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ECTS catalogue for courses offered in English at Faculty of Mathematics and Information Technology in academic year 2025/2026

Course code	Course name	Semester	Number of hours	Teacher	ECTS
WI01	C++ programming – WI01	W	30	dr hab. Inż. Dariusz Czerwiński, prof. uczelni	3
WI02	Calculus – WI02	W,S	30	dr inż. Magdalena Jastrzębska	3
WI03	Cloud Computing – WI03	S	30	dr hab. Inż. Dariusz Czerwiński, prof. uczelni	3
WI04	Complex Analysis – WI04	W,S	30	dr inż. Anna Futa	3
WI05	Econometrics – WI05	S	15	dr Anna Makarewicz-Trześniewska	2
WI06	Electronics – WI06	W,S	30	dr inż. Michał Charlak	3
WI07	Full-Stack Development in Cloud Computing – WI07	S	30	dr hab. Inż. Dariusz Czerwiński, prof. uczelni	3
WI08	Fundamentals of Control Theory – WI08	W,S	60	dr inż. Radosław Cechowicz	5
WI09	Graph Theory – WI09	W	30	dr Izolda Gorgol	3
WI10	Introduction to Data Analysis – WI10	W	30	dr Dariusz Majerek	3
WI11	Introduction to Functional Analysis – WI11	W,S	15	dr Renata Buczko	2
WI12	Introduction to Industrial Robotics – WI12	W,S	60	dr inż. Radosław Cechowicz	5
WI13	Introduction to Machine Learning – WI13	W,S	30	mgr inż. Michał Błaszczykowski	3
WI14	Pneumatics and hydraulics drives – WI14	W,S	45	Dr inż Jarosław Zubrzycki	4
Wi15	Industrial Microcontrollers – WI15	W,S	45	Dr inż Jarosław Zubrzycki	4

WI16	Linear Algebra – WI16	W,S	30	dr Ewa Łazuka, prof. uczelni	3
WI17	Mathematical Foundations of Life Insurance – WI17	W,S	30	dr Paweł Wlaź	3
WI18	Probability Theory – WI18	W,S	30	mgr inż. Dagmara Dudek	3
WI19	Random Processes – WI19	W,S	30	dr hab. Yaroslav Chabanyuk, prof. uczelni	3
WI20	Selected Topics of Financial Mathematics – WI20	W,S	30	dr Janusz Szuster	3
WI21	Reliability Theory and Predictive Maintenance – WI21	W,S	30	dr inż. Bartłomiej Ambrożkiewicz	3
WI22	Fundamentals of Control Theory – WI22	W,S	30	dr inż. Radosław Cechowicz	3
WI23	Programming of Industrial Robots – WI23	W,S	30	dr inż. Radosław Cechowicz	3
WI24	Introduction to deep learning in Python – WI24	W,S	30	dr Maciej Czarnacki	3
WI25	Introduction to Logic and Formal Languages – WI25	W,S	45	dr inż. Radosław Cechowicz	4
WI26	Applications of MATHCAD to some technical issues of mechanics and physics – WI26	W	30	prof. Mykhaylo Pashechko	3
WI27	Diploma Seminar – WI27	S	30	dr hab. Inż. Dariusz Czerwiński, prof. uczelni	3
WI28	Web technologies – WI28	S	30	dr inż. Barbara Buraczyńska	3

Semester: W – winter (Oct.-Feb.); S – summer (Feb. – Jun.)

There is no possibility to apply for the whole academic year, only applications for one semester can be approved.

A course will be opened if at least 5 students apply. In case of fewer students interested in a course an individual work may be proposed.

A student can prepare his/her Learning Agreement with at most 33 ECTS.

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C++ programming – WI01

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture and laboratory**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter	**CLASS LEVEL: undergraduate**
NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: basic skills of programming

CONTENTS: C++ language – overview of basic paradigms, inheritance, Operator overloading, this pointer, references, Virtual functions and classes, Input-output system, formatting mechanisms, Dynamic memory allocation, static class elements, Function and class templates, namespaces, Exceptions and their handling, String class – C++-style strings, standard template library

EFFECTS OF EDUCATION PROCESS: Basic knowledge of object-oriented programming and C++ language elements used to create object-oriented applications. Students knows inheritance techniques, operator overloading, references and virtualization of functions and classes, the I/O library, formatting methods, the iOS class and manipulators, the exception mechanism and the technique of using it.

