College of Biomedical Engineering

Bachelor of Engineering Program in Biomedical Engineering, Academic Year 2025

Section I: General Information

PHY 138 Biomedical Engineering Physics I 3(2-3-6)

Course Type: Core Course
Prerequisites: None
Semester Offered: 1/2025
Sections: 01,021,12,121
Course Category: Professional Core Course

Instructors	Asst. Prof. Dr. Sani Boonyagul	■ Full -Time Lecturer
	Dr.Kitakorn Jatiyanon	■ Full -Time Lecturer

Teaching Location: On Campus

Date of preparation: 14/8/2025

Section 2: Course Objective

1. Objectives

1) To enable students to understand the fundamental principles of physics as they apply to physical and biological systems.
2) To develop students' analytical and computational skills in key physics topics, such as mechanics, fluid mechanics, and thermodynamics.
3) To equip students with the ability to connect and apply their physics knowledge appropriately when analyzing biomedical engineering problems.
4) To enhance students' capability in using measurement instruments and conducting physics experiments to collect, analyze, and interpret biomedical engineering data.
5) To foster systems thinking and reasoning skills for applying physics principles in design and problem-solving within health and biomedical contexts

2. Course Description:

Units and measurement in physical and biological contexts, vector algebra, basic principles of mechanics: work, energy, power, and momentum, statics: equilibrium and fundamental principles of engineering statics, elastic properties of materials, principles of fluid mechanics, ideal gas laws and thermodynamics and applications of these topics in biomedical engineering.

3. Weekly Academic Consultation Hours

The instructor provides **3 hours per week** of academic consultation and guidance to students.

E-mail: sani@rsu.ac..th
Facebook: ……
Line: ……
Other (please specify): ……

4. Course Learning Outcomes (CLOs)

1) Demonstrate foundational knowledge in mechanics, heat physics, and thermodynamics.
2) Demonstrate knowledge and skills in applying principles of mechanics, heat physics, and thermodynamics for designing and conducting experiments, as well as analyzing and interpreting data relevant to biomedical engineering.
3) Apply foundational knowledge in mechanics, heat physics, and thermodynamics to explore and address diverse contexts within biomedical engineering.

Section 3: Development of Student Learning Outcomes

The development of course learning outcomes, aligned with the expected standards in each domain, is as follows:

1. Knowledge

PLOs	CLOs	Teaching methods	Assessment methods
1	Demonstrate fundamental knowledge in mechanics, heat physics, and thermodynamics.	○ **Lecture-based instruction** using problem posing followed by solving related physics principle problems, then practical laboratory training ○ **Assigning independent research tasks** for further exploration ○ **Homework assignments** focused on problem-solving practice	• **Evaluation and grading** based on assigned tasks. • **Assessment through midterm and final exams** using written tests.

2. Skills

PLOs	CLOs	Teaching methods	Assessment methods
1	Demonstrate knowledge and skills in applying principles of mechanics, heat physics, and thermodynamics to design and conduct experiments, as well as analyze and interpret data relevant to biomedical engineering	• **Lecture and laboratory-based instruction** • **Interactive Q&A sessions** with assignments that promote systematic analytical thinking • **Project-based learning approach**, where instruction is centered around student-led projects	• **Evaluation and grading** based on assigned tasks. • **Assessment through midterm and final exams**. • **Evaluation based on project work**, including project presentations and reports
1	Apply foundational knowledge in mechanics, heat physics, and thermodynamics to study and address various	• **Lecture and laboratory-based instruction** • **Interactive Q&A sessions** with assignments that promote systematic analytical thinking	• Grading assigned work, mid-term and final exams, project assessment, project presentation, and reports

	biomedical engineering contexts	• **Project-based learning approach**, where instruction is centered around student-led projects	

3. Ethics

PLOs	CLOs	Teaching methods	Assessment methods
1	Respect human rights, dignity, and value	• Integrating content on respecting human rights, dignity, and value, teamwork, punctuality, and responsibility to oneself and society.	• Observing behavior regarding self and others' rights • Observing learning behavior, project selection, and teamwork

4. Personal Attributes

PLOs	CLOs	Teaching methods	Assessment methods
1	Have leadership, be eager to learn, can work with others, accept and understand individual differences, and respect human rights and dignity.	• Project-based learning.	• Observing behavior during both theory and practical sessions • grading based on the project's process and success, and teamwork.

