

Course Title: Bio Engineering
Course Prefix: **CHEG**

Course No.: 4153

Section No.: **P01**

Department of | Chemical Engineering

College of | Engineering

Instructor Name: | *Dr. Michael Gyamerah*
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Office Hours: | MWF 10:00 A. M. - 11:00 A.M; MWF 1:00 – 2:30 PM & WF 2:30 P.M. – 4:00 P.M.
Virtual Office Hours: | None

Course Location: | *Gilchrest Engineering Building 109*
Class Meeting Days & Times: | MWF 12:30 p.m. - 1:50 p.m.

Catalog Description: | (3-0) Credit 3 semester hours. Design and analysis of biochemical systems with applications in biomedical engineering and metabolic processes, enzyme catalyzed reactions and product separation, biomass production, and wastewater treatment. Emphasis is placed upon the application of biochemical systems structure, reaction kinetics, transport processes, and control in the design and use of biochemical reactors and separation units.

Prerequisites: | Senior standing in any engineering major or by permission of Department Head.
Co-requisites:

Required Text: | None

Recommended Text/Readings: | 1. “Bioprocess Engineering: Basic Concepts” by Michael L. Shuler and Fikret Kargi, and Matthew DeLisa, 3rd Edition (2017)), Prentice Hall PTR (Pearson Education, Inc.) ISBN-13: 978-0137062706; ISBN-0: 0137062702
2. “Bioprocess Engineering Principles” by Pauline M. Doran, 2nd Edition (2013), Academic Press, ISBN-13: 978-0-12-220851-5

Access to Learning Resources: | PVAMU Library:
phone: (936) 261-1500;
web: <http://www.tamu.edu/pvamu/library/>
University Bookstore:
phone: (936) 261-1990;
web: <https://www.bkstr.com/Home/10001-10734-1?demoKey=d>

Course Goals or Overview:

This course emphasizes the application of chemical engineering principles to biological systems. Design and analysis of biochemical systems with applications fermentation processes, enzyme catalyzed reactions, biomass production and product separation. Biochemical reactors, transport processes and separation units will be considered. This course is designed to introduce the student of chemical engineering to analytical tools necessary for a successful career in the biological/biochemical and biopharmaceutical process industries.

Course Outcomes/Objectives

At the end of this course, the student will have achieved and demonstrated the following outcomes.

1 | Be able to demonstrate knowledge of microbial growth and kinetics

- 2 Be able to demonstrate an understanding how enzymes work and enzyme kinetics.
- 3 Be able to demonstrate knowledge of bioreactor types, their design and selection, operation, and control
- 4 Be able to demonstrate understanding the principles involved in scale-up to industrial operation and the importance of the use of scale-down procedures in bioprocessing
- 5 Be able to demonstrate knowledge of the required utilities, and sterilization and general heat transfer requirements in bioprocessing
- 6 Be able to demonstrate knowledge and understanding of the unit operations in downstream processing for product recovery, and effluent disposal

Course Requirements & Evaluation Methods

This course will utilize the following instruments to determine student grades and proficiency of the learning outcomes for the course. The course has been designed to ensure that students acquire a solid grounding in ABET 2000 outcomes *e, h and j*. Continuous assessment of students' homework assignments and exams will be used to evaluate their competence in the ABET 2000 outcomes *e, h and j* as presented below.

Exams – written tests designed to measure knowledge of presented course material

Homework Exercises – written assignments designed to supplement and reinforce course material.

Class Participation – daily attendance and participation in class discussions

Grading Matrix

Instrument	Total
Homework Assignments	20%
Exams	40%
Mid Term Exam	15%
Final Exam	25%
Total	100%
Discount for lack of participation	-10%
<i>Extra credit (as assigned by instructor)</i>	

Grade Determination:

A = 100 – 90pts;

B = 89 – 80pts;

C = 70 – 79pts;

D = 60 – 69pts;

F = 59pts or below

Course Procedures

Textbook Policy

Students must acquire the textbook that is listed as “required” on the course syllabus. The textbook must be acquired by the 10th class day. Students are not allowed to share textbooks with other students who are currently registered in the same class. Failure to acquire (or show proof of purchase) the required textbook by the 10th class day will result in the student being administratively dropped from the course. The University will assess financial obligations for the course to the student as with any other dropped class according to the fee schedule. In addition, your financial aid may be affected by the subsequent registration action(s).

Go to <http://www.pvamu.edu/pages/195.asp> for the Roy G. Perry College of Engineering Textbook Policy.

Conduct:

1. Students will conduct themselves in a manner that is respectful to their fellow classmates and the instructor at all times.
2. **Cell phones, ipads and smart phones or similar electronic devices MUST** be turned off and stowed away during class time. Students are **NOT** allowed to leave class to answer cell phones or use these devices.
3. Students caught using ipads and smart phones or similar electronic devices during exams will receive **ZERO** for the exam and be subject to sanctions as stipulated under **Academic Misconduct**.
4. Students should be prepared to stay in the classroom for the duration of the exam. Students who have any condition that may require them to leave the exam room should make prior arrangements with the Instructor. Students who decide to leave the exam room for any other reason must handover their exam

- paper and consider the exam over for them.
5. Programmable calculators are **NOT** allowed in class.
 6. Students should dress professionally and are **NOT** allowed to wear caps/hats in class.
 7. Students are NOT allowed to bring food to the classroom or eat in class
 8. Arrive to class prepared to discuss lesson; Always bring essential tools: Textbook, paper, calculator.