LITERATURE (OPTIONAL): Mark Reed. C++: 2 books in 1 - The Ultimate Beginners Guide to Master C++ Programming Quickly with No Prior Experience. 2022
Malik, D. S. "C++ Programming: From problem analysis to program design." Cengage Learning 2017

TEACHING METHODS: theory – lecture, practice – laboratory

ASSESSMENT METHODS: Final coursework assessment (exam)

TEACHER (NAME, EMAIL CONTACT): prof. Dariusz Czerwiński, university professor, d.czerwinski@pollub.pl

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Calculus – WI02

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture + class**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: basic mathematical knowledge

CONTENTS: concepts of functions, limits and continuity, differentiation rules, applications of derivatives, techniques of integration

EFFECTS OF EDUCATION PROCESS: acquiring basic concepts, facts and methods in the field of the differential and integral calculus, developing skills in the mathematical reasoning, solving problems related to the mathematical analysis

LITERATURE (OPTIONAL): C. L. Mett, J. C. Smith, Calculus with applications, New York [etc.] : McGraw-Hill Book Company, 1985
A. Howard, Calculus with analytic geometry, New York : John Wiley & Sons, 1989
O. Hijab, Introduction to Calculus and Classical Analysis, Springer-Verlag, New York, 1966

TEACHING METHODS: lecture, solving exercises

ASSESSMENT METHODS: homework, written exam

TEACHER (NAME, EMAIL CONTACT): Ph. D. Magdalena Jastrzębska, m.jastrzebska@pollub.pl

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Cloud Computing – WI03

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture and laboratory**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: summer	**CLASS LEVEL: undergraduate**
NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: basic skills of programming, Java programming

CONTENTS: The concept of cloud, types of clouds, the concept of cloud services, computer clouds and virtualization, Cloud storage support, mass storage virtualization, Cloud solutions on Linux systems, MapReduce parallel programming paradigm, Hadoop system as an example of cloud programming, Elements of a cloud computing task, Using Java for programming in the cloud

EFFECTS OF EDUCATION PROCESS: Understands the role and importance of cloud technology and knows its applications in business. Knows the principles of operation of clouds in various operating systems. Knows the techniques of creating a cloud application.

LITERATURE (OPTIONAL): Rafaels, Ray J. Cloud computing: From beginning to end. CreateSpace Independent Publishing Platform, 2015.
Erl, Thomas, Ricardo Puttini, and Zaigham Mahmood. Cloud computing: concepts, technology & architecture. Pearson Education, 2013.

TEACHING METHODS: theory – lecture, practice – laboratory

ASSESSMENT METHODS: Final coursework assessment (exam)

TEACHER (NAME, EMAIL CONTACT): prof. Dariusz Czerwinski, university professor, d.czerwinski@pollub.pl

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Complex Analysis – WI04

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture + class**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: calculus

CONTENTS: complex sequences and series, analytic functions, Cauchy's Theorem, residue calculus, harmonic functions

EFFECTS OF EDUCATION PROCESS: acquiring basic concepts, facts and methods in the field of the complex analysis, developing skills in the mathematical reasoning, solving problems related to the complex analysis

LITERATURE (OPTIONAL): L.V.Ahlfors, Complex Analysis, 3rd edition, McGraw Hill, 2000

TEACHING METHODS: lecture, solving exercises

ASSESSMENT METHODS: homework, written exam

TEACHER (NAME, EMAIL CONTACT): Ph. D. eng. Anna Futa, a.futa@pollub.pl

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Econometrics – WI05

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: laboratories**
NUMBER OF HOURS: 15	**ECTS: 2**
SEMESTER: summer	**CLASS LEVEL: undergraduate/master**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Computer skills, including using a spreadsheet. Knowledge of the basics of linear algebra, mathematical analysis and probability theory.

CONTENTS: Choosing independent variables. Matrix of correlation coefficients. Simple regression model. Ordinary Least Squares Method. Nonlinear models reducible to linear models**.**

EFFECTS OF EDUCATION PROCESS: Knowledge of basic types of econometric models, constructs econometric models of selected phenomena by selecting appropriate variables for the model.

LITERATURE (OPTIONAL): Damodar N. Gujarati, Dawn C. Porter, Basic Econometrics, Published by McGraw-Hill/Irwin
https://www.cbpbu.ac.in/userfiles/file/2020/STUDY_MAT/ECO/1.pdf

TEACHING METHODS: Working with learning materials, laboratory classes**.**

ASSESSMENT METHODS: Active participation in laboratories, doing homework on time.

TEACHER (NAME, EMAIL CONTACT): Ph. D. eng. Anna Makarewicz – Trześniewska a.makarewicz@pollub.pl

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Electronics – WI06

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: tutorial**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS:

CONTENTS: Semiconductors: diode, bipolar transistor, operational amplifier. Rectifier. AC/DC Power Adapter. Power amplifier. Function generator. Logic gates, flip-flops. Microprocessor architecture.

