FACULTY OF ENVIRONMENTAL ENGINEERING AND ENERGY
- LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

ERASMUS+ Courses Catalogue for the academic year 2026/27

Approved by:

DEAN OF THE FACULTY OF ENVIRONMENTAL ENGINEERING AND ENERGY

Beata Kowalska, Prof.

DEPUTY DEAN FOR STUDENT AFFAIRS

Łukasz Guz, PhD

ERASMUS+ COORDINATOR

Wojciech Cel, PhD

WINTER SEMESTER				
SUBJECT	**CODE**	**ECTS**	**HOURS**	**PAGE**
Air Pollution and Protection	I15	3	30	5
Basics of Structural Mechanics and Strength of Materials	I02	4	45	6
Characteristic of Water Supply and Wastewater Treatments Systems	I03	3	30	7
Computer Aided Designing – 2D vector graphics	I04	4	45	8
Computer Science II	I06	4	45	9
Energy Efficiency Technologies in Waste and Wastewater Management	I07	3	30	10
Energy-saving Buildings Environmental, Energetic, Architectural and Economical Aspects of Rising and Exploiting	I08	4	45	11
Environmental Law	I09	3	30	12
Environmental Nanotechnology	I31	3	30	13
Indoor Air Quality	I23	3	30	14
Sustainable Development Course	I10	3	30	15
Sustainable Domestic Water Heating Systems	I11	3	30	16
Waste Management	I13	4	45	17
Wastewater Treatment	I14	3	30	18
Diploma Seminar	I32	3	30	30

SUMMER SEMESTER				
SUBJECT	**CODE**	**ECTS**	**HOURS**	**PAGE**
Basics of Environmental Chemical Analysis	I16	3	30	19
Basics of Structural Mechanics and Strength of Materials	I02	4	45	6
Computer Aided Designing – 3D vector graphics	I17	4	45	20
Designing and Simulations of PV rooftop systems	I28	2	15	21
Energy-saving Buildings Environmental, Energetic, Architectural and Economical Aspects of Rising and Exploiting	I08	4	45	11
Environmental Law	I09	3	30	12
Environmental Chemistry	I19	3	30	22
Environmental Nanotechnology	I31	3	30	13
Fundamentals of Energy Conversion	I20	3	30	23
Heat Pumps	I29	3	30	24
Modeling and Simulation of Photovoltaic Systems	I24	2	15	25
Modeling of Wastewater Treatment Systems	I25	4	45	26
Ventilation and Air Conditioning	I26	3	30	27
Water Distribution Modelling	I30	2	15	28
Sustainable domestic water heating systems	I11	3	30	16
Wastewater Treatment	I14	3	30	18
Water Treatment for Industry	I27	3	30	29
Diploma Seminar	I32	3	30	30

FACULTY OF ENVIRONMENTAL ENGINEERING AND ENERGY
- GENERAL RULES

- Total amount of ECTS credits chosen by students for each semester cannot exceed 33 ECTS.
- Learning Agreement changes made at the beginning of each semester should not exceed 10 ECTS credits.
- The "During the mobility" form must be delivered to the Coordinator no later than 14 days after the organizational meeting held at the faculty.
- The Faculty Coordinator must be informed about classes taken at other Faculties of LUT.
- The total amount of ECTS credits chosen by students from other Faculties of LUT cannot exceed 10 ECTS credits.
- When the number of students applying for a given course is less than specified in the offer, the faculty will have the right to cancel the course. In this case the student should amend his/her Learning Agreement.
- Students are obliged to attend classes.
- In exceptional cases, i.e. a pandemic due to sanitary restrictions, field classes will be held in the form of a seminar.

