COLLEGE OF ENGINEERING
Chemical & Environmental Engineering

CHEE 377 – Microbiology for Engineers

MWF 1:00PM-1:50PM in AME S212

Description of Course

This course focuses on the principles of microbiology, including physiology, metabolism, genetics, and ecology. The course explores fundamental microbial processes as well as their environmental significance and application in environmental engineering. In addition to traditional microbiology theory, modeling will be used to help explore microbial kinetics.

Course Prerequisites:

Advanced Standing in Engineering

Instructor and Teaching Team Contact Information

Instructor:	Dr. Byron Hempel
Email:	byronhempel@arizona.edu
Office:	HB 105D
Student Hours:	See D2L
Teaching Team Info	See D2L

Course Format and Teaching Methods

This course is an in-person course where students are expected to attend lectures three times per week. During lecture, students are expected to interact with formative assessment polling questions, work on group mini assignments/tasks in class, and engage in discussions on pair, small group, and large group discussion. Outside of the classroom, students are expected to collaborate on homework assignments and reading assignments in preparation for and reinforcement of lecture material. The class will include various forms of active engagement to facilitate learning.

Course Objectives

The course will cover the following topics, of which students are expected to gain a basic working understanding. The course will have five main sections with the subtopics below:

1. Cells and What They Do
2. Inside the Cell
    a. Biomolecules
    b. Metabolism

   c. Bioxidation and bioreduction
   d. Biodegradation
   e. Biosynthesis
   f. Cells and cellular aggregates
   g. Reproduction, proliferation and growth
3. Cell Types
   a. Microbial ecology
   b. Groups of anaerobic fermenting prokaryotes
   c. Anoxic prokaryotes
   d. Microaerophilic and facultative aerobic microbes
   e. Aerobic prokaryotes
4. Specialty Topics
   a. Students will select and learn in depth from 3 of the following topics:
      i. Microorganisms and public health
      ii. Biosafety in civil and environmental engineering
      iii. Biotechnical processes
      iv. Microbiological methods used in engineering
      v. Aquatic ecosystems
      vi. Biotreatment of polluted water
      vii. Anaerobic and anoxic biotreatment of waste
      viii. Aerobic biotreatment of wastewater
      ix. Value-added microbial byproducts
      x. Biotreatment of industrial hazardous wastes
      xi. Solid waste biotreatment
      xii. Bioremediation of polluted soil
      xiii. Biomaterial and bioprocess of construction biotechnology
      xiv. Microbiology of air and air biotreatment
      xv. Microbiology of closed ecosystems
      xvi. Biodeterioration, biocorrosion, and biofouling

Expected Learning Outcomes

Upon completion of the course, students will be able to:

Content or "Hard Skills" – Directly Measured During Course

- Describe* the various types of microbes found in the environment.
- Describe* the interactions of cells in the environment.
- Describe* how cells function on a molecular and organelle level to survive.
- Analyze data to determine kinetics of cellular reactions.
- Define the various types of cells in oxygen rich or deprived environments.

- Explain three different specialty topics of application for microbes in environmental engineering.

*Descriptions are encouraged pictorially, verbally, and mathematically.

Professional Skills or "Soft Skills" – Indirectly Measured During Course

- Work well in a team and communicate effectively to all members. This involves identifying and rectifying group conflicts.
- Identify personal difficulties during problem solving and to take corrective action.
- Apply a growth mindset to learning about microbes and build self-efficacy of learning abilities.
- Conceptually link levels of information and ideas in a problem-solving framework.

Required Texts or Readings

The following text will be used through the website Perusall.com:

Volodymyr Ivanov. (2020). *Environmental microbiology for engineers*. Crc Press. ISBN 9780367321659

Required or Special Materials

Students will need a laptop, the most current version of MatLab, and the Microsoft Suite 365 downloaded (to have Excel access). Note, if you are using a Mac, it may help to use the virtual desktop vcat.arizona.edu. It is not required, but TurningPoint clickers are encouraged in the course.

Assignments and Examinations: Schedule/Due Dates

There will be 11 homework assignments due for the course, due at the end of almost every week graded on a summation of 2 P/F items. There will be 34 Perusall readings which will be graded on a P/F basis. There will be four midterms and a final, worth 6 or 7 pass items each. You have the option to substitute a project for the final exam. There is an experiential learning project in week 3, and specialty jigsaw topics for the last three lectures of the course. There are extra assignments under "character growth;" see D2L for more information. Late work will not be accepted.

Experiential Learning Project (3 P/F items)

During the third week of the course, class will not be in person. In place of in-person classes, students will select one of a few options for a learning project. See D2L for options and a more in-depth description.

Perusall Readings (32 P/F items)

Each Perusall reading will be graded on a pass/fail basis. Complete the readings before each lecture and make at least three interactions with your peers on the document. This can include a general comment, or a reply to another student's comment. Grades will be updated throughout the semester to reflect the P/F.