EFFECTS OF EDUCATION PROCESS: Students can apply fundamental electrical circuit's laws to design and measure simply electronic device

LITERATURE (OPTIONAL): Kuphaldt T.R., 2009 Lessons In Electric Circuits. Volume III – Semiconductors. full text access http://openbookproject.net/electricCircuits/

TEACHING METHODS: tutorial in lab

ASSESSMENT METHODS: exercise evaluation, class test

TEACHER (NAME, EMAIL CONTACT): Ph. D. eng. Michał Charlak, m.charlak@pollub.pl

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Full-Stack Development in Cloud Computing – WI07

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture and laboratory**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: summer	**CLASS LEVEL: master**
NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Knowledge of the following languages and tools: JavaScript, HTML, CSS, PHP, SQL, Java, basic programming in algorithmic languages

CONTENTS: Levels of computer clouds used in application programming, Full-stack programming, Full-stack programming in the computer cloud, Computer cloud services available to full-stack developers, Kubernetes as a full-stack tool, microservices in Kubernetes, pods and their settings, deployments in Kubernetes

EFFECTS OF EDUCATION PROCESS: Student understands the role and importance of full-stack programming in cloud computing.
Student knows how to configure an environment for designing and implementing full-stack applications for cloud computing.

LITERATURE (OPTIONAL): Northwood, Chris. The full stack developer: your essential guide to the everyday skills expected of a modern full stack web developer. Apress, 2018. Zammetti, Frank. Modern Full-Stack Development: Using TypeScript, React, Node. js, Webpack, and Docker. Apress, 2020.

TEACHING METHODS: theory – lecture, practice – laboratory

ASSESSMENT METHODS: Final coursework assessment (exam)

TEACHER (NAME, EMAIL CONTACT): prof. Dariusz Czerwinski, university professor, d.czerwinski@pollub.pl

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Fundamentals of Control Theory – WI08

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Lecture + Laboratory**
NUMBER OF HOURS: 60 (30 lecture + 30 laboratory)	**ECTS: 5**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic skills in numerical software (like Matlab/Scilab), fundamentals of calculus
CONTENTS: Mathematical models of real systems, differential equations, state-space equations, dynamic properties, standard signals, typical responses, system identification. Laplace's transform, Laplace's transfer function. System analysis – zeros, poles, dynamic response, stability, root locus. Frequency domain analysis, frequency response, Nyquist and Bode plots. Closed-loop control, compensation, pure time delay, PID Control. Quality of control process, performance of the system, dynamic and static errors. Robust control, IMC. Examples of control systems in industry.
EFFECTS OF EDUCATION PROCESS: Students will get acquainted with fundamentals of formal knowledge and methods in the area of control theory and its applications. Students will learn to design simple control systems.
LITERATURE (OPTIONAL): K. J. Åström, R. M. Murray: Feedback Systems: An Introduction for Scientists and Engineers http://www.cds.caltech.edu/~murray/amwiki/Main_Page P. Dawkins,: Paul's Online Notes, http://tutorial.math.lamar.edu/
TEACHING METHODS: lecture, laboratory exercises
ASSESSMENT METHODS: lecture: exam, laboratory: assessment of reports,
TEACHER (NAME, EMAIL CONTACT): Ph. D. eng. Radosław Cechowicz r.cechowicz@pollub.pl

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Graph Theory – WI09

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS:

CONTENTS: fundamentals of graph theory: connectivity, trees, minimal spanning trees, shortest paths, Euler and Hamilton cycles, planarity, colorings

EFFECTS OF EDUCATION PROCESS: recognizing basic properties of graphs, constructing minimal spanning trees and shortest paths, recognizing planar graphs, ability of applying vertex and edge colorings of graphs

LITERATURE (OPTIONAL): G. Chartrand, L. Lesniak, P. Zhang, Graphs and digraphs, CRC, 2011

TEACHING METHODS: lecture, solving exercises

ASSESSMENT METHODS: written exam

TEACHER (NAME, EMAIL CONTACT): Ph. D. Izolda Gorgol, i.gorgol@pollub.pl

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Introduction to Data Analysis – WI10

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Lecture**
NUMBER OF HOURS: 15	**ECTS: 2**
SEMESTER: winter	**CLASS LEVEL: bachelor/master**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: base knowledge of R or Python

CONTENTS: data science methods

EFFECTS OF EDUCATION PROCESS: point estimation, testing parametric and nonparametric hypotheses, sampling designs, linear and nonlinear models, feature selection, multidimensional scaling, cluster analysis, regression and classification models

LITERATURE (OPTIONAL): M.Khun, K. Johnson, Applied predictive modeling, Springer, 2013, S.J. Sheather, A modern approach to regression with R, Springer, 2009, T. Raykov, G. A. Marcoulides, Basic statistics, An introduction with R, Rowman & Littlefield, 2013

TEACHING METHODS: lectures with examples

ASSESSMENT METHODS: project

TEACHER (NAME, EMAIL CONTACT): Ph. D. Dariusz Majerek, d.majerek@pollub.pl

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Introduction to Functional Analysis – WI11