Air Pollution and Protection – I15

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+seminars
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: winter	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: -
CONTENTS: structure of the atmosphere, sources of major gaseous pollutants and their effects (environmental, economic and health), particulate matter in the atmosphere, odors, emission estimation from technical and combustion processes, the theory of dispersion of air pollution in the atmosphere, atmospheric stability classes, indoor air pollution and personal exposure to air pollution, air sampling and analysis, current standards and legislation.
EFFECTS OF EDUCATION PROCESS: The students gain general knowledge of the major sources of gaseous air pollutants, particulate matter and their health, environmental and economic effects. The students understand the techniques for measurement, data collection and analysis of chemicals and PM in air samples. The students can estimate emissions from industry and non-industry processes.
LITERATURE (OPTIONAL): Lists of suitable books and papers will be provided in the lecture.
TEACHING METHODS: multimedia lecture, class discussion, computational tasks, filed trips.
ASSESSMENT METHODS: written test of knowledge seminars - student's presentation.
TEACHER (NAME, EMAIL CONTACT): Amelia Staszowska PhD, a.staszowska@pollub.pl

Basics of Structural Mechanics and Strength of Materials – I02

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+seminars
NUMBER OF HOURS: 15+30	**ECTS:** 4
SEMESTER: winter/summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basics of physics and mathematics.
CONTENTS: Classical, Newtonian mechanics, laws of motion. External and internal forces, reaction forces. Beams, frames, trusses – determination of internal forces. Elements of strength of materials, geometry, cross-sections, moments of inertia. Stresses, normal and shear stresses. Deformations.
EFFECTS OF EDUCATION PROCESS: Ability to calculate reaction forces. Ability to determine internal forces in beams, frames and trusses. Ability to calculate normal and shear stresses in simple constructions. Ability to determine deformations of simple constructions.
LITERATURE (OPTIONAL):
TEACHING METHODS: Lectures with multimedia. Discussions. Solving practical tasks.
ASSESSMENT METHODS: Project of simple beam, frame and truss. Knowledge tests.
TEACHER (NAME, EMAIL CONTACT): Zbigniew Suchorab PhD, z.suchorab@pollub.pl

Characteristic of Water Supply and Wastewater Treatments Systems – I03

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+field classes
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: winter	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge of chemistry and biology.
CONTENTS: Water cycle and resources of water. Water intake stations, pumping stations, water treatment stations, filters, water distribution systems and their control, sewage networks, sewage treatment plants, mechanical sewage treatment, biological sewage treatment, advanced nutrient removal, sludge management, sludge dewatering and drying.
EFFECTS OF EDUCATION PROCESS: General knowledge of functioning of water supply systems and sewage systems. Ability to recognize basic devices used in treatment processes and their functions.
LITERATURE (OPTIONAL): Handbook of Environmental Engineering Calculations by Ronald A.Walsh
TEACHING METHODS: multimedia lecture and field classes – several trips to water intake stations and wastewater treatment plant
ASSESSMENT METHODS: test of knowledge and students' written reports
TEACHER (NAME, EMAIL CONTACT): Agnieszka Żelazna PhD, **a.zelazna@pollub.pl,** Grzegorz Łagód PhD, g.lagod@pollub.pl,

Computer Aided Designing – 2D vector graphics – I04

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+laboratory
NUMBER OF HOURS: 15+30	**ECTS:** 4
SEMESTER: winter	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge connected with 2D geometry, coordinate geometry, technical drawing and graphic documentation of engineering object.
CONTENTS: Computer Aided Designing, two dimensional vector graphics, technical drawing, drawing of environmental engineering devices by CAD tools, AutoCad, Autodesk Building System.
EFFECTS OF EDUCATION PROCESS: Knowledge about the basic and advanced functions of AutoCAD settings and options, ability of drawing of 2D engineering projects.
LITERATURE (OPTIONAL):
TEACHING METHODS: Lecture – multimedia presentations, examples of using following options for preparing technical documentation with vector graphics, laboratory – exercises with AutoCAD program using proper tools and settings for preparing technical documentation.
ASSESSMENT METHODS: Two tests of knowledge and abilities, first connected with basic settings, drawing and description of object, second with advanced settings, edition and preparation of engineering graphical documentation for printing.
TEACHER (NAME, EMAIL CONTACT): Grzegorz Łagód PhD, **g.lagod@pollub.pl,** Zbigniew Suchorab PhD, z.suchorab@pollub.pl

