BIOT 6311 **Biotechnology I** **Credit Hours: 3**

Semester:	Fall	**Year:**	2024
Class Day/Time:	Mondays, 9 am - 5 pm	**Class Location:**	Lecture: B12.1, Lab: D12

Instructor of Record: Dr. Vijay Boggaram
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Office Hours: Fridays, 3 - 4 PM

Course Description: A comprehensive study of molecular biology applications and techniques as they relate to biotechnology. The topics covered in this course include RNA isolation and real-time quantitative PCR, gene cloning, mutation of DNA, gene editing, bioinformatics, expression of recombinant proteins, and generation of transgenic animals.

Prerequisite: BIOT 5221/5221L **Co-requisite:** None

Goals of Course:

1. To demonstrate proficiency in advanced molecular biology techniques.
2. To understand and comply with standards of professional ethics.
3. To fully understand lab safety issues associated with toxic chemicals, infectious agents, and manipulation of DNA.
4. To be able to correctly, completely and accurately maintain a laboratory notebook suitable for lab use and legal records.

Student Learning Outcomes (SLO or "course objectives"):

1. The student will be able to correctly maintain an accurate record of laboratory procedures, techniques, and exercises.
2. The student will be able to perform experiments and evaluate data collected from advance DNA processing and manipulation techniques in molecular biology
3. The student will be able to produce professional industrial and research laboratory quality scientific write-ups
4. The student will demonstrate an advanced understanding of molecular biology experimental design and data analysis.
5. The student will demonstrate an understanding of advance molecular biology techniques, including advanced background information and theory, applications, limitations, advantages and disadvantages, common problems, and troubleshooting.

Course Assessment/Methods of Evaluation:

Student understanding will be evaluated based on written lab reports and lab participation. Student may alternatively be evaluated with lab quizzes.

- **Written Lab Reports:** Lab reports are required for all labs performed unless otherwise noted. These should be written in correct scientific technical format, and will be scored based on content, clarity, and quality of writing. These reports must include the following seven (7) sections: Title, Abstract (Summary), Introduction (Purpose and Background), Materials and Methods, Results, Discussion, and any References (required only as needed). The report should clearly address any specific questions that may be posed by the instructor.

- **Class Participation and Attendance.**

Grading: Based on accumulation of points.

1. Lab attendance (participation): 100 pts each (14 lab days: 1400 pts)
2. Lab Reports: 100 pts each (7 reports: 700 pts)
3. Quizzes: 25 pts each (12 Pre-lab quizzes: 300, 4 post-Lab quizzes: 100 pts) (Total: 400)
   Point total = 2,500 pts

   Final Exam (*optional*) up to 255 pts can be added to your point total (potentially bumping you up one full letter grade).

Your grade will be determined based on the total points you accumulated divided into the total points possible:

A = 90% to 100% (2250+ pts)
B = 80% to 89% (2000 – 2225 pts)
C = 70% to 79% (1750 – 1975 pts)
D = 60% to 69% (1500 – 1725 pts)
F = < 60% (< 1500 pts)

The Final Exam is *optional* and can only bring up your grade, not reduce it.

- A grade of less than a B may result in loss of Graduate Assistantships.
- No grades will be withheld to wait for completion of work except in extreme circumstances. *(Get all your assignments submitted before the end of semester!)*
- Reports will be due by 5 pm one week after completion of the series of labs on that topic.

***** Late reports will lose 5% for one day late, 10% for 2-3 days late, 20% for 4-7 days late, 30% for over 7 days late. Lab reports will not be accepted after 2 weeks late, and you will receive a zero**.***

- Lab reports will be expected to be formal write-ups with an emphasis on computer manipulation and presentation of data as is expected in industry and research laboratories. These reports must include the following seven (7) sections: Title, Abstract (Summary), Introduction (Purpose and Background), Materials and Methods, Results, Discussion, and any References (required only as needed). The report should clearly address any specific questions that may be posed by the instructor.

Linked Program Learning Outcomes:
The student learning outcomes listed above address the following Biotechnology Program PLOs:

- PLO1 - The student will demonstrate English communication skills in both oral and written forms.
- PLO2 - The student will demonstrate mastery of basic and advanced biotechnology methods.
- PLO3 - The student will demonstrate the ability to safely operate basic and advanced laboratory equipment, analytic devices, and computers.
- PLO4 - The student will demonstrate independent and critical thinking skills integrated with the ability to utilize multiple informational resources.
- PLO5 - The student will explain the principles, mechanisms, and interrelatedness of both in vivo and in vitro biochemical, molecular biological, and genetic processes.

Textbook: *Recombinant DNA*, 3rd Edition by J.D. Watson, et al. CSHL Press, New York
Suggested Reading: *CRISPR-Cas: Applications in Gene Editing & Beyond* by Roohi Bansal

Course Content:

Other Class Policies

Attendance:
Regular or punctual attendance is expected. If a student misses a class or lab, the student is responsible for obtaining any information distributed during those times. Make-ups are possible only under certain instances (labs cannot be made up). Arrangements for any make-ups and/or missed labs should be discussed directly with the instructor for that day's class.

