

Syllabus for ENCH 482/682. Biochemical Engineering

Instructor: Dr. David Garcia Office: ENG 315, dgarcia5@umbc.edu

Office Hours: By appointment

Logistics: This course meets Tuesdays and Thursdays, 1:00 to 2:15 PM, in Math & Psychology 102 on the main campus, from August 24 through December 9, 2026.

Description: Introduction to biochemical, microbiological and physical phenomena relevant in the bioprocess industry: basic biochemistry, enzyme and cell growth kinetics, modern biological techniques (e.g., DNA sequencing, microarray analysis, proteomics) and topics related to industrial fermentation. The course applies chemical engineering principles to systems that use a biological catalyst, an enzyme or a whole cell, to carry out a desired chemical transformation, and builds from the biology of the cell up through the design and operation of production-scale bioreactors. The week will generally be split into two sections. Tuesdays will be lecture material on that week's topic, and Thursdays will be discussion time to go over a paper from the primary literature connected to that topic. Lectures will directly inform the papers chosen and the discussion on them, as well as the exams.

Course Objectives:

In this course, you will be expected to learn and apply the following:

- Understand and discuss basic biological principles and techniques in molecular biology relevant to biochemical engineering and the production of microbially derived products.
- Solve problems, analyze data, and draw conclusions regarding biochemical transformations and their connection to industrial processes.
- Understand how principles of transport (heat, mass, momentum), microbial growth kinetics, and stoichiometry are applied in the design, scale-up, and control of biological production.
- Develop the ability to read, analyze, and discuss the biochemical engineering literature to encourage creative thinking and to develop writing skills.
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Prerequisites: ENCH 427 and ENCH 440 with a grade of 'C' or better.

Brief overview of topics to be covered (Subject to Change):

Week	Tuesday	Lecture Topic	Thursday	Literature Paper & Activities
1	Aug-25-2026	Topic 1-Biochemical & Bioprocess Engineering	Aug-27-2026	Literature Paper 1-discussion
2	Sep-1-2026	Topic 2-Basic Biology & Biochemistry of Cells, Part I	Sep-3-2026	Literature Paper 2-discussion
3	Sep-8-2026	Topic 2-Basic Biology & Biochemistry of Cells, Part II	Sep-10-2026	Literature Paper 3-discussion
4	Sep-15-2026	Topic 3-Synthetic Biology, Part 1	Sep-17-2026	Literature Paper 4-discussion Take-Home Exam 1 released

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5	Sep-22-2026	Topic 3-Synthetic Biology, Part 2	Sep-24-2026	Literature Paper 5-discussion Take-Home Exam 1 due before class
6	Sep-29-2026	Topic 4-Enzyme Kinetics	Oct-1-2026	Literature Paper 6-discussion
7	Oct-6-2026	Topic 4-Enzyme Inhibition & Immobilization	Oct-8-2026	Literature Paper 7-discussion
8	Oct-13-2026	Topic 5-Genetics & Cellular Control Systems	Oct-15-2026	Literature Paper 8-discussion
9	Oct-20-2026	Topic 6-Metabolism, Part I	Oct-22-2026	Literature Paper 9-discussion Select topics for final paper
10	Oct-27-2026	Topic 6-Metabolism, Part II	Oct-29-2026	Literature Paper 10-discussion Take-Home Exam 2 released
11	Nov-3-2026	Topic 7-Metabolic Engineering	Nov-5-2026	Literature Paper 11-discussion Take-Home Exam 2 due before class
12	Nov-10-2026	Topic 8-Genetic Engineering	Nov-12-2026	Literature Paper 12-discussion Outlines for final paper due before class
13	Nov-17-2026	Topic 9-Cell Growth Kinetics, Part I	Nov-19-2026	Literature Paper 13-discussion
14	Nov-24-2026	Topic 9-Cell Growth Kinetics, Part II	Nov-26-2026	No class-Thanksgiving recess
15	Dec-1-2026	Topic 10-Bioreactor Operation, Selection, Scale-up, and Control	Dec-3-2026	Literature Paper 14-discussion
16	Dec-8-2026	Literature Paper 15-discussion (bioreactors) Course wrap-up and review; final presentations begin	Dec-10-2026	No Class
Final	Final paper due during the University final examination period (December 10–16, 2026); exact date and time TBD.			

