LUBLIN UNIVERSITY OF TECHNOLOGY
PL LUBLIN03

FACULTY OF MECHANICAL ENGINEERING (FME)

ERASMUS+ Courses Catalogue

for the academic year 2019/20

Prepared by the FME ERASMUS+ Teachers

Approved by:

DEPUTY DEAN FOR STUDENT AFFAIRS
Tomasz JACHOWICZ, PhD Eng.

FME ERASMUS+ COORDINATOR
Sylwester SAMBORSKI, Assoc. Prof. DSc Eng.

LUBLIN, March 2019

(ALPHABETICAL) LIST OF COURSES WITH CODES

3D Software Engineering I	M01	Fundamentals of Control Theory	M22
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Advanced Strength of Materials	M03	General Mechanics I	M24
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Ceramic Materials	M08	Industrial discrete control systems	M29
CNC Programming	M09	Machine parts/elements I	M30
Combustion Engines and Hybrid Propulsion Systems	M10	Machine parts/elements II	M31
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Computational Fluid Dynamics	M12	Materials selection and design	M33
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Diagnostics of vehicles	M14	Measurements	M35
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Engineering drawing I	M17	Mechatronics systems	M38
Engineering drawing II	M18	Bulk Metal Forming and Numerical Modeling	M39
Sheet Metal Forming and Numerical Modeling	M19	Modern welding and joining technology	M40
Fluid Mechanics I	M20	Nanomaterials	M41
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(ALPHABETICAL) LIST OF COURSES WITH CODES –continued

Numerical Simulation of Polymer Processing	M43	Theory of machines I	M50
Non-destructive testing of materials	M44	Theory of Machines II	M51
Polymer Materials	M45	Thermodynamics I	M52
Polymer Processing	M46	Thermodynamics II	M53
Powder metallurgy	M47	Materials for power industry and aeronautics	M54
Fatigue and Failure of Materials and Structures	M48	Wear mechanisms of materials	M55
Surface engineering	M49	Welding metallurgy	M56

Important Note:

According to the respective regulations of the Deputy Rector for Student Affairs of LUT and the Deputy Dean For Student Affairs of the Faculty of Mechanical Engineering, LUT the maximum number of the ECTS points is 32; the number of points that can be gained at the other faculties of LUT should not exceed 12.

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

3D Software Engineering – M01

FACULTY: Mechanical Engineering	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: 15+30h	ECTS: 4
SEMESTER: WINTER / SUMMER	CLASS LEVEL: 1 stage (Engineer), 2 stage (Master of Science)

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: No additional requirements

CONTENTS:

- Introduction in Catia v5 software environment,
- Introduction in Sketch module,
- Drawing a simple figure in sketch (Rectangle, Circle etc.),
- Drawing a more complicated figure in sketch (Spline, Ellipse, Profile etc.),
- Part Design Modeling of simple engine parts (Pad, Pocket, Shaft, Groove operations etc.),
- Part Design Modeling of more complicated engine parts (Hole, Edge Filet, Chamfer etc.),
- Assembly Design Modeling of an engine,
- DMU Kinematics of an engine.

EFFECTS OF EDUCATION PROCESS: Student with no experience in CAD systems will learn Catia v5 modeling (Part Modeling, Assembly Modeling, DMU Kinematics). He will be able to draw 3D parts on his own, and will be able to make drawings from 3D parts. In addition he will learn how to make simulation and analysis of movement in Catia v5 system.

LITERATURE (OPTIONAL): no literature

TEACHING METHODS: Students will work with the computer and will do the examples given from teacher.

ASSESSMENT METHODS: Exam. Assessment will depends on the level that student will reach.

TEACHER (NAME, EMAIL CONTACT):Konrad Pietrykowski, PhD. Eng., k.pietrykowski@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

3D Software Engineering II (advanced) – M02

FACULTY: Mechanical Engineering	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: 15+ 30	ECTS: 4
SEMESTER: WINTER/SUMMER	CLASS LEVEL: 1 stage (Engineer), 2 stage (Master of Science)
MINIMAL NUMBER OF STUDENTS: 8	
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: No additional requirements	

CONTENTS:

Lecture:

- Introduction in 3D Software Engineering. CAD systems. Rapid prototyping technology, 3D printing technology. Reserve engineering technology, 3D scanning technology.

Laboratory:

- Repetition of Catia v5 software environment. Development of basic modules eg. Sketch, Part Design, Assembly Design. Repetition of DMU Kinematics. Generative shape Design modelling. Modelling simple shapes in Free Style module. Processing of 3D scanning surfaces using Digitized Shape Editor module.

