MINISTRY OF EDUACATION AND TRAIINING
CAN THO UNIVERSITY

SOCIALIST REPUBLIC OF VIETNAM
Independence- Freedom-Happiness

DETAIL SYLLABUS

1. Course name: Molecular Biology

- **Course number :** BB801C
- **Number of credits :** 03
- **Distribution of credit hours:** Theory hours: 45 hours

2. Academic unit responsibility for courses:

- Department: Molecular biotechnology

- Institute : Biotechnology Research and Development Institute

3. Course prerequisite: ZO341C Fundamental Genetics, BC461 Biochemistry I, BC462 Biochemistry II

4. Course objectives:

4.1. Knowledge:

By the end of the semester, you should be able to do the following:

4.1.1. Explain and give examples of how ionic, hydrophobic, and hydrogen bonding interactions determine the structure of nucleic acids. How nucleotides join together to form nucleic acids

4.1.2 The different classes of nucleic acids? how information stores in nucleic acids, the biological functions of nucleotides and nucleic acids.

4.1.3. Understanding the higher-order structure of DNA

4.1.4. Explain how DNA topology and chromatin structure affects the processes of DNA replication, repair, and transcription.

4.1.5. Understanding what are gene and allele

4.1.6. Understanding structure and function of mRNA, tRNA and rRNA

4.1.7. Understanding the mechanisms of DNA replication, the properties of DNA Polymerases

4.1.8. How DNA replicates in Eukaryotic cells, how the ends of chromosomes replicate, how RNA Genomes replicate

4.1.9. Describe mechanisms by which DNA can be damaged and describe the molecular mechanisms by which protein complexes repair different forms of DNA damage.

4.1.10. Understanding the function of enzymes that modify DNA and their apllications in biotechnology

4.1.11. Understanding basic molecular biology techniques,

4.1.12. Distinguish between different molecular biology techniques that are used to isolate, separate, and probe for specific proteins, nucleic acids. Identify limitations of these techniques.

4.1.13. Given a particular biological question, identify which experimental techniques are best used to answer that question.

4.1.14. Understanding Holliday model, understanding double strand break repair model and how this mechanism differs from Holliday model. Understandinh the cellular functions of homologous recombination
4.1.15. Provide examples of how homologous recombination, site-specific recombination, and transposition can promote both genome stability and genetic diversity.
4.1.16. Understanding the function of promoter, terminater, RNA polymerase. Understanding the mechanisms of transcription: initiation, elongation and termination.
4.1.17. Understanding the function of RNA polymerase I,II and III, and how mRNA is transcribed in eukaryotes.
4.1.18. Understanding how Eukaryotic transcripts are processed and delivered to the ribosomes for translation. Describe the mechanism of splicing and how introns are removed via splicing.
4.1.19. Understanding the genetic code, how an amino acid is matched with its proper tRNA, the rules in Condon-Anticodon pairing, the mechanism of mRNA translation and how proteins are synthesized in Eukaryotic cells.
4.1.20. Understanding the basis of gene regulation, describe the structure of operon
4.1.21. Explain the regulation of lactose system
4.1.22. Explain the regulation of tryptophan system
4.1.23. Describe the basic structure of chromatin and relate its structure to gene regulation
4.1.24. Explain the transcriptional and post-transcriptional events that affect gene expression in eukaryotes
4.1.25. Define RNAi and miRNA, describe molecular mechanism of RNAi and miRNA
4.1.26. RNAi applications

4.2. Skills:

Provide the following skills for students:

4.2.1. Hard skills:

- Logical thinking skill and apply the acquired knowledge of molecular biology to solve important, complex problems in biotechnology.

4.2.2. Soft skills:

- Students should be able to: work in a group, use bioinformatics, develop the appropriate skills to communicate (write, discuss, analyze and evaluate) using the term of molecular biology.

