2021 Biological/Bioprocess Engineering I
CHBE 381/560

Academic Integrity
The academic enterprise is founded on honesty, civility and integrity. All students must know, understand, and follow the codes of conduct for maintaining academic integrity. At the most basic level, this means submitting only original work done by you, acknowledging all sources of information and attributing them to others as required.

UBC Academic Honesty and Standards:
http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,286,0,0

Lectures: 10 – 11:30 Monday & Friday

Tutorials: 14 – 16:00 "Alternating" Mondays
January 18, February 1, March 1, March 15 March 29 & April 12

Instructor: **James Piret** 604-822-5835, jpiret@chbe.ubc.ca
Department of Chemical & Biological Engineering
Michael Smith Labs (2185 East Mall)
Office hours: email to schedule a Zoom

Teaching Assistant: **Alina Kunitskaya** 604-827-3271, akunitsk@mail.ubc.ca
Michael Smith Labs (2185 East Mall)
Office hours: email to schedule a Zoom

Pre-requisites: BIOL 112; one of MATH 101, 103, 105, CHBE 241 & 251
(CHBE 560 cannot be taken for credit if CHBE 381 completed)

Course Web Site: https://canvas.ubc.ca

Course Textbook: "Bioprocess Engineering: Basic Concepts" 3rd edition
Shuler, M.L., F. Kargi and Delisa, Prentice Hall (2017)
Available at Bookstore or free on-line at UBC library (search for the textbook title at):
https://resources.library.ubc.ca/page.php?details=oreilly-for-higher-education&id=2460

Other Textbook References:

- "Bioprocess Engineering" by Clarke, Woodhead Publishing, 2013
- "Cell Biology" by Pollard, Earnshaw, Lippincott & Johnson, Elsevier, 2017

Course Description:

This course provides the knowledge needed to understand and analyze biotechnology processes in order to design, develop and operate them effectively. The main topics cover the kinetics of enzymatic, microbial and mammalian cell processes, including bioreactor design, operation and scale-up.

Course Objectives:

Students will understand the life science knowledge base and bioprocess engineering concepts needed to effectively solve biological process engineering problems.

By the end of the course you should be able to:

1) Understand the biological knowledge base of bioprocesses
2) Select bioprocess conditions and configurations
3) Use process modeling to analyze bioreactor performance
4) Optimize bioprocess engineering technology

CHBE Evaluation:

	CHBE 381	CHBE 560
Assignments	20	50*
Tutorials	45	28
Final exam	35	22
Total	**100**	**100**

Individual problem set assignments will be posted on the course website.
These assignments are due by **4 pm** on the course web site.
Late assignment penalty: -10% per day, for up to 2 days late and then scored 0%.

*CHBE 560 - additional bioprocess literature critique and review assignments, presented in extra classes 2~4:30 pm on the Mondays alternating with tutorials

Exam, Quizzes and Conflicts:

Dr. Piret must be emailed **2 weeks in advance** regarding any exam or tutorial conflicts due to athletic or other events.

The tutorial quizzes and final exam will be closed book, with computational problems as well as questions targeting biological terms and concepts that should be known by a bioprocess engineer.

CHBE 381/560 Course Modules

	Textbook (optional reading)
A. INTRODUCTION TO BIOPROCESS ENGINEERING (1 lecture) *Description of the course, bioprocess engineering and products.*	Chapters 1 & 2
B. REGULATORY CONTEXT & QUALITY BY DESIGN (1 lecture) *Regulatory constraints on bioprocess engineering of therapeutic products. Quality by Design.*	Chapter 1
C. ENZYME ATTRIBUTES & MASS TRANSPORT LIMITS (2 lectures) *Comparisons with non-biological catalysts and mass transport limitations in immobilized enzyme systems.*	Chapter 3
D. CELL METABOLISM & GROWTH MODELS (2 lectures) *Major metabolic pathways, growth kinetics and cell enumeration methods. Unstructured, unsegmented, segmented and structured models.*	Chapters 5 & 6
E. CULTURE MEDIUM DESIGN & OPTIMIZATION (1 lecture) *Fermentation and cell culture medium design.*	Chapters 6 & 7
F. GENE REGULATION & GENETIC ENGINEERING (2 lectures) *Biotechnology protein production cell line and process development.*	Chapters 4 & 8
G. PROCESS ENGINEERING, BIOREACTOR SCALE-UP, OXYGENATION & STERILIZATION (7 lectures) *Bioreactor operated in batch, fed-batch and perfusion modes, mass transport of oxygenation, and scale-up/down methods.*	Chapters 9 & 10
H. EMERGING TECHNOLOGIES & PROCESSES (10 Lectures) *Cell and gene therapy process optimization microfluidic to manufacturing scales, design of cell encapsulation devices for implantation, metabolic engineering, single-use-technology, drug delivery and principals of analytical devices, downstream processing.*	