Section 4: Teaching and Assessment Plan

1. Teaching Plan

Week	Topics/ details		Activities	Hours	Lecturer
	Lecture	Laboratory			
1 20/08/2025	Mathematical foundations for physics-vector algebra	Mathematical foundations for physics-vector algebra	1. Lecture-practcie 2. Indirect teaching on discipline and punctuality 3. Using computers for teaching and processing 4. Assigning a simple biomedical engineering project	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul
2 27/08/2025	Units and measurements in physics and biology.	**Lab 1.** Measurement and uncertainty in measurement.	1. Lecture-practice 2. Indirect teaching on discipline and punctuality 3. using vernier calipers, micrometers, and computers for teaching and processing.	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul
3 3/09/2025	Fundamental principles of kinematics.	**Lab 2:** Applying Excel to analyze data using graphs.	1. Lecture-practice 2. Indirect teaching on discipline and punctuality 3. Using computers for teaching and processing	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul

Week	Topics/ details		Activities	Hours	Lecturer
	Lecture	Laboratory			
4 10/09/2025	Fundamental principles of kinematics.	**Lab 3:** Analyzing linear motion using Excel.	1. Lecture-practice 2. Indirect teaching on discipline and punctuality 3. using linear motion experimental kits and computers for teaching and processing.	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul
5 17/09/2025	Fundamental principles of dynamics.	**Lab 4:** Analyzing angular motion using Excel.	1. Lecture-practice 2. Indirect teaching on discipline and punctuality 3. using angular motion experimental kits and computers for teaching and processing.	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul
6 24/09/2025	Fundamental principles of dynamics.	**Lab 5:** Dynamics of linear motion.	1. Lecture-practice 2. Indirect teaching on discipline and punctuality 3. using linear motion experimental kits and computers for teaching and processing	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul
7 1/10/2025	Fundamental principles of work, energy, power, and momentum.	**Lab** 6: Dynamics of angular motion.	1. Lecture-practice 2. Indirect teaching on discipline and punctuality 3. using angular motion experimental kits and computers for teaching and processing.	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul
8 8/10/2025	**Mid-Term Break**	-	1. Mid-term exam 2. students present assigned project topics.	5	Dr.Kitakorn Jatiyanon
9 15/10/2025	Equilibrium and fundamental principles of engineering statics, elastic properties of objects.	-	1. Lecture-demonstration 2. Indirect teaching on discipline and punctuality 3. using computers for teaching and processing.	5	Dr.Kitakorn Jatiyanon
10 22/10/2025	Fundamental principles of fluid mechanics.	**Lab 7:** Testing elasticity of objects using computer models.	1. Lecture- practice 2. Indirect teaching on discipline and punctuality 3. using pressure measurement kits and computers for teaching and processing.	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul
11 29/10/2025	Fundamental principles of fluid mechanics.	**Lab 8:** Principles of blood pressure measurement	1. Lecture-practice 2. Indirect teaching on discipline and punctuality 3. using blood pressure measurement kits and computers for teaching and processing	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul

Week	Topics/ details		Activities	Hours	Lecturer
	Lecture	Laboratory			
12 5/11/2025	Fundamental principles of fluid dynamics.	**Lab 9:** Measuring the flow rate of an intravenous infusion pump.	1. Lecture-practice 2. Indirect teaching on discipline and punctuality 3. using IV flow rate measurement kits and computers for teaching and processing	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul/ Aj/ Kittipan Roongprasert
13 12/11/2025	Fundamental principles of gas laws and heat.	Fundamental principles of gas laws and heat (lecture)	1. Lecture-Demonstration 2. Indirect teaching on discipline and punctuality 3. Using computers for teaching and processing	5	Dr.Kitakorn Jatiyanon/
14 19/11/2025	Fundamental principles of thermodynamics.	Fundamental principles of thermodynamics. (lecture)	1. Lecture-Demonstration 2. Indirect teaching on discipline and punctuality 3. Using computers for teaching and processing	5	Dr.Kitakorn Jatiyanon/
15 26/11/2025	Elastic properties of objects and introduction to biomaterials.	Elastic properties of objects and introduction to biomaterials.	1. Lecture-Demonstration 2. Indirect teaching on discipline and punctuality 3. using computers for teaching and processing, and simulating elasticity tests.	5	Asst. Prof.Sani Boonyagul
16 3/12/2025	Elastic properties of objects and introduction to biomaterials	• Lab exam • project presentation,	1. Lab exam 2. project presentation 3. Indirect teaching on discipline and punctuality	5	Dr.Kitakorn Jatiyanon/ Asst. Prof.Sani Boonyagul

