Course Syllabus

MBMG514 Protein Structure and Function

Academic year 2022

Course ID and Name: MBMG 514 Protein Structure and Function

Course coordinator: Assoc. Prof. Panadda Boonserm, Ph.D.
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Instructors:

1. Assoc. Prof. Chartchai Krittanai, Ph.D.
2. Assoc. Prof. Panadda Boonserm, Ph.D.
3. Assoc. Prof. Surapon Piboonpocanun, Ph.D.
4. Assoc. Prof. Sarin Chimnaronk, Ph.D.
5. Asst. Prof. Chalongrat Noree, Ph.D.
6. Chonticha Saisawang, Ph.D.
7. Duangnapa Kovanich, Ph.D.

Supporting Staff:

1. Chanikarn Boonchuay
2. Htut Htut Htoo
3. Naraporn Sirinonthanawech
4. Monrudee Srisaisap
5. Potchaman Sittipaisan
6. Somsri Sakdee

Credits: 3(2-2-5)

Curriculum: Master of Science Program in Molecular Genetics and Genetic Engineering (required course)
Doctor of Philosophy Program in Molecular Genetics and Genetic Engineering (required course for students from B.Sc.)

Semester offering: Second semester

Pre-requisites: None

Course learning outcomes (CLOs):

Upon completion of this course, students are able to:

1. Acquire new knowledge and innovation in protein structure and function
2. Integrate and apply comprehensive knowledge in molecular biology of proteins to solve scientific research questions
3. Analyze and present lab data by using appropriate information and communication technologies
4. Demonstrate scientific integrity, responsibility, and safety practice
5. Demonstrate teamwork, interpersonal skills and responsibilities for the work assignments

Alignment of teaching and assessment methods to course learning outcome:

Course learning outcome	Teaching method	Assessment method
1. Acquire new knowledge and innovation in protein structure and function	(1) In-class/ on-line lecture (2) In-class/on-line discussion	(1) Written examination (2) In-class/on-line discussion (3) Quizzes (4) Assignment
2. Integrate and apply comprehensive knowledge in molecular biology of proteins to solve scientific research questions	(1) In-class/on-line discussion (2) Hands-on practice/VDO lab demonstration (3) Problem-based learning	(1) Direct observation (2) Lab performance/discussion (3) Problem-based learning presentation
3. Analyze and present lab data by using appropriate information and communication technologies	(1) Experimental data presentation and discussion	(1) Reports (2) Lab notebooks (3) Short presentation (4) In-class/on-line discussion

4. Demonstrate scientific integrity, responsibility, and safety practice	(1) Assignment (2) Lab safety guidelines	(1) Assessment of assigned work (2) Direct observation (3) Class attendance
5. Demonstrate teamwork, interpersonal skills and responsibilities for the work assignments	(1) Group/individual assignment	(1) Direct observation (2) Assessment of assigned work (3) Assessment of responsibility for assigned work.

Course description:

Molecular biology of proteins; PCR-based site-directed mutagenesis; BioEdit for sequence analysis; fluorescence microscopy; DNA sequence analysis; protein chromatography; antibody production; SDS-PAGE and Western blot analysis; protein purification; Circular Dichroism spectroscopy; enzyme kinetic assay; Image J; protein-protein interaction; immunoprecipitation assay; Pymol; X-ray crystallography

Course schedule:

Date: Monday-Friday

Time: 09.00-16.30

Rooms C405 (On-site lecture) and D401 (On-site lab), Institute of Molecular Biosciences or Webex/Zoom meetings for Online activities

Topic/Details	Time	Class Activity	Lecturer
7 November 2022			
Overview: Molecular Biology of Proteins	9.00 – 10:30 AM	Lecture	Panadda
PCR-based site-directed mutagenesis (Part I)	10:30 AM - 12:00 PM	Lab	Chalongrat, Duangnapa, Panadda
PCR-based site-directed mutagenesis (Part II)	1:00 – 4:00 PM	Lab	Chalongrat, Duangnapa, Panadda