4.3. Attitudes:

Students should be developed attitudes relevant to molecular biology such as:

- Understanding the importance of the knowledge of molecular biology in biological processes, biomedical and biotechnology to have a serious attitude in study and research.
- Morality in molecular biotechnology research

5. Brief description of module content:

Molecular biology deals with nucleic acids and proteins and how these molecules interact within the cell to promote proper growth, division, and development. In this course, the student will learn the structure and function of nucleic acids (DNA and RNA) and how these molecules act to copy, express and accurately transmit genetic information. The course focuses on mechanisms of: DNA structure and topology, DNA modifing enzymes, DNA replication, DNA repair, DNA recombination, DNA

rearrangements, transcription, splicing, translation (protein synthesis) and the genetic code, RNA editing, miRNA and RNAi and molecular biology techniques based on DNA-DNA and DNA-RNA complementarity to study molecular biology

6. Structure of course content:

Chapter	Content	Hour	Objective
Chapter 1.	**Nucleid acids**	3	
1.1.	Nucleosids		4.1.1
1.2.	Nucleotid		4.1.1
1.3.	Nucleid acids		4.1.2
Chapter 2.	**DNA structure and topology**	4	
2.1.	Primary structure		4.1.3
2.2.	Secondary structure – Denaturation and renatuararion of DNA molecules		4.1.3
2.3.	Tertiary structure		4.1.3
2.4.	Chromatin and chromosomes		4.1.4
2.5.	DNA topology		4.1.4
2.6.	Definiton of gene and allele		4.1.5
Chapter 3.	**RNA structure**	3	
3.1.	RNA structure		4.1.6
3.2.	mRNA, tRNA, rRNA		4.1.6
Chapter 4	**DNA metabolism**	6	
4.1.	DNA replication		4.1.7
4.2.	Overview, basic rules and mechanics		4.1.7
4.3.	Bacterial replication		4.1.7
4.4.	Eukaryotid replication - Telomeres		4.1.8
4.5.	DNA repair		4.1.9
Chapter 5	**DNA modifing enzymes**	3	
5.1.	DNA polymerases		4.1.10
5.2.	Polynucleotid kinases		4.1.10
5.3.	Exonucleases –Endonucleases		4.1.10
5.4.	Restrition endonucleases		4.1.10
5.5.	other DNA modifying enzymes		4.1.10
Chapter 6	**Molecular biology techniques based on DNA-DNA and DNA –RNA complementarity**	3	4.1.11
6.1.	Nucleid acid blotting – Types of blots		4.1.12-4.1.13
6.2.	Polymerase chain reaction		4.1.12-4.1.13
6.3.	Sequencing		4.1.12-4.1.13
	Midterm examination		
Chapter 7	**Recombination**	3	
7.1.	Homologous recombination		4.1.14 - 4.1.15
7.2.	Gene conversion		4.1.14 - 4.1.15

7.3.	Site-specific recombination		4.1.14 - 4.1.15
Chapter 8	**Mechanisms of transcription**	3	
8.1.	Transcription in Prokaryotes		4.1.16
8.2.	Transcription in Eukaryotes		4.1.17
Chapter 9	**RNA processing**	3	
9.1.	mRNA processing in Eukaryotes		4.1.18
9.2.	tRNA processing in Eukaryotes		4.1.18
9.3.	rRNA processing in Eukaryotes		4.1.18
Chapter 10	**Translation**	4	
10.1.	The ribosome: structure and function		4.1.19
10.2.	Translation in Prokaryotes		4.1.19
10.3.	Translation in Eukaryotes		4.1.19
Chapter 11	**Regulation of gene expression in Prokaryotes**	3	
11.1.	Operon in gene regulation of Prokaryotes		4.1.20
11.2.	Lactose operon		4.1.21
11.3.	Tryptophan operon		4.1.22
Chapter 12	**Regulation of gene expression in Eukaryotes**	4	
12.1.	Chromatin – gene regulation		4.1.23
12.2.	DNA methylation		4.1.23
12.3.	Control at transcription inititation		4.1.24
12.4.	Control at RNA processing		4.1.24
12.5.	Control at translaion		4.1.24
12.6.	Control at post-translation		4.1.24
Chapter 13	**small RNA - RNAi**	3	
13.1.	RNAi		4.1.25
13.2.	miRNA		4.1.25
13.3.	RNAi applications		4.1.26
	Final examination		

7. Teaching methods:

- Explaning, demonstrating and collaborating.