Computer Science II – I06

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+laboratory
NUMBER OF HOURS: 15+30	**ECTS: 4**
SEMESTER: winter	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: basic computer science course
CONTENTS: programming in C, main structure of a code, loops, arithmetic and logical operators, functions, variables, and prototypes, strings and arrays, pointers, input/output, character manipulation.
EFFECTS OF EDUCATION PROCESS: ability to program and execute a simple programs in C language, understanding of program syntax and main elements of language
LITERATURE (OPTIONAL): internet sources, manuals for C language, examples of code
TEACHING METHODS: lecture for theoretical information, laboratory for practical applications of gained knowledge
ASSESSMENT METHODS: 2 written tests, 2 demonstration programs written by each student, assessment of progress during laboratory exercises
TEACHER (NAME, EMAIL CONTACT): Grzegorz Łagód PhD, **g.lagod@pollub.pl**, Zbigniew Suchorab PhD, z.suchorab@pollub.pl

Energy Efficiency technologies in waste and wastewater management – I07

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+field classes
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: winter	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: -
CONTENTS: : Solid waste types and composition. Classification of fuels. Waste to Energy Technology. Energy from Municipal Solid Waste. Utilization of Municipal Solid Waste. Waste water and sewage sludge management. Anaerobic digestion and co-digestion process. Sewage sludge utilization. Fuel from waste and wastewater treatment systems.
EFFECTS OF EDUCATION PROCESS: basic information about development of alternative fuels, new means of generating energy, energy efficiency technologies in waste and wastewater technologies.
LITERATURE (OPTIONAL): Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Printice Hall, 2000 Parker, Colin, & Roberts, Energy from Waste -An Evaluation of Conversion Technologies, Elsevier Applied Science, London, 1985
TEACHING METHODS: multimedia presentation, discussion, field studies
ASSESSMENT METHODS: test of knowledge, student's written reports
TEACHER (NAME, EMAIL CONTACT): Magdalena Lebiocka PhD, **m.lebiocka@pollub.pl**; Grzegorz Łagód PhD, g.lagod@pollub.pl

Energy-saving Buildings Environmental, Energetic, Architectural and Economical Aspects of Rising and Exploiting – I08

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+seminars
NUMBER OF HOURS: 15+30	**ECTS:** 4
SEMESTER: winter/summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge of buildings performance.
CONTENTS: Bases of building physics. Architecture of energy-saving and passive buildings. Evaluation of energy-safe and passive buildings parameters, evaluation of buildings energetic performance. Sanitary systems in energy-saving buildings. Application of renewable sources of energy in housing sector.
EFFECTS OF EDUCATION PROCESS: Ability to calculate heat parameters of the buildings. Ability to design energy-saving and passive houses. Ability to design sanitary systems in energy saving buildings. Ability to calculate energetic parameters of energy-saving buildings. Ability to calculate costs of exploitation of energy-saving buildings in comparison to the traditional houses. Ability to calculate influence of energy-saving buildings on environment in comparison to traditional houses.
LITERATURE (OPTIONAL):
TEACHING METHODS: Lectures with multimedia. Discussions about problems of buildings performance in home countries of Erasmus students. Simplified designing of energy-safe buildings.
ASSESSMENT METHODS: Making a simplified project of energy-safe building together with calculation of energetic performance, exploitation costs and influence on environment.
TEACHER (NAME, EMAIL CONTACT): Zbigniew Suchorab PhD, z.suchorab@pollub.pl

Environmental Law – I09

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+seminars
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: winter/summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: -
CONTENTS: Case study class led by USA specialist of environmental law and energy law. Elements of environmental law and energy law are based on practical examples.
EFFECTS OF EDUCATION PROCESS: Basic knowledge about the regulations concerning environmental and energy issues.
LITERATURE (OPTIONAL):
TEACHING METHODS: multimedia lecture, individual work with students on their reports
ASSESSMENT METHODS: written reports
TEACHER (NAME, EMAIL CONTACT): visiting professor

