



a place of mind  
THE UNIVERSITY OF BRITISH COLUMBIA

Chemical & Biological Engineering  
Faculty of Applied Science

**CHBE 402/GBPR 501**  
**[2021W-T2]**  
**Biomass Fractionation**  
**Technology**

(3 credits)

**Instructor**

Dr. Trajano, Associate Professor, *Ph.D.*  
Chemical and Biological Engineering  
✦ CHBE 203  
✉ [chbe402@chbe.ubc.ca](mailto:chbe402@chbe.ubc.ca)

**Dr. Trajano's  
Office Hours**

To be determined.

**Class**

Monday, Wednesday, and Friday  
🕒 2:00 pm – 3:00 pm  
✦ CHBE 103

**No classes on:**

- Midterm Break (Monday, February 21-Friday, February 25)

**Course Website**

[www.canvas.ubc.ca](http://www.canvas.ubc.ca)  
Check the course web site regularly and frequently for lecture notes, assignments, announcements, and other relevant course materials.

**Course Email**

[chbe402@chbe.ubc.ca](mailto:chbe402@chbe.ubc.ca)

- I will check this email once per day from Monday to Friday and answer questions.
- If the question is regarding an assignment, include the assignment name in the subject.
- To facilitate an appointment, include **THREE** times that you are available (e.g. Tuesday at 11-12, Tuesday at 2:30-3:30, Wednesday at 11-12) in your email.

**Recommended  
Resources- Purchase is  
not required.**

- Fengel D, Wegener G. “Wood: Chemistry, ultrastructure and reactions”, Walter de Gruyter, New York (1984).
- Smook G, “Handbook for Pulp and Paper Technologists, 4<sup>th</sup> ed.”, TAPPI Press (2016).
- Sjoström E, “Wood chemistry: fundamentals and applications”, Academic Press: New York (1981).
- Fengel & Wegener is available online through the UBC Library.
- Sjoström and Smook are available in print through the UBC Library.
- Other readings will be assigned as necessary.

**Learning Outcomes**

**After taking this course, you will be able to:**

- ☑ Describe the concepts of bio-economy, biorefinery, and bio-products.
- ☑ Describe the chemistry of biomass.
- ☑ Relate the characteristics of biomass to its processing (e.g. pulping, bleaching, refining)
- ☑ Explain the principles of pulp and paper operations: kraft pulping, mechanical pulping, bleaching, papermaking. Perform pertinent calculations.
- ☑ Interpret data using fundamental knowledge from lectures and technical literature.
- ☑ Assess novel and emerging biorefining processes.
- ☑ Summarize ongoing research at UBC related to bio-based chemicals and nanomaterials, biofuels, and biogas.

**Class Guidelines**

- Consistent attendance is strongly recommended for success in this course.
- Material presented in lecture may not be found in readings. Students are responsible for knowing material covered in class as well as the material found in the assigned readings.
- The professor will treat students with respect. Students' behavior towards fellow students, the professor, and guest lecturers will also be respectful.
- Cell phones must be turned off and put away during class. **NO TEXTING!**
- No food or drink is to be brought into the classroom if it will cause a distraction (slurping, rustling, etc.)
- Any activities that cause distractions, such as chatting, should be avoided.

<b>Evaluation</b>	Presentations (3)	25%
	• To be determined	
	Tests (2)	25%
	• To be determined	
	Take-home assignments (2)	25%
	Quizzes on Guest lectures	15%
In-class participation	10%	

- In-class Participation**
- In-class activities will require completion of assigned readings or preparation of materials in advance. You should come to class prepared to actively contribute to the activity/discussion.
  - The quantity and quality of contributions will be assessed.

**Presentations**

Presentations will be performed in pairs or small groups. Guidelines for content and marking guides will be posted for each assignment at least 1 week in advance. Time limits are to be strictly adhered to; presenters will be cut-off at end of prescribed time.

**Tests**

Tests are **closed-book** and **closed-notes**. A non-programmable or programmable calculator is allowed but may not be necessary.

- **There is no final exam.**
- UBC's grading policies are outlines here:  
<http://www.calendar.ubc.ca/vancouver/?tree=3,42,96,0>

**Missed Tests** **Engineering Student Services consider academic concessions to be a privilege, not a right.**

- There are no excused absences from the tests other than a **verified medical condition** that prevents attendance. Schedule an appointment with the professor to discuss your absence from the midterm exam.
- If you are unable to take a test and know in advance, please make arrangements with the instructor, prior to the examination, to take the test. Make-up tests will be given at the discretion of the professor and generally will be more difficult than the regular exam.