Academic Honesty:
Any student who commits an act of scholastic dishonesty is subject to discipline. Scholastic dishonesty includes, but is not limited to, cheating, plagiarism, collusion, the submission for credit of any work or materials that are attributable in whole or in part to another person, taking an examination for another person, any act designed to give unfair advantage to a student or the attempt to commit such acts.

Cheating
Dishonesty of any kind involving examinations, assignments, alteration of records, wrongful possession of examinations, and unpermitted submission of duplicate papers for multiple classes or unauthorized use of keys to examinations is considered cheating. Cheating includes but is not limited to:

- Using or attempting to use unauthorized materials to aid in achieving a better grade on a component of a class.
- Falsifying or inventing any information, including citations, on an assigned exercise.
- Helping or attempting to help another in an act of cheating or plagiarism.

Plagiarism
Plagiarism is presenting the words or ideas of another person as if they were your own. Materials, even ideas, borrowed from others necessitate full and complete acknowledgment of the original authors. Offering the work of another as one's own is plagiarism and is unacceptable in the academic community. A lack of adequate recognition constitutes plagiarism, whether it utilizes a few sentences, whole paragraphs, articles, books, audio-visual materials, or even the writing of a fellow student. In addition, the presentation of material gathered, assembled or formatted by others as one's own is also plagiarism. Because the university takes such misconduct very seriously, the student is urged to carefully read university policies on Misconduct in Research and Other Scholarly Activity 05.00. Examples of plagiarism are:

- Submitting an assignment as if it were one's own work when, in fact, it is at least partly the work of another.
- Submitting a work that has been purchased or otherwise obtained from an Internet source or another source.
- Incorporating the words or ideas of an author into one's paper without giving the author due credit.

Adding/Dropping:
The official deadline for adding and dropping courses is as published in the academic calendar (Registrar Withdrawal webpage). However, students are strongly encouraged to meet with their graduate advisor or the Program Coordinator prior to adding/dropping courses. Movement into and out of classes after the 4th class day requires approval of the Program Director. Each student is responsible for their own enrollment status with the university.

Disability Accommodations:
UT Tyler HSC abides by Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act, which mandate reasonable accommodations be provided for students with documented disabilities. If you have a disability and may require some type of instructional and/or examination accommodations, please contact me early in the semester so that I can provide or facilitate provision of accommodations you

may need. If you have not already done so, you *will* need to register with the Student Services Office (located on the main campus). You may call 903-566-7079 for more information.

AI Tools:
UT Tyler is committed to exploring and using artificial intelligence (AI) tools as appropriate for the discipline and task undertaken. We encourage discussing AI tools' ethical, societal, philosophical, and disciplinary implications. All uses of AI should be acknowledged as this aligns with our commitment to honor and integrity, as noted in UT Tyler's Honor Code. Faculty and students must not use protected information, data, or copyrighted materials when using any AI tool. Additionally, users should be aware that AI tools rely on predictive models to generate content that may appear correct but is sometimes shown to be incomplete, inaccurate, taken without attribution from other sources, and/or biased. Consequently, an AI tool should not be considered a substitute for traditional approaches to research. You are ultimately responsible for the quality and content of the information you submit. Misusing AI tools that violate the guidelines specified for this course (see below) is considered a breach of academic integrity. The student will be subject to disciplinary actions as outlined in UT Tyler's Academic Integrity Policy.

For this course, **AI is not permitted in this course at all.**

To best support your learning, you must complete all graded assignments by yourself to assist in your learning. Doing your own work, without human or artificial intelligence assistance, is best for your efforts in mastering course learning objectives. This exclusion of other resources to help complete assignments includes artificial intelligence (AI). Refrain from using AI tools to generate any course context (e.g., text, video, audio, images, code, etc.) for any assignment or classroom assignment.

UTTyler MEDICINE

Course Content:

1. **August 26 - INTRODUCTION & OVERVIEW OF THE COURSE (Boggaram)**

   ***** Pre-Lab Quiz 1 – take it in the class (not graded)***

2. **September 02 - Labor Day Holiday**

3. **September 9 - METHODS FOR INTRODUCING MUTATIONS (Sakai) -** ***Pre-Lab Quiz 2***
   - Design of PCR-based mutagenesis strategies and procedures.
   - Site-directed mutagenesis experiments.

*****Mutagenesis Lab Report - Submit on Canvas before next class!***

4. **September 16 - REAL-TIME QUANTITATIVE PCR 1 (Guo and Guoqing) -** ***Pre-Lab Quiz 3***
   - Lecture on principles and operation of Real Time PCR instrument.
   - Lab- quantitation of templates - detection of single DNA molecules.

5. **September 23 - REAL TIME QUANTITATIVE PCR 2 (Guo and Guoqing)**
   - Continuing lectures on principles and operation of Real Time PCR instrument.
   - Setup and analysis of PCR and melt curve experiments.