Homework (22 P/F items)

There are eleven homework assignments, each with two pass/fail criteria. They will each come with a few grading criteria on a pass/fail basis. See D2L for more information.

Midterms (four exams worth 6 or 7 P/F items each)

Each exam will have an individual and group portion. Individual portions are modeled off the Fundamentals of Engineering (FE) exam with around 2.5 minutes per question in a D2L quiz. The group portion of the exam will be project based, where students will have the option to do a preview exam which closely reflects the given exam. There will be three pass/fail sections for the individual portion and three or four pass/fail sections for the written group portion.

Final or Final Replacement Project (worth 7 P/F items)

The final exam will be modeled similarly to the in-semester exams. You are welcome to substitute the final for a final replacement project. See D2L for options.

Specialty Topics and Peer Review (worth 6 P/F items)

The last three lecture days in the course will involve peer-led teaching in the classroom. Groups or individuals will pick a specialty topic for the day and disseminate what they find to peers in the class. More information will be available when we get closer to these class days. Each day will provide two P/F items for each group: 1 P/F item for the information, and 1 P/F for peer feedback over the three days of class.

Character Growth (up to 5 P/F items)

Fundamentally, I believe that my role as an instructor is to help students not only learn content, but also develop character as individuals. See D2L page for more information on character growth.

Final Examination

The final exam will be on the last day of the course. You can opt to replace the final exam with a project. See D2L for more information.

Final Exam Regulations and Final Exam Schedule: https://registrar.arizona.edu/faculty-staff-resources/room-class-scheduling/schedule-classes/final-exams

Grading Scale and Policies

University policy regarding grades and grading systems is available at http://catalog.arizona.edu/policy/grades-and-grading-system

Specifications Grading

All my courses follow the formatting of "specifications grading." Specifications grading relies on a pass/fail grading of assignments and assessments, the structuring of course content into modules linked to learning outcomes, and the bundling of assignments and assessments within those modules. The completion of course modules and bundles is linked to traditional course grades. The course will rely heavily on group work. Learning together, and giving and receiving feedback, is a subject we will discuss in depth. *It is the single most valuable life skill you can take away from this course.*

Grade Calculating

There are only two grades for any component to an assignment: Satisfactory and Unsatisfactory. Satisfactory (pass) is full credit. Unsatisfactory (fail, poor quality, late, or not submitted) is no credit. Some assignments, such as homework, may be a summation of pass/fail items. At the end of the course, we tally.

Grades

Grades Overview		
Item	P/F Items	Notes
Profile	1	Due at end of week 1
PLR	34	Before all lectures
HW	22	2 P/F Items Each
Exam 1 & 4	14	3 P/F Ind. 4 P/F Group
Exam 2 & 3	12	3 P/F Ind. 3 P/F Group
ELP	3	3rd Week of Class
Jigsaw	6	2 P/F Items Each
Project/Final	7	3 P/F Ind. 4 P/F Group
CG	1	Can get up to 5 (4 are extra credit)
Total	100	

Letter Grade	A	B	C	D	E

Number of P/F Items Needed	90	80	70	60	<60

Incomplete (I) or Withdrawal (W):

Requests for incomplete (I) or withdrawal (W) must be made in accordance with University policies, which are available at http://catalog.arizona.edu/policy/grades-and-grading-system#incomplete and http://catalog.arizona.edu/policy/grades-and-grading-system#Withdrawal respectively.

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Scheduled Topics/Activities

Week	Date	Homework/Peer Review	Prelecture ID	Subtopics	Lecture Number
1	21-Aug		P1	Introduction to Course	1
	23-Aug		P2	Intro to Course	2
	25-Aug	Profile	P3	Engr Practice 1	3
2	28-Aug	Work on HW1	P4	Microorganisms	4
	30-Aug		P5	Microorganisms Pt2	5
	1-Sep	HW1 Due on Sunday	P6	Engr Practice 2	6
3	4-Sep	Experiential Learning Project		No class	holiday
	6-Sep				ELP
	8-Sep				
4	11-Sep	Work on HW2	P7	Biomolecules	7
	13-Sep		P8	Biomolecules Pt2	8
	15-Sep	HW2 Due on Sunday	P9	Engr Practice 3	9
5	18-Sep	Work on HW3	P10	Metabolism	10
	20-Sep		P11	Metabolism Pt2	11
	22-Sep	HW3 Due on Sunday		Exam 1	exam
6	25-Sep	Work on HW4	P12	Biooxidation and Bioreduction	12
	27-Sep		P13	Biooxidation and Bioreduction Pt2	13
	29-Sep	HW4 Due on Sunday	P14	Engr Practice 4	14
7	2-Oct	Work on HW5	P15	Biodegradation	15
	4-Oct		P16	Biodegradation Pt2	16
	6-Oct	HW5 Due on Sunday	P17	Engr Practice 5	17
8	9-Oct	Work on HW6	P18	Biosynthesis	18
	11-Oct		P19	Biosynthesis Pt2	19
	13-Oct	HW6 Due on Sunday		Exam 2	exam

