

Title of the Course: Molecular Genetics	Field and Degree: Human Genetics – Master's Program	Faculty: School of Medicine
Course Code: 7	Academic Year: 2025–2026	Prerequisite: genetics of microorganism
Credits: 3 Credits	Semester: First Semester	Credit Distribution: 2 Theoretical Credits – 1 Practical Credit
Teaching Staff: Dr. Tahmasbi, Dr. Yousefi	Class Day and Time: Sunday, 8:00–10:00	Course Coordinator: Dr. Tahmasbi
Email: tahmasebi.birgani62@gmail.com	Office Hours: Every day, 08:00–16:00	

General Objectives

To provide students with a comprehensive understanding of bacterial genetics, gene regulation, genetic engineering strategies, genome editing technologies, molecular diagnostic methods, and essential laboratory skills required for modern molecular microbiology

Specific Objectives

Explain the fundamental concepts and applications of genetic engineering.

- Describe the major mechanisms of gene regulation in prokaryotes and eukaryotes.
- Compare and analyze the mechanisms of horizontal gene transfer in bacteria.
- Characterize extrachromosomal DNA elements and their biological significance.
- Explain the structure and function of transposons and integrons in genome dynamics.
- Describe gene deletion processes and their applications in functional genomics.
- Explain the molecular mechanisms of DNA repair pathways.
- Analyze the epidemiology and molecular diagnostic methods used for bacterial identification.
- Explain genome editing strategies in bacteria using the CRISPR–Cas system.
- Describe the clinical importance of the human microbiome and its impact on diagnostic and therapeutic decisions.
- Explain the molecular and clinical foundations of DNA structure and function.

Practical Objectives

- Apply biosafety principles and good laboratory practices in bacterial genetics laboratories.
- Perform genomic and plasmid DNA extraction and evaluate quality using electrophoresis.
- Extract high-quality RNA and assess its integrity for downstream applications.
- Design primers according to established thermodynamic and specificity guidelines.
- Perform Polymerase Chain Reaction (PCR) following standard laboratory protocols.
- Explain the principles of DNA sequencing and prepare samples for sequencing workflows.
- Conduct enzymatic digestion of PCR products and interpret digestion profiles.
- Perform Real-Time PCR and analyze amplification curves and quantification data..

Course Description

This course introduces the fundamental and advanced concepts of bacterial genetics, genetic engineering, gene regulation, genome editing, and molecular diagnostic techniques. The course integrates theoretical principles with practical laboratory exercises, including DNA/RNA extraction, primer design, PCR, Real-Time PCR, enzymatic digestion, electrophoresis, and sequencing.

Lecturer	Teaching Method	Student Activities	Expected Teaching Concepts	Session
Theoretical				
Dr. Tahmasebi	interactive lecture	Q & A method	Overview of Genetic Engineering	1
Dr. Yousefi	interactive lecture	Q & A method	Mechanisms of Gene Regulation	2
Dr. Tahmasebi	interactive lecture	Q & A method	Mechanisms of Gene Transfer	3
Dr. Yousefi	interactive lecture	Q & A method	Extrachromosomal DNA Elements	4

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مرکز مطالعات و توسعه آموزش علوم پزشکی

Dr. Tahmasebi	interactive lecture	Q & A method	Transposons and Integrans	5
Dr. Yousefi	interactive lecture	Q & A method	Gene Deletion Processes	6
Dr. Tahmasebi	interactive lecture	Q & A method	DNA Repair Mechanisms	7
Dr. Yousefi	interactive lecture	Q & A method	Epidemiology and Molecular Diagnostics of Bacteria	8
Dr. Tahmasebi	interactive lecture	Q & A method	Genome editing in bacteria using the CRISPR–Cas system	9
Dr. Yousefi	interactive lecture	Q & A method	Clinical importance of the microbiome and its role in diagnostic and therapeutic decision-making	10
Dr. Tahmasebi	interactive lecture	Q & A method	Molecular and clinical foundations of DNA	11
Practical				
Dr. Tahmasebi	Demonstration	Q & A method	Biosafety Principles in Bacterial Genetics Labs	1
Dr. Yousefi	Demonstration	Q & A method	Genomic and Plasmid DNA Extraction and Electrophoresis	2
Dr. Tahmasebi	Demonstration	Q & A method	RNA extraction	3
Dr. Yousefi	Demonstration	Q & A method	Primer Design guide line	4
Dr. Tahmasebi	Demonstration	Q & A method	Polymerase Chain Reaction (PCR) guide line	5
Dr. Yousefi	Demonstration	Observation, practice and report	DNA Sequencing	6
Dr. Tahmasebi	Demonstration	Observation, practice and report	Enzymatic Digestion of PCR Products	7
Dr. Yousefi	Demonstration	Observation, practice and report	Real-Time PCR	8
Dr. Tahmasebi	Demonstration	Observation, practice and report	Realtime PCR	9

Student Assignments
Presentation on a Current Topic in Molecular Genetics
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Course Evaluation Method
Final Exam 70 % + class assignment 30 %

Reference

1. Woodford N, et al. Molecular Bacteriology: Protocols and Clinical Applications. Latest edition
2. Ream W, Geller B, Trempey J, Field K. Molecular Microbiology Laboratory. New York: Academic Press. Latest edition
3. Dale JW, Park SF. Molecular Genetics of Bacteria. Sussex: Wiley & Sons Inc Publication. Latest edition
4. Streips UN, Yasbin RE. Modern Microbial Genetics, New York: Wiley & Sons Inc Publication, Latest edition
5. Sussman M. Molecular Medical Microbiology. New York: Academic Press. Latest edition