Lecture slides will be sent to students via their email address on 2-3 days before the class. These will serve as a guide to what their should focus on the lecture and these are also very useful in taking notes, it means that the students are required to print out your own copies and bring them to the class.

8. Student's tasks:

It is important to attend all of the lectures during the course and to take good notes for study. Prior to attending each lecture, it is important to have read the appropriate portions of the textbook. However, many of the lectures will contain new and additional information that is not in the textbook and will be included in the exams.

9. Evaluation of student learning outcomes:

9.1. Evaluation Methods

The students are evaluated based on the following accumulation of points:

N°	Component grades	Define	Weight of grade	Goals
1	Exercise	solving problems – work in group	10%	4.2.1- 4.2.2; 4.3
2	Midterm exam	multiple choice, short answer, true/false and solving problem ***Students must take this exam***	30%	4.1.1 -4.1.13
3	Final exam	multiple choice, short answer, true/false and solving problem ***Students must take this exam***	60%	4.1.14- 4.1.26

9.2. Grading policy

The final grade of the accumulated points will be computed on the following scale:

8.7 - 10: A
7.8- 8.6: B+
6.3 – 7.7: B
5.3 – 6.2: C+
4.3 – 5.2: C
4 – 4.2: D
< 4.0 : F

10. Required textbook:

The following book is required for the course:

[1] **Molecular Biology of the Gene** by Watson, James D., Baker, Tania A., Bell, Stephen P., Gann, Alexander, Levine, Michael, Losick, Richard, 5th edition, 2004, ISBN 0-8053-4635-X.

[2] **Lehninger Principles of Biochemistry** by David L. Nelson and Michael M. Cox, 4th edition, 2004. ISBN13 9780716743392

[3] **Principles of Gene Manipulation,** Primrose, S.B., Twyman, R.M. & Old, R.W, 5th Edition, 1994. ISBN: 0-632-03712-1

11. Self-study Guide:

Week	Content	Hour	Student's task: Read the textbook before coming to the class
1	Chapter I: Nucleid acids	3	Textbook [2] Chapter 8, p. 273-300
2	Chapter II: DNA structure and topology - DNA structure - Chromosome - DNA topology	4	Textbook [1] (Ch. 2, p. 19-36; Ch.6, p. 97-111) (Ch. 7, p. 129-150); (p. 112-122)
3	Chapter 3: RNA structure	3	Textbook [2] Chapter 8, p. 287-291
4-5	Chapter 4: DNA metabolism	6	Textbook [1] Chapter 4
6	Chapter 5: DNA modifing	3	Textbook [1]

	enzymes		p. 647-652
7	Chapter 6: Molecular biology techniques - Nucleid acid blotting – Types of blots - PCR, sequencing	3	Textbook [3] Chapter 2, p. 6-21 Chapter 10, p. 178-190
8	***Midterm exam***		
9	Chapter 7: Recombination	3	Textbook [1] Chapter 10, p.259-310
10	Chapter 8: Mechanisms of transcription	3	Textbook [1] Chapter 12, p. 347-376
11	Chapter 9: RNA processing	3	Textbook [1] Chapter 13, p. 379-406
12	Chapter 10: Translation	4	Textbook [1] Chapter 14, p. 411-477
13	Chapter 11: Regulation of gene expression in Prokaryotes	3	Textbook [1] Chapter 16, p. 483-525
14	-Chapter 12: Regulation of gene expression in Eukaryotes -Chapter 13: small RNA - RNAi	7	Textbook [1] Chapter 17, p. 529-566 Chapter 17, p. 567-571
15	Reviews		
16	***Final exam***		

Can Tho, 20 February, 2014

By order of the rector
Director

Head of department