## Assignments

- Will be posted on Canvas.
- **You will work on your assignments in groups of 2-3** (pending final class size). You may work with a different partner for different assignments.
- **Assignments** should be **submitted to the professor at the start of class on the day of the deadline.**
- Your solution presentation should:
  - **Start with a sketch of the problem statement outlining:**
    - The given situation
    - What needs to be determined
    - Variables clearly labeled
    - Assumptions made to reach the solution
  - **A logical step-by-step solution analysis should then follow demonstrating:**
    - Equations used and the calculations performed
    - Answers should have **three significant digits.**
    - Final answers should contain appropriate units and be clearly identified by a box  
e.g.  $q_{\text{cond}} = 5.00 \text{ W}$
    - Partial credit will be awarded as appropriate.
- Your submission should be clear, legible, and reasonably organized (e.g. include page numbers). **Remember, if it can't be read, it can't be graded!**
- Your assignment should have a cover page, clearly showing your names, student numbers, course number, assignment number, and due date.
  - The cover page template is provided on Canvas.
  - Assignments without a cover page will not be graded.
  - Make sure you include your name on the cover page. Grades will only be given to students whose names are on the cover page.

## Extension/Late Policy

- Assignments will be **due at the start of class on the specified day.**
- Assignments submitted within 24 hours of deadline will have 10% deducted.
- Assignments submitted within 48 hours of deadline will have 25% deducted.
- **No marks will be given for assignments handed in after the 48 hour grace period.**

## Regrading

- You may request the grading of your tests/take-home assignments be reconsidered.
- A regrading request form is available on Canvas. It **must be submitted** to the instructor **within 1 week of the grades being released**. Your submission should include a written explanation of your concern as well as your test/assignment.
- If the professor decides the original mark was too generous, the revised grade may end up being lower than the original grade. **The revised grade will be the final grade.**

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## Academic Integrity

The academic enterprise is founded on **honesty, civility, and integrity**. All students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means **submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others** as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e. misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. **Incidences of plagiarism or cheating [will] be reported to the Dean's office. Incidences of plagiarism or cheating [will] result in a mark of zero on the assignment or exam and more serious consequences may apply.** Careful records are kept in order to monitor and prevent recurrences.

- Expectations for student conduct with respect to academic honesty is stipulated in UBC Policy 85 available [here](#).
- Refer to the academic calendar for more details:  
<http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,286,0,0>
- From <http://www.calendar.ubc.ca/vancouver/?tree=3,54,111,959>:

Academic misconduct that is subject to disciplinary measures includes, but is not limited to, ***engaging in, attempting to engage in, or assisting others to engage***, in any of the actions described below:

**Cheating:** This includes but is not limited to dishonest or attempted dishonest conduct at tests or examinations.

**Plagiarism:** This includes but is not limited to the presentation or submission of the work of another person, without citation or credits, as the student's own work.

**Your success is important. Reach out and ask for help if you need it.**

University students often encounter setbacks from time to time that can impact academic performance.

If you run into difficulties and need assistance, I encourage you to contact me by email or phone during my office hours, before or after class, or by dropping into my office (CHBE 203).

I will do my best to support your success during the term:

- This includes identifying concerns I may have about your academic progress or wellbeing through Early Alert.
- With Early Alert, faculty members can connect you with advisors who offer support and assistance to help students get back on track to success.
- Only specialized UBC advisors would be able to access any concerns I may identify.
- Early Alert does not affect your academic record.

For more information, visit [earlyalert.ubc.ca](https://earlyalert.ubc.ca)

For information about addressing mental or physical health concerns, including seeing a UBC counsellor or doctor, visit <https://students.ubc.ca/health-wellness>

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## **Course Outline- subject to modification at professor's discretion**

### Module 1: Bio-economy and bioproducts

Introduction of concepts, biomass feedstocks, biomass fractionation and biorefinery.

### Module 2: Chemical building blocks of biomass

Cellulose, hemicellulose, lignin, extractives, cell wall interactions

Starch, sugar cane, algae

### Module 3: Pulp Mill Operations

Introduction to chemical and mechanical pulping + process overview

Kraft pulping: vocabulary, process chemistry, digesters, digester additives

Kraft recovery cycle

Mechanical pulping: TMP, CTMP SCMP

Other: sulfite pulping + dissolving pulp

Bleaching

Environmental considerations

The pulp mill as a biorefinery: bio-electricity, by-products: extractives and lignin

Modern process control

### Module 4: Papermaking

Paper grades + process overview

Paper making: water removal

Paper making: additives

Microfibrillated cellulose, hyper-refined Kraft, applications

Nanocrystalline cellulose

### Module 5: Emerging Opportunities

Biofuels, biogas, bioenergy