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture+class+discussion**
NUMBER OF HOURS: 15	**ECTS: 2**
SEMESTER: winter	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: basis mathematical analysis
CONTENTS: inner product, norm, metric, Hilbert space, Banach space, bounded and linear operator on normed spaces
EFFECTS OF EDUCATION PROCESS: the students can apply the concepts and method described in syllabus
LITERATURE (OPTIONAL):
TEACHING METHODS: lecture, solving exercises
ASSESSMENT METHODS: homework, written exam
TEACHER (NAME, EMAIL CONTACT): Ph. D. Renata Buczko, r.buczko@pollub.pl

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Introduction to Industrial Robotics – WI12

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Lecture + Laboratory**
NUMBER OF HOURS: 60 (30+30)	**ECTS: 5**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: none

CONTENTS: Basic concepts in industrial robotics: terminology, classification of robots, coordinate systems, workspace, tools, equipment, applications. Planning of motion trajectories. Applied robotics: programming languages, presentation of the selected programming environments, offline modeling, offline simulation and programming, load assessment, component wear planning, tool selection, auxiliary equipment, data exchange, planning of safety procedures, scheduling of tasks in robotic systems, process optimization.

EFFECTS OF EDUCATION PROCESS: Students acquire knowledge on: the use of robotized manufacturing cells, the general rules of design of automated manufacturing cells with industrial robots. Skills: Students will be able to select an appropriate robot for a task (palletizing, welding, assembly), select robot tools and program robot movements.

LITERATURE (OPTIONAL):

Craig JJ (2005) Introduction to Robotics - Mechanics and Control. Pearson Education International, Upper Saddle River, NJ 07458
Murray RM et al. (1994) A Mathematical Introduction to Robotic Manipulation. CRC Press;

TEACHING METHODS: lecture, laboratory exercises

ASSESSMENT METHODS: lecture: exam, laboratory: assessment of reports,

TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng Radosław Cechowicz, r.cechowicz@pollub.pl

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Introduction to Machine Learning – WI13

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: laboratory**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: logical thinking, basic computer skills, basic knowledge in probability

CONTENTS: machine learning fundamentals, regression analysis, classification techniques, clustering algorithms, dimensionality reduction methods, data preprocessing

EFFECTS OF EDUCATION PROCESS: The course will provide students with a thorough understanding of traditional machine learning algorithms and their practical application in solving real-world predictive problems. Additionally, the course will cover data clustering methods and dimensionality reduction techniques. Students will also acquire skills in data preprocessing and identifying dependencies essential for conducting effective analyses. Furthermore, participants will be introduced to tools for reporting and visualizing results. During the laboratory sessions, key data analysis libraries from Python and R will be utilized.

LITERATURE (OPTIONAL): C.M. Bishop, „Pattern Recognition and Machine Learning", Springer, 2006

TEACHING METHODS: laboratory

ASSESSMENT METHODS: project

TEACHER (NAME, EMAIL CONTACT): M. Sc. Eng. Michał Błaszczykowski, m.blaszczykowski@pollub.pl

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Pneumatics and hydraulics drives – WI14

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Lecture + Laboratory**
NUMBER OF HOURS: 45 (15+30)	**ECTS: 4**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate/master**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Knowledge of the basics of physics in the field of mechanics and thermodynamics. Ability to use engineering graphics

CONTENTS: Basic knowledge of fluid and gas mechanics - Pascal's law, Bernoulli's equation, equation of continuity of motion, types of fluid flows in a pipe. Working fluids – compressed air, working fluids, basic properties of working fluids, density, compressibility, viscosity, emulsions, anhydrous liquids. Energy converters - pumps and compressors, actuators, engines. Control elements – flow direction control valves, distributors, check valves, flow rate control valves. Monostable and bistable valves with electropneumatic control - automatic control system of a double-acting actuator using road distributors. Pneumatic and hydraulic actuators - single-acting and double-acting. Throttle control on the inlet, throttle control on the outlet. Control of the speed of extension and retraction of the piston rod of a double-acting actuator with a bistable valve.

EFFECTS OF EDUCATION PROCESS: the student is able to build a pneumatic and hydraulic drive system with control, is able to build an electropneumatic and electrohydraulic drive system with control, knows the principles of building pneumatic and hydraulic drives and their control

LITERATURE (OPTIONAL): Parr A.A.: Hydraulics and pneumatics. Elsevier Science & Technology Books, 2011

TEACHING METHODS: lecture, laboratory exercises

ASSESSMENT METHODS: lecture: exam, laboratory: assessment of reports

TEACHER (NAME, EMAIL CONTACT): Ph. D. eng. Jarosław Zubrzycki, j.zubrzycki@pollub.pl

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Industrial Microcontrollers – WI15

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Lecture + Laboratory**
NUMBER OF HOURS: 45 (15+30)	**ECTS: 4**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate/master**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: basic knowledge of electronics, electrical engineering and programming

