CENG 4620 BioProducts and Processing

Course Objectives:

This course aims to equip students with foundational knowledge and skills related to the production and downstream processing of biologically derived products and compounds.

By the end of the course, students will be able to:

- Understand Bioproducts: Gain a comprehensive overview of various bioproducts, ranging from bulk enzymes to high-value therapeutic proteins, and their significance in biotechnology and industry.
- Analyze Microbial Kinetics: Introduce and apply the principles of microbial kinetics to assess the growth and productivity of microorganisms used in bioproduct production.
- Evaluate Production Methods: Explore and critically evaluate different production methodologies, with an emphasis on bioreactor design and operation, to optimize the yield of bioproducts.
- Implement Downstream Processing Techniques: Familiarize students with essential downstream processing techniques, including recovery, isolation, purification, and formulation of bioproducts, ensuring product integrity and efficacy.
- Integrate Knowledge and Skills: Synthesize theoretical knowledge with practical applications to tackle real-world challenges in bioproduct production and processing.
- Promote Sustainable Practices: Discuss the importance of sustainability in bioproducts and processing, emphasizing environmentally friendly practices and innovations in the field.

Reading Materials

Recommended textbook: "Bioprocess Engineering" 2rd Edition by M.L. Shuler and F. Kargi, Prentice Hall PTR, 2002

Recommended textbook: "Bioseparations Science and Engineering" by Harrison, Todd, Rudge and Petrides, Oxford University Press 2015 (2nd ed.)

"Brock Biology of Microorganisms" 13th Edition by M.T. Madigan, J. Martinko and J. Parker, Prentice Hall PTR, 2012

Ebooks:

Bioseparations Science and Engineering, **by Harrison, Todd, Rudge, Scott, Oxford University Press, 2015 (2nd ed.)**

"Bioprocess engineering: an introductory engineering and life science approach", by Kim Gail Clarke, Woodhead Publishing, 2013

"Bioprocess engineering principles", by Pauline M. Doran, 2nd edition, Academic Press, 2013

Exams and Grade

- Class performance (Q&A, discussion) 5%
- Homework (4~5) 10%
- In-class MCQ quizzes (~5, exclude the lowest) 20%
- A hands-on group project (work in lab) 12.5%
- A literature review group project presentation 12.5%
- Final exam (open book/computer) 40%

Tentative lecture schedules

Contents	Chapters and Topics	Classes	Week
Introduction	1. Introduction to bioproducts and bioprocess	4.5	1-2
Bioreaction & Bioreactors	2. Biological basis: Microbiology, Metabolism, Bioproducts, Medium composition	6	2-3
	3. Microbial growth kinetics and culture processes (batch, fed-batch, Continuous, Perfusion)	4.5	4-5
	4. Bioreactor Design & Operation: agitation, scale up, aeration, heat removal. Animal cell cultivation	7.5	6-8
Bioseparation	5. Introduction to Bioseparation & cell lysis	2	9
	6. Filtration & membrane separation	3	10
	7. Chromatography	2	11
	8. Centrifugation, Precipitation and formulation	3	12
Presentation	Group project	2	13