TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

INTRODUCTION TO BIOPHYSICS

by

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UNIVERSITAS INDONESIA
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
PHYSICS UNDERGRADUATE STUDY PROGRAM

TEACHING INSTRUCTIONAL DESIGN

Course Name	Introduction to Biophysics	**Credit(s)**	**Prerequisite course(s)**	**Requisite for course(s)**	**Integration Between Other Courses**
Course Code	SCPH603718	2	General Biology	None	None
Relation to Curriculum	Elective				
Semester	6/7				
Lecturer(s)	Dr. Nurlely, M.Si.				
Course Description	After completing this course, medical physics and biophysics students are able to understand basic biophysics concepts especially in applying physics concepts to living things. Broadly speaking, this course consists of several topics, including cell biophysics, molecule structure and interaction, bioenergy, membrane transport, electrical characteristic of cell membrane, bioelectromagnetic, biophotonic related to vision, bioacoustics related to hearing, biomechanics, and a few other special topics related to experiment method and measurement. This course will be taught in Indonesian.				

Program Learning Outcome (PLO)	
PLO 1	Able to explain basic biophysics concepts in everyday life.
PLO 2	Able to classify and understand biophysics phenomenon related to live science.

PLO 3	Able to determine method of measurement of biological material through its macromolecule structure, intra and inter molecular interaction as well as different kind of measurement technique.
Course Learning Outcome (CLO)	
CLO 1	After completing this course, medical physics and biophysics student are able to know and understand biophysics phenomenon that happen in biology and medicine or other live sciences.
Sub-CLO(s)	
Sub-CLO 1	Able to explain and apply basic biophysics concepts to classify structure, characteristic, and function of macromolecule.
Sub-CLO 2	Able to explain and apply thermodynamics concepts on biological process and system.
Sub-CLO 3	Able to explain and apply electromagnetism concepts on cell membrane.
Sub-CLO 4	Able to explain and apply biophotonic and bioacoustics concepts to vision and hearing sense.
Sub-CLO 5	Able to explain and apply biophysics concepts on muscle contraction, biomechanics of hard and soft structure as well as the biophysics of radiation.
Sub-CLO 6	Able to explain and apply biophysics concepts and its application in determining characteristics of macromolecule.
Study Materials	1. Introduction to cell biophysics 2. Molecular structure and interaction 3. Bioenergy 1 4. Bioenergy 2 5. Membrane Transport 6. Electrical characteristics of cell membrane 7. Bioelectromagnetic 8. Biophotonic 9. Bioacoustics 10. Biomechanics 11. Biophysics of radiation

	12. Biophysics technique and application 1 13. Biophysics technique and application 2
Reading List	1. W. Hoppe, W. Lohmann, H. Markl, H. Ziegler, Biophysics, Publisher : Springer; 1st Edition (September 21, 1983). 2. Patrick F. Dillon, Biophysics, Published in the United States of America by Cambridge University Press, New York, 2012. 3. Rodney M J Cotteril, Introduction to Biophysics, Published by John Wiley & Sons Ltd, 2002. 4. Thomas Heimburg, Thermal Biophysics of Membrane , WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, 2007. 5. MUDr. Elena Kukurová, CSc**,** Eva Kráľová, Michal Trnka, Basics of Medical Physics and Biophysics for electronic education of health professionals, Publisher: Asklepios, Bratislava 2013.

I. Teaching Plan

Week	Sub-CLO	Study Materials [with reference]	Teaching Method [with est. time]	Learning Experiences (*O-E-F)	Sub-CLO Achievement Indicator		Sub-CLO Weight on Course (%)
					General	Specific	
1	1	Cell biophysics References: [1] & [5]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	Orientation: Synchronous lecture, watching lecture video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)	Able to understand basic concept of emission, absorption, and molecular interaction	Able to understand basic cell biophysics concept and design an application of it for biology, medicine, or other live sciences.	8.33%
2	1	Molecular structure and interaction References: [1] & [5]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes Synchronous:	Orientation: Synchronous lecture, watching lecture video, reading material (40%) Exercise:	Able to understand basic concept of emission, absorption, and molecular interaction	Able to understand basic cell biophysics concept and design an application of it for biology, medicine, or other live sciences.	8.33%