CONTENTS: Basic concepts: processor, microprocessor, microcontroller, interface, computer. History and development of microprocessors. Typical microprocessor architectures, their advantages and disadvantages. Overview of the most popular microprocessor and microcontroller models. Basic elements of a single-chip computer: control unit, ALU, registers, program memory, RAM, buses, clock signal and its sources, reset and watchdog circuits, integrated interfaces. Methods of programming non-volatile memory. Programming the microcontroller with demonstration programs and testing their operation. Sequential control of LED numeric display. BCD code. Number display. Communication with a computer via a serial port. Communication with measuring transducers via I2C interface. Alphanumeric LCD display support

EFFECTS OF EDUCATION PROCESS: students have the knowledge to describe the architecture of a typical microprocessor system and explain the functions of its basic components. Students can correctly read a schematic diagram and design a simple embedded system based on a microcontroller and typical peripheral devices

LITERATURE (OPTIONAL): 1. Banzi M., Shiloh M.: Getting started with Arduino. 4th Edition. O'Reilly Media 2024; 2. Monk S. : Programming Arduino. Getting started with sketches. McGraw Hill Book Co, 2023

TEACHING METHODS: lecture, laboratory exercises

ASSESSMENT METHODS: lecture: exam, laboratory: assessment of reports

TEACHER (NAME, EMAIL CONTACT): Ph. D. eng. Jarosław Zubrzycki, j.zubrzycki@pollub.pl

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Linear Algebra – WI16

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture + class + discussion**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: basic mathematical concepts and notations

CONTENTS: complex numbers; matrix algebra; determinants; systems of linear equations; vector spaces, linear independence, basis and dimension; linear transformations; eigenvectors and eigenvalues; diagonalization

EFFECTS OF EDUCATION PROCESS: the students will be able to apply the concepts and methods described in the syllabus and will be able to solve different mathematical problems using linear algebra

LITERATURE (OPTIONAL): S. J. Axler, Linear Algebra Done Right, Springer-Verlag., D. H. Griffel, Linear Algebra and Its Applications, Chichester: Ellis Horwood Limited., D. C. Lay, Linear Algebra and Its Applications, Addison Wesley., S. J. Leon, Linear Algebra with Applications, Pearson Prentice Hall., D. Poole, Linear Algebra: A Modern Introduction, Brooks/Cole**.**

TEACHING METHODS: lecture, solving exercises, discussion

ASSESSMENT METHODS: homework, written exam

TEACHER (NAME, EMAIL CONTACT): Ph. D. Ewa Łazuka, e.lazuka@pollub.pl

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Mathematical Foundations of Life Insurance – WI17

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE:** lectures and exercises
NUMBER OF HOURS: 30	**ECTS:** 3
SEMESTER: summer	**CLASS LEVEL: undergraduate/master**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: differential and integral calculus, probability theory (discrete and continuous random variables)
CONTENTS: demographic models, life tables, typical life insurance policies and their actuarial values, life annuities, premiums, losses and reserves
EFFECTS OF EDUCATION PROCESS: student knows the concept of future lifetime as a random variable, student knows analytical laws of mortality, student knows life tables based model of mortality, student is able to apply methods of calculating actuarial values (also with commutation function), student is able to calculate premium and reserves
LITERATURE (OPTIONAL): N.L. Bowers, H.U. Gerber, J.C. Hickman, D.A. Jones, C.J. Nesbitt, Actuarial Mathematics, The Society of Actuaries 1997
TEACHING METHODS: lectures by teacher, textbook assignments, problem solving
ASSESSMENT METHODS: recognition of course work, written and oral examinations
TEACHER (NAME, EMAIL CONTACT): Ph. D. PAWEŁ WLAŹ, p.wlaz@pollub.pl

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Probability Theory – WI18

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture+class**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge and skills in the field of calculus, set theory and algebra
CONTENTS: 1. Basic combinatorial schemes. 2. Geometric probability, conditional probability, law of total probability, Bayes's theorem. 3. Independent events, Borel–Cantelli lemma. 4. Random variables, discrete and continuous random variables. 5. Parameters of a distribution, well-known probability distributions. 6. Characteristic functions, central limit theorem.
EFFECTS OF EDUCATION PROCESS: 1. Knows and understands the basic concepts of the probability theory. 2. Knows the basic methods and computational techniques used in the theory of probability.
LITERATURE (OPTIONAL):
TEACHING METHODS: Lecture and practical classes
ASSESSMENT METHODS: Written exam
TEACHER (NAME, EMAIL CONTACT): M. Sc. Eng. Dagmara Dudek dagmara.dudek@pollub.pl

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Random Processes – WI19

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture + class**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate/master /PhD**
MINIMAL NUMBER OF STUDENTS: 8 * should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Knowledge: derivative, integral, concept of probability, application of numerical characteristics of random quantities