Environmental Nanotechnology – I31

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+seminar
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: winter/summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: -
CONTENTS: Nanomaterials – classification, synthesis, application in outdoor and indoor air protection, water and wastewater treatment, soil remediation. Biosensors. Fuel cell catalysts. Nananocatalysts used in environmental engineering. Environmental hazard of selected nanomaterials.
EFFECTS OF EDUCATION PROCESS: General knowledge of nanotechnology application for environmental engineering and potential hazard to the environment.
LITERATURE (OPTIONAL): Lists of suitable books and papers will be provided in the lecture.
TEACHING METHODS: multimedia lecture, class discussion, computational tasks
ASSESSMENT METHODS: lectures -written test of knowledge; seminars - student's presentation
TEACHER (NAME, EMAIL CONTACT): Amelia Staszowska PhD, a.staszowska@pollub.pl

Indoor Air Quality – I23

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+laboratory
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: winter	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: -
CONTENTS: major classes of indoor air pollutants, suspended particulate matter, bioaerosols, molds, indoor dust as a sink for semi-volatile and nonvolatile compounds, health effects of personal exposure to indoor air pollution, Sick Building Syndrome, methods for improving indoor air quality: low emission building materials, air duct cleaning, photocatalysis, bioremediation, disinfection; air sampling and analysis, current standards and legislation
EFFECTS OF EDUCATION PROCESS: The students gain general knowledge of the major sources of indoor air pollutants, particulate matter and their health effects. The students understand the techniques for measurement, data collection and analysis of chemicals and PM in air samples.
LITERATURE (OPTIONAL): Lists of suitable books and papers will be provided in the lecture.
TEACHING METHODS: multimedia lecture, class discussion,
ASSESSMENT METHODS: written test of knowledge, seminars - student's presentation
TEACHER (NAME, EMAIL CONTACT): Amelia Staszowska PhD, a.staszowska@pollub.pl

Sustainable Development Course – I10

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture
NUMBER OF HOURS: 30	**ECTS:** 3
SEMESTER: winter	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge from the field of protection of the environment.
CONTENTS: Background: the roads towards sustainability; Energy & climate: from fossil fuels to sustainable energy resources; Resources: Man and material flows; Urbanisation: cities and community development; Sustainable industrial production and consumption; Life, & food: sustainable agriculture, forestry and fishery; Mobility: towards sustainable transport; Welfare & lifestyle: social sustainability; Economics: the dilemma of economic growth; Politics: international cooperation for sustainable development, change & education.
EFFECTS OF EDUCATION PROCESS: Studying sustainable development is a way to come to grips with questions concerning present and future situation of human societies. The course provides knowledge of basic issues connected with three pillars of sustainable development (ecological, economic and social). Important part is also learning of evaluation abilities concerning sustainable development issues.
LITERATURE (OPTIONAL): Materials from the official website of the Baltic University: http://www.balticuniv.uu.se/index.php/introduction/home L. Ryden, P. Migula, N. Andersson (ed.), *Environmental Science*, Uppsala Publishing House, Uppsala 2003.
TEACHING METHODS: lectures
ASSESSMENT METHODS: examination
TEACHER (NAME, EMAIL CONTACT): Artur Pawłowski Prof, a.pawlowski@pollub.pl

Sustainable domestic water heating systems - I11

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+project
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: winter/summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: technical design and drawings, basic knowledge on AutoCAD operating.
CONTENTS: Domestic hot water requirements and preparation systems, photothermal conversion of solar radiation, types of solar collectors – technology and principles of operation, water tanks dedicated for the solar systems, solar control system, vapor compression heat pumps, horizontal and vertical ground heat exchangers, technical drawing (AutoCAD).
EFFECTS OF EDUCATION PROCESS: General knowledge about different techniques used to heat domestic water, use of photothermal conversion of solar radiation for domestic hot water preparation. General knowledge about the application of heat pump for space heating and domestic hot water preparation. Ability to design simple system with solar collectors and heat pump for domestic hot water preparation.
LITERATURE (OPTIONAL):
TEACHING METHODS: Multimedia presentation, discussion during the class and student's own projects
ASSESSMENT METHODS: Test of knowledge and projects of students
TEACHER (NAME, EMAIL CONTACT): Justyna Gołębiowska PhD, j.golebiowska@pollub.pl