			Discussion through msTeams 50 minutes	Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)			
3	2	Thermodynamics, Conservation of Energy, Biological Process References: [1]-[3]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	Orientation: Synchronous lecture, watching lecture video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)	Able to understand basic concept of conservation of energy and biological process and system.	Able to understand basic thermodynamics concepts and design an application of it for biology, medicine, or other live sciences.	8.33%
4	2	Bioenergy, Gibbs free energy for metabolic reaction References: [1] & [5]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes Synchronous:	Orientation: Synchronous lecture, watching lecture video, reading material (40%)	Able to understand basic concept of bioenergy and Gibbs free energy for metabolic reaction	Able to understand basic bioenergy concepts and Gibbs free energy for metabolic reaction and design an application of it for biology, medicine, or other live sciences.	8.33%

			Discussion through msTeams 50 minutes	Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)			
5	3	Difusion, Osmosis, Selective Membrane References: [1] & [4]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	Orientation: Synchronous lecture, watching lecture video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)	Able to understand basic biophysics concept of diffusion, osmosis, and selective membrane	Able to understand basic biophysics concepts for diffusion, osmosis, and selective membrane and design an application of it for biology, medicine, or other live sciences.	5.55%
6	3	Potential membrane and electrical impulse in cell References: [1] & [5]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes	Orientation: Synchronous lecture, watching lecture video, reading material (40%)	Able to understand basic concept of potential membrane and impulse conduction in cell	Able to understand basic biophysics concepts of potential membrane and impulse conduction and design an application of it for biology, medicine, or other live sciences.	5.55%

			Synchronous: Discussion through msTeams 50 minutes	Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)			
7	3	Magnetic characteristic and biological material interaction with low frequency electrical current References: [1] & [5]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	Orientation: Synchronous lecture, watching lecture video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)	Able to understand basic concept of magnetic character of biological material	Able to understand basic biophysics concept of magnetic character and biological material interaction with low frequency current and design an application of it for biology, medicine, or other live sciences.	5.55%
8	Mid-Term Exam						
9	4	Biophysics of hearing References: [1] - [3]	Asynchronous: Reading, lecture video,	Orientation: Synchronous lecture, watching lecture	Able to understand basic biophysics concepts of hearing	Able to understand basic biophysics concept of human hearing system and design an	8.33%

			assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)		application of it for biology, medicine, or other live sciences.	
10	4	Mechanism of human hearing References: [1] – [3]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	Orientation: Synchronous lecture, watching lecture video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)	Able to understand basic concept vibration and waves as well as mechanism of human hearing.	Able to understand basic physics concept of vibration and waves related to human hearing and ultrasound therapy and diagnostic and design an application of it for biology, medicine, or other live sciences.	8.33%
11	5	Biomechanic and muscle contraction	Asynchronous: Reading, lecture video,	Orientation: Synchronous lecture,	Able to understand basic concept of biomechanics and muscle contraction	Able to understand basic concepts of biomechanics, contraction and elasticity of	5.55%

		References: [1] & [5]	assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	watching lecture video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)		muscle and design an application of it for biology, medicine, or other live sciences.	
12	5	Biomechanics of hard and soft structure References: [1] & [5]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	Orientation: Synchronous lecture, watching lecture video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)	Able to understand basic biomechanics concept of soft and hard structure	Able to understand basic biomechanics concept of soft and hard structure in human and design an application of it for biology, medicine, or other live sciences.	5.55%
13	5	Biophysics of radiation, radioactivity, radiation	Asynchronous:	Orientation:	Able to understand basic concept of radioactivity,	Able to understand basic concept of radioactivity, radiation	5.55%

		interaction and cellular/molecular effect of ionizing radiation. References: [1] & [5]	Reading, lecture video, assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	Synchronous lecture, watching lecture video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)	radiation interaction, and cellular/molecular effect of ionizing radiation	interaction, and cellular/molecular effect of ionizing radiation and design an application of it for biology, medicine, or other live sciences.	
14	6	Spectroscopy and electrophoresis References: [1] & [5]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	Orientation: Synchronous lecture, watching lecture video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)	Able to understand basic concept of spectroscopy measurement and electrophoresis	Able to understand basic concept of spectroscopy measurement and electrophoresis and design an application of it for biology, medicine, or other live sciences.	8.33%

15	6	Characterization and measurement method using AFM, SEM, and XRD References: [1] & [5]	Asynchronous: Reading, lecture video, assignment, discussion 150 minutes Synchronous: Discussion through msTeams 50 minutes	Orientation: Synchronous lecture, watching lecture video, reading material (40%) Exercise: Discussion with lecturer/class (30%) Feedback: Question and answer with lecturer (30%)	Able to understand basic concept of AFM, SEM, and XRD	Able to understand basic concept AFM, SEM, and XRD for characterization and measurement and design an application of it for biology, medicine, or other live sciences.	8.33%
16	Final Exam						