Submission of Assignments:

All homework assignments are due directly to the Instructor, prior to the start of class or the assignment will not be accepted. All homework assignments and exams should be written on one side of the page only, and should use the appropriate cover sheet, with the name, assignment title and date. All pages should be numbered. Failure to use the correct cover sheet will result in the assignment grade being reduced by 20%.

Formatting Documents:

Microsoft Word is the standard word processing tool used at PVAMU. If you're using other word processors, be sure to use the "save as" tool and save the document in either the Microsoft Word, Rich-Text, or plain text format.

Exam Policy

Exams should be taken as scheduled. No makeup examinations will be allowed except under documented emergencies (See Student Handbook).

Professional Organizations and Journals

As directed by instructor.

References

As directed by instructor.

16 WEEK CALENDAR

Week One: Topic	Review of Syllabus; Course Overview ; Introduction: Steps in Bioprocess Development; Microbial growth and kinetics; stoichiometry of cell growth and product formation
Chapter (s):	1, 2 and 6 (Shuler and Kargi) and Handout
Assignment (s):	Homework 1; Reading: Chapter 1, 2 and 6 (Shuler and Kargi) and Handout
Week Two: Topic	Microbial growth and kinetics, and fermentation medium design; stoichiometry of cell growth and product formation
Chapter (s):	2 and 6 (Shuler and Kargi)
Assignment (s):	Reading: Chapters 2 and 6 (Shuler and Kargi)
Week Three: Topic	Microbial growth and kinetics, and fermentation medium design; Enzymes and enzyme kinetics
Chapter (s):	3, 6 and 7 (Shuler and Kargi)
Assignment (s):	Homework 2; Reading: Chapters 3, 6 and 7 (Shuler and Kargi)
Week Four: Topic	Enzymes and enzyme kinetics
Chapter (s):	3 (Shuler and Kargi)
Assignment (s):	Reading: Chapter 3 (Shuler and Kargi)
Week Five: Topic	Energy Balances: General energy balance equation and heat transfer, maintenance of fermentation temperature
Chapter (s):	10 (Shuler and Kargi)
Assignment (s):	Exam 1; Reading: Chapter 10(Shuler and Kargi)
Week Six: Topic	Energy Balances: Heating, cooling and refrigeration, and sterilization.
Chapter (s):	10 (Shuler and Kargi)
Assignment (s):	Homework 3; Reading: Chapter 10 (Shuler and Kargi)
Week Seven: Topic	Mass Transfer: Role of diffusion in bioprocessing, and aeration of fermentation media
Chapter (s):	9 and 10 (Shuler and Kargi)
Assignment (s):	Exam 2; Reading: Chapters 9 and 10 (Shuler and Kargi)
Week Eight: Topic	Mass Transfer: Oxygen transfer in fermentors and measurement of k_{La}
Chapter (s):	9 and 10 (Shuler and Kargi)

Assignment (s):	Mid Term; Reading assignment: Chapters 9 and 10 (Shuler and Kargi)
Week Nine: Topic	
Chapter (s):	Spring Break
Assignment (s):	
Week Ten: Topic	Bioreactor Engineering: Bioreactor design, bioreactor configurations and operation and scale-up using scale-down procedures
Chapter (s):	9 and 10 (Shuler and Kargi)
Assignment (s):	Reading: Chapters 9 and 10 (Shuler and Kargi)
Week Eleven: Topic	Bioreactor Engineering: Bioreactor configurations and operation, monitoring and control
Chapter (s):	10 (Shuler and Kargi)
Assignment (s):	Homework 4; Reading: Chapter 10 (Shuler and Kargi)
Week Twelve: Topic	Downstream processing: Cell disruption, filtration and centrifugation
Chapter (s):	11 (Shuler and Kargi)
Assignment (s):	Exam 3; Reading: Chapter 11(Shuler and Kargi)
Week Thirteen: Topic	Downstream processing: Liquid-liquid extraction, Adsorption and Chromatography
Chapter (s):	11 (Shuler and Kargi)
Assignment (s):	Reading: Chapter 11 (Shuler and Kargi)
Week Fourteen: Topic	Downstream processing: Adsorption and Chromatography
Chapter (s):	11 (Shuler and Kargi)
Assignment (s):	Reading: Chapter 11 (Shuler and Kargi)
Week Fifteen: Topic	Course Review
Chapter (s):	All chapters listed above
Assignment (s):	
Week Sixteen	Final Exam

University Rules and Procedures

Disability statement (See Student Handbook):

Students with disabilities, including learning disabilities, who wish to request accommodations in class should register with the Services for Students with Disabilities (SSD) early in the semester so that appropriate arrangements may be made. In accordance with federal laws, a student requesting special accommodations must provide documentation of their disability to the SSD coordinator.