2. Learning Outcome Assessment Plan

2.1 Lecture Portion (65%)

CLOs	Assessment Method	Week	Proportion
1.1,2.3,2.3	Mid-Term Exam	8	15%
	Final Exam	17	30%
		Total	**45%**
3.1,4.1	**1.** Class attendance, assigned work, class participation, discussion, expressing opinions	Throughout the semester.	10%
	2. respect for self and others, leadership, and group work.	Throughout the semester.	10%
		Total	20%

2.2 Laboratory 35%

CLOs	Assessment Method	Week	Proportion
1.1,2.3,2.3,3.1,4.1	1. Practical skills and lab reports	Throughout the semester	15%
	2. project results, project	8,16	10%
	3. Lab exam	16	10%

3. Alignment of Course Learning Outcomes (CLOs) with Learning Outcomes

CLOs	1. Knowledge		2. Skills		3. Ethics		4. Personal Attributes	
	1.1	1.2	2.1	2.2	3.1	3.2	4.1	4.2
CLO 1 Demonstrates foundational knowledge in mechanics, thermal physics, and thermodynamics (Aligned with Knowledge)	✓							
CLO 2 Demonstrates knowledge and skills in applying principles of mechanics, thermal physics, and thermodynamics to design and conduct experiments, as well as to analyze and interpret relevant data in biomedical engineering (Aligned with Skills)			✓					
CLO 3 Applies foundational knowledge in mechanics, thermal physics, and thermodynamics for related studies in biomedical engineering in various contexts (Aligned with Skills).				✓				
CLO 4 Respects human rights, dignity, and value (Aligned with Ethics).					✓			
CLO 5 Has leadership, is eager to learn, can work with others, accepts and understands individual differences, and respects human rights and dignity (Aligned with Personal Attributes).							✓	

Section 5: Learning Resources

1. Main Textbooks and Documents

- Assoc. Prof. Nanthachai Thongpaen. *Teaching materials for Biomedical Engineering Physics 1*. Biomedical Engineering College, Rangsit University, 2025.

- Raymond A. Serway, John W. Jewett, Jr. *Physics for scientists and engineers with modern physics*. 10th edition, Thomson/Brooks/Cole, 2018.
- John D. Cutnell, Kenneth W. Johnson. *Physics*. 11th edition, Wiley, 2018.
- Sani Boonyagul (2018). *Introduction of Biomaterial*.

2. Important Documents and Data

- Hugh D. Young. *Physics*. Addison-Wesley Publishing Company, Eighth Edition, 1992.
- Douglas C. Giancoli. *Physics For Scientists and Engineers with Modern Physics*. Second Edition, Prentice-Hall, int, United States of America, 1988.

Section 6: Course Evaluation and Improvement

1. **Strategies for evaluating the effectiveness of the course by students**

- ☐ Evaluation of teaching effectiveness by students.
- ☐ Course evaluation form.
- ☐ Group discussion between instructors and students.
- ☐ Reflection on student behavior.
- ☐ Suggestions through online channels provided by the instructor for communication with students.

2. Strategies for evaluating learning management

- ☐ Instructor evaluation form.
- ☐ Reflection by students.
- ☐ Exam results.
- ☐ Verification of learning outcome assessment results.
- ☐ Evaluation by the academic standards committee.
- ☐ Observation of teaching by teaching team members.

3. Mechanisms for improving learning management

- ☐ Teaching and learning management seminars.
- ☐ In-class and out-of-class research.

4. Process for verifying student learning outcomes for the course

- ☐ A committee is established in the department to check student learning outcome assessment results by reviewing exams, reports, grading methods, and behavior scores.
- ☐ Verification of grading student work by the department and faculty committee.
- ☐ Verification of grading by randomly checking student work by instructors or other experts who are not permanent lecturers in the program.
- ☐ Other (specify) Verification by the academic standards committee.

5. Review and planning for improving the effectiveness of the course

- ☐ Improve the course annually based on suggestions and verification results from item 4.
- ☐ Improve the course annually based on the results of the instructor evaluation by students.