaneous class discussions may not appear in the pre-prepared lecture notes posted on the Scholar website; however, this material may appear in a homework or exam question. Class participation accounts for 3 credits; attending Friday's lecture will help get this credit.

**Disability Statement:** Reasonable accommodations are available for students who have a disability. Students should contact the Services for Students with Disabilities (SSD), 150 Henderson Hall, 231-3788 (V), 231-1740 (TTY); Susan P. Angle, [spangle@vt.edu](mailto:spangle@vt.edu), [www.ssd.vt.edu](http://www.ssd.vt.edu). "Students with disabilities are responsible for self-identification....To be eligible for services, documentation of the disability from a qualified professional must be presented to SSD upon request. Academic adjustments may include, but are not limited to: priority registration, auxiliary aids, program and course adjustment, exam modifications, oral or sign language interpreters, cassette taping of text/materials, notetakers/readers, or assistive technology."

**Honor Code Statement:** The Honor Code will be strictly enforced in this course. All assignments submitted shall be considered graded work, unless otherwise noted. All aspects of your coursework are covered by the Honor System. Any suspected violations of the Honor Code will be promptly reported to the Honor System (see <http://www.honorsystem.vt.edu/>). The following is the Honor Code written verbatim from the VT Honor System Constitution:

The Honor Code is the University policy that expressly forbids the following academic violations:

1. Cheating -- Cheating includes the actual giving or receiving of any unauthorized aid or assistance or the actual giving or receiving of any unfair advantage on any form of academic work, or attempts thereof.
2. Plagiarism -- Plagiarism includes the copying of the language, structure, ideas and/or thoughts of another and passing off same as one's own, original work, or attempts thereof.
3. Falsification -- Falsification includes the statement of any untruth, either verbally or in writing, with respect to any circumstances relevant to one's academic work, or attempts thereof. Such acts include, but are not limited to, the forgery of official signatures, tampering with official records, fraudulently adding or deleting information on academic documents such as add/drop requests, or fraudulently changing an examination or other academic work after the testing period or due date of the assignment.

While group work on homework assignments is encouraged to facilitate cooperative learning, each student is expected to complete each assignment him/herself and to turn in his/her own work. Copying of another student's work (currently or previously enrolled students) is not allowed. Utilizing the same computer or the same calculator to complete the assignment is not allowed unless each student completes the calculations individually. Copying (either direct cut and paste or slight rewording) of written material, such as from the internet or another student's work, is strictly forbidden. All exams should be solely and completely the work of the individual student. **Violations of the Honor Code will be turned over to the Honor Court.**

**Virginia Tech's Principles of Community:** Virginia Tech is a public land-grant university, committed to teaching and learning, research, and outreach to the Commonwealth of Virginia, the nation, and the world community. Learning from the experiences that shape Virginia Tech as an institution, we acknowledge those aspects of our legacy that reflected bias and exclusion. Therefore, we adopt and practice the following principles as fundamental to our on-going efforts to increase access and inclusion and to create a community that nurtures learning and growth for all of its members:

- We affirm the inherent dignity and value of every person and strive to maintain a climate for work and learning based on mutual respect and understanding.
- We affirm the right of each person to express thoughts and opinions freely. We encourage open expression within a climate of civility, sensitivity, and mutual respect.
- We affirm the value of human diversity because it enriches our lives and the University. We acknowledge and respect our differences while affirming our common humanity.
- We reject all forms of prejudice and discrimination, including those based on age, color, disability, gender, national origin, political affiliation, race, religion, sexual orientation, and veteran status. We take individual and collective responsibility for helping to eliminate bias and discrimination and for increasing our own understanding of these issues through education, training, and interaction with others.
- We pledge our collective commitment to these principles in the spirit of the Virginia Tech motto of *Ut Prosim* (That I May Serve).

**BSE 3524 Spring 2016 Schedule**

(The schedule of topics listed below is subject to change)

	<b>Meeting</b>	<b>Topic</b>	<b>Readings</b>
W1	1. 01/20 (W)	Introduction	Chapter 1
W2	2. 01/25 (M)	Evaporation (1)	Chapter 8
W2	3. 01/27 (W)	Evaporation (2)	Chapter 8
W3	4. 02/01 (M)	Evaporation (3)	Chapter 8
W3	5. 02/03 (W)	Evaporation (4)	Chapter 8
W4	6. 02/08 (M)	Drying (1)	Chapter 9
W4	7. 02/10 (W)	Drying (2)	Chapter 9
W5	8. 02/15 (M)	Drying (3)	Chapter 9
W5	9. 02/17 (W)	Drying (4)	Chapter 9
W6	10. 02/22 (M)	Gas-liquid separation (1)	Chapter 10
W6	11. 02/24 (W)	Gas-liquid separation (2)	Chapter 10
W7	12. 02/29 (M)	Gas-liquid separation (3)	Chapter 10
W7	13. 03/04 (W)	Gas-liquid separation (4)	Chapter 10
W8	Spring Break (March 5 – 13)		
W9	14. 03/14 (M)	<b>Exam 1 (Evaporation and Drying)</b>	
W9	EX 03/16 (W)	<i>Experimental Design and Scientific Method</i>	Self Learning (PPT)
W9	15. 03/18 (F)	Gas-liquid separation (5)	Chapter 10
W10	16. 03/21 (M)	Adsorption (1) – Simple Adsorption	Chapter 12
W10	17. 03/23 (W)	Adsorption (2) – Ion Exchange	Chapter 12
W11	18. 03/28 (M)	Adsorption (3) – Extraction	Chapter 12
W11	19. 03/30 (W)	Adsorption (4) – Extraction/Leaching	Chapter 12
W12	20. 04/04 (M)	Adsorption (5) – Leaching	Chapter 12
W12	21. 04/06 (W)	Crystallization (1)	Chapter 12
W13	22. 04/11 (M)	<b>Exam 2 (Gas-Liquid sep'n, Ads, Extraction; No leaching)</b>	
W13	23. 04/13 (W)	Crystallization (2)	Chapter 12
W14	24. 04/18 (M)	Crystallization (3)	Chapter 12
W14	25. 04/20 (W)	Membrane separation (1)	Chapter 13
W15	26. 04/25 (M)	Membrane separation (2)	Chapter 13
W15	27. 04/27 (W)	Membrane separation (3)	Chapter 13
W16	28. 05/02 (M)	Mechanical-physical separation (1)	Chapter 14
W16	29. 05/04 (W)	Mechanical-physical separation (2)	Chapter 14
May 4 Class End and May 5 Reading day			
<b>30. Final exam III (12M), May 07 (Sat), 10:05PM-12:05 PM, Seitz 105</b>			