

## COURSE INFORMATION

Course Title	Course Code Number	Credit Value
Biomass Fractionation Technology	CHBE 402/CHBE 502	3

## CONTACTS

Course Instructor(s)	Office Location	Office Hours
Dr. Trajano <a href="mailto:chbe402@chbe.ubc.ca">chbe402@chbe.ubc.ca</a>	CHBE 203	By appointment; please email to set up a time to meet.  Masks are strongly recommended for in-person meetings in my office.  If you cannot wear a mask, then we will schedule our meeting for outdoors.

**If you wish to make an appointment, please suggest that 3 times that you are available** (e.g. Monday at 4PM PST, Tuesday at 2PM PST, Thursday at 2PM PST).

I will check and answer course emails once per day from Monday to Friday. I dedicate my weekends to mindfully enjoying time with my family.

## WELCOME TO CHBE 402/CHBE 502

Welcome to CHBE 402/502. We are gathering and learning on the traditional, ancestral, and unceded territory of the x<sup>w</sup>məθk<sup>w</sup>əyəm (Musqueam) people. The land it is situated on has always been a place of learning for the Musqueam people, who for millennia have passed on their culture, history, and traditions from one generation to the next on this site.

I recognize that you are bringing your own goals, perspectives, experiences, and challenges to this course. My goal is to provide a learning environment in which all students can master the Learning Outcomes. **Your success is important. Reach out and ask for help if you need it.**

I invite you to help me cultivate an environment and culture where everyone feels a sense of belonging. In this class, a sense of belonging means:

- everyone feels connected, supported, and respected
- everyone is confident that they are seen as a person of value

I have prepared a separate page identifying on-campus resources to support your well-being and academic performance. It is provided in the “Student Resources” module on Canvas.

The course relies on material delivered during lectures. Therefore, **consistent in-person attendance is strongly recommended for success** in this course. Lectures will be synthesized from multiple sources.

Most sources will be available from UBC Library. Students are responsible for knowing material covered in class as well as the material found in the assigned readings. Lecture recordings and notes will be posted on Canvas.

## COURSE STRUCTURE

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Course Website: [www.canvas.ubc.ca](http://www.canvas.ubc.ca)

**Check the course website regularly and frequently** for lecture notes, assignments, announcements, and other relevant course materials. **Read my emails.**

### Lecture

Monday/Wednesday/Friday 14:00-14:50 Pacific Standard Time (PST). **SWNG 308**

No classes on February 20-24 (Mid-Term Break), April 7, April 10.

I teach CHBE 345 in the CHBE building on Monday 13:00-13:50 PST. I will do my best to arrive promptly.

## LEARNING OUTCOMES

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At the end of the semester, the successful CHBE 402 student should 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.

## TEXTBOOK

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**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).
- Sjostrom E, "Wood chemistry: fundamentals and applications", Academic Press: New York (1981).
- Fengel & Wegener and Smook are available online through the UBC Library.
- Sjostrom is available in print through the UBC Library.
- Other readings will be assigned as necessary.

## EVALUATION

<b>Presentations</b>	CHBE 402	CHBE 502
Presentation 1- Biomass Structure and Processing (group) Given on Mon/Jan 30 or Wed/Feb 1	10	10
Self-reflection on Presentation 1 (individual) Due Mon/Feb 6	2.0	2.5
Presentation 2- Bleaching Chemicals Mechanism and HSE (group) Given on Fri/Feb 17	5	5
Presentation 3- Pulp/Paper Mill Research Paper Critique (group) Given on Mon/Feb 27 or Wed/Mar or Fri/Mar 3	15	20
Self-reflection on Presentation 3 (individual) Due Mon/Mar 13	2.5	2.5
Presentation 4- Mini-Lecture on Biorefinery Process/Product (group) Given on Mon/Apr 3 or Wed/Apr 5 or Wed/Apr 12	15	20
Self-reflection on Presentation 4 (individual) Due Mon/Apr 17	5	5
<b>Assignments</b>		
Assignment 1- Pulp Mill Travel Poster (group) Due Mon/Jan 23	5	5
Assignment 2- Calculations for Kraft Pulping (group) Due Wed/Mar 1	2.5	2.5
Assignment 3a- Papermaking Laboratory- Preparation (group) Due Mon/Mar 20	5	5
Assignment 3b- Papermaking Laboratory- Post-“Lab” Preparation (group) Due Wed/Mar 29	10	5
Assignment 4- Reflection on EDI+I Event/Podcast/Reading Due Mon/Apr 17	5	2.5
<b>Final Exam</b> During UBC Examination Period	18	15

- UBC's grading policies are outlined here: <http://www.calendar.ubc.ca/vancouver/?tree=3,42,96,0>

### PRESENTATIONS

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- Presentations will be performed in groups of 2-3.
- Guidelines for content and marking guides will be posted at least 1 week in advance.
- Time limits are to be strictly adhered to; presenters will be cut-off at end of prescribed time.