Waste Management – I13

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+seminar
NUMBER OF HOURS: 30+15	**ECTS:** 4
SEMESTER: winter	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS:
CONTENTS: Basic definitions, waste classification. Waste management strategies and waste utilization methods. No waste and low waste technologies. Waste minimization, material recycling, energy recovery. Waste deposition on landfills – localization, construction, management and reclamation of landfill. Thermal, chemical and biological methods of waste utilization. Thermal methods: incineration, pirolysis, incineration in cement kilns. Biological methods: composting and methane digestions – basics of processes, installations. Chemical methods – selected processes for selected industrial wastes, no-waste technologies. Management of selected categories of waste. Industrial and municipal waste. Nuclear waste.
EFFECTS OF EDUCATION PROCESS: : Basic knowledge about waste management and effects of waste management strategies and utilization methods on the environment. Basic knowledge about thermal, chemical and biological methods of waste utilization. Knowledge about byproducts of various waste management methods and their influence on the environment. Detailed knowledge about the management of selected categories of waste. The ability to assess waste management methods from the point of the influence on the environment, on the basis of the critical analysis of literature and available information. The awareness about extra-technical aspects and results of localization and building waste landfills and other installations for waste utilization.
LITERATURE (OPTIONAL): handouts plus recommended articles
TEACHING METHODS: lecture, individual work with students preparing their presentations
ASSESSMENT METHODS: lecture – two tests (midterm and final), seminar – students' presentation (oral supported by Power Point)
TEACHER (NAME, EMAIL CONTACT): Marzenna R. Dudzińska Prof., m.dudzinska@pollub.pl

Wastewater Treatment – I14

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+seminar
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: winter/summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: -
CONTENTS: Wastewater classification from various points of view. Equipment of wastewater treatment plants. The technological lines of wastewater treatment and sludge disposal. Mechanical, chemical and biological stage of wastewater treatment. Pretreatment and primary stage of wastewater treatment - mechanical separators, sedimentation and flotation, settling tank. The secondary stage of wastewater treatment - activation and secondary settling tank, the basic parameters of activation, the types of aerobic bioreactors, nitrification and denitrification, phosphorus removal. Anaerobic processes - the types of anaerobic bioreactors. Treatment of sewage sludge.
EFFECTS OF EDUCATION PROCESS Knowledge about basic characteristics of wastewater, quality and quantity of wastewater, mechanical, biological and chemical ways of wastewater treatment .
LITERATURE (OPTIONAL): Wastewater treatment / edit. by David H. F. Liu, Béla G. Lipták., Wastewater treatment plant design ed/. by P. Aarne Vesilind [et al.]
TEACHING METHODS: multimedia presentation , class discussion
ASSESSMENT METHODS: test of knowledge and student's written reports
TEACHER (NAME, EMAIL CONTACT): Magdalena Lebiocka PhD, m.lebiocka@pollub.pl

Basics of Environmental Chemical Analysis – I16

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+seminars
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basics of chemistry and physics
CONTENTS: Basic concepts of novel instrumentation in the analysis of environmental contaminants. Their possibilities and limitations.
EFFECTS OF EDUCATION PROCESS: Knowledge on possibilities and limitations methods which can be used in environmental analysis.
LITERATURE (OPTIONAL): K. Danzer Analytical Chemistry – Theoretical and Metrological Fundamentals, Springer, 2007; F. Rouessac, A. Rouessac, Chemical Analysis - Modern Instrumentation Methods and Techniques, Wiley, 2007
TEACHING METHODS: lectures, demonstrations, discussions, solving real problems of environmental analysis
ASSESSMENT METHODS: demonstrations at the Laboratory of Environmental Analyses
TEACHER (NAME, EMAIL CONTACT): Jacek Czerwiński PhD, j.czerwinski@pollub.pl