EFFECTS OF EDUCATION PROCESS: With respect to basic 3D software engineering, student will improve skills in solid modelling using Part Design. In addition he will learn other way to modelling, based on the surface modelling technics. Student will be able to use file from 3D scanning to make surface model in Generative Shape Design, Free Style and Digitized Shape Editor module. Student will learn how to change solid model to surfaces model and vice versa.

LITERATURE (OPTIONAL): no literature

TEACHING METHODS: Students will work with the computer and will do the examples given from teacher.

ASSESSMENT METHODS: Exam. Assessment will depends on the level that student will reach.

TEACHER (NAME, EMAIL CONTACT): Konrad Pietrykowski, PhD. Eng., k.pietrykowski@pollub.pl

Advanced Strength of Materials-– M03

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + classroom exercises + laboratory exercises
NUMBER OF HOURS: 15 + 15 + 15 + E	ECTS: 4
SEMESTER: /winter/summer	CLASS LEVEL: advanced
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: knowledge of maths and physics at advanced level; knowledge of strength of materials at intermediate level	
CONTENTS: Buckling. Elastic energy calculation in structures. Energetical methods. Mechanics of thin-walled plates and shells. Classical Lamination Theory. Basics of fracture mechanics. Dynamical problems.	
EFFECTS OF EDUCATION PROCESS: Students should gain understanding of an advanced problems of mechanics of materials	
LITERATURE (OPTIONAL): R.C. Hibbeler: Mechanics of Materials, Prentice Hall, 2011; J.N. Reddy: Mechanics of Laminated Composite Plates and Shells: Theory and Analysis, CRC Press, 2004	
TEACHING METHODS: multimedial lecture + problem solving exercises under the teacher's guidance + laboratory exercises under the teacher's guidance	
ASSESSMENT METHODS: lecture: final exam: classroom exercises: two written tests in a semester; laboratory exercises: defence of reports	
TEACHER (NAME, EMAIL CONTACT): Sylwester SAMBORSKI, Assoc. Prof. DSc Eng.; s.samborski@pollub.pl; A. Teter, Assoc. Prof. DSc Eng., a.teter@pollub.pl | T. Kazmir, PhD Eng., t.kazmir@pollub.pl | J. Latalski, Assoc. Prof. DSc Eng., j.latalski@pollub.pl; M. Kowalczuk, MSc Eng. m.kowalczuk@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Advanced Numerical Methods – M04

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture and computer laboratory
NUMBER OF HOURS: 15+15	ECTS: 2
SEMESTER: Winter/Summer	CLASS LEVEL:
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: programing in any language	
CONTENTS: Basics in programing in Matlab and Scilab, errors and error sources, numerical methods for nonlinear equations: simple iteration methods, Newton-Raphson, bisection method, regula falci, numerical methods for a nonlinear set of equations, linear equations and matrix manipulations, numerical integration of functions and differential equations, numerical differentiation , interpolation.	
EFFECTS OF EDUCATION PROCESS: Student knows: how to solve linear (matrix) and nonlinear equations numerically, how to integrate functions and make numerical simulations of differential equations	
LITERATURE (OPTIONAL): Amos Gilat and Vish Subramanian, Numerical Methods for Engineers and Scientists, John Wiley & Sons, Cleveland 2008; Frank Thuselt and Felix Paul Gennrich, Praktische Mathematik mit MATLAB, Scilab und Octave, Springer Berlin 2013.	
TEACHING METHODS: Multimedia lecture, calculation projects; computer laboratory – practical experiments	
ASSESSMENT METHODS: Lecture – the received a course with the mark based on calculation projects (homework) Laboratory – the received a course with the mark based on partial marks from reports and class activity.	
TEACHER (NAME, EMAIL CONTACT): Grzegorz Litak, Ph.D., D.Sc., Professor, g.litak@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Assembly Technology – M05

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture and laboratory
NUMBER OF HOURS: 15+15	ECTS: 2
SEMESTER: Winter/Summer	CLASS LEVEL:

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Machine technology – basics;

CONTENTS:
Assembly methods, Assembly organisation systems, Types of joints: adhesives, thread, pin, bolt, riveted joints
Producibility in assembly process, Flexible assembly systems

EFFECTS OF EDUCATION PROCESS:
Student knows: the types of assembly methods, the types of joints used in assembly constructions.
Student can: analyze the assembly process, select the appropriate method of joining, and draw the simple conclusions from experiments.
Student sights problem of assembly in various constructions.

