56S1-INZYNPRO **PROCESS ENGINEERING** **ECTS: 3.0**

HOURS PER SEMESTER/WEEK: LECTURES: 15/1; CLASSES: 30/2
FIELD OF THE STUDY: Environmental protection
Level of study: First-cycle (Engineer's degree) program

Course status: obligatory *
Year of the study: III

COURSE CONTENTS

LECTURES: definition of the subject of process engineering. Absorption processes. Fundamentals of the adsorption process. Diffusion, an introduction to the phenomenon of mass movement. Mass transfer through semipermeable membranes. Distributed systems - properties. Liquid purification processes - filtration. Removal of ions and anions - ion exchange. Colloids. Physicochemical methods to reduce colloidal dispersion. Gravity sedimentation. Mass and heat transport.

CLASSES: Gay-Lussac's law of volume ratios. Avogadro's law. Boyle's and Mariotte's law - isothermal transformation. Isobaric and isochoric transformation. Clapeyron equation. Gas constant. Dalton's law. Density and molecular weight of gas. Adsorption. Adsorption equilibrium. The degree of coverage of the adsorbent surface. Langmuir isotherm equation. Determination of the constants of the Langmuir adsorption isotherm equation. The specific surface area of the adsorbent. Balancing of periodic adsorbents. Absorption. Equilibrium of absorption. Absorption isotherm. Henry's constant. Mass balance of countercurrent absorbers. Oxygenation of water and wastewater. Degree of saturation of water with oxygen. Degree of oxygen enrichment. Efficiency of aeration devices. Diffusion. Molar flux density of the component. Molar diffusion flux density of the component. Equimolar counter-propagating diffusion. Counter-propagating, non-molar diffusion. Diffusion of a component through an inert component. Diffusion coefficient. Membrane processes.

EDUCATIONAL PURPOSE: To teach the basic definitions and the meaning of the engineering calculations that characterize the unit processes used in the technologies employed for environmental protection

LEARNING OUTCOMES

Knowledge. Characterizes and applies the mathematical description of selected unit processes. Knows the unit processes used in environmental technologies.
Skills. Calculates parameters of adsorption, absorption, and membrane processes. Able to apply basic gas laws.
Social competences. Is aware of the importance of basic knowledge applied in the development and implementation of technologies to prevent damage to the natural environment.

TEACHING FORMS AND METHODS

Lectures. Informative lecture with a multimedia presentation
Classes. Exercises in the auditorium, computational exercises.

FORM AND CONDITIONS FOR VERIFICATION OF LEARNING OUTCOMES

Lectures. Written test with grade.
Classes. Written test with grade.

BASIC LITERATURE

1) Zarzycki R., Wymiana ciepła i ruch masy w inżynierii środowiska. Wyd. WNT Warszawa, 2005

ADDITIONAL LITERATURE

1) Ciborowski J., Inżynieria chemiczna. Inżynieria procesowa, WNT Warszawa, 1973. 2) Tabiś B. Zasady inżynierii reaktorów chemicznych. WNT Warszawa, 2000. 3) Gawroński R., Procesy oczyszczania cieczy. Oficyna Wydawnicza Politechniki Warszawskiej, 1999.

THE TEACHER/TEACHERS CONDUCTING THE CLASSES:

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* note: optional course availability depends on Polish students' choice!