CONTENTS: Multiplication Rule. Permutation. Combination. Probability Measure.Some Properties of the Probability Measure Conditional Probabilities Bayes' Theorem Distribution Functions of Discrete Random Variables Distribution Functions of Continuous Random Variables Percentiles for Continuous Random Variables Expected Value of Random Variables Variance of Random Variables Chebychev Inequality Moment Generating Functions Bernoulli Distribution Geometric Distribution Hypergeometric Distribution Poisson Distribution Uniform Distribution Gamma Distribution Normal Distribution Lognormal Distribution Bivariate Discrete Random Variables Conditional Distributions Independence of Random Variables Covariance of Bivariate Random Variables Independence of Random Variables Variance of the Linear Combination of Random Variables Correlation and Independence Moment Generating Functions Conditional Expected Values Conditional Variance Distribution Function Method Random Processes. Definition and Simple Examples. Averages of a Random Process TIME AVERAGE, TIME VARIANCE, TEMPORAL CROSS/AUTO CORRELATION EXPECTED VALUE, STATISTICAL VARIANCE, AUTO-CORRELATION Stationary Random Processes Markov Processes Independent Increment Processes Counting Processes and Poisson Process Mean and Autocorrelation Functions

EFFECTS OF EDUCATION PROCESS: Be able to calculate and apply the main numerical characteristics of stationary and non -stationary random processes

LITERATURE (OPTIONAL): Rosenthal, J. S. (2000). A First Look at Rigorous Probability Theory. Singapore: World Scientific. Ross, S. (1988). A First Course in Probability. New York: Macmillan. Ross, S. M. (2000). Introduction to Probability and Statistics for Engineers and Scientists. San Diego: Harcourt Academic Press. Roussas, G. (2003). An Introduction to Probability and Statistical Inference. San Diego: Academic Press. Sahai, H. and Ageel, M. I. (2000). The Analysis of Variance. Boston: Birkhauser.Prasanna Sahoo. (2010). Bruce Hajek. (2015). Random Processes for Engineers. Cambridge University Press

TEACHING METHODS: lecture

ASSESSMENT METHODS: The assessment is obtained on the basis of a written exam

TEACHER (NAME, EMAIL CONTACT): prof. Yaroslav Chabanyuk, university professor; y.chabanyuk@pollub.pl

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Selected Topics of Financial Mathematics – WI20

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: seminar**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter/summer	**CLASS LEVEL: undergraduate/master /PhD**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Knowledge of calculus II and basic probability theory

CONTENTS: Types of accumulation and discounting; Basic annuities; The term structure of interest rates; Types of interest rates; Fundamental categories of derivatives; FRA contracts; IRS contracts; Futures and Forward; Stock options; Binomial models.

EFFECTS OF EDUCATION PROCESS: : The student knows and understands: notions of accumulation and discounting and types of them, the dependence of the term structure of the type of the accumulation process, types of annuities, types of interest rates. The student knows and understands notions and properties of basic derivatives. The student knows and understands the structure of FRA and IRS contracts and also he knows the methods of valuation of those contracts. The student knows and understands Futures and Forward contracts and stock options.The student knows and understands the binomial models: one-step and multi-step as well as methods of valuation of derivatives and the algorithm of the valuation of the contract with use of binomial tree. The student is able to: utilize the notions of nominal and effective interest rates and the relation between the term structure of interest rates and the type of the accumulation process, use the notion of the annuity and apply the appropriate types of annuities to determine the present and future value of the capital and loan, use derivatives related notions and apply the properties of basic derivatives, apply FRA, IRS, Future and Forward contracts in basic investment strategies, perform the valuation of the derivative instrument with use of the binomial models.

LITERATURE (OPTIONAL): Hull J.C., Options, Futures & Other Derivatives, Prentice Hall, 2002; Kellison S.G., The Theory of Interest, McGraw-Hill, 1991

TEACHING METHODS: seminar

ASSESSMENT METHODS: The student presents main theoretical concepts and ideas and solves the problems.

TEACHER (NAME, EMAIL CONTACT): Ph. D. Janusz Szuster, university profesor, j.szuster@pollub.pl

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Reliability Theory and Predictive Maintenance – WI21

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Lecture and Laboratory**
NUMBER OF HOURS: 15 Lecture + 15 Laboratory	**ECTS: 3**
SEMESTER: Winter/Summer	**CLASS LEVEL: undergraduate/master**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: none

CONTENTS: This course covers the fundamentals of Reliability Theory, including failure modeling, reliability assessment, and risk analysis, as well as their applications in maintenance strategies. Emphasis is placed on Predictive Maintenance, utilizing data-driven techniques, condition monitoring, and machine learning to optimize system performance and prevent failures.

EFFECTS OF EDUCATION PROCESS: Students will gain the ability to analyze system reliability, apply predictive maintenance techniques, and utilize data-driven methods to optimize performance and prevent failures.

