

Interfacial Phenomena

Co-listed and cross-listed as CHBE 487; CHBE 587; FNH 419; FOOD 519*

January 2021

* The content of this syllabus applies to all four course listings (CHBE 487; CHBE 587; FNH 419; FOOD 519) except where explicitly stated in italics.

Course Details

Course Website: hosted on Canvas (canvas.ubc.ca)

Required Text: *An Introduction to Interfaces & Colloids: The Bridge to Nanoscience*. John C. Berg. World Scientific Publishing Co. (2010)

Course Objectives

An interface occurs wherever two immiscible phases of matter come into contact. The properties of this interface can be very different from the properties of either of the two bulk phases. These interfacial properties in turn can have a significant impact on the overall system.

By the end of this course students should be able to do the following:

- **recognize** the importance of interfacial phenomena in a variety of industrial processes and consumer products
- **explain** the physics driving interfacial phenomena in an area of application that is of interest to the student
- **calculate** the quantitative effects of various interfacial phenomena
- **estimate** the relative importance of different physical phenomena by implementing dimensional analysis
- **know** where to look to find information to solve specific problems related to interfacial phenomena

Selection of Industrial Applications

To give context to the course and encourage students to focus on material that will be of use in their careers, each student must select one of the following areas of industrial application to focus on. The selected application will be the basis for the report and will be the topic of at least one question on each of the homework assignments and exams.

- Purification of pharmaceutical compounds by chromatography
- Processing of food emulsions
- Separation of crude oil from oil sands
- Stability and/or rheology of a multiphase consumer product (ex: lotion, fabric softener, ice cream, etc.)
- Other application (must be approved by instructor)

Assessment

Overall Grade

CHBE 487 and FNH 419: There are three different scenarios for grading, depending on if the student elects to complete a report and if the student's report is selected for an oral presentation. The breakdown of the grade for each scenario is given in Table 1.

CHBE 587 and FOOD 519: All students must complete a report and there are two different scenarios for grading, depending on if the student's report is selected for an oral presentation. The breakdown of the overall grade is given in Table 2.

Table 1: Overall Grade Breakdown for CHBE 487 and FNH 419

	Participation	Homework	Practical	Exam	Report
No Report	10%	25%	25%	40%	-
Report	10%	25%	25%	30%	10%
Report + Presentation	10%	25%	25%	20%	20%

Table 2: Overall Grade Breakdown for CHBE 587 and FOOD 519

	Participation	Homework	Practical	Exam	Report
No Presentation	10%	25%	25%	30%	10%
Presentation	10%	25%	25%	20%	20%

Participation

All students begin with full participation points and can miss up to 2 lectures with no penalty. Attendance will be tracked by participation in the survey questions in class. Missing additional lectures or presentation days will result in loss of points as follows:

- Missed lecture = -1% of overall grade (up to -5%)
- Missed presentation day = -2% of overall grade

Discussion Boards

Discussion boards will be used to answer questions related to the course and homework assignments. Please post your questions there rather than emailing the instructor directly unless the matter is personal. Note that the instructor will check the discussion board approximately once per day, so be sure to post your questions well in advance of any deadlines.

Homework Assignments

There will be 5 homework assignments, each worth 5% of the overall grade.

Assignments will be based on exercises taken from the textbook and will normally include at least one problem related to each student's selected area of industrial application. *Some exercises will be tailored to the specific course that you are enrolled in and these will be clearly indicated on each assignment.* Assignments must be submitted on time to receive credit and any exceptions must be requested **before** the deadline.

Practical Exercises

There will be 5 practical exercises, each worth 5% of the overall grade. Each exercise will consist of one or more tasks that require hands-on work or another form of experiential learning.

Exams

On the exams, students may use a physical copy of the textbook (open book), a non-programmable calculator, and possibly one page of handwritten notes (TBD). *Exams will be tailored to the specific course that you are enrolled in* and will include at least one question based on each student's selected area of industrial application.

Report

CHBE 487 and FNH 419: Completing the report is **optional**.

CHBE 587 and FOOD 519: Completing the report is **required**.

