CHEM3017: MOLECULAR BIOLOGY

Effective Term
Semester A 2022/23

Part I Course Overview

Course Title
Molecular Biology

Subject Code
CHEM - Chemistry
Course Number
3017

Academic Unit
Chemistry (CHEM)

College/School
College of Science (SI)

Course Duration
One Semester

Credit Units
4

Level
B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction
English

Medium of Assessment
English

Prerequisites
CHEM1200/BCH1200 Discovery in Biology (for normative 4-year students) or A Level Biology (for advance standing I students)

Precursors
CHEM2003/BCH2003 Biochemistry
CHEM3012/BCH3012 Genetics
CHEM2013/BCH2013 Microbiology

Equivalent Courses
BCH3017 Molecular Biology

Exclusive Courses
Nil

Part II Course Details

Abstract

In this course, students will:

- explore the relationship between genes and their activities at the molecular, biochemical and organismal level
- develop an understanding of a range of advanced molecular genetic techniques and strategies, and their application to functional genomic studies
- identify the major differences between prokaryotic and eukaryotic genes/genomes, and diverse gene regulatory mechanisms
- devise appropriate recombinant DNA experiments to address specific applied genetic problems
- will learn how to clone and characterize genes in the final year project (CHEM4036)

Course Intended Learning Outcomes (CILOs)

	CILOs	Weighting (if app.)	DEC-A1	DEC-A2	DEC-A3
1	Relate the molecular structure to the function and information encoded in DNA, RNAs and proteins.	25		x	
2	Apply the principles of molecular biology to elucidate gene control mechanisms and functions, and facilitate the discovery/design of novel proteins in prokaryotic and eukaryotic systems.	45	x	x	
3	Evaluate the impact of recombinant DNA technology in agriculture, forensic science, medicine, pharmaceuticals, and industry.	15	x	x	
4	Discover aspects of current in vitro and in vivo molecular techniques and their applications in functional genomics and/or systems biology.	15	x	x	x

A1: Attitude
Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability
Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments
Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

	TLAs	Brief Description	CILO No.	Hours/week (if applicable)
1	Group discussion activities, written assignments, tutorials and laboratory practicals	Students will undertake large and small group discussion activities, written assignments, tutorials and laboratory practicals to examine different levels of DNA expression and control mechanisms that operate in bacteria and eukaryotes.	1, 2, 3, 4	
2	Tutorials, and laboratory practicals	In large and small group sessions including tutorials, and laboratory practicals, students will learn how to clone genes, construct DNA libraries, express and characterize recombinant proteins. Using computer softwares (e.g. Foldit), students will attempt to design (and discover) "newer" and "better" proteins to address specific challenges and opportunities in the fields of biotechnology and medical sciences. Tutorials will be supplemented with case examples to enable students to collect, process, present and interpret molecular data using a variety of bioinformatic resources.	2	
3	Group discussion activities and written assignments	Students will undertake large and small group discussion activities and written assignments to examine case studies of particular aspects of biotechnology.	3	

4	Use of Internet resources and investigation of scientific literature	Through extensive use of Internet resources and investigation of scientific literature, students in small groups will apply their knowledge to provide a review on the development and application of a variety of new in vitro and in vivo molecular techniques (e.g. new PCR-based techniques, DNA fingerprinting techniques, DNA microarrays functional genomics, etc) and clearly communicate and evaluate their findings orally and in writing.	4	

Assessment Tasks / Activities (ATs)

	ATs	CILO No.	Weighting (%)	Remarks (e.g. Parameter for GenAI use)
1	Short Quizzes	1, 2	3	
2	Laboratory Report	1, 2	15	
3	Tutorial / Discussion	1, 2	6	
4	Oral Presentation / Essay	3, 4	16	

Continuous Assessment (%)

40

Examination (%)

60

Examination Duration (Hours)

3

Additional Information for ATs

Starting from Semester A, 2015-16, students must satisfy the following minimum passing requirement for courses offered by CHEM:
"A minimum of 40% in both coursework and examination components."