LITERATURE (OPTIONAL):
Assembly technology (different authors)
Journals on-line

TEACHING METHODS: Multimedia lecture, discussion based on the student's presentations; Laboratory – practical experiments

ASSESSMENT METHODS: Lecture – the received a course with the mark

Laboratory – the received a course with the mark based on partial marks from reports.

TEACHER (NAME, EMAIL CONTACT): Izabela Miturska, MSc Eng., i.miturska@pollub.pl

Biomaterials – M06

FACULTY: MECHANICAL ENGINEERING, DEPARTMENT OF MATERIALS ENGINEERING	CLASS TYPE: Lecture and laboratory
NUMBER OF HOURS: 20-h LECTURE + 10-h LABORATORY	ECTS: 2
SEMESTER: summer	CLASS LEVEL: Level 1 (eng.) or II (Msc.)
MINIMAL NUMBER OF STUDENTS: 6	
LANGUAGE OF INSTRUCTION: ENGLISH	
PRELIMINARY REQUIREMENTS: Materials engineering – basics; chemistry - basics	
CONTENTS: Metallic biomaterials – steels, cobalt alloys, titanium and its alloys, shape memory alloys, noble metals matrix alloys. Monolithic bioceramic and ceramics layers – properties, methods of testing, applications. Composites biomaterials and their applications. Long term biopolymers to the implantation. Conditions of materials admissibility in medicine – biocompatibility, the criteria, standards, testing methods etc.	
EFFECTS OF EDUCATION PROCESS: Student knows: the types of biomaterial, describe the properties and applications of biomaterials. Student can: analyze the special properties of biomaterials, select the appropriate material, draw the simple conclusions from experiments. Student understands social role of engineer intervention to alive organism.	
LITERATURE (OPTIONAL): Encyclopedia of Materials: Science and Technology, Elsevier Ltd., 2007 (on line at LUT) The Biomedical Engineering HandBook, Second Edition., Ed. Joseph D. Bronzino, Boca Raton: CRC Press LLC, 2000 Brunette D. M., Tengvall P.i wsp., Titanium in Medicine, Springer Verlag, Berlin, Heidelberg, New York, 2001 Journals on-line and papers ed. at LUT	
TEACHING METHODS: Multimedia lecture, discussion based on the student's presentations; Laboratory – practical experiments	
ASSESSMENT METHODS: The received a course with the mark based on partial marks from lecture and laboratory.	
TEACHER (NAME, EMAIL CONTACT): PhD. Eng. Monika Ostapiuk , m.ostapiuk@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Casting technology – M07

FACULTY: Faculty of Mechanical Engineering	**CLASS TYPE: Lecture, laboratory**
NUMBER OF HOURS: 30 lectures, 15 laboratory	**ECTS: 4**
SEMESTER: Winter/Summer	**CLASS LEVEL: Level 1 (Eng)**

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Basic knowledge about physics, chemistry and general knowledge related to materials science

CONTENTS: Introduction to metallurgy, structure of metals and alloys. Physical metallurgy. Ferrous and nonferrous metallurgy. Principles of solidification, crystallization. The moulding material: properties, preparation and testing. The feeding of castings. Casting design. Melting and casting. Casting technology techniques. The manufacture of sand castings. Shell, investment and die casting processes. Further casting techniques. Continuous casting. Finishing operations. Defects in castings. Characterization of ferrous and nonferrous casting alloys.

EFFECTS OF EDUCATION PROCESS: This course helps students develop and understand basic metallurgical and foundry technology principles. Students acquire knowledge covering forming properties of engineering materials (metal alloys), the processes involved in the production and shaping properties of engineering materials applied in casting technology likewise metals, metal alloys, metal matrix

LITERATURE (OPTIONAL):
On-line journals related to casting technology and metallurgy and available at Lublin University of Technology.

TEACHING METHODS: Combination of theory and practice, group work and reporting, individual project work and investigation

ASSESSMENT METHODS: Final exam based on compiling theory or homework assignments; reports, test or project evaluation

TEACHER (NAME, EMAIL CONTACT): Mirosław SZALA, PhD Eng, m.szala@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Ceramic Materials – M08

FACULTY: Mechanical Engineering	CLASS TYPE: Lecture
NUMBER OF HOURS: 30	ECTS: 2
SEMESTER: winter/ summer	CLASS LEVEL: Level 1 (Eng), Level 2 (MSc)
MINIMAL NUMEBER OF STUDENTS: 6	

LANGUAGE OF INSTRUCTION: english

PRELIMINARY REQUIREMENTS:
The student has a basic knowledge of materials science and chemistry. It has a general knowledge of ceramics. He can recognize the basic ceramic materials. Is aware of the role of knowledge about the materials in engineering practice

CONTENTS:
1. Definition and classification of ceramic engineers.
2. Properties of ceramic materials in connection with the structural and phase construction,
3. Ceramic engineering technology: powder synthesis, forming, sintering, physical and chemical aspects of manufacturing processes,
4. Monolithic engineering ceramics, porous ceramics, thin-layer ceramics,
5. Ceramics tool, ceramic composites and nanocomposites,
6. Functional Ceramics, bioceramics materials.

