COURSE SYLLABUS

Course code	1070-ICGTE-MSA-205
Course name	Engineering Methods in Physiology
Course version	2026Z
Level of education	second cycle programme
Form and mode of study	full-time study
Study profile	general academic profile
Field of study	Chemical and Process Engineering
Specialisation	Green Technologies in Chemical Engineering
Organizational unit	The Faculty of Chemical and Process Engineering
Implementing unit	The Faculty of Chemical and Process Engineering
Course unit	n/a
Course groups	-
Course status	Obligatory
Language of the course	English
Study stage code	ICZTC-S2-MSA-1070
Number of ECTS credits	2

Part I

01. Learning outcomes and the method of conducting classes

Learning outcomes	see table "Learning outcomes"
Forms of classes and the number of hours in the semester	
lectures	20.00 h

02. ECTS balance

Number of ECTS credits	2	
Course workload	**Hours**	**ECTS**
Total number of hours and ECTS credits for the course:		
Hours and ECTS credits for courses involving direct participation of academic teachers	30	1.20
Hours and ECTS credits involving student's independent work	20	0.80
Total	50	2.00
Number of hours involving direct participation of academic teachers:		
Hours connected with class participation	20	
Other synchronous hours	10	
Total	30	
Number of hours involving student's independent work:		
Hours for student's independent work	20	

03. Course content

Part I

lectures	1. Basic concepts of chemical engineering as applied to medicine. Quantitative analysis of the human organism and its functions: the organism as a complex process system; use of mass balance principles; a set of standard parameters ("standard man"); 2. Decomposition of the organism into sub-systems: block diagrams, compartmental models, regional models (e.g., blood/tissue). Elements of pharmacodynamics. 3. Heat transfer phenomena in the body and heat exchange with the environment. Energy balance of the body. 4. Hydrodynamics of the circulatory system: physicochemical and rheological characteristics of blood; issues of flow in blood vessels, extracorporeal circulation. 5. Geometrical structure of the respiratory system, mechanics of the lungs and ventilation, respiratory parameters and gas exchange in the lungs - a process approach. 6. Examples of solutions of the gas flow equation in the bronchial tree, mechanisms of deposition of aerosol particles and their removal from the lungs.7 7. Pulmonary surfactant dynamics and capillary effects in the respiratory system. Effects of surfactant on respiratory mechanics and clearance. Methods for measuring the dynamic properties of pulmonary surfactant in vitro. Disruption of surfactant function by inhaled agents. 8. Medical aerosols and engineering problems of aerosol therapy: inhalers and their types, liquid atomization, powder dispersion, standard methods of measuring aerosol particle size (according to Pharmacopoeia, FDA, EMA). Demonstration of inhalers and systems for testing medical aerosols. 9. Permeation processes in the body and their implementation in artificial organs (artificial kidney, artificial liver). Biocompatible materials for use in implants and artificial organs.

Table: Learning outcomes	
Knowledge	
Outcomes code	P_W02
Description	In-depth knowledge of physics necessary to interpret physical phenomena in industrial processes
Related field-of-study learning outcomes	K2_W02
Outcomes code	P_W04
Description	The well-established knowledge necessary to draw up mass, component, momentum and energy balances taking into account the phenomena of momentum, mass and energy transfer.
Related field-of-study learning outcomes	K2_W04
Outcomes code	P_W09
Description	Knowledge of the directions of industrial technology development and the latest developments in chemical and process engineering
Related field-of-study learning outcomes	K2_W09
Skills	
Outcomes code	P_U01
Description	Ability to obtain information from literature, databases and sources, including foreign language, in the field of chemical and process engineering; abiliity to integrate obtained information, interpret and critically evaluate it, as well as draw conclusions and formulate and justify opinions.
Related field-of-study learning outcomes	K2_U01