Topic/Details	Time	Class Activity	Lecturer
8 November 2022			
Master plate preparation	8:30 – 9:30 AM	Lab	Chalongrat, Duangnapa, Panadda
Primer design / Sequence analysis	9:30 AM – 12:30 PM	Lecture / Computer	Chalongrat, Duangnapa, Panadda
Fluorescence microscopy	1:30 PM – 3:30 PM	Lecture	Chalongrat
Liquid culture preparation	3:30 – 4:30 PM	Lab	Chalongrat, Duangnapa, Panadda
9 November 2022			
SDS-PAGE and Western blot analysis	9:00 – 11:00 AM	Lecture	Panadda
Acrylamide gel preparation	11:00 AM – 12:30 PM	Lab	Chalongrat, Duangnapa, Panadda
Protein sample preparation	1:30 – 2:30 PM	Lab	Chalongrat, Duangnapa, Panadda
Image J	2:30 – 4:30 PM	Lecture / Computer	Chalongrat
10 November 2022			
SDS-PAGE	9:00 AM – 12:00 PM	Lab	Chalongrat, Duangnapa, Panadda
Western blot analysis	1:00 – 4:00 PM	Lab	Chalongrat, Duangnapa, Panadda
Discussion / Quiz	4:00 AM – 5:00 PM	Discussion / Quiz / Self-study	Chalongrat, Duangnapa, Panadda
14 November 2022			
Protein Purification - Bacterial culture preparation	9:00 – 9:30 AM	Lab	Panadda, Duangnapa,
Protein chromatography	9:30 – 11:30 AM	Lecture	Panadda
-Buffer preparation and cell harvest	1:00 – 4:00 PM	Lab	Panadda, Duangnapa,

Topic/Details	Time	Class Activity	Lecturer
15 November 2022			
-Sonication and centrifugation	9:00 AM – 12:00 PM	Lab	Panadda, Duangnapa,
-Nickel-NTA affinity chromatography	1:00 – 4:00 PM	Lab	Panadda, Duangnapa,
16 November 2022			
-SDS-PAGE analysis	9:00 AM – 12:00 PM	Lab	Panadda, Duangnapa,
-Desalting and protein concentration assay	1:00 – 4:00 PM	Lab	Panadda, Duangnapa,
17 November 2022			
Circular dichroism	9:00 – 11:00 AM	Lecture	Chartchai
-Circular dichroism lab	1:00 – 3:00 PM	Lab	Panadda, Duangnapa,
-Discussion / Quiz	3:00 – 4:00 PM	Discussion / Quiz	Panadda, Duangnapa,
21 November 2022			
Enzyme kinetics assay	9:30 – 11:30 AM	Lecture	Chonticha
Self-study	1.00-3.00PM		
22 November 2022			
Protein-protein interaction: Yeast two-hybrid assay	9:00 – 12:00 PM	Lecture	Surapon
Protein-protein interaction: Antigen and antibody			
Protein-protein interaction: Immunoprecipitation	1:00 – 3:00 PM	Lecture	Surapon
23 November 2022			
X-ray crystallography	9:00 – 11:00 AM	Lecture	Sarin
Pymol	1:00 – 3:00 PM	Lecture / Computer	Sarin
Self-study	3:00 – 4:30 PM		
24 November 2022			

Topic/Details	Time	Class Activity	Lecturer
Problem-based learning presentation day (may be combined with MBMG515)	9:00 – 11: AM	Problem-based learning	All staff
After-action review	11:00 AM – 12:00 PM	After-action review	Panadda
Self-study	1.00-4.30 PM		
25 November 2022			
Written exam	9:00 – 11:00 AM	Exam	TBA

Assessment Criteria:

Assessment Criteria	Assessment Method	Scoring Rubric
Laboratory performance 30%	(1) Direct observation (2) Practical examination/Quizzes (3) In-class/on-line discussion (4) Short presentation	(1) Ability to follow procedure or to design a procedure for experiment (2) Use of equipment (3) Working area and safety
Laboratory report/ Lab notebook 10%	(1) Reports (2) Lab notebooks	(1) Writing style (2) Report submission time (3) Presentation of data (4) Data analysis and conclusion (5) Lab notebook
Quizzes and exercises 20%	(1) Quizzes (2) Written examination	(1) Comprehension

Assessment Criteria	Assessment Method	Scoring Rubric
	(3) Assignment	
Problem-based learning presentation 20%	(1) Presentation	(1) Ability to apply knowledge to solve research problems (2) Ability to answer questions
Class participation, Group presentation, Group assignment 20%	(1) Direct observation (2) Short presentation	(1) Class participation (2) Group work (3) Assigned work submission time (4) Group presentation

