Course Description from Bulletin
The analysis and design of microbial reactions and biochemical unit operations, including processes used in conjunction with bioreactors, are investigated in this course. Industrial enzyme technologies are developed and explored. A strong focus is given to the basic processes for producing fermentation products and biofuels. Biochemical systems for organic oxidation and fermentation and inorganic oxidation and reduction are presented. Prerequisites: CBEN375, CHGN428, CHGN462. 3 hours lecture; 3 semester hours.

Text Book
Bioprocess Engineering, Basic Concepts, 3rd ed.
Michael L. Shuler, Fikret Kargi, & Matthew DeLisa
Prentice Hall, 2017

Supplemental Text & Materials
Bioprocess Engineering Principles, 2nd ed.
Pauline Doran
Elsevier Science & Technology, 2012

Course Objective
The objective of this course is to acquaint the student with the engineering fundamentals associated with biochemical technology. The student will have a greater understanding of the application of biology & biotechnology in an overall process setting. This should better enable the student to review & use new developments in microorganisms, analytical tools, & process designs.

Emphasis will be placed on comparing similarities & differences between the three major biotechnology industries:
- Alternate fuels & commodity chemicals
- Biopharmaceuticals
- Food science.

Topics
Introduction & Basics
- Material Properties & Stoichiometry
- Transient Material Balances
- Energy Balances
- Data Analysis
- Enzyme Kinetics
- Cell Growth & Decay Kinetics
- Fluid & Slurry Flow
- Heat Transfer
- Moisture Content, Drying, & Evaporation
- Mass Transfer & Transport Phenomena
- Filtration & Centrifugation
- Flocculation & Coagulation
- Purification & Recovery Technologies
- Scale-up
- Sterilization
- Instrumentation & Control

Engineering Principles
- Batch & Continuous Bioreactors
- Tank Mixing, Agitation, & Aeration
- CBEN 460 Fall 2017
Grading Policies

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Homework</td>
<td>25%</td>
</tr>
<tr>
<td>Short Quizzes</td>
<td>15%</td>
</tr>
<tr>
<td>Mid-Term Exams (2)</td>
<td>20% each</td>
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<tr>
<td>Final Exam (cumulative)</td>
<td>20%</td>
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The Mid-Term Exams will be given during the normal class period. The Final Exam will be given during Mines’ specified Final Exam week. If the student is unable to take any of the exams during scheduled period then he/she must make special arrangements with the instructor to take the exam prior to the scheduled time.

There will also be multiple (5 to 10) short quizzes given throughout the semester. The quizzes will be 10 minutes in length and given at the very beginning of the class. Quizzes will be unannounced. There will be no make-up quizzes. It will be up to the discretion of the instructor to excuse an absent student from a particular quiz. To be eligible for an excused absence the student must notify the instructor of the absence via email before the class period.

There will be about 5 to 10 homework assignments. Homework will be announced at least one week before it is due. Homework will be due by 9:00 pm on the due date and is to be emailed to the instructor. Late homework will not be accepted.

Policy on academic integrity/misconduct
The Colorado School of Mines affirms the principle that all individuals associated with the Mines academic community have a responsibility for establishing, maintaining and fostering an understanding and appreciation for academic integrity. In broad terms, this implies protecting the environment of mutual trust within which scholarly exchange occurs, supporting the ability of the faculty to fairly and effectively evaluate every student’s academic achievements, and giving credence to the university’s educational mission, its scholarly objectives and the substance of the degrees it awards. The protection of academic integrity requires there to be clear and consistent standards, as well as confrontation and sanctions when individuals violate those standards. The Colorado School of Mines desires an environment free of any and all forms of academic misconduct and expects students to act with integrity at all times.

Academic misconduct is the intentional act of fraud, in which an individual seeks to claim credit for the work and efforts of another without authorization, or uses unauthorized materials or fabricated information in any academic exercise. Student Academic Misconduct arises when a student violates the principle of academic integrity. Such behavior erodes mutual trust, distorts the fair evaluation of academic achievements, violates the ethical code of behavior upon which education and scholarship rest, and undermines the credibility of the university. Because of the serious institutional and individual ramifications, student misconduct arising from violations of academic integrity is not tolerated at Mines. If a student is found to have engaged in such misconduct sanctions such as change of a grade, loss of institutional privileges, or academic suspension or dismissal may be imposed.

The complete policy is online.

Disability support statement
The Colorado School of Mines is committed to ensuring the full participation of all students in its programs, including students with disabilities. If you are registered with Disability Support Services (DSS) and I have received your letter of accommodations, please contact me at your earliest convenience so we can discuss your needs in this course. For questions or other inquiries regarding disabilities, I encourage you to visit disabilities.mines.edu for more information.