BIOL 4005.001/5005.001

Special Topics: Principles of Synthetic Biology

Tuesday & Thursdays – 9:30 – 10:50 AM

LANG 223

SPRING 2026 – SYLLABUS

Instructor: Dr. Mauricio S. Antunes

Contact Information: **Email:** Mauricio.Antunes@unt.edu

Office: Science Research Building (SRB), Room 126
Office Phone: (940) 369-5457
Office Hours: by scheduled appointment

Course Description and Objectives:

Synthetic biology is a rapidly developing new field that can be defined as the engineering of biology. It borrows principles from engineering disciplines to design, build and implement genetically encoded circuits that, much like their electronic counterparts, are enabled with information-processing and decision-making capabilities. Synthetic biology approaches can be used to introduce novel cellular functions and traits in microbes, plants and animals, in addition to improving human health. In this course, concepts of molecular engineering and genetic circuit design will be introduced, along with the most up-to-date approaches for high-throughput DNA manipulation and function prediction. We will also discuss issues of ethics and public perception associated with these applications in different organisms.

Course Pre-requisites, Co-requisites, and/or Other Restrictions:

For BIOL 4005 students: BIOC/BIOL 4570
For BIOL 5005 students: basic molecular biology knowledge (equivalent to BIOC/BIOL 5340)

Student Learning Goals:

1. Understanding of the principles of gene regulation.
2. Understanding the design rules of synthetic biological circuits.
3. Basic concepts and applications of mathematical modeling of gene activity and protein production in biological processes.
4. Basic approaches to assembling and debugging genetic circuits and implementing them in living organisms.
5. Common applications of synthetic biology to prokaryotes and eukaryotes.
6. Understanding ethical issues and public perception associated with synthetic biology applications.

Textbook:

This course does not follow a published textbook. The instructor will make available published literature that covers the specific topics. Students are expected to read the provided literature.

Attendance:

Attendance is expected for all classes. Class starts promptly at 9:30 am and ends at 10:50 am. **Please do not be late!** Laptop and tablet-style computers are allowed during class as long as they are being used appropriately (i.e., taking notes). You will be asked to put your device away if you are using it for something other than class. Please make sure that your phone is on silent when class is in session and stowed away during exams.

Exams:

There will be 2 exams and a final project presentation for this course.

- Attendance is required for all exams. **There will be no make-up exams**, except in cases of emergencies, which will be considered on a case-by-case basis.
- Any student found cheating on any exam will receive a grade of zero (0) for that exam and may face other disciplinary action(s).
- **The exam dates will be announced at the beginning of the semester**; the topics included on each exam will be announced in class and on Canvas one week before the scheduled exam date. Students will not be tested on concepts that have not been covered in class.
- Please be on time for the exams! After the first student leaves the exam room, late arrivals will not be allowed to take exams.
- We will also have discussions of published papers in class, and participation is expected from all students. A participation score will be part of your final course grade.

Grading:

Your final course grade will include 2 in-class exam scores, a participation score from paper discussions in class, and the final project presentation. There are **400 total possible points** available in this class. Grading will follow a standard scale:

100 – 90%	A
89 – 80%	B
79 – 70%	C
69 – 60%	D
59% & below	F

Students with Disabilities:

UNT makes reasonable academic accommodation for students with disabilities. Students seeking accommodation must first register with the Office of Disability Accommodation (ODA) to verify their eligibility. If a disability is verified, the ODA will provide a student with an accommodation letter to be delivered to faculty to begin a private discussion regarding one's specific course needs. Students may request accommodations at any time, however,

ODA notices of accommodation should be provided as early as possible in the semester to avoid any delay in implementation. Note that students must obtain a new letter of accommodation for every semester and must meet with each faculty member prior to implementation in each class. For additional information see the ODA website at disability.unt.edu. If you believe you have a disability requiring accommodation, please see Dr. Antunes and/or contact the Office of Disability Accommodation at 940-565-4323 during the first week of class.

Academic Integrity:

According to UNT Policy 06.003, Student Academic Integrity, academic dishonesty occurs when students engage in behaviors including, but not limited to cheating, fabrication, facilitating academic dishonesty, forgery, plagiarism, and sabotage. A finding of academic dishonesty may result in a range of academic penalties or sanctions ranging from admonition to expulsion from the University. The Department of Biological Sciences adheres to and enforces UNT's policy on academic integrity. **Absolutely no form of copying, plagiarism, or any other type of academic dishonesty will be tolerated.** Students who turn in plagiarized work or who are caught cheating will receive a grade of zero for that assignment or exam and may even be withdrawn from the course.