LITERATURE (OPTIONAL):

TEACHING METHODS: Multimedia lectures, laboratory exercises

ASSESSMENT METHODS: Lecture: final exam, Laboratory: submission of final report

TEACHER (NAME, EMAIL CONTACT): PhD Eng. Bartłomiej Ambrożkiewicz, b.ambrozkiewicz@pollub.pl

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Fundamentals of Control Theory – WI22

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Lecture + Laboratory**
NUMBER OF HOURS: 60 (30 Lecture + 30 Laboratories)	**ECTS: 4**
SEMESTER: Winter/Summer	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Basic skills in numerical software (like Matlab/Scilab), fundamentals of calculus

CONTENTS: Mathematical models of real systems, differential equations, state-space equations, dynamic properties, standard signals, typical responses, system identification. Laplace's transform, Laplace's transfer function. System analysis – zeros, poles, dynamic response, stability, root locus. Frequency domain analysis, frequency response, Nyquist and Bode plots. Closed-loop control, compensation, pure time delay, PID Control. Quality of control process, performance of the system, dynamic and static errors. Robust control, IMC. Examples of control systems in industry.

EFFECTS OF EDUCATION PROCESS: Students will get acquainted with fundamentals of formal knowledge and methods in the area of control theory and its applications. Students will learn to design simple control systems.

LITERATURE (OPTIONAL): K. J. Åström, R. M. Murray: Feedback Systems: An Introduction for Scientists and Engineers http://www.cds.caltech.edu/~murray/amwiki/Main_Page ; P. Dawkins: Paul's Online Notes, http://tutorial.math.lamar.edu/

TEACHING METHODS: lecture, laboratory exercises

ASSESSMENT METHODS: Lecture: final exam, Laboratory: submission of final report

TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng. Radosław Cechowicz; r.cechowicz@pollub.pl

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Programming of Industrial Robots – WI23

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Lecture + Laboratory**
NUMBER OF HOURS: 60 (30 Lecture + 30 Laboratories)	**ECTS: 4**
SEMESTER: Winter/Summer	**CLASS LEVEL: undergraduate**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Basic knowledge of kinematics of articulated robots, basic knowledge of manufacturing operations

CONTENTS: On-line and off-line robot programming of common manufacturing tasks: part manipulation, pick and place, palletizing/depalletizing, welding, painting assembly. Configuration of robot safety system, integration of smart sensors, synchronization with other machines, path planning, parametrization and optimization, assessment of robot load, modelling, and simulation of robot cells.

EFFECTS OF EDUCATION PROCESS: Student will learn how to prepare an industrial robot for a typical manufacturing task using dedicated tools for configuration, programming, simulation, and analysis of the robot load, and performance. After a successful completion of the course, the student should be able to operate and program an industrial robot safely, using off-line programming and simulation tools for program validation.

LITERATURE (OPTIONAL): Craig JJ (2005) Introduction to Robotics - Mechanics and Control. Pearson Education International, Upper Saddle River, NJ 07458; Murray RM et al. (1994) A Mathematical Introduction to Robotic Manipulation. CRC Press; Manuals for specific robots available on-site

TEACHING METHODS: Lecture, Laboratory exercises, Project task

ASSESSMENT METHODS: Lecture: test of knowledge; Laboratory: assessment of reports, assessment of prepared project

TEACHER (NAME, EMAIL CONTACT): Radosław Cechowicz, PhD Eng.; r.cechowicz@pollub.pl

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Introduction to deep learning in Python – WI24

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Lecture + Laboratory**
NUMBER OF HOURS: 30 (15 hours of lectures and 15 hours of laboratories)	**ECTS: 3**
SEMESTER: Winter/Summer	**CLASS LEVEL: undergraduate/master**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Mathematics at an academic level, basics of programming in Python, including knowledge of object-oriented programming
CONTENTS: Learning the principles of construction and operation of neural networks from scratch, construction of deep neural networks, i.e. dense networks, CNN, RNN, LSTM using deep learning libraries such as Tensorflow or Pytorch.
EFFECTS OF EDUCATION PROCESS: After completing the course, students will be able to prepare training data, construct neural networks and select deep learning algorithms appropriate to specific problems (regression, binary and multiclass classification, object detection, image recognition, time series prediction).
LITERATURE (OPTIONAL): Deep learning from Scratch: Building with Python from First Principles - Seth Weidman, Hands-on Machine Learning with Scikit-Learn, Keras, and Tensorflow: Concepts, Tools, and Techniques to build Intelligent Systems, 2nd Edition or higher - Aurelien Geron
TEACHING METHODS: Lectures and laboratories
ASSESSMENT METHODS: Final test and assessment of the final project from the laboratory classes
TEACHER (NAME, EMAIL CONTACT): Ph. D. Maciej Czarnacki, m.czarnacki@pollub.pl

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Introduction to Logic and Formal Languages – WI25

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Lecture + Laboratory**
NUMBER OF HOURS: 45 (15 Lecture + 30 Laboratory)	**ECTS: 4**
SEMESTER: Winter/Summer	**CLASS LEVEL: undergraduate/master**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: None

CONTENTS: The course focuses on essential elements of logic and formal languages that can be used to develop efficient programs for logic controllers used in many industrial applications, machine controllers, IoT devices, and smart things. You will learn how to efficiently use formal laws to analyse a problem and produce a minimal switching function suitable for specific hardware (eg. discrete logic gates), programmable logic device (eg. smart switch) or a computer program. Using formal languages will make the process of designing and programming of any sequence (or discrete event controller) easy and straightforward, plus your programs will be easy to debug and upgrade.

