Department of Biology

College of Education

Salahaddin University-Erbil

Subject: Practical Molecular Biology

Course Book – (4th stage)

Lecturer's names: Assist. Prof. Dr. Sevan O Majed

Academic Year: 2023-2024

Course Book

1. Course name	**Practical Molecular Biology**
2. Lecturer in charge	**Sevan Omer Majed**
3. Department/ College	**Biology Dept./ College of Education**
4. Contact (e-mail)	**sevan.majed@su.edu.krd**
5. Time (in hours) per week	**Practical: 6hrs**
6. Office hours	**12 hrs**
7. Course code	
8. Teacher's academic profile	**Dr. SEVAN OMER MAJED** **Specialist: Molecular Biology/Bioinformatician** **Profile** **In 2009, I finished my B.Sc at Biology Department, College of Education, Salahaddin University-Erbil, Kurdistan-Iraq. My major practical expertise was in the mycological laboratory. I also have experience in laboratory-based Phycology having done it in the assistant laboratory.** **In 2013, I gained a master's degree in Bioinformatics Department, Bioscience, University of Exeter-UK. I used computational methods to analyze the problems of a database of gene and protein sequences in biology, especially focusing on comparative genomics of plant-associated microbes, amino acids, and nucleotide sequences of eukaryotes. I worked also in the biological laboratory on bacteria, seaweeds, and fungi.** **I was teaching Practical molecular biology, Practical Phycology and Mycology at Biology Department, College of Education, Salahaddin University-Erbil, Kurdistan-Iraq. I am also doing research.** **In 2021, I achieved Ph.D. in the Biology Department, College of Science, Salahaddin University-Erbil. I am well-experienced in Molecular techniques, such as DNA and RNA extraction, Small RNA extraction, SDS-PAGE, Western Blot, Gene expression analysis, Gel electrophoresis, PCR, RT-qPCR, RNA-Seq, Small RNA-Seq, Genomics, Proteomics, Metabolomics, Gene Ontology Enrichment analysis, and Bioinformatic Scripts such as R and Perl**

	scripts **Now, I am teaching Molecular Biology and also doing research.** **Career** **2021 until present: Ph.D. in Molecular Biology at Salahaddin University-Erbil.** **2018: Lecturer (MSc), Salahaddin University-Erbil.** **2013-2017: Assistant lecturer, Salahaddin University-Erbil.** **2011-2013: MSc in Bioinformatics at University of Exeter.** **2009-2011:Assistant laboratory, Salahaddin University-Erbil**
9. Keywords	

10. **Course overview:**

Molecular Biology is the field of biology that deals with the composition, structure and interactions of cellular molecules, such as nucleic acids and proteins, that carry out the biological processes essential for the cells functions and maintenance. One of the most basic techniques of molecular biology to study protein function is **molecular cloning**. In this technique, DNA coding for a protein of interest is cloned using polymerase chain reaction (PCR), and/or restriction enzymes into a plasmid (expression vector). A vector has 3 distinctive features: an origin of replication, a multiple cloning site (MCS), and a selective marker usually antibiotic resistance. Located upstream of the multiple cloning site are the promoter regions and the transcription start site which regulate the expression of cloned gene. This plasmid can be inserted into either bacterial or animal cells. **Polymerase chain reaction (PCR)** is an extremely versatile technique for copying DNA. In brief, PCR allows a specific DNA sequence to be copied or modified in predetermined ways. The reaction is extremely powerful and under perfect conditions could amplify one DNA molecule to become 1.07 billion molecules in less than two hours**. Gel electrophoresis** is one of the principal tools of molecular biology. The basic principle is that DNA, RNA, and proteins can all be separated by means of an electric field and size. In agarose gel electrophoresis, DNA and RNA can be separated on the basis of size by running the DNA through an electrically charged agarose gel. Proteins can be separated on the basis of size by using an SDS-PAGE gel, or on the basis of size and their electric charge by using what is known as a 2D gel electrophoresis. Named after its inventor, biologist **Edwin Southern, the Southern blot** is a method for probing for the presence of a specific DNA sequence within a DNA sample. DNA samples before or after restriction enzyme (restriction endonuclease) digestion are separated by gel electrophoresis and then transferred to a membrane by blotting via capillary action. The membrane is then exposed to a labeled DNA probe that has a complement base sequence to the sequence on the DNA of interest. **Allele-specific oligonucleotide (ASO)** is a technique that allows detection of single base mutations without the need for PCR or gel electrophoresis. Short (20–25 nucleotides in length), labeled probes are exposed to the non-fragmented target DNA, hybridization occurs with high specificity due to the short length of the probes and even a single base change will hinder

hybridization.

11. Course objective (Intended Learning Outcomes)

After this term students should be able to...

1. 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, protein synthesis ….. etc.
2. At the end of this course students should be able to demonstrate a clear understanding of the facts and basic concepts of molecular biology which are covered in lectures, including:
3. To provide with the core principles of molecular biology.
4. To gain higher level thinking skills that is necessary for scientists.
5. To excite about basic science and its applications.

12. Student's obligation

Students must attend at the lectures. At the beginning of each lecture, they will do a quiz about last lecture. At the end of each lecture, I will ask one or two question/s about the present lecture. For the next lecture, students must bring their own answers. Each student must make one assignment about one technique of molecular biology during the term.