Part I

Outcomes code	P_U02
Description	Ability to communicate on topics related to chemical engineering in diverse social and professional environments, including in a foreign language, and debate.
Related field-of-study learning outcomes	K2_U02
Outcomes code	P_U05
Description	Ability to plan and conduct research work, use measuring instruments and interpret the results obtained and draw conclusions.
Related field-of-study learning outcomes	K2_U05
Outcomes code	P_U17
Description	Ability to assess the suitability of methods and tools for solving an engineering task specific to chemical engineering and identify the limitations of these methods and tools
Related field-of-study learning outcomes	K2_U17
Social competence	
Outcomes code	P_K01
Description	Readiness to critically evaluate his knowledge and improve it using various sources of information.
Related field-of-study learning outcomes	K2_K01
Outcomes code	P_K04
Description	Awareness of the social role of a graduate of a technical university and understands the need to formulate and communicate to the public information and opinions on the achievements of technology and engineering and scientific activities in a commonly understood manner.
Related field-of-study learning outcomes	K2_K04
Outcomes code	P_K05
Description	Awareness of the importance of non-technical aspects and consequences of engineering activities, including their impact on the environment and the associated responsibility for decision-making.
Related field-of-study learning outcomes	K2_K05

Part II

04. Year and semester of studies	
Year	2026Z
Semester	2

05. Course leader and course teachers	
lectures	Tomasz Sosnowski
lectures	Tomasz Sosnowski

06. Course objective	
Course objective	The subject covers applications of quantitative methods to the analysis of physiological processes, Presentation of issues of momentum, energy and mass transfer in the human body, with example calculations Presentation of selected applications of chemical engineering methods in the design of drug delivery systems and artificial organs.

07. Teaching methods and techniques	
lectures	Subject delivered as a lecture - 20 hours per semester.

08. Methods of verifying learning outcomes	
Knowledge	
Outcomes code	P_W02

Part II	
Description	In-depth knowledge of physics necessary to interpret physical phenomena in industrial processes
Verification methods	lectures: written test
Outcomes code	P_W04
Description	The well-established knowledge necessary to draw up mass, component, momentum and energy balances taking into account the phenomena of momentum, mass and energy transfer.
Verification methods	lectures: written test
Outcomes code	P_W09
Description	Knowledge of the directions of industrial technology development and the latest developments in chemical and process engineering
Verification methods	lectures: written test
Skills	
Outcomes code	P_U01
Description	Ability to obtain information from literature, databases and sources, including foreign language, in the field of chemical and process engineering; abiliity to integrate obtained information, interpret and critically evaluate it, as well as draw conclusions and formulate and justify opinions.
Verification methods	lectures: written test
Outcomes code	P_U02
Description	Ability to communicate on topics related to chemical engineering in diverse social and professional environments, including in a foreign language, and debate.
Verification methods	lectures: written test
Outcomes code	P_U05
Description	Ability to plan and conduct research work, use measuring instruments and interpret the results obtained and draw conclusions.
Verification methods	lectures: written test
Outcomes code	P_U17
Description	Ability to assess the suitability of methods and tools for solving an engineering task specific to chemical engineering and identify the limitations of these methods and tools
Verification methods	lectures: written test
Social competence	
Outcomes code	P_K01
Description	Readiness to critically evaluate his knowledge and improve it using various sources of information.
Verification methods	lectures: written test
Outcomes code	P_K04
Description	Awareness of the social role of a graduate of a technical university and understands the need to formulate and communicate to the public information and opinions on the achievements of technology and engineering and scientific activities in a commonly understood manner.
Verification methods	lectures: written test
Outcomes code	P_K05
Description	Awareness of the importance of non-technical aspects and consequences of engineering activities, including their impact on the environment and the associated responsibility for decision-making.
Verification methods	lectures: written test

09. Required and recommended reading list

Part II

Required reading	1. O. Cooney, Biomedical engineering principles: an introduction to fluid, heat and mass transport processes, Marcel Dekker Inc., NY-Basel, 1976 2. M. Saltzman, Drug delivery. Engineering principles for drug therapy, Oxford University Press, 2001. 3. Rubenstein, W. Yin, M.D. Frame, Biofluid Mechanics: An Introduction to Fluid Mechanics, Macrocirculation, and Microcirculation, Academic Press, 2015 + Internet sources (biomedical engineering, drug delivery systems, etc)

10. Other information	
Other information	-