TUSKEGEE UNIVERSITY
COLLEGE OF ENGINEERING
CHEMICAL ENGINEERING DEPARTMENT
Spring 2026

COURSE:	**CENG 415 – Bioseparation Engineering**
SCHEDULE:	MWF 9-10 AM; Room #528
INSTRUCTOR:	Shamim Ara Begum
OFFICE:	516 Luther Foster Hall
TELEPHONE:	ext. 8795
FAX:	(334) 724-4188
E-MAIL:	sbegum@tuskegee.edu
OFFICE HOURS:	M: 1 - 5; T: 9 - 12; W: 12:30 - 2 and F: 1:30 - 3
TEXT:	Bioseparations Science and Engineering by Roger G Harrison, Paul W. Todd, Scott R. Rudge, and Demetri P. Petrides, Second Edition, Oxford University Press, 2015.
REFERENCES:	Bioseparation, Downstream Processing for Biotechnology by P.A. Belter, E.L. Cussler, and W. Hu, John Wiley and Sons, 1988.

CATALOG DESCRIPTION

Recovery and purification of biologically produced proteins and chemicals. Basic principles and engineering design of various separation processes including chromatography, electrophoresis, extraction, crystallization, and membrane separation.

COURSE OBJECTIVES:

Students will:

1. Understand the basic information about bioproducts and engineering analysis
2. Develop an understanding of a broad range of analytical methods for bioproduct
3. Gain advanced knowledge of the basic principles of bioseparation processes
4. Design and scaleup of many unit operations involved in bioseparation
5. Demonstrate an ability to utilize a process flow diagram

Objectives		Tasks	
1	Understand the basic information about bioproducts and engineering analysis	1	Classify different types of bioproducts, their differences and structures
		2	Demonstrate the concepts of engineering analysis (material balance, equilibria, transport phenomena)
2	Develop an understanding of a broad range of analytical methods for bioproducts	3	Demonstrate an appreciation for the terminology used in quality control and analytical development activities
		4	Identify and select laboratory methods for assaying biological activity and purity
3	Gain advanced knowledge of the basic principles of biosepartion processes	5	Describe the role of electrokinetic phenomena in the flocculation and apply the Schulze-Hardy rule for flocculation
		6	Apply the engineering analysis concepts of material balance, equilibria, and transport phenomena for various unit operations
		7	Calculate the precipitate and crystal growth rate
4	Design and scaleup of many unit operations involved in bioseparation	8	Demonstrate an appreciation for the terminology of bioseparation processes
		9	Scale up and design calculations for filtration system, centrifuge, extractor, chromatography, precipitation system, crystallizer, dryers
5	Demonstrate an ability to utilize a process flow diagram	10	Draw process flow diagram using various unit operations for recovery & purification of the bioproducts

COURSE OUTCOMES:

Outcomes	1	2	3	4	5	6	7
Objective 1	X						
Objective 2	X						
Objective 3	X						
Objective 4	X	X	X				X
Objective 5	X						

1. An ability to identify, formulate and solve complex engineering problems by applying principles of engineering, science, and mathematics.
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors.
3. An ability to communicate effectively with a range of audiences.
4. An ability to recognize ethical and professional responsibilities in engineering solutions and make informed judgements, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts.
5. An ability to function effectively on a team whose members together provide leadership, create a collaborative and inclusive environment, establish goals, plan tasks, and meet objectives.
6. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgement to draw conclusions.
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

PREREQUISITES: CENG 380
HOURS: 3 credit hours

GRADING:

Criteria:	Homework	10%	**Scale:** A = 90 - 100
	Design Report	15%	B = 80 – 89
	Class attendance, Participation & Quizzes	15%	C = 70 - 79
	Exams	40%	D = 60 - 69
	Final Exams	20%	F = 0- 59

COURSE POLICIES:

You are expected to be in the class on time. If you are unable to attend the class or take an exam, it is your responsibility to present an excuse to your instructor. Valid excuses include serious illness, death in the immediate family, and participation in University-sponsored events. Any other excuse will be evaluated by the instructor. An excused absence allows you to make up any work you missed without any late penalties. Excused students are required to complete any missed work within one week of their return to class. If the students miss the makeup exam, they must show the written valid excuse to makeup it again. Failure to contact the instructor and present her with a valid excuse will result in an unexcused absence. An unexcused absence means that any work (homework, design report) you missed cannot be turned in. Any makeup exam cannot be taken for an unexcused absence. It is the student's responsibility to meet with the instructor to submit the missed work for an excused absence.

The student is expected to attend the class within 5 minutes after the class starts and remain present until the class ends. Otherwise, the student will be given a zero in attendance for that day. It is students' responsibility to check whether their attendances have been recorded by the instructor.