Emergency Notification & Procedures:

UNT uses the Eagle Alert system to quickly notify students with critical information in the event of an emergency (i.e., severe weather, campus closing, and health and public safety emergencies like chemical spills, fires, or violence). In the event of a university closure, please refer to Canvas for contingency plans for covering course materials.

Acceptable Student Behavior:

Student behavior that interferes with an instructor's ability to conduct a class or other students' opportunity to learn is unacceptable and disruptive and will not be tolerated in any instructional forum at UNT. Students engaging in unacceptable behavior will be directed to leave the classroom and the instructor may refer the student to the Dean of Students to consider whether the student's conduct violated the Code of Student Conduct. The University's expectations for student conduct apply to all instructional forums, including University and electronic classroom, labs, discussion groups, etc. The Code of Student Conduct can be found at deanofstudents.unt.edu/conduct.

Access to Information - Eagle Connect:

Students' access point for business and academic services at UNT is located at: my.unt.edu. All official communication from the University will be delivered to a student's Eagle Connect account. For more information, please visit the website that explains Eagle Connect and how to forward e-mail: eagleconnect.unt.edu/

Student Expectations:

- **Come to class!** Use the learning opportunities that lecture provides. You don't only learn about course content in lecture, you also learn to get disciplined about a schedule, how to take notes, how to sort through the material covered, and how to apply what you read about to novel situations. Attendance will be taken periodically.
- **Participate in class!** By communicating your ideas, you organize your thoughts. I want to hear what you have to say! Ask questions, during or after class.
- **Take good notes!** Be selective about what you write down. You don't have to copy slides word for word – I post the lecture slides on Canvas. Not all of the points made in class will be written out on the lecture slides, so it is important for you to come to class and take notes on what I say. *Listen*, and write only the main points. Get notes from a classmate if you miss class.
- **Read ahead!** It is really important that you read the suggested literature. You will get more out of lecture if you read ahead of time. By reading the papers before we cover them in lecture, you will familiarize yourself with some of the terms and concepts the instructor will be using, allowing you to get more out of the class.
- **Study!** The rule of thumb is that you spend 2 hours of study time for each hour spent in class, but you may need more or less time – only you can determine that. Some topics will require more time, others less. You should get into the habit of studying weekly, not just right before exams. We cover a lot of material and it will get overwhelming quickly if you do not keep up. Studying for exams will be a lot easier if you have reviewed on a weekly basis. Your grade will show it!
- **Draw and write as you study!** Test yourself. Writing and drawing things out is a great way to make sure you really understand the material.
- **Study in groups!** Discussing the material with others always helps reinforce concepts. It forces you to organize thoughts and think about important points. Talking with peers about the material also helps you clarify misconceptions. Also, teaching others is a great way to improve your own understanding of the material!
- **Get help if you need it!** Ask questions. I want to know if I need to clarify concepts. Stop me in lecture or see me during office hours and ask if things don't make sense. Seek help early on, before the amount of material gets out of hand.

Tentative Class Schedule – SPRING 2026

WEEK	TOPICS
1	Cell Biology Review (eukaryotes & prokaryotes, metabolism, pathways)
2	Molecular Biology Review (gene expression, regulation, modern cloning)
3	Introduction to Synthetic Biology (concepts, goals, approaches) – new technologies driving the field
4	Parts Building and Standardization, Promoter Engineering (common protein domains, DNA motifs, RBS)
5	Protein Engineering (*de novo* vs. re-engineering, biosensors, transcription factors)
	EXAM 1
6	Logic Operations and Genetic Modules (switches, oscillators, feedback loops and feedforward motifs)
7	DNA and RNA Genetic Circuits (design principles, testing, debugging, DBTL cycles)
8	High Throughput Technologies (next-generation sequencing, parts libraries, screening, directed evolution) and CRISPR SynBio Applications
9	SPRING BREAK (NO CLASSES)
10	Modeling and Simulation (noise, parameters, ODEs, stochastic *vs.* deterministic simulations, static vs. dynamic modeling, steady state)
	EXAM 2
11	Prokaryotic and Yeast Synthetic Biology – examples and applications
12	Animal and Mammalian Synthetic Biology – examples and applications
13	Plant Synthetic Biology – examples and applications
14	Ethics, Dual Use Research of Concern (DURC) and Public Acceptance of SynBio
15	Future Perspectives, Limitations and Societal Impact of SynBio
	FINAL PROJECT PRESENTATIONS