Computer Aided Designing – 3D vector graphics – I17

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+lab
NUMBER OF HOURS: 15+30	**ECTS:** 4
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge on AutoCAD operating. Ability to work in 2D environment. Ability to use Cartesian and polar coordinates. Ability to draw and modify two-dimensional objects.
CONTENTS: Computer Aided Designing. Introduction to 3D Modeling environment of AutoCAD. Spherical and Cylindrical coordinates. User Coordinate System. Types of three-dimensional objects (wireframes, faces, solids). Solid primitives. Advanced solids. Edition of the 3D objects. Visual styles. Basics of Rendering. Drawing 3D models of the engineering objects.
EFFECTS OF EDUCATION PROCESS: Ability to use Spherical and Cylindrical coordinates. Ability to use User Coordinate Systems. Ability to draw particular types of 3D objects. Ability to draw and visualize 3D models of engineering objects.
LITERATURE (OPTIONAL): Suchorab Z., Łagód G., Computer Aided Designing – 3D Modeling of the Passive House, Monografie Komitetu Inżynierii Środowiska PAN vol. 111, 2013.
TEACHING METHODS: Visual presentation of working in AutoCAD 3D on projector. Working with students on their computers.
ASSESSMENT METHODS: Drawing an advanced model of engineering object. Showing the results in the form of vector graphics and in the form of the rendered rasters.
TEACHER (NAME, EMAIL CONTACT): Zbigniew Suchorab PhD, z.suchorab@pollub.pl,

Designing and simulations of PV rooftop systems – I28

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** project
NUMBER OF HOURS: 15	**ECTS:** 2
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: basic information about: photovoltaic (PV) systems, technical design and drawings
CONTENTS: designing the PV rooftop installation: estimation of energy demands, preparation of 2D/3D house model, PV sizing (PV modules and inverter), PV configuration and system arrangement according to the location, simulation of the energy yield
EFFECTS OF EDUCATION PROCESS: ability to design PV rooftop system in order to fulfill the energy consumption demands of a single-family house; general knowledge about PV designing and the use of PV designing software
LITERATURE (OPTIONAL):
TEACHING METHODS: multimedia presentation, visual presentation of designing in PV software, preparation of the PV project
ASSESSMENT METHODS: project of the PV rooftop installation with energy yield prognosis
TEACHER (NAME, EMAIL CONTACT): Ewelina Krawczak PhD, e.krawczak@pollub.pl

Environmental Chemistry – I19

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+seminars
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: -
CONTENTS: Introduction to environmental chemistry. Technosphere. Chemistry of atmosphere - structure, sources of pollutant emissions, dispersion, transformations. Principles of photochemistry and environmental catalysis. Smog phenomena. Greenhouse effect. Acid rains. Ozone layer depletion. Water pollution. Water disinfection by-products. Soil pollution. Fundamentals of radiochemistry. Persistent organic pollutants and emerging environmental pollutants - occurrence, classification, removal and analysis. Health risk assessment.
EFFECTS OF EDUCATION PROCESS: Students will gain knowledge about sources of pollutants in the environment, their transformation, health hazard and remediation techniques.
LITERATURE (OPTIONAL) 1. Harrison R.M., *Principles of environmental chemistry*. 2. Manahan S., *Environmental chemistry*. Additional reading materials will be assigned before and/or after classes.
TEACHING METHODS: multimedia lectures, class discussion, computational tasks, field trips
ASSESSMENT METHODS: test of knowledge
TEACHER (NAME, EMAIL CONTACT): Amelia Staszowska PhD, a.staszowska@pollub.pl

Fundamentals of Energy Conversion – I20

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+lab
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basics of physics and chemistry
CONTENTS: Forms of energy. Photovoltaic, photothermal, photoelectrochemical conversion of solar radiation. Thermoelectric effects. Electrochemical conversion of energy.
EFFECTS OF EDUCATION PROCESS: Knowledge of physic phenomena occurring in solar cells, solar collectors, thermogenerators, and electrochemical cells. Ability to measure experimentally characteristic parameters of energy conversion devices.
LITERATURE (OPTIONAL):
TEACHING METHODS: multimedia lecture, laboratory experiments
ASSESSMENT METHODS: test of knowledge and lab reports, grades based on reports from exercises
TEACHER (NAME, EMAIL CONTACT): Agata Zdyb PhD, a.zdyb@pollub.pl