EFFECTS OF EDUCATION PROCESS: Student will acquire basic formal knowledge on logic and systems of logic and on the basic concepts of formal languages useful for designing and analysing of deterministic finite automata (DFA). Skills: Student will learn to use formal problem analysis to develop control programs for simple logic controllers (like smart switches) and popular industrial control devices (I/O modules, PLC controllers)

LITERATURE (OPTIONAL):

TEACHING METHODS: Lecture, Laboratory exercises, Work in groups

ASSESSMENT METHODS: Lecture: test of knowledge; Laboratory: assessment of reports

TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng. Radosław Cechowicz; r.cechowicz@pollub.pl

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Applications of MATHCAD to some technical issues of mechanics and physics – WI26

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture+ laboratory**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: winter	**CLASS LEVEL: undergraduate/master**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: calculus, basic physics

CONTENTS: matrix calculations, plotting, solving system of equations, differential and integral calculus, limits, technical mechanics and physics, kinematics, dynamics

EFFECTS OF EDUCATION PROCESS: student will be able to apply MATHCAD to solve some technical problems from mechanics or physics

LITERATURE (OPTIONAL):

TEACHING METHODS: lecture+ laboratory

ASSESSMENT METHODS: project

TEACHER (NAME, EMAIL CONTACT): prof. Mychajło Paszeczko, m.paszeczko@pollub.pl

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Diploma Seminar – WI27

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: lecture and seminar**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: summer	**CLASS LEVEL: master**
NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: knowledge of literature searching, ability to think logically, knowledge regarding the topic of the diploma thesis

CONTENTS: Presentation of the principles of writing diploma theses, discussion. Methods of acquiring knowledge for scientific work. Collecting materials from literature and the Internet. Critical analysis of the collected materials. Preparing and conducting research. Rules for the correct presentation of scientific works.
Case studies. Students will independently develop issues related, directly or indirectly, to the subject of their diploma theses - according to the schedule established at the beginning of the classes. Discussion with the participation of students and the lecturer regarding both the content and the form of presentation of the presented studies.

EFFECTS OF EDUCATION PROCESS: Has knowledge of scientific work, formulating questions, theses and research hypotheses, organizing experiments and using literature. Is able to present the topic and results of the diploma thesis. Is able to edit and write scientific texts.

LITERATURE (OPTIONAL): Murray, Rowena. How to write a thesis. McGraw-Hill Education (UK), 2017.
Evans, David, Paul Gruba, and Justin Zobel. How to write a better thesis. Melbourne Univ. Publishing, 2011.

TEACHING METHODS: theory – lecture, practice – seminar

ASSESSMENT METHODS: Final coursework assessment (exam)

TEACHER (NAME, EMAIL CONTACT): prof. Dariusz Czerwinski, university professor, d.czerwinski@pollub.pl

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Web technologies – WI28

FACULTY: Faculty of Mathematics and Information Technology	**CLASS TYPE: Project**
NUMBER OF HOURS: 30	**ECTS: 3**
SEMESTER: summer	**CLASS LEVEL: undergraduate/master**
MINIMAL NUMBER OF STUDENTS: 5	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS:
Knowledge of basic concepts in the field of information technology
All students willing to participate in the class are required to contact the teacher, personally or via email, before first lecture.

CONTENTS:
Web application design. Basic development tools and frameworks. jWebsite skeleton and organization of basic information on the page using HTML and cascading style sheets CSS. Website layout, navigation, positioning of elements on the page. jBasics of JavaScript programming language and application of ready-made JavaScript and jQuery scripts on websites to increase the functionality of the page. jCode optimization and functionality tests of web applications. Content management systems (CMS). Implementation of a web application according to the assigned project and its publication on the server

EFFECTS OF EDUCATION PROCESS:
Student knows and understands the technologies of designing and implementing web applications. Student has knowledge in the field of protecting intellectual property of content published on websites. Student is able to plan, design and program websites and web applications in the layer of elements supported by web browsers (front-end), using HTML, CSS and JavaScript technology. Student is able to select and use appropriate tools supporting the work of the creator of web applications and increasing the usability and functionality of websites
Student is ready to comply with the principles of professional ethics of a webmaster and is aware of the responsibility for the operation of the created web applications

LITERATURE (OPTIONAL):

TEACHING METHODS: Project

ASSESSMENT METHODS: Pracitcal task

TEACHER (NAME, EMAIL CONTACT): Ph. D. eng. Barbara Buraczyńska, b.buraczynska@pollub.pl