The purpose of the report is for students to develop some expertise in a specific process or product that will be of use in their future careers. It will also enable students to extend their individual learnings to topics not covered

in the regular lectures and homeworks. Students may work individually or in groups of two and will be required to submit an outline, a first draft, and a final draft or final presentation. Specific instructions for each draft along with a sample report are provided on Canvas. After reviewing the 1st drafts of the report, ~6 high-quality reports will be selected to prepare and give a presentation during the last week of class. The students selected to give a presentation *will not be required* to submit a final draft of the report.

Tentative Course Outline

Breakdown of Semester

25 class periods = 21 lectures + 1 review + 1 exam + 2 presentation days

Week #	Tuesday	Thursday	Notes
1			
2			
3	HW #1 Due		Report Decision Due
4			
5			
-	Mid-term Break		Report Outline Due
6	HW #2 Due		
7			
8			
9	HW #3 Due		
10			Report 1st Draft Due
11	HW #4 Due	Exam Review	
12	Exam	Presentations	
13	Presentations	HW #5 Due; No Class	Report Final Draft Due

Unit 1. Fluid Interfaces and Capillarity (~4 lectures)

- Introduction to interfacial phenomena and colloids
- Interfacial tension
- Young-Laplace equation and measuring interfacial tension
- Dimensional analysis (Bond number, Capillary number, Weber number)

Unit 2. Thermodynamics of Interfacial Systems (~3 lectures)

- Free energy, enthalpy, entropy
- Surfactants and micelles
- Adsorption isotherms
- Fluid-solid interfaces

Unit 3. Solid-Fluid Interactions: Wetting and Spreading (~5 lectures)

- Contact angle
- Wetting and spreading
- Wicking
- Particles at interfaces

Unit 4. Solid-Fluid Interactions: Colloids (~4 lectures)

- Sedimentation and Aggregation

- Electric double layer
- DLVO theory
- Rheology

Unit 5. Fluid-Fluid Interactions: Emulsions and Foams (~4 lectures)

- Coalescence and breakup
- Emulsion and foam stability
- Interfacial rheology
- Pickering emulsions

Additional Notes

The instructor reserves the right to deviate from the syllabus as needed. Students requesting an exception to the syllabus must submit the request via Canvas email to the instructor.

Academic Integrity

The integrity of academic work depends on the honesty of all those who work and study at the university and the acknowledgement of the work of others through careful citation of all sources used in your work. Plagiarism and other forms of academic misconduct are treated as serious offenses at UBC, whether committed by faculty, staff, or students.

You should be aware of the sections of the University Calendar that address academic integrity (<http://www.students.ubc.ca/calendar/index.cfm?tree=3,286,0,0>) and plagiarism (<http://vpacademic.ubc.ca/integrity/ubc-regulation-on-plagiarism/>). The UBC library also has a useful web-based Plagiarism Resource Centre (www.library.ubc.ca/home/plagiarism/) that explains what plagiarism is and how to avoid it. The copying of passages from any sources, without proper reference will be considered plagiarism. If you have questions or concerns about any of these policies or conventions in relation to how they apply to the work you do in this course, please discuss them with the instructor.

UBC Policies and Regulations

Students are reminded that they are subject to the University's Policies and Regulations (<http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,0,0,0>), and are directed especially to "Student Declaration and Responsibility", "Academic Honesty and Standards", and "Academic Freedom" sections.

Academic Concession

Students facing any medical, emotional, or personal circumstances that may negatively impact academic attendance or performance are expected to notify their instructor as well as their home Faculty's Academic Advising Office. Instructors and Advisors can help by explaining your options and working with you to access supports or explore a form of academic concession.

Change of Registration

Students are permitted to change their registration, by adding or dropping courses, but must be mindful of the deadlines.

Personal Support

Students experiencing personal challenges that are impacting their academics and well-being are strongly encouraged to learn more about the resources available on the Health and Wellness website.

Academic Support

Please visit Academic Success to learn more about campus resources to support your success.

Accommodations for Students with Disabilities

Students requiring accommodation in this course, or in need of support for an on-going medical condition please provide the instructor with documentation and recommendations from Centre for Accessibility as soon as possible. You can find more information about the services provided by Centre for Accessibility