Academic misconduct (See Student Handbook):

You are expected to practice academic honesty in every aspect of this course and all other courses. Make sure you are familiar with your Student Handbook, especially the section on academic misconduct. Students who engage in academic misconduct are subject to university disciplinary procedures.

Forms of academic dishonesty:

1. Cheating: deception in which a student misrepresents that he/she has mastered information on an academic exercise that he/she has not mastered; giving or receiving aid unauthorized by the instructor on assignments or examinations.
2. Academic misconduct: tampering with grades or taking part in obtaining or distributing any part of a scheduled test.
3. Fabrication: use of invented information or falsified research.
4. Plagiarism: unacknowledged quotation and/or paraphrase of someone else's words, ideas, or data as one's own in work submitted for credit. Failure to identify information or essays from the Internet and submitting them as one's own work also constitutes plagiarism.

Nonacademic misconduct (See Student Handbook)

The university respects the rights of instructors to teach and students to learn. Maintenance of these rights requires campus conditions that do not impede their exercise. Campus behavior that interferes with either (1) the instructor's ability to conduct the class, (2) the inability of other students to profit from the instructional program, or (3) campus behavior that interferes with the rights of others will not be tolerated. An individual engaging in such disruptive behavior may be subject to disciplinary action. Such incidents will be adjudicated by the Dean of Students under nonacademic procedures.

Sexual misconduct (See Student Handbook):

Sexual harassment of students and employers at Prairie View A&M University is unacceptable and will not be tolerated. Any member of the university community violating this policy will be subject to disciplinary action.

Attendance Policy:

Prairie View A&M University requires regular class attendance. Excessive absences will result in lowered grades. Excessive absenteeism, whether excused or unexcused, may result in a student's course grade being reduced or in assignment of a grade of "F". Absences are accumulated beginning with the first day of class.

Student Academic Appeals Process

Authority and responsibility for assigning grades to students rests with the faculty. However, in those instances where students believe that miscommunication, errors, or unfairness of any kind may have adversely affected the instructor's assessment of their academic performance, the student has a right to appeal by the procedure listed in the Undergraduate Catalog and by doing so within thirty days of receiving the grade or experiencing any other problematic academic event that prompted the complaint.

Technical Considerations for Online and Web-Assist Courses

Minimum Hardware and Software Requirements:

- Pentium with Windows XP or PowerMac with OS 9
- 56K modem or network access
- Internet provider with SLIP or PPP
- 8X or greater CD-ROM
- 64MB RAM
- Hard drive with 40MB available space
- 15" monitor, 800x600, color or 16 bit
- Sound card w/speakers
- Microphone and recording software
- Keyboard & mouse
- Netscape Communicator ver. 4.61 or Microsoft Internet Explorer ver. 5.0 /plug-ins
- Participants should have a basic proficiency of the following computer skills:
 - Sending and receiving email
 - A working knowledge of the Internet
 - Proficiency in Microsoft Word
 - Proficiency in the Acrobat PDF Reader
 - Basic knowledge of Windows or Mac O.S.

Netiquette (online etiquette): students are expected to participate in all discussions and virtual classroom chats when directed to do so. Students are to be respectful and courteous to others in the discussions. Foul or abusive language will not be tolerated. When referring to information from books, websites or articles, please use APA standards to reference sources.

Technical Support: Students should call the Prairie View A&M University Helpdesk at 936-261-2525 for technical issues with accessing your online course. The helpdesk is available 24 hours a day/7 days a week. For other technical questions regarding your online course, call the Office of Distance Learning at 936-261-3290 or 936-261-3282

Communication Expectations and Standards:

All emails or discussion postings will receive a response from the instructor within 48 hours.

You can send email anytime that is convenient to you, but I check my email messages continuously during the day throughout the work-week (Monday through Friday). I will respond to email messages during the work-week by the close of business (5:00 pm) on the day following ***my receipt*** of them. Emails that I receive on Friday will be responded to by the close of business on the following Monday.

Submission of Assignments:

Assignments, Papers, Exercises, and Projects will distributed and submitted through your online course. Directions for accessing your online course will be provided. Additional assistance can be obtained from the Office of Distance Learning.

Discussion Requirement:

Because this is an online course, there will be no required face to face meetings on campus. However, we will participate in conversations about the readings, lectures, materials, and other aspects of the course in a true seminar fashion. We will accomplish this by use of the discussion board.

Students are required to log-on to the course website often to participate in discussion. It is strongly advised that you check the discussion area daily to keep abreast of discussions. When a topic is posted, everyone is required to participate. The exact use of discussion will be determined by the instructor.

It is strongly suggested that students type their discussion postings in a word processing application and save it to their PC or a removable drive before posting to the discussion board. This is important for two reasons: 1) If for some reason your discussion responses are lost in your online course, you will have another copy; 2) Grammatical errors can be greatly minimized by the use of the spell-and-grammar check functions in word processing applications. Once the post(s) have been typed and corrected in the word processing application, it should be copied and pasted to the discussion board.