EFFECTS OF EDUCATION PROCESS:
1. The student defines and classifies ceramic engineering
2. The student describes the stages of production of ceramic engineering
3. The student has the properties of engineering ceramics,
4. The student compares ceramics for properties and applications.

LITERATURE (OPTIONAL):

TEACHING METHODS: lecture with the use of multimedia presentations, discussion based on the student's presentations

ASSESSMENT METHODS: presentation / test

TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng. Patryk Jakubczak, p.jakubczak@pollub.pl

CNC Programming – M09

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture + Laboratory
NUMBER OF HOURS:15 Lecture +15 Laboratory	ECTS: 3
SEMESTER: Winter/Summer	CLASS LEVEL: Basic
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: none	
CONTENTS: History of CNC machines, main features, construction details, axes and the coordinate system, overview of programmable functions. Role of the CNC machines in the manufacturing system. Structure of a NC program, code formatting, debugging and program verification techniques. Coordinate systems used in CNC machines (axes, directions), zero point register, program zero point. Absolute and incremental coordinate systems, inch and metric modes. Part programming - documentation flow in a typical company, preparation for programming, program portability. Basic machining operations, milling and turning technology, tools, plan of operations. Tool path programming, offsets, tool programmable point, tool length, cutting speed, feed, interpolation. Turning – tool geometry and wear compensation, lathe controller offsets. Milling – tool geometry and wear compensation, machine controller offsets. Lathe fixed cycles, fixed cycles for milling machines. Advanced programming – communication to the operator, optional stop, block skip, thread cutting, active lathe tools. CNC and CAM, basic concepts, CNC programming with CAM systems.	
EFFECTS OF EDUCATION PROCESS: Student will get acquainted with the role and operation of cnc machines in a manufacturing system, basic procedures and safety standards. Student will learn the basic CNC process including: writing a nc program, setting-up the machine, running the program and verifying the machined part.	
LITERATURE (OPTIONAL): P. Smid, CNC Programming Handbook	
TEACHING METHODS: multimedial lecture, laboratory exercises	
ASSESSMENT METHODS: lecture: final exam	
TEACHER (NAME, EMAIL CONTACT): Radosław Cechowicz, PhD Eng.; r.cechowicz@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Combustion Engines and Hybrid Propulsion Systems – M10

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + project + laboratory
NUMBER OF HOURS: 30 + 15 + 15	ECTS: 5
SEMESTER: Winter/summer	CLASS LEVEL: intermediate
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: knowledge of physics, mechanics, thermodynamics	
CONTENTS: Ideal and real engine cycles. Engine geometry and kinematics: volume above the piston, valves cross-section area. Intake and exhaust phenomena: gas flow through restrictions, volumetric efficiency. Combustion processes: combustion in spark ignition engines, combustion in diesel engines, modelling of combustion using heat release model, the first law of thermodynamics. Fuels, including mineral and renewable. Mixture formation and combustion control. Exhaust emissions: mechanisms of toxic compounds formation in the combustion chamber. Heat exchange: empirical correlations for heat exchange, heat losses in combustion engines. Engine as energy converter: fuel conversion efficiency, energy balance. Engine performance and characteristics: torque, power and brake mean effective pressure, fuel consumption and efficiency. Engine testing on a test bench. Thermodynamic analysis of real in-cylinder processes. Advanced combustion systems: homogeneous charge compression ignition, reactivity controlled compression ignition. Hybrid electric propulsion systems – design, operation and properties.	
EFFECTS OF EDUCATION PROCESS: Knowledge of combustion engines processes and operation. Knowledge of hybrid propulsion architecture. Ability to model engine processes. Ability to perform engine testing.	
LITERATURE (OPTIONAL): J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill, 1988	
TEACHING METHODS: multimedia lecture + laboratory experiments+ self-contained project consulted with the teacher	
ASSESSMENT METHODS: lecture: final exam; project: discussion	
TEACHER (NAME, EMAIL CONTACT): Jacek Hunicz, D.Sc. Eng.; j.hunicz@pollub.pl	

Composite Materials – M11

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: 30 (Lecture) + 30 (Laboratory)	ECTS: 4
SEMESTER: Summer	CLASS LEVEL: I (eng.) or II (MSc)

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Materials engineering – basics; chemistry – basics;

CONTENTS:
Elementary knowledge. Definitions and classification of composites. Matrix and reinforcement. Structure and properties of composites. Metal and ceramic matrix composites. Polymer composites. Sandwich composites. Fibre Metal Laminates (FML). Intelligent composites. Nanocomposites. Mechanics of composites (selected problems). Progress in composite materials. Application of composites.