Lab Performance Evaluation Rubric				
Criteria	**Excellent (4)**	**Good (3)**	**Satisfactory (2)**	**Need to Improve (1)**
1. Ability to Follow Procedure or to Design a Procedure for Experiment (20 %)	Actively followed the instructions in the procedure with no assistance. Showed ability to perform additional experiments or tests beyond what was required in the procedure.	Followed the instructions in the procedure with little or no assistance. If the procedure was not provided, the student was able to determine an appropriate experiment to satisfy the lab objectives.	Had difficulty with some of the instructions in the procedure and needed clarification from the instructor or lab partner. If the procedure was not provided, the student needed some guidance about experiments to perform to satisfy the lab objectives.	Had difficulty reading the procedure and following the directions. Several mistakes were made during the experiment. If the procedure was not provided, student was incapable of designing a set of experiments to satisfy the given lab objectives.
2. Use of Equipment (5 %)	Showed proper techniques for handling tools and lab	Showed proper techniques for handling tools and lab	Showed adequate care for handling tools and lab	Showed improper techniques for handling with some major errors.

	equipment without error.	equipment with a few minor errors.	equipment with some minor errors.	
3. Working Area and Safety (5 %)	Experiment was carried out with full attention to relevant safety procedures & directions. No incident occurred. Outstanding job on cleaning up working area, tools and equipment. Lab tools were organized and stored with care.	Experiment was generally carried out with attention to relevant safety procedures & directions. No incident occurred. Good job on cleaning up working area, tools and equipment. Lab tools were properly stored.	Experiment was carried out with some attention to relevant safety procedures & directions. A few incidents occurred. Had to be reminded to clean up area and equipment. Sometimes showed disorganized storage of lab tools.	Safety procedures were ignored. Did not follow directions. Several incidents occurred. Did not clean up area and equipment after working. Showed disorganized storage of lab tools.
Total (30 %)	**Total points earned =**			

Student's achievement will be graded using symbols: A, B+, B, C+, C, D+, D and F based on the criteria as follows:

Percentage	Grade	Description
80–100	A	Excellent
75–79	B^+	Very Good
70–74	B	Good
65–69	C^+	Fairly Good
60–64	C	Fair
55–59	D^+	Poor
50–54	D	Very Poor
0–49	F	Fail

Lab Report/ Lab notebook Evaluation Rubric				
Criteria	**Excellent (4)**	**Good (3)**	**Satisfactory (2)**	**Need to Improve (1)**
1. Writing Style (2%)	Report was neat and well organized with minimum spelling error.	Report was neat and appropriately organized with a few spelling errors.	Report was somewhat neat and organized with some spelling errors.	Report was disorganized with many spelling errors.
2. Report Submission time (1%)	Report was sent on time.	Report was sent one day late.	Report was sent two days late.	Report was sent more than two days late.
3. Presentation Of Data (2%)	Experimental data was clearly presented with tables, diagrams, pictures or graphs that effectively present the experimental data. Showed clear detail of results and graphical data were labelled accurately.	Experimental data was presented in an appropriate format with only a few minor errors or omissions. Showed clear detail of results and graphical data were labelled accurately.	Experimental data was presented in an appropriate format but some significant errors were noticed. Some tables, graphical data could be better organized. Some units, labels, and titles were missing.	Experimental data was poorly presented. Graphs or tables were poorly constructed with several errors. Data was missing or incorrect. Some units, labels, and titles were not included.
4. Data Analysis and Conclusion (2%)	Reasonable scientific explanation for the results were discussed and logically analyzed. Conclusion was well written with a complete answer to the question or hypothesis. Provided description of what was learned, possible sources of error, good suggestions for improving the	Scientific explanation for the results were given. Conclusion was appropriately written with a possible answer to the question or hypothesis. Provided description of what was learned, possible sources of error, suggestions for improving the	Scientific explanation for the results were given but neither complete nor accurate. Conclusion was written with inaccurate answer to the question or hypothesis. Description of what was learned, possible sources of error, suggestions for improving the	Scientific explanation for the results were given but neither complete nor accurate. Conclusion was poorly written with inaccurate answer to the question or hypothesis. Description of what was learned, possible sources of error, suggestions for improving the experiment and application were missing.