Assessment Rubrics (AR)

Assessment Task

Short Quizzes/Tutorial Discussion

Criterion

Ability to explain and discuss the principles of DNA replication, transcription, and gene expression regulation in prokaryotic and eukaryotic systems

Excellent (A+, A, A-)

Shows excellent understanding of the general principles, and ability to explain, explore and integrate the knowledge

Good (B+, B, B-)
Shows a good understanding of the general principles, and ability to explain, explore and integrate the knowledge

Fair (C+, C, C-)
Shows adequate understanding of the general principles, and able to explain, explore and integrate the knowledge

Marginal (D)
Shows a weak understanding of the general principles, and marginal ability to explain, explore and integrate the knowledge

Failure (F)
Shows very poor understanding of the general principles, and unable to explain, explore and integrate the knowledge

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Assessment Task
Laboratory Report

Criterion
Ability to produce a concise and precise scientific lab report.

Excellent (A+, A, A-)
Background information is researched and cited. Hypothesis is stated in "If…then…" format and explained.

Data is complete and relevant. Tables are easy to read and units are provided. Graphs are labeled and show trends. Questions are answered completely and correctly.

Conclusion summarizes experiment, cites data, addresses hypothesis, and cites sources of error.

Report is well organized and cohesive and contains no mechanical errors. Presentation seems polished.

Good (B+, B, B-)
Background information is researched and cited. Hypothesis is stated but not explained and not in "If…then…" format.

One component of data incomplete:
___Tables
___Graphs
___Questions

One component of conclusion missing:
___Summary
___Data
___Hypothesis
___Errors

Report is well organized and cohesive but contains some spelling or grammatical errors.

Fair (C+, C, C-)
Background information is vague or brief. Hypothesis is stated but not explained and not in "If…then…" format.

Two components of data incomplete or one missing:
___Tables
___Graphs
___Questions

Two components of conclusion missing:
___Summary
___Data
___Hypothesis
___Errors

Report is somewhat organized with some spelling or grammatical errors.

Marginal (D)
Background is vague or brief, hypothesis is vague, or background or hypothesis is missing.

Data is brief and missing significant pieces of information.

Conclusion is brief and is missing significant pieces of information.

Report contains many errors.

Failure (F)
No introduction is presented.

No data reported.

No conclusion present.

No attention to detail evident.

Assessment Task
Oral Presentation / Essay

Criterion
(1) Content and context
(2) Presentation skills
(3) Questions & Answers

Excellent (A+, A, A-)
(1) Content and context
Excellent logical structure with coverage and relevance. The work is presented in an accurate, concise and coherent fashion.
(2) Presentation skills
Fluent language with a formal but conversational tone and no help from cue cards. Keeps eye contact with audience throughout the presentation. Good timing.
(3) Questions &Answers
Provides detailed answers to all questions. Illustrates the answers with additional PowerPoint slides (prepared in advance).

Good (B+, B, B-)
(1) Content and context
Good logical structure with coverage and relevance. The work is presented in an accurate fashion.
(2) Presentation skills
Appropriate use of language with the help of cue cards. Keeps eye contact with audience. Good timing.
(3) Questions &Answers
Can answer all questions in detail.

Fair (C+, C, C-)

(1) Content and context
Acceptable logical structure with coverage and relevance. The work is presented in an acceptable fashion.
(2) Presentation skills
Reading from single-page notes or cue cards. Occasional eye contact with audience. Either too short or overruns by only one to two minutes.
(3) Questions &Answers
Can answer most questions

Marginal (D)

(1) Content and context
No structure with no/little coverage and relevance. Very easy to find mistakes in the presented work.
(2) Presentation skills
Mumbling. No eye contact with audience. Very poor timing (e.g., either far too short or manages to present only a small part of the material).
(3) Questions &Answers
Fails to answer most questions and has difficulty understanding many of them.

Failure (F)

Zero contribution in the whole presentation, including information research, data processing, preparation works and presentation

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Assessment Task

Examination

Criterion

Ability to explain and describe the principles of DNA replication, transcription, and gene expression regulation in prokaryotic and eukaryotic systems. Ability to apply the basic molecular biological principles/knowledge to problem solving.

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

- In vitro and in vivo genetic manipulation
- Gene structure, function and regulation
- Biochemical engineering

- Creation and application of transgenic animals and plants
- Molecular biology and biotechnology
- Bioinformatics – application of basic computational techniques

Reading List

Compulsory Readings

	Title
1	Nil

Additional Readings

	Title
1	Robert J. Weaver (2008) Molecular Biology. (4th edition), McGraw-Hill Co., Inc., USA.
2	James D. Watson et al (2008) Molecular Biology of the Gene. (6th edition), Pearson, CSHL Press, Inc.
3	Online Resources: To be provided, as required, in lectures and tutorials.