### ASSIGNMENTS

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- Assignments are a mix of individual and group work. Expectations will be clearly stated with assignment instructions.
- **Assignment files** should be **submitted online (Canvas)**. Submission details will be posted for each assignment.
- Mathematical solution presentation should follow the general guidelines (see page 5).
- 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!**
- Phone photos are not acceptable. You may use regular scanners or apps such as [iScanner](#), [Tiny Scanner](#), or [Office Lens](#) to take photos of your work and easily email a neat single PDF to yourself.
- **Your assignment must 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.
  - Make sure you include your name on the cover page. Grades will only be given to students whose names are on the cover page.

### FINAL EXAM

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- Details of permitted materials, exam content, and format will be provided at least one week prior to end of classes.
- Sample questions based on previous tests will be provided in advance approximately one week before the end of classes.
- I will schedule an additional information session to discussing test expectations and review sample questions near the end of semester. As it will be difficult to find a time suitable for everyone, I will stream and record this session via Zoom. The recording will be available via Canvas.

ACADEMIC CONCESSIONS

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- I am committed to providing support to students in their academic pursuits through the application of *academic concessions* in the event that students experience unanticipated events or circumstances that interfere with their ability to accomplish academic work.
- **Each assignment will be accompanied by an extension/late policy:**
  - *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.*
  - Penalties will be applied at the end of the semester during course grade compilation.
  - If you feel that your circumstances merit an academic concession (e.g. extension without penalty), submit a request via [Engineering Academic Services](#). A copy of your request is automatically forwarded to me. Extensions will be granted only for exceptional circumstances.
- **Final exam:**
  - Email Dr. Trajano to discuss your absence from the final exam as soon as possible. Grounds for an excused absence from the midterm and final are described in the [UBC Academic Calendar](#).
  - **If you are absent from the final exam**, you must submit your request for an academic concession through [Engineering Academic Services](#) **within 72 hours**.

GENERAL GUIDELINES FOR PROBLEM SOLVING

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- **Your solution presentation should include:**
  - **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 if the solution approach is correct, but an incorrect answer is given because of a simple mathematical error.
- 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!**

LEARNING MATERIALS

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All course material will be posted on Canvas.

UNIVERSITY POLICIES

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UBC provides resources to support student learning and to maintain healthy lifestyles but recognizes that sometimes crises arise and so there are additional resources to access including those for survivors of sexual violence.

UBC values respect for the person and ideas of all members of the academic community. Harassment and discrimination are not tolerated nor is suppression of academic freedom. Review the [UBC Respectful Environment Statement](#) and [UBC Student Code of Conduct](#).

UBC provides appropriate accommodation for students with disabilities and for religious, spiritual and cultural observances.

UBC values academic honesty and students are expected to acknowledge the ideas generated by others and to uphold the highest academic standards in all of their actions.

Details of the policies and how to access support are available on [the UBC Senate website](#).

ACADEMIC INTEGRITY

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1. **The academic enterprise is founded on honesty, civility, and integrity.** As members of this enterprise, 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. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or report and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences. See: <http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,286,0,0>.

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:

- a. **Cheating:** This includes but is not limited to dishonest or attempted dishonest conduct at tests or examinations.
  - b. **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.
2. You will one day become a Professional Engineer therefore you should also consider [EGBC's Code of Ethics](#).

*Registrants must act at all times with fairness, courtesy and good faith toward all persons with whom the registrant has professional dealings, and in accordance with the public interest.*

*Registrants must uphold the values of truth, honesty, and trustworthiness and safeguard human life and welfare and the environment. In keeping with these basic tenets, registrants must:*

*11. "clearly identify each registrant who has contributed professional work, including recommendations, reports, statements, or opinions;*

**I expect everyone to conduct themselves in a manner befitting a future E.I.T. and P.Eng. I have these high expectations because I know that you can reach them.** Many of you may also be an [Iron Pin Founder or Supporter](#). I am confident that you will uphold the UBC Engineering Code of Ethics.

3. **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.

## COURSE OUTLINE

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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, lignocellulose

#### Module 3: Pulp Mill Operations

Introduction to chemical and mechanical pulping + process overview  
Wood yard operations + chip preparation  
Kraft pulping: vocabulary, process chemistry, digesters, digester additives  
Kraft recovery cycle  
Mechanical pulping: TMP, CTMP SCMP  
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

#### Module 5: Emerging Opportunities

Nanocrystalline cellulose  
Lignin materials and chemicals  
Syngas platform  
Sugars platform