II. Assignment Design

Week	Assignment Name	Sub-CLOs	Assignment	Scope	Working Procedure	Deadline	Outcome
1	Individual Assignment 1	SUB-CLO 1	Individual Assignment	• Biophysics • Cell • Chromosome • DNA • RNA	Homework	1 week	Answer sheet
2	Individual Assignment 2	SUB-CLO 2	Individual Assignment	• Emission and absorption • Molecular interaction	Homework	1 week	Answer sheet
3	Group Assignment 1	SUB-CLO 2	Group Assignment	• Bioenergy • Thermodynamics and biological process • First Law of Thermodynamics • Enthalpy • Conservation of Energy	Group Assignment	1 week	Answer sheet
4	Group Assignment 2	SUB-CLO 2	Group Assignment	• Bioenergy • Entropy and Gibbs Free Energy • Second Law of Thermodynamics • Metabolic reaction	Group Assignment	1 week	Answer sheet
5	Individual Assignment 3	SUB-CLO 3	Individual Assignment	• Membrane transport • Diffusion • Osmosis • Gradient potential • Gas transport	Homework	1 week	Answer sheet
6	Individual Assignment 4	SUB-CLO 4	Individual Assignment	• Electrical characteristic of cell membrane • Membrane potential • Action potential and impulse conduction	Homework	1 week	Answer sheet
7	Group Assignment 3	SUB-CLO 4	Group Assignment	• Bioelectromagnetic • Dielectric of biological material • Magnetism of biological material • Interaction of biological material with low frequency electric current	Group Assignment	1 week	Answer sheet
9	Tugas mandiri 5	SUB-CLO 4	Individual Assignment	• Biophotonic	Homework	1 week	Answer sheet

				• Human vision • Vision correction • Color • Aberration			
10	Group Assignment 4	SUB-CLO 4	Group Assignment	• Bioacoustic • Vibrations and Waves • Mechanism of hearing • Ultrasound for therapy and diagnostic	Group Assignment	1 week	Answer sheet
11	Individual Assignment 6	SUB-CLO 5	Individual Assignment	• Biomechanic • Biophysics of muscle contraction • Mechanics of muscle • Elasticity of muscle	Homework	1 week	Answer sheet
12	Individual Assignment 7	SUB-CLO 5	Group Assignment	• Biomechanics of soft and hard structure	Group Assignment	1 week	Answer sheet
13	Individual Assignment 8	SUB-CLO 5	Individual Assignment	• Radioactivity • Interaction of radiation with matter • Cellular and molecular effect of radiation	Homework	1 week	Answer sheet
14	Group Assignment 5	SUB-CLO 6	Group Assignment	• Ultracentrifuge • Electrophoresis • Spectroscopy	Group Assignment	1 week	Answer sheet
15	Group Assignment 6	SUB-CLO 6	Group Assignment	• SEM • XRM • AFM	Group Assignment	1 week	Answer sheet

III. Assessment Criteria (Learning Outcome Evaluation)

Evaluation Type	Sub-CLO	Assessment Type	Frequency	Evaluation Weight (%)
Individual Assignment	1 - 5	Homework	8	30 %
Group Assignment	2 - 6	Group Assignment	6	30 %
Mid-Term Exam	1 - 4	Problem sets	1	20 %
Final Exam	4 - 6	Problem sets	1	20 %
			Total:	100%

IV. Rubric(s)

This rubric is used as a guideline for assessing or giving levels of student performance results. a rubric usually consists of assessment criteria that include the dimensions / aspects that are assessed based on indicators of learning achievement. This assessment rubric is useful for clarifying the basics and aspects of the assessment so that students and lecturers can be guided by the same thing regarding the expected performance demands. Lecturers can choose the type of rubric according to the assessment given.

A. Conversion of the student's final score

Score	Grade	Equivalent
85 - 100	A	4.00
80 - < 85	A-	3.70
75 - < 80	B+	3.30
70 - < 75	B	3.00
65 - < 70	B-	2.70
60 - < 65	C+	2.30
55 - < 60	C	2.00
40 - < 50	D	1.00
< 40	E	0.00

B. Assessment rubric: project report and papers

Rubric 1 (Mid-Term Exam and Final Exam)

1) Able to write down their ideas and use it to solve a problem (25%);

2) Able to use the correct concept in solving the problem (35%);

3) Able to formulate the final result correctly (30%);

4) Able to use the appropriate dimension, units, and significant figures (10%);