Grading:

Metric	Percentage of Grade:
Class Attendance	5
Class Participation and Discussion	20
Exams	40
Final Paper	20

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Homework	15
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Participation: You'll notice that participation is a pretty significant part of this class, as each Thursday session will be spent discussing a piece of literature related to the topic covered in that week's Tuesday lecture. Participation will be dependent on reading the paper and being able to make insightful observations, questions, or critiques. You don't need to be compelled to absolutely say something for each paper that we discuss. Some may be more interesting to you than others, but if you're worried about the grade, come talk to me or find alternative ways to engage with the literature. A well-marked-up paper examining the paper may also suffice.

Exams: Each exam will be structured with 4-8 take-home questions that will ask the student to answer using both material from the class and from literature. Questions will be structured as research questions to be addressed or as traditional problems to be solved. Each Exam will be due one week after the class date it is assigned. The exact time will be on Blackboard.

Term Papers: For undergrads papers will be structured as either literature reviews that present a general topic and discuss the current literature surrounding that topic or will analyze a specific paper and critique or support the authors' methods, analysis, and conclusions. Undergraduate papers will be 6-8 single-spaced pages, including figures. Graduate student papers will be 10-12 single-spaced pages, including figures, and follow an NSF or NIH style grant application. Students should feel free to discuss with the instructor if they would like to use this as an opportunity to prepare a specific fellowship application. The only caveat is that it must largely be based on research.

Homework: Homework will largely be short project-based, and will be due one week after it has been assigned.

Formatting: Unless otherwise specified, all papers and take-home exams should be typed in 12-point font, printed in black ink, and double-spaced with one-inch margins. You will be submitting your papers and exams on Blackboard as .doc or .docx files and receive feedback as digital comments.

Late Work and Extensions

Given the constraints of the academic schedule, our classes and assignments have to be on a timeline; as a result, I ask that you communicate with me well in advance if you need a deadline to be relaxed.

Additionally, if circumstances arise that impact your ability to participate in class or meet deadlines, please let me know so we can work some alternative plans. I don't need details, but if there are circumstances beyond your control (illness, housing issues, grief, etc.), communicate it as quickly as you can so we can come up with a plan to make sure all of the work required for the course is completed. Participation during days where lurchers discussed may be made up by delivering a self-annotated version of the paper.

Accessibility:

There is no one correct way to learn and everyone has different means of most effectively engaging with demonstrating knowledge. While we have a variety of means of doing so in this class, I welcome input on the course materials, lessons, and examinations more accessible and inclusive. If there are any accommodations that may facilitate your success in the class, please

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let me know regardless of documentation status.

If you have a disability for which you are requesting accommodations, please contact the Office of [Accessibility and Disability Services](#) so we can determine reasonable accommodations for this course.

Resources:

Writing Center: I recommend making use of the writing center if you need assistance with any of the presentations or writing assignments that will be part of this course. See academicsuccess.umbc.edu/writing-center for more info.

Classroom Etiquette:

In classrooms, we are often expected to behave in ways that are counterintuitive to our normal behavior and even workplace expectations. Always sitting still in class can sometimes get in the way of learning, and it's certainly not unusual in a real workplace to get up and move if you need a quick break. I welcome you to stand up, stim, move your body, stretch, pace, or do whatever else you need to remain comfortable and engaged during discussions

Discussions may sometimes, even in scientific environments, get heated. If you disagree with someone's perspective, listen first, and think carefully about your rationale. I invite you to share your perspectives, whatever they may be, as long as you do so with respect for everyone.

Laptops are allowed, but please refrain from using the Internet for non-class purposes while we are in class.

Dr. Garcia's Availability: The easiest way to get in contact with me if you need something quickly is to send me an email at dgarcia5@umbc.edu. I generally respond within 24 hours and check my email often between 9 AM and 5 PM.

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Accessibility and Disability Accommodations, Guidance and Resources:

Accommodations for students with disabilities are provided for all students with a qualified disability under the Americans with Disabilities Act (ADA & ADAAA) and Section 504 of the Rehabilitation Act who request and are eligible for accommodations. The Office of Student Disability Services (SDS) is the UMBC department designated to coordinate accommodations that creates equal access for students when barriers to participation exist in University courses, programs, or activities.

