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: 10:00 – 11:30 Mondays & Fridays (CHBE Room 102)

Tutorials: 14:00 – 16:00 alternating Mondays (CHBE Room 101)
January 16 & 30, February 13 & 27, March 13 & 27

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: CHBE 221 or BMEG 245 and one of MATH 101, 103 or 105

Course Web Site: Canvas

Reference Textbooks: (not at UBC Bookstore)
Bioprocess Engineering (2nd or 3rd edition)
by Shuler, Kargi & Delisa, Prentice Hall (2002 or 2017)
TP248.3 .S58 2017, Woodward library reserve collection (3rd ed.)

Bioprocess Engineering (3rd edition)
by Liu, eBook available through Library, Elsevier (2020)

"Cell Biology",
by Pollard et al., eBook available through Library, 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. For any other extension / concession, please complete the self-declaration form at:
https://academicservices.engineering.ubc.ca/form-request-for-academic-concession-in-term-work

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 Modules and Related Text Resources

	Shuler	Liu
A. INTRODUCTION TO BIOPROCESS ENGINEERING (1 lecture) *Description of bioprocess engineering and products.*	Chapters 1, 2	Chapters 1, 2
B. REGULATORY CONTEXT & QUALITY BY DESIGN (1 lecture) *Regulatory constraints on bioprocess engineering of therapeutic products, process Quality by Design.*	Chapter 1	Chapter 1
C. ENZYME ATTRIBUTES & MASS TRANSPORT LIMITS (3 lectures) *Comparisons with non-biological catalysts and mass transport limitations in immobilized enzyme systems.*	Chapter 3	Chapter 7
D. CELL METABOLISM & GROWTH MODELS (3 lectures) *Major metabolic pathways, growth kinetics and cell enumeration methods, unstructured and structured models, industrial microbiology.*	Chapters 5 & 6	Chapters 11, 13
E. CULTURE MEDIUM DESIGN & OPTIMIZATION (1 lecture) *Fermentation and cell culture medium design.*	Chapters 6 & 7	Chapters 2, 13, 20
F. GENETIC ENGINEERING & MODELING KINETICS (2 lectures) *Biotechnology protein production cell line and process development.*	Chapters 4 & 8	Chapters 11, 12, 15
G. PROCESS ENGINEERING, BIOREACTOR SCALE-UP, OXYGENATION & STERILIZATION (5 lectures) *Bioreactor operated in batch, fed-batch and perfusion modes, mass transport of oxygenation, and scale-up/down methods.*	Chapters 9 & 10	Chapters 14, 15, 18
H. EMERGING TECHNOLOGIES & PROCESSES (10 Lectures) *Vaccine, cell and gene therapy process design, modeling and bioprocessing, microfluidic to manufacturing scales, design of cell encapsulation devices for implantation, metabolic engineering, single-use-technology, biofuels and principals of analytical devices.*		Chapters 17, 18