9	16-Oct	Work on HW7	P20	Cells and Cellular Aggregates	20
	18-Oct		P21	Cells and Cellular Aggregates Pt2	21
	20-Oct	HW7 Due on Sunday	P22	Engr Practice 6	22
10	23-Oct	Work on HW8	P23	Reproduction, Proliferation, and Growth	23
	25-Oct		P24	Reproduction, Proliferation, and Growth Pt2	24
	27-Oct	HW8 Due on Sunday		Exam 3	exam
11	30-Oct	No Homework	P25	Microbe Classification	25
	1-Nov		P26	Microbial Environments	26
	3-Nov		P27	Engr Practice 7	27
12	6-Nov	Work on HW9	P28	Anaerobic Fermentation Prokaryotes	28
	8-Nov		P29	Anoxic Prokaryotes	29
	10-Nov	HW9 Due on Sunday		Holiday	holiday
13	13-Nov	Work on HW10	P30	Microaerophilic and Facultative Aerobic Prokaryotes	30
	15-Nov		P31	Engr Practice 8	31
	17-Nov	HW10 Due on Sunday	P32	Engr Practice 9	32
14	20-Nov	Work on HW11	P33	Aerobic Prokaryotes	33
	22-Nov		P34	Engr Practice 10	34
	24-Nov	Eat food		Holiday	holiday
15	27-Nov	HW11 Due on Monday	Make up	Exam 4	exam
	29-Nov	Jigsaw		Jigsaw Work Day	JS
	1-Dec			Jigsaw	JS
16	4-Dec	Jigsaw		Jigsaw	JS
	6-Dec			Jigsaw	JS
	13-Dec	10:30 AM - 12:30PM		Final Exam / FP Due on Sunday	exam

Teaching Philosophy

I have a strong student-centered focus for my teaching philosophy. I truly believe in student success and adapting my instruction to ensure an ideal learning environment for students. Several different instructional mindsets to help me accomplish my goal are:

1. Everyone has the right and ability to be successful in my courses. I provide many chances for low-stakes points for my courses. As a future engineer, I want to provide a level of rigor (appropriate for each course!) that will promote my students to be the best engineers they can be.
2. I vary my teaching methods to ensure that my courses are accessible to all students. I frequently was students to give any feedback onto what works or does not work for them so I can modify my instruction.
3. I believe in transparency and open communication, meaning I wish to be as clear as possible in class and give students insight into my teaching decisions. I want my classroom to be one where students can feel free to express their own ideas and thoughts to contribute to the wider discussions.
4. Foremost, I believe in student-centered active learning using evidence-based teaching practices (EBTP). Literature through EBTP support nearly every aspect and decision in this course. I am always open to students' feedback on each practice so I can continually develop them. Just as I want students to have a growth mindset, I too want to continuously improve my courses to be the best they can be.

Classroom Behavior Policy

To foster a positive learning environment, students and instructors have a shared responsibility. We want a safe, welcoming, and inclusive environment where all of us feel comfortable with each other and where we can challenge ourselves to succeed. To that end, our focus is on the tasks at hand and not on extraneous activities (e.g., texting, chatting, reading a newspaper, making phone calls, web surfing, etc.).

Additional Resources for Students

UA Academic policies and procedures are available at http://catalog.arizona.edu/policies

Campus Health
http://www.health.arizona.edu/
Campus Health provides quality medical and mental health care services through virtual and in-person care.
Phone: 520-621-9202

Counseling and Psych Services (CAPS)

https://health.arizona.edu/counseling-psych-services
CAPS provides mental health care, including short-term counseling services.
Phone: 520-621-3334

The Dean of Students Office's Student Assistance Program
http://deanofstudents.arizona.edu/student-assistance/students/student-assistance
Student Assistance helps students manage crises, life traumas, and other barriers that impede success. The staff addresses the needs of students who experience issues related to social adjustment, academic challenges, psychological health, physical health, victimization, and relationship issues, through a variety of interventions, referrals, and follow up services.
Email: DOS-deanofstudents@email.arizona.edu
Phone: 520-621-7057

Survivor Advocacy Program
https://survivoradvocacy.arizona.edu/
The Survivor Advocacy Program provides confidential support and advocacy services to student survivors of sexual and gender-based violence. The Program can also advise students about relevant non-UA resources available within the local community for support.
Email: survivoradvocacy@email.arizona.edu
Phone: 520-621-5767

Confidentiality of Student Records

http://www.registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa?topic=ferpa

University-wide Policies link

Links to the following UA policies are provided here,
https://academicaffairs.arizona.edu/syllabus-policies

- Absence and Class Participation Policies
- Threatening Behavior Policy
- Accessibility and Accommodations Policy
- Code of Academic Integrity
- Nondiscrimination and Anti-Harassment Policy
- Subject to Change Statement