If you have a documented disability and need to request academic accommodations in your courses, please refer to the SDS website at sds.umbc.edu for registration information and office procedures.

SDS email: disAbility@umbc.edu

SDS phone: [410-455-2459](tel:410-455-2459)

If you will be using SDS approved accommodations in this class, please contact the instructor to discuss implementation of the accommodations. During remote instruction requirements due to COVID, communication and flexibility will be essential for success.

Sexual Assault, Sexual Harassment, and Gender Based Violence and Discrimination

[UMBC Policy](#) in addition to federal and state law (to include Title IX) prohibits discrimination and harassment on the basis of sex, sexual orientation, and gender identity in University programs and activities. Any student who is impacted by sexual harassment, sexual assault, domestic violence, dating violence, stalking, sexual exploitation, gender discrimination, pregnancy discrimination, gender-based harassment, or related retaliation should contact the University's Title IX Coordinator to make a report and/or access support and resources. The Title IX Coordinator can be reached at ecr@umbc.edu or 410-455-1717.

You can access support and resources even if you do not want to take any further action. You will not be forced to file a formal complaint or police report. Please be aware that the University may take action on its own if essential to protect the safety of the community.

If you are interested in making a report, please use the [Online Reporting/Referral Form](#). Please note that, if you report anonymously, the University's ability to respond will be limited.

Notice that Faculty and Teaching Assistants are Mandated Reporters with Mandatory Reporting Obligations

All faculty members and teaching assistants are considered Mandated Reporters, per UMBC's [Interim Policy on Sex Discrimination, Sex-Based Harassment, and Sexual Misconduct](#). Faculty and teaching assistants therefore required to report all known information regarding alleged conduct that may be a violation of the Policy to the Title IX Coordinator, even if a student discloses an experience that occurred before attending UMBC and/or an incident that only involves people not affiliated with UMBC. Reports are required regardless of the amount of detail provided and even in instances where support has already been offered or received.

While faculty members want to encourage you to share information related to your life experiences through discussion and written work, students should understand that faculty are required to report past and present sexual harassment, sexual assault, domestic and dating

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violence, stalking, and gender discrimination that is shared with them to the Title IX Coordinator so that the University can inform students of their [rights, resources, and support](#). While you are encouraged to do so, you are not obligated to respond to outreach conducted as a result of a report to the Title IX Coordinator.

If you need to speak with someone in confidence, who does not have an obligation to report to the Title IX Coordinator, UMBC has a number of [Confidential Resources](#) available to support you:

[Retriever Integrated Health](#) (Main Campus): 410-455-2472; Monday – Friday 8:30 a.m. – 5 p.m.; For After-Hours Support, Call 988.

[Center for Counseling and Well-Being](#) (Shady Grove Campus): 301-738-6273; Monday-Thursday 10:00a.m. – 7:00 p.m. and Friday 10:00 a.m. – 2:00 p.m. (virtual) [Online Appointment Request Form](#)

Pastoral Counseling via [The Gathering Space for Spiritual Well-Being](#): 410-455-6795; i3b@umbc.edu; Monday – Friday 8:00 a.m. – 10:00 p.m.

[Women, Gender, and Equity Center](#) (open to students of all genders): 410-455-2714; womenscenter@umbc.edu; Monday – Thursday 9:30 a.m. – 5:00 p.m. and Friday 10:00 a.m. – 4 p.m.

Other Resources

[Shady Grove Student Resources](#), [Maryland Resources](#), [National Resources](#).

[Child Abuse and Neglect](#)

Please note that Maryland law and [UMBC policy](#) require that faculty report all disclosures or suspicions of child abuse or neglect to the Department of Social Services and/or the police even if the person who experienced the abuse or neglect is now over 18.

Pregnant and Parenting Students

UMBC's [Interim Policy on Sex Discrimination, Sex-Based Harassment, and Sexual Misconduct](#) expressly prohibits all forms of discrimination and harassment on the basis of sex, including pregnancy. Resources for pregnant, parenting and breastfeeding students are available through the University's [Office of Equity and Civil Rights](#). Pregnant and parenting students are encouraged to contact the Title IX Coordinator to discuss plans and ensure ongoing access to their academic program with respect to a leave of absence – returning following leave, or any other accommodation that may be needed related to pregnancy, childbirth, adoption, breastfeeding, and/or the early months of parenting.