Heat Pumps – I29

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+project
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 7* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basics of environmental engineering
CONTENTS: History, operating principles, thermodynamic cycle, heat pump design and building installations. Kinds of heat sources for heat pumps. Recommended heating systems. Economic issues and current directions of heat pumps' market development. Designing of heating system supplied by heat pump – calculations and drawings.
EFFECTS OF EDUCATION PROCESS: Knowledge of heat pumps operation, types and applications. Ability to calculate the heat pump output and selection/dimensioning of accompanying devices.
LITERATURE (OPTIONAL): Heat Pump Planning Handbook by Jürgen Bonin (GoogleBooks)
TEACHING METHODS: multimedia lecture, practical examples, calculation tasks
ASSESSMENT METHODS: test of knowledge, calculation task
TEACHER (NAME, EMAIL CONTACT): Agnieszka Żelazna PhD, a.zelazna@pollub.pl

Modeling and Simulation of Photovoltaic Systems – I24

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** laboratory
NUMBER OF HOURS: 15	**ECTS:** 2
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Computer programming basics, basic knowledge about PV systems and photovoltaics
CONTENTS: Modeling of the Solar source, PV modules' characterization and modeling, the single-diode model for PV parameters estimation, energy yield analysis, performance metrics, and degradation rate of the PV systems
EFFECTS OF EDUCATION PROCESS: Modeling and data analysis of the solar radiation dependency on location, declination and tilt angle, current-voltage (I-V) characterization of the PV modules, I-V curves parameters extraction, five-parameters single diode model for energy prognosis, large-scale PV power output data analysis of the PV systems, performance analysis based on PV output data, degradation rate estimation
LITERATURE (OPTIONAL): Tamer Khatib, Wilfried Elmenreich. Modeling of Photovoltaic Systems Using Matlab. Wiley, 2016
TEACHING METHODS: Laboratories using Matlab software
ASSESSMENT METHODS: Laboratory exercises, final test of knowledge
TEACHER (NAME, EMAIL CONTACT): Slawomir Gulkowski PhD, s.gulkowski@pollub.pl

Modeling of Wastewater Treatment Systems – I25

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+laboratory (with computers)
NUMBER OF HOURS: 15+30	**ECTS:** 4
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* Should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge of wastewater treatment processes.
CONTENTS: Basics of computer modelling, main models in wastewater treatment, use of modern modelling software package, application of selected dynamic models, interactive simulation as a tool to observe different relationships between key parameters in wastewater treatment processes, the effects of dynamic operation and control on the performance of wastewater treatment plants, simulation results analysis.
EFFECTS OF EDUCATION PROCESS: knowledge on various processes used in modern wastewater treatment; ability to indicate relationships between key parameters in wastewater treatment processes; knowledge on basics of computer modeling; ability to use modern computer simulation program; ability to build wastewater treatment plant models; ability to simulate various configurations of the system modeled; ability to evaluate the performance of the system; ability to modify the key parameters to enhance the efficiency of the wastewater treatment plant
LITERATURE (OPTIONAL):
TEACHING METHODS: short lecture with multimedia presentation plus students' own work on set topics
ASSESSMENT METHODS: test of issues raised during the lecture; written report on simulation task
TEACHER (NAME, EMAIL CONTACT): Adam Piotrowicz PhD, a.piotrowicz@pollub.pl

Ventilation and Air Conditioning – I26

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+exercises
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basics of environmental engineering
CONTENTS: Thermal comfort in buildings. Internal and external air parameters calculations. Heat gains and losses. The quality of indoor air. The aerodynamics of air flows in rooms. Natural ventilation. Mechanical ventilation. Hybrid systems. Hydraulics in ventilation. Molier's graph and air parameters. Elements of ventilation systems.
EFFECTS OF EDUCATION PROCESS: Knowledge of systems and devices used in ventilation. Ability to calculate the basic air parameters. Basic knowledge of mechanical systems designing.
LITERATURE (OPTIONAL): Building Design and Construction Handbook by: Frederick S. Merritt, Jonathan T. Ricketts
TEACHING METHODS: multimedia lecture, practical examples, calculation tasks
ASSESSMENT METHODS: test of knowledge, calculation task
TEACHER (NAME, EMAIL CONTACT):): Łukasz Guz PhD, l.guz@pollub.pl, Agnieszka Żelazna PhD, **a.zelazna@pollub.pl**