13. Forms of teaching

Different forms of teaching will be applied to reach the objectives of the course: power point presentations for the head titles, definitions and description images, summary of conclusions, classification of materials and any other illustrations, besides worksheet will be designed to let the chance for practicing on several aspects of the course in the classroom, furthermore students will be asked to prepare fortnightly reports about selective topics.

14. Assessment scheme

Class Participation: 15%

Course Works: 15%

Examinations: 70%

There will be two midterm examinations and a final examination. Midterm 1 covers material through Meeting 12. Midterm 2 covers material through Meeting 24. The final exam is truly cumulative; questions cover the entire course. No notes, books or other materials will be allowed during the testing periods unless stated otherwise. All exams are mandatory. If you have a schedule conflict involving other courses, religious observance, or personal matters, you must see Mr. Sevan and Mr. Raste. Any missed exam will result in a grade of 0 for that exam, unless there are serious extenuating personal circumstances that are immediately brought to the attention of Dr. Hero. Illness will be accepted as a justification for absence from a scheduled test if a doctor’s excuse is presented. The excuse must be dated on or immediately prior to the exam date, and you must contact Dr. If either of these conditions is not met, you will be given a grade of 0. If you miss a midterm exam and present a legitimate excuse, then, at the discretion of the instructors, either a make-up test will be made available to you or the final exam will count more toward your grade.

EXCELLENT (A) = 90% and above, VERY GOOD (B) = 80% and above, GOOD (C) = 70% and above, SATISFACTORY (D) = 60% and above, PASS (E) = 50% and above, FAIL (F) = Any under 50%

15. Student learning outcome:

After this term students should be able to...

I. To demonstrate a clear understanding of the facts and basic concepts of molecular biology which are covered in lectures, including:
II. To provide with the core principles of molecular biology.
III. To gain higher level thinking skills that is necessary for scientists.
IV. This course should excite about basic science and its applications.

16. Course Reading List and References:

I. https://1lib.eu/book/2800721/02f7b7?regionChanged=&redirect=42320074
II. https://1lib.eu/book/5439789/c45a21?regionChanged=&redirect=42320280
III. https://1lib.eu/book/5333925/e3aa94?dsource=recommend&regionChanged=&redirect=42320797

17. The Topics:	**Lecturer's name Sevan O Majed**
	ex: (3 hrs) ex: 4/9/2022

18. Practical Topics (If there is any)

weeks	Subject	(2hrs.)
1.	**Materials and Methods used in the molecular labs**	
2.	**Bacterial DNA extraction** Isolation & Purification of Chromosomal DNA from *E. coli*, Importance, Background, Basic principle of DNA extraction, Experimental protocol.	
3.	**Agarose gel electrophoresis: DNA conformation and size.** Definition, Requirements of Gel electrophoresis, what is agarose & why it is used, Experimental protocol.	
4.	**Isolation of plasmid from *E. coli*.** Isolation & Purification of Bacterial Plasmid DNA by Alkaline lysis, what is a Plasmid, Principle of method, Experiment protocol.	
5.	**Polymerase chain reaction (PCR).** Definition, Application of PCR, Invention of PCR, components, PCR process, Properties of PCR content, Basics of primer design.	

6.	**Real Time PCR.** Definition, RT-PCR methods, Real-time PCR components, SYBR Green dye assay, what is TaqMan Probe, How TaqMan Probe works.	
7.	**DNA sequencing.** Definition, Principle, Historical background, Historical background, Chain terminator sequencing, Reaction procedure, Automated Cycle sequencer.	
8.	**DNA cloning.** Molecular cloning of Recombinant DNA, Background, definition, Requirements, Restriction Enzyme, Ligation enzyme, Protocol of preparation of competent E. coli using CaCl2.	
9.	**DNA cloning(continue)** Transformation of recombinant plasmids DNA into E. coli using CaCl2, Transformation using CaCl2 procedure, LacZα/β-galactosidase complementation system (blue / white colony screening), Results.	
10.	**DNA microarrays.** Definition, Applications, Procedure, Scanning of microarrays, DNA spotting.	
11.	**DNA Blotting.** Definition, Types of DNA blotting, Applications, DNA blotting procedure.	
12.	**Transformation.** **Preparation of Competent Cell** Definition of Competent Cell, Why we are using *E. coli* as a host, Preparation of competent *E. coli* using CaC_{l2}, Protocol.	
13	**Transformation.** Transformation of plasmids DNA into *E. coli* using CaC_{l2}, Properties of transformation, Transformation using CaC_{l2} procedure.	

14	**DNA marker** Definition of RAPd, Applications, Definition of RFLP, Applications, procedure.	
15	**DNA Forensics.** Definition, Types of DNA blotting, Applications, Invention of DNA forensics, procedure.	
16	**DNA Curing.** Definition, Types of DNA curing, DNA curing by Ethidium bromide, DNA curing procedure	
17	**Restriction endonulease digestion of DNA.** Definition of restriction endonuclease, Applications, Invention of Restriction endonuclease digestion of DNA, procedure.	

19. Examinations:

1. Compositional:

How can the PCR work?

2. True or false type of exams:

Cloning is the process naturally occurred in bacteria.

3. Multiple choices:

PCR needs one of the following

A. restriction enzyme B. **specific primer** C. **low temperature**

4. **Fill the gaps with the convenient worde?**

Microarray technique is ……

20. Extra notes:

21. Peer review پێداچوونەوەی هاوەڵ