*****qPCR Lab Report - Submit on Canvas before next class!***

6. **September 30 - RESTRICTION ENZYME ANALYSIS (Yi) -** ***Pre-Lab Quiz 4***
   - Use of restriction enzymes for DNA mapping.

*****Restriction Analysis Lab Report - Submit on Canvas before next class!***

7. **October 7 - REPORTER ASSAYS (Tang) -** ***Pre-Lab Quiz 5***
   - Luciferase
   - Alkaline Phosphatase

*****Reporter Assay Lab Report - Submit on Canvas before next class!***

8. **October 14 – GEL-SHIFT ASSAYS (Samten) -** ***Pre-Lab Quiz 6***
   - Principles of gel-shift
   - Super-shifting

*****Gel-shift Lab Report - Submit on Canvas before next class!***

9. **October 21, 9 am – 12 noon - TRANSGENIC/KNOCKOUT ANIMALS (Samten)**
   - Principles and methods for generation of transgenic mice.
   - Principles and methods for generation of gene knockout mice.

***** Quiz 1 – Take on Canvas before next class!***

1 pm – 5 pm - **MICROBIOLOGY, CLINICAL LABORATORY (Kant)**

- Lecture
    a. Microbiology staining procedures.
    b. Quality assurance in the clinical laboratory.
    c. Mechanisms of antibiotic resistance
    d. Susceptibility testing

10. October 28 - MICROBIOLOGY, CLINICAL LABORATORY (Kant) - ***Pre-Lab Quiz 7***

***** Quiz 2 – Take on Canvas before next class!***

11. November 4- RNA STRUCTURE, FUNCTION & BIOTECHNOLOGY (Shetty)

- ***Pre-Lab Quiz 8***

- siRNA
- microRNA

***** Quiz 3 – Take on Canvas before next class!***

12. November 11- GENE EDITING (1) (Sakai) – ***Pre-Lab Quiz 9***

- CRISP/cas9 gene editing

13. November 18 - GENE EDITING (2) (Sakai) - ***Pre-Lab Quiz 10***

*****Gene Editing Lab Report - Submit on Canvas before next class***

14. November 25 – 29, Week of Thanksgiving, no classes

15. December 2, 9 am - 12 noon, PROTEIN EXPRESSION 1 (Neuenschwander)

Pre-Lab Quiz 11

- PCR strategies designed for expression.
- Different strategies for expression in bacteria, yeast, insect cells, mammalian cells.
- DNA strategies for protein purification- 6His tags, Xpress, thioredoxin, enterokinase, *etc*.

***** Quiz 4 – Take on Moodle before next class!***

1 - 4 pm, PROTEIN EXPRESSION 2 (Sato) - ***Pre-Lab Quiz 12***

- Expression of recombinant protein in insect cells.
- Use of baculovirus expression system for mammalian gene expression.

*****Protein Expression Lab Report - Submit on Canvas before end of semester!***

17. December 9 - 13, FINALS WEEK

Final Exam (optional)

- Course evaluations & faculty evaluations.

Program:	Master of Science in Biotechnology
Degree:	MS
Department:	Cellular and Molecular Biology
School:	Medical Biological Sciences
Course:	**BIOT6311/6312– Biotechnology I and II**

Area	Marketable Skill*
TASKS	Maintain accurate laboratory records and data.
	Design molecular or cellular laboratory experiments, oversee their execution, and interpret results.
	Perform laboratory procedures following protocols including deoxyribonucleic acid (DNA) sequencing, cloning and extraction, ribonucleic acid (RNA) purification, protein purification, or gel electrophoresis.
TECHNOLOGY SKILLS	Analytical or scientific software; Graphics or photo imaging software - GraphPad, ImageJ, Adobe; Office suite software - Microsoft Office
SKILLS	**Critical Thinking** — Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems.
	Writing — Communicating effectively in writing as appropriate for the needs of the audience.
ABILITIES	**Written Comprehension** — The ability to read and understand information and ideas presented in writing.
	Written Expression — The ability to communicate information and ideas in writing so others will understand.
WORK ACTIVITIES	**Documenting/Recording Information** — Entering, transcribing, recording, storing, or maintaining information in written or electronic/magnetic form.
	Getting Information — Observing, receiving, and otherwise obtaining information from all relevant sources.
	Processing Information — Compiling, coding, categorizing, calculating, tabulating, auditing, or verifying information or data.
	Updating and Using Relevant Knowledge — Keeping up-to-date technically and applying new knowledge to your job.
WORK CONTEXT	Wear Common Protective or Safety Equipment such as Safety Shoes, Glasses, Gloves, Hearing Protection, or PPE.
	Importance of Being Exact or Accurate

*All marketable skills listed for this course and program were drawn from the Knowledge, Skills, and Abilities identified by the US Department of Labor and Statistics for "Biological Technicians" and "Molecular and Cellular Biologists" as published on O*Net Online (www.onetonline.org)