University of Management & Technology
School of Science
Department of Life Sciences

BT-307 Molecular Biology

Lecture Schedule	Tuesday 03:30-04:45 Friday 03:30-04:45	**Semester**	Spring 2021
Pre-requisite	---	**Credit Hours**	4
Instructor	Dr. Muhammad Sohail Afzal	**Contact**	sohail.afzal@umt.edu.pk
Office	3S-37	**Office Hours**	See office window

Course Description

Molecular biology deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development. It is a large and ever-changing discipline. This course will emphasize the molecular mechanisms of DNA replication, repair, transcription, splicing, protein synthesis, and gene regulation in different organisms. We will study the techniques and experiments used to discern these mechanisms, often referring to the original scientific literature.

Expected Outcomes

By the end of this semester, we would like you to:

1. Understand how molecular machines are constructed and regulated so that they can accurately copy, repair, and interpret genomic information.
2. Explain and give examples of how ionic, hydrophobic, and hydrogen bonding interactions determine the structure of nucleic acids and proteins and modulate the specificity of binding between them.
3. Compare and contrast the mechanisms of bacterial and eukaryotic DNA replication, DNA repair, transcription, and translation.
4. Explain how DNA topology and chromatin structure affects the processes of DNA replication, repair, and transcription.
5. Describe mechanisms by which DNA can be damaged and describe the molecular mechanisms by which protein complexes repair different forms of DNA damage.
6. Provide examples of how homologous recombination is used to ensure genome stability and promote genetic diversity.
7. Describe how pre-mRNA splicing occurs and explain how alternative splicing and backsplicing can generate protein diversity.
8. Explain the molecular mechanisms behind different modes of gene regulation in bacteria and eukaryotes at both pre- and post-transcriptional levels.
9. Interpret and critique data from primary research articles.
10. Write a perspective about a primary research article.

Textbook(s)

1. Molecular biology / Robert F. Weaver. 5th ed. p. cm. ISBN 978–0–07–352532–7. The McGraw-Hill Companies, Inc., 1221 Avenue of the Americas, New York, NY 10020. 2012
2. Molecular Biology of the Genes/ Watson. COLD SPRING HARBOR LABORATORY PRESS Cold Spring Harbor, New York.2014

Grading Policy	• Quizzes & Assignments: 20% • Presentation 05% • Midterm: 30% • Final Exam: 45%

Course Schedule

Lecture #	TOPICS	Readings
Week 1	**A brief History:** 1.1Transmission Genetics 1.2 Molecular Genetics 1.3 The Three Domains of Life **The Molecular Nature of Genes** 2.1 The Nature of Genetic Material 2.2 DNA Structure 2.3 Genes Made of RNA 2.4 Physical Chemistry of Nucleic Acids	Molecular Biology (Robert F. Weaver) Chapter 1 Molecular Biology (Robert F. Weaver) Chapter 2
Week 2	**An Introduction to Gene Function** 3.1 Storing Information 3.2 Replication 3.3 Mutations	Molecular Biology (Robert F. Weaver) Chapter 3
Week 3	**The Mechanism of Transcription in Bacteria** 6.1 RNA Polymerase Structure 6.2 Promoters 6.3 Transcription Initiation 6.4 Elongation 6.5 Termination of Transcription	Molecular Biology (Robert F. Weaver) Chapter 6
Week 4	**Operons: Fine Control of Bacterial Transcription** 7.1 The lac Operon 7.2 The *ara* Operon 7.3 The *trp* Operon 7.4 Riboswitches	Molecular Biology (Robert F. Weaver) Chapter 7
Week 5	**Eukaryotic RNA Polymerases and Their Promoters** 10.1 Multiple Forms of Eukaryotic RNA Polymerase 10.2 Promoters 10.3 Enhancers and Silencers	Molecular Biology (Robert F. Weaver) Chapter 10
Week 6	**Chromatin Structure and Its Effects on Transcription** 13.1 Chromatin Structure 13.2 Chromatin Structure and Gene Activity	Molecular Biology (Robert F. Weaver) Chapter 13
Week 7	**RNA Processing I: Splicing** **14.1 Genes in Pieces** **14.2 The Mechanism of Splicing of Nuclear mRNA Precursors** **14.3 Self-Splicing RNAs**	Molecular Biology (Robert F. Weaver) Chapter 14
Week 8	**RNA Processing II: Capping and Polyadenylation** 15.1 Capping 15.2 Polyadenylation 15.3 Coordination of mRNA Processing Events	Molecular Biology (Robert F. Weaver) Chapter 15
Week 9	**Mid Term Exam** **The Mechanism of Translation I:Initiation** 17.1 Initiation of Translation in Bacteria 17.2 Initiation in Eukaryotes 17.3 Control of Initiation	Molecular Biology (Robert F. Weaver) Chapter 17

Week 10	**The Mechanism of Translation II:Elongation and Termination** 18.1 The Direction of Polypeptide Synthesis and of mRNA Translation 18.2 The Genetic Code 18.3 The Elongation Cycle 18.4 Termination	Molecular Biology (Robert F. Weaver) Chapter 18
Week 11	Ribosomes and Transfer RNA 19.1 Ribosomes 19.2 Transfer RNA	Molecular Biology (Robert F. Weaver) Chapter 19
Week 12	DNA Replication, Damage, and Repair 20.1 General Features of DNA Replication 20.2 Enzymology of DNA Replication 20.3 DNA Damage and Repair	Molecular Biology (Robert F. Weaver) Chapter 20
Week 13	**DNA Replication II: Detailed Mechanism** 21.1 Initiation 21.2 Elongation 21.3 Termination	Molecular Biology (Robert F. Weaver) Chapter 21
Week 14	**Homologous Recombination** 22.1 The RecBCD Pathway for Homologous Recombination 22.2 Experimental Support for the RecBCD Pathway 22.3 Meiotic Recombination 22.4 Gene Conversion	Molecular Biology (Robert F. Weaver) Chapter 22
Week 15	**Transposition** 23.1 Bacterial Transposons 23.2 Eukaryotic Transposons 23.3 Rearrangement of Immunoglobulin Genes 23.4 Retrotransposons	Molecular Biology (Robert F. Weaver) Chapter 23