Water Distribution Modelling – I30

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** project
NUMBER OF HOURS: 15	**ECTS:** 2
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Hydraulics theory, water supply systems theory
CONTENTS: Basics of modelling of water supply systems. The application of a specialized modelling software. The analysis of hydraulic performance of a water distribution system in an extended period simulation (EPS). Different modelling scenarios: water age, fire flow, flushing, pumps scheduling, energy analysis.
EFFECTS OF EDUCATION PROCESS: Knowledge of basics of water supply systems modelling. The ability to build a EPS model of a water distribution system and analyse the hydraulic performance parameters of the network. Ability to perform different modelling scenarios – water age, fire flow, flushing, pumps scheduling, energy analysis.
LITERATURE (OPTIONAL): EPANET User's Manual
TEACHING METHODS: Multimedia presentations and students own project in specialized software
ASSESSMENT METHODS: Validation of projects
TEACHER (NAME, EMAIL CONTACT): Paweł Suchorab PhD, p.suchorab@pollub.pl

Water Treatment for Industry – I27

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** lecture+project
NUMBER OF HOURS: 15+15	**ECTS:** 3
SEMESTER: summer	**CLASS LEVEL:** undergraduate/master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: -
CONTENTS: Water resources for industry. Technological concepts for industry water treatment. Best available techniques (BAT) for industry branches. Unit processes: preliminary screening, aeration, chemical pretreatment, coagulation, sedimentation, filtration, sorption, ion exchange, membrane processes, storage. Treatment systems of boiling and cooling water**.**
EFFECTS OF EDUCATION PROCESS: Students will be given an overview of the water treatment technologies that are typically used in different industry branches and will learn how to design these systems.
LITERATURE (OPTIONAL): Pal P., *Industrial water treatment process technology*. Additional reading materials will be assigned before and/or after classes.
TEACHING METHODS: multimedia lectures, computational tasks, field trips
ASSESSMENT METHODS: lecture -written test of knowledge; project - technological calculation and description of water treatment technology
TEACHER (NAME, EMAIL CONTACT): Amelia Staszowska PhD, a.staszowska@pollub.pl

Diploma Seminar - I32

FACULTY: Environmental Engineering and Energy	**CLASS TYPE:** seminars
NUMBER OF HOURS: 30	**ECTS:** 3
SEMESTER: summer / winter	**CLASS LEVEL:** master
MINIMAL NUMBER OF STUDENTS: 10* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: A defined Master's thesis topic and basic knowledge related to the selected research area.
CONTENTS: Individual preparation of a selected research topic related to the student's Master's thesis. Development of the research problem, objectives and research methodology. Planning and conducting experimental, field or computational research under the supervision of the academic teacher. Collection, processing and analysis of research data. Preparation of the main assumptions, thesis statement and outline of the Master's thesis. Discussion of research results and their interpretation. Individual consultations with the supervising academic teacher.
EFFECTS OF EDUCATION PROCESS: The student is able to define a research problem and formulate the objectives and main assumptions of a Master's thesis. The student can select and apply appropriate research methods, conduct research under academic supervision, and collect, process, and analyze research data. The student develops the ability to critically interpret research results and draw appropriate conclusions. The student is able to prepare a preliminary structure and outline of the Master's thesis and present the progress of the research work.
LITERATURE (OPTIONAL): Literature will be selected individually according to the subject and scope of the student's Master's thesis. The student will use scientific books, research papers, technical publications and other relevant scientific sources recommended by the supervising academic teacher.
TEACHING METHODS: individual consultations with the supervising academic teacher, individual research work, project-based learning, practical research activities, analysis and interpretation of research results, literature review, discussion of research progress.
ASSESSMENT METHODS: Assessment based on the student's individual research work, progress in the preparation of the Master's thesis, consultations with the supervising academic teacher, research results and the preparation of a preliminary thesis outline
TEACHER (NAME, EMAIL CONTACT): Wojciech Cel PhD, w.cel@pollub.pl