Homework and design project will be assigned in the CANVAS/Class. Hard copy of the completed homework needs to be submitted to the instructor at the beginning of the class on the due date. Design report needs to be submitted in the CANVAS/Class **on the due date**. Homework, and design report will not be accepted via email without the permission of the instructor. **Students are required to use Tuskegee email (outlook 365) for all communications with the instructor.**

Students are responsible to check the CANVAS regularly for any assigned tasks and announcements.

Students need to be present in the class to take exam on time. Exam time will not be extended without a valid written excuse.

Quizzes may or may not be announced.

No make-up exams or retests will be taken without a valid written excuse.

Cheating will not be tolerated. Any student caught cheating will get a zero for that homework, design report, quiz and exam.

Students are not allowed to talk with each other during lecture, quizzes, exams, and final exam.

Students are not allowed to do other class work during this class.

No electronic devices except calculator are allowed in the class.

Effective Spring 2018, the outlook 365 (tuskegee.edu) email system at Tuskegee University is REQUIRED for all instructional administrators, faculty, staff and students.

Dress Code:
Tuskegee University has implemented a dress code for students, faculty, and staff on campus. The dress general code is "**Business Casual**". Students are required to adhere to this dress code in the classroom. Any student violating the dress code will be asked to leave the classroom, and such student(s) cannot return to class until they are properly dressed. The following are basic requirements of the dress code:

1. Jeans and T-shirts cannot be worn to class unless on Fridays.
2. No head gear, hats, or head covers unless it is required under special circumstances.
3. No sagging or wearing of dark sunshades in class
4. **Any outfit that will inappropriately expose body parts is unacceptable**.
5. **Sando genji is not allowed in the class.**

COVID Policy:
"Excuses related to Covid infection as well as exposure have to be received from the Dean of Students office. Students should request the excuse for absence from the Dean of Students office as soon as they become aware of covid infection or exposure. Students may request a classes missed memo by completing this form (https://forms.gle/4ozusHX2tTCUW4yK6) and then contact the Office of the Dean of Students and Student Conduct (334) 727-8421, via e-mail THarper@Tuskegee.edu or by going into the office located in suite 203 Tompkins Hall."

Additional policies will be issued, if they are necessary.

Course Outline

- Introduction to Bioproducts and Bioseparations (Ch. 1) (Session: 1-3)
- Analytical Methods (Ch. 2) (Session: 4 - 6)
- Cell Lysis and Flocculation (Ch. 3) (Session: 7 - 9)
- **Exam 1***
- Filtration (Ch. 4) (Session: 10 - 14)
- Sedimentation (Ch. 5) (Session: 15 - 18)
  Exam 2*

- Extraction (Ch. 6) (Session: 19 - 21)
- Adsorption (Ch. 7) (Session: 22 - 27)
- Precipitation (Ch. 8) (Session: 28 - 31)

Exam 3*

- Crystallization (Ch. 9) (Session: 32 - 35)
- Drying (Ch. 11) (Session: 36 - 38)
- Process Flow Diagram (Ch. 12) (Session: 39 - 42)

Final Exam: Date will be announced by the university.
Note: *Tentative

STATEMENTS OF COE EXPECTATIONS REGARDING STUDENTS' ACADEMIC PROFICIENCY

Academic excellence is a tradition of the Tuskegee University College of Engineering, (COE). Students and faculty must collectively and proactively guard this tradition. The college hereby renews its commitment to the tradition by stating as follows:

1. Students are expected to develop self-confidence through acquisition of in-depth knowledge in all subjects through, as a minimum:
    a. Studying to understand rather than studying to get by.
    b. Challenging oneself to solve problems independent of textbooks or formulae sheets
    c. Attempting diverse and multiple problems, multiple times, for depth and breadth of knowledge

2. Students are expected to be self-motivated through setting their own goals & schedules, spending time to study, and sharing their knowledge with peers.
    a. Students should invest a minimum of two hours of study-time per week for every credit hour taken.
    b. Students should seek or establish environments that encourage positive social interaction and engages in active learning.

3. COE is committed to providing support systems to students for higher achievement through the following avenues:
    a. Direct access to instructors
    b. Archives of faculty recorded course lectures
    c. Dedicated peer tutors by fellow students at all academic levels
    d. Periodic visits by alumni and industry subject matter experts
    e. Opportunities for local and national academic related competitions

4. All COE students are expected to take advantage of all support systems. Students are particularly expected to adopt the notions of "self-confidence through knowledge acquisition" and "self-motivation to bring out best in self" as the COE fundamental culture for success.