EFFECTS OF EDUCATION PROCESS:
Student knows: the types of composite materials, describe the properties and applications of composites. Student can: analyze the special properties of composites, select the appropriate material, draw the simple conclusions from experiments. Student understands role of new materials such as composites

LITERATURE (OPTIONAL):
Encyclopedia of Materials: Science and Technology, Elsevier Ltd., 2007 (on line at LUT)
ScienceDirect and SpringerLink data bases (scientific journals) in Lublin University of Technology Library.
ASM Handbook Vol.: 1,2,4-7,15,16,21.

TEACHING METHODS: Multimedia lecture, discussion based on the student's presentations; Laboratory – practical experiments

ASSESSMENT METHODS: Lecture – the received a course with the mark; Laboratory – the received a course with the mark based on partial marks from tests and reports.

TEACHER (NAME, EMAIL CONTACT): Dr Eng. Jarosław Bieniaś j.bienias@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Computational Fluid Dynamics – M12

FACULTY: Mechanical Engineering	CLASS TYPE: Laboratory
NUMBER OF HOURS: Laboratory 30h	ECTS: 2 points
SEMESTER: Winter/Summer	CLASS LEVEL: 1 stage (Engineer), 2 stage (Master of Science)
MINIMAL NUMBER OF STUDENTS: 5* is the minimal number of students, otherwise the course may not be started	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: No additional requirements

CONTENTS: Introduction to Computational Fluid Dynamics and Finite Volume Method. Pre–Processing (creating 2D and 3D models of the domain, import prepared geometry form CAD systems, preparing models to meshing, design and create the mesh, preparing mesh for solver, boundary conditions and start conditions), solver (set up the solver, preparing data output, compute the solution), post–processing.

EFFECTS OF EDUCATION PROCESS: During the lecture, students get the information about Computational Fluid Dynamics (CFD), Finite Volume Method and at which stages of the engineering process they can use CFD. With respect to Computational Fluid Dynamics, students can improve their skills in 2D and 3D modelling of the computational domain. Students can learn how to obtain a model of the fluid region e.g. make use of existing CAD models, extract the fluid region from a solid part or create it from scratch. Students can simplify the geometry by removing unnecessary features that could complicate meshing (fillets, bolts etc.). Students can learn about a degree of mesh resolution required in each region of the domain and the most appropriate type of mesh to adopt. They are able to define: material properties for: fluid, solid, mixture, select appropriate physical models, prescribe operating conditions, prescribe boundary conditions for all boundary zones, provide initial values or a previous solution, set up solver controls, set up convergence monitors. After the calculations, students can examine their results to review their solution and extract useful data.

LITERATURE:

1. Versteeg K. K., Malalasekera W.: „An introduction to Computational Fluid Dynamics”. Person Education Limited, London 2007.
2. Wilox D. C.: „Turbulence Modeling for CFD- Third Edition”. DCW Industries, United States 2006.

TEACHING METHODS: Students attend the lecture and work with the computer and do the exercises given by the teacher.

ASSESSMENT METHODS: Assessment depends on the level reached by a student.

TEACHER (NAME, EMAIL CONTACT): D.Sc. Ph.D. Eng Jacek Czarnigowski, prof. PL, j.czarnigowski@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Corrosion – M13

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture and laboratory
NUMBER OF HOURS: 30+15	ECTS: 3
SEMESTER: WINTER/SUMMER	CLASS LEVEL: I
MINIMAL NUMBER OF STUDENTS: 6	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Materials engineering – basics; chemistry - basics
CONTENTS: Base of corrosion, Types of corrosion, Corrosion in different environments, Corrosion protection, Corrosion resisting materials
EFFECTS OF EDUCATION PROCESS: Student knows: the types of corrosion and environment, describe the relationship between environment and materials. Student can: analyze the degradation process of materials, select the appropriate protection method, draw the simple conclusions from experiments. Student sights problem of corrosion in natural environment.
LITERATURE (OPTIONAL): West J.M., Basic corrