IBMS 7310 Genetic Manipulation and Gene Editing **Credit Hours: 3**

Semester: Fall **Year:** 2025
Class Day/Time: Thursday 2p-5p **Class Location:** 135

Instructor of Record: Dr. Guohua Yi
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Office Hours: Thursday between 2 pm to 5 pm

Course Description: This course will give the students a detailed overview of the methodologies and techniques of molecular biology that allow genetic manipulation and genome editing to obtain genetically modified proteins or alter the genome of cells or organisms. In addition, students will explore the principles, methodologies, and applications of emerging gene engineering technologies, such as ZFNs, TALENs and CRISPR-Cas, and CAR-T cell technologies. The discussion of potential ethical concerns of genome manipulations will also be included in this course.

Prerequisite: [Prerequisite Course ID] **Co-requisite:** [Corequisite]
Successful completion of two semester of biology/biotechnology courses, or approval by the instructor. It is recommended to have at leat one other more specialized course such as General Microbiology or Introduction to Biotechnology.

Goals of Course:

1. To be able to understand the principles and methodologies of transgenesis and site-specific recombination.
2. To be able to understand the principles and methodologies of ZFNs and TALENs.
3. To be able to understand the principles, methodologies, and applications of CRISPR-Cas systems.
4. To be able to understand the principles, methodologies, and applications of CAR-T cell technologies.
5. To be able to understand the techniques and applications of the delivery approaches for genetic manipulations and genome editing.
6. To be able to understand the applications of gene editing techniques for gene and cell therapies.
7. To be able to understand the potential ethical concerns of genetic manipulations and genome editing.

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

1. The students will learn about the discovery of genetic manipulation and genome editing techniques, with emphasis on the molecular mechanisms of how these gene editing techniques work in mammalian cells.
2. The students will understand the methodologies of the gene editing and their applications in engineering mammalian cells and organisms.
3. The students will be able to explore the applications of these technologies for gene therapy and the discovery of novel therapeutics.

4. The students will become familiar with the experimental design and potential pitfalls to consider when applying these genetic manipulation and genome editing technologies to their own research.
5. The students will be able to critically evaluate recent literature and debate about the future perspective of using these emerging genome editing techniques in the industry and clinical settings, and whether or not their applications in certain contexts should be limited.
6. The students will be able to design and complete a gene editing mini-project.

Subject-specific Skills:

1. The students will be able to design ZFN, TALEN, and CRISPR/Cas9 vectors, use it for gene editing, and characterize the gene edited cells/organisms.
2. The students will be able to construct CAR-T cells.

Course Delivery Methods:
The course will be delivered by lectures, journal clubs and mini-project (lab).

Course Assessment/Methods of Evaluation:
The students' understanding to the course contents will be evaluated by 1) Discussions in the take home open questions for each lecture and journal club article, 2) Lab report for the mini-project, and 3) Final examination will be a mini review article on any topic of gene editing.

Grade:
A>90%
B 89-80%
C 79-70%
D 69-60%
F <59%

Linked Program Learning Outcomes:
The student learning outcomes listed above address the following Integrated Biomedical Sciences Program PLO domains:

- PLO1 - Core Knowledge domain
- PLO2 - Research Methods and Analysis domain
- PLO3 - Scholarly domain
- PLO4 - Professionalism domain
- PLO5 - Independent Research domain

Textbook:

1. **Genome Engineering via CRISPR-Cas9 System,** 1st Edition - February 18, 2020.
   Editors: Vijai Singh, Pawan K. Dhar
   Paperback ISBN: 9780128181409
   eBook ISBN: 9780128181416
2. **The Use of CRISPR/Cas9, ZFNs, and TALENs in Generating Site-Specific Genome Alterations**
   Editors: Jennifer A. Doudna, Erik J. Sontheimer
   ISBN: 978-0-12-801185-0 (eBook will be distributed to the students by the instructor)

Course Content:
Lecture Topical Outline:

- Genome structure, organization, and gene regulation
- Introduction to genome manipulation techniques I: ZFN, and TALEN, CRISPR-Cas9, and base editing

- CRISPR knockout and knockin concept and strategies
- CRISPR Lab techniques: Experimental design, Guide RNA design, delivery into cells, and validation
- Various CRISPR-Cas system and their mechanism of gene editing
- Application of CRISPR system for genome-wide screen and inteference
- Off-target, specificity, and ethical considerations of gene editing
- *In vitro* and *in vivo* delivery methods for somatic cell genome editing
- Applications of CRISPR in disease diagnostics and treatments
- Concept, principle, and application of CAR-T cell therapy

2022 Advanced Immunology Summer Lecture Schedule

Date		Topic
Week 1:	8/28	Introduction to genomics and gene regulation (Lecture)
Week 2:	9/4	Introduction to gene manipulation techniques I: ZFN, and TALEN, CRISPR-Cas9, and base editing (Lecture)
Week 3:	9/11	CRISPR Knockout and knockin (Journal club, two assigned papers)
Week 4:	9/18	Target a specific gene in 293 T cells using CRISPR-Cas9 RNP: Experimental design, Guide RNA design, delivery into cells, and validation (Mini-project (lab))
Week 5:	9/25	CRISPR to target RNA and other Cas Proteins (Lecture)
Week 6:	10/2	CRISPR screens and interference (Lecture)
Week 7:	10/9	Safety, specificity, and ethical considerations of gene editing (Lecture)
Week 8:	10/16	CRISPR screen and specificity (Journal club, two assigned papers)
Week 9:	10/23	Delivery of CRISPR gene editing machenary *in vitro* and *in vivo* (Lecture)
Week 10:	10/30	Design and construct an all-in-one AAV-based plasmid (Mini-project (lab))
Week 11:	11/6	Applications of CRISPR in disease diagnostics and treatments (Lecture)
Week 12:	11/13	Introduction of CAR-T cell therapy (Lecture)
Week 13:	11/20	Applications of CAR-T cell therapy (Journal club, two assigned papers)
Week 14:		**Fall break**
Week 15:		**TAKE-HOME EXAM**

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.

Participation:

For regular lectures, students will need to actively participate in discussions. For journal clubs, the students will need to participate in both presentation and discussion. For the mini project, the students will be grouped or work together to finish the project and write the own lab report.

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.