In addition, students who are pregnant and have an impairment related to their pregnancy that qualifies as disability under the ADA may be entitled to accommodations through the [Office of Student Disability Services](#).

Religious Observances & Accommodations

UMBC [Policy](#) provides that students should not be penalized because of observances of their religious beliefs, and that students shall be given an opportunity, whenever feasible, to make up

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within a reasonable time any academic assignment that is missed due to individual participation in religious observances. It is the responsibility of the student to inform the instructor of any intended absences or requested modifications for religious observances in advance, and as early as possible. For questions or guidance regarding religious observances and accommodations, please contact the Office of Equity and Civil Rights at ecr@umbc.edu.

Hate, Bias, Discrimination and Harassment

UMBC values safety, cultural and ethnic diversity, social responsibility, lifelong learning, equity, and civic engagement.

Consistent with these principles, [UMBC Policy](#) prohibits discrimination and harassment in its educational programs and activities or with respect to employment terms and conditions based on race, creed, color, religion, sex, gender, pregnancy, ancestry, age, gender identity or expression, national origin, veterans status, marital status, sexual orientation, physical or mental disability, or genetic information.

Students (and faculty and staff) who experience discrimination, harassment, hate, or bias based upon a protected status or who have such matters reported to them should use the [online reporting/referral form](#) to report discrimination, hate, or bias incidents. You may report incidents that happen to you anonymously. Please note that, if you report anonymously, the University's ability to respond may be limited.

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General Rubric

	Expert (Full Points)	Proficient (75% of Points)	Needs Improvement (50% of Points)	Not Satisfactory (25% of Points)
Integration of Knowledge	The paper demonstrates that the author fully understands and has applied concepts learned in sufficient depth. Concepts are integrated into the writer's own insights. The writer provides concluding remarks that show analysis and synthesis of ideas.	The paper demonstrates that the author, for the most part, understands and has applied concepts learned in the course. Some of the conclusions, however, are not supported in the body of the paper.	The paper demonstrates that the author, to a certain extent, understands and has applied concepts learned in the course. The writer has omitted pertinent content or content runs-on excessively.	The paper does not demonstrate that the author has fully understood and applied concepts learned in the course or discussed in the paper.
Topic focus	The topic is focused narrowly enough for the scope of this assignment. A thesis statement provides direction for the paper, either by stating a position or hypothesis.	The topic is focused but lacks direction. The paper is about a specific topic but the writer has not established a position.	The topic is too broad for the scope of this assignment.	The topic is not clearly defined.
Cohesiveness	Ties together information from all sources. Paper flows from one issue to the next without the need for headings. Author's writing demonstrates an understanding of the relationship among material obtained from all sources.	For the most part, ties together information from all sources. Paper flows with only some disjointedness. Author's writing demonstrates an understanding of the relationship among material obtained from all sources.	Sometimes ties together information from all sources. Paper does not flow - disjointedness is apparent. Author's writing does not demonstrate an understanding of the relationship among material obtained from all sources.	Does not tie together information. Paper does not flow and appears to be created from disparate issues. Headings are necessary to link concepts. Writing does not demonstrate understanding any relationships
Spelling and grammar	Minimal noticeable spelling &/or grammar mistakes.	Noticeable spelling &/or grammar mistakes.	Spelling & grammar mistakes impacts readability.	Unacceptable number of spelling and/or grammar mistakes.
Sources	More than 5 current sources using a common scientific citation method, of which at least 3 are peer-review journal articles or scholarly books. Sources include both general background sources and specialized sources.	5 current sources using a common scientific citation method, of which at least 2 are peer-review journal articles or scholarly books. All web sites utilized are authoritative.	Fewer than 5 current sources using a common scientific citation method, or fewer than 2 of 5 are peer-reviewed journal articles or scholarly books. All web sites utilized are credible.	Fewer than 5 current sources using a common scientific citation method, or fewer than 2 of 5 are peer-reviewed journal articles or scholarly books. Not all web sites utilized are credible, and/or sources are not current.