Lab Report/ Lab notebook Evaluation Rubric				
Criteria	**Excellent (4)**	**Good (3)**	**Satisfactory (2)**	**Need to Improve (1)**
	experiment and application.	experiment and application.	experiment and application were missing.	
5. Lab notebook (3%)	Lab notebook was completed including procedures for each experiment, calculation, results and conclusion.	Lab notebook was sufficiently complete with only minor omissions.	Lab notebook had partial information with major omissions.	Lab notebook was incomplete and difficult to understand.
Total (10 %)	**Total points earned =**			

Problem-based learning Presentation Rubric				
Criteria	**Excellent (4)**	**Good (3)**	**Satisfactory (2)**	**Needs to Improve (1)**
1.Scientific background (4%)	Main ideas were presented with depth and details. All key elements were included. Experimental design answered all questions. Poster contained accurate information.	Main ideas were presented with appropriate depth and details. Most key elements were included. Experimental design answered almost all questions. Poster contained a few mistakes.	Main ideas were presented but not complete or with superficial details. Some key elements were missing. Experimental design answered some questions. Poster contained some mistakes.	Main ideas were not presented and lack of details. Most key elements were missing. Experimental design could not directly answer questions. Poster contained many mistakes.
2. Innovative and creative ideas (4%)	Presenter extended a novel or unique idea/ product to create new knowledge by	Presenter recognized and incorporated some alternative or diverse perspectives. Presenter	Presenter incorporated a few alternative perspectives. Presenter	Presenter used only a single approach to solve the problem. Presenter reformulated a collection of already available ideas.

Problem-based learning Presentation Rubric				
Criteria	**Excellent (4)**	**Good (3)**	**Satisfactory (2)**	**Needs to Improve (1)**
	integrating alternative, or diverse perspectives. Presenter transformed ideas or solutions into entirely new forms.	experimented with creating a novel or unique idea /product and made some efforts to synthesize new ideas or solutions.	experimented with creating a novel or unique idea /product and made little efforts to synthesize new ideas or solutions.	
3. Presentation skills (4%)	Delivery was clear and smooth with good language skills. Visuals were attractive and effectively enhanced the presentation. Length of presentation was within the assigned time limits.	Delivery was clear and smooth with good language skills. Visuals were appropriately used to enhance the presentation. Length of presentation was one minute over the assigned time limits.	Delivery had some broken sentences. Visuals were not well used to enhance the presentation. Length of presentation was more than one minute over the assigned time limits.	Delivery had many broken sentences and was not clear. Visuals were not used to enhance the presentation. Length of presentation was a few minutes over the assigned time limits.
4.Debate and argument skills (4%)	Presenter debated and responded to questions confidently and completely.	Presenter debated and responded to most questions but needed some clarification.	Presenter debated and responded to some questions but always needed some clarification.	Presenter could not debate and respond to most questions.
Total (20 %)	**Total points earned =**			

Class participation, Group presentation, Group assignment Rubric				
Criteria	**Excellent (4)**	**Good (3)**	**Satisfactory (2)**	**Needs to Improve (1)**
1. Class participation (5 %)	Used time well in class and focused attention on the lecture and experiments. Actively participated in the	Used time pretty well. Stayed focused on the lecture and experiments most of the time. Usually provided useful ideas when participating in	Focused on the class but did not appear very interested. Sometimes provided useful ideas when participating in the	Participation was minimal. Rarely provided useful ideas when participating in the group and in classroom discussion.

Class participation, Group presentation, Group assignment Rubric				
Criteria	**Excellent (4)**	**Good (3)**	**Satisfactory (2)**	**Needs to Improve (1)**
	group and in classroom discussion.	the group and in classroom discussion.	group and in classroom discussion.	
2. Group work (5%)	Shared a lot of work with others. Gave ideas and helped others to complete the assigned work.	Shared equal work as others. Gave ideas and completed the assigned work in the group.	Did almost as much work as others. Sometime gave ideas and asked for help from others.	Did less work than others. Did not give ideas or ask for help from others.
3.Assigned work submission time (5%)	Completed assigned work on time.	Completed assigned work one day late.	Needed some reminding; work was late but no more than two days.	Needed much reminding; work was late more than two days.
4.Group presentation (5%)	The presentation was well organized, and easy to follow. All of the group members contributed equally to the presentation.	The presentation had good organization. Everyone gave some presentation but someone gave more contribution than others.	The presentation could be better organized. Certain people did not do as much work as others.	The presentation lacked organization. A few people or only one person worked on the presentation.
Total (20 %)	**Total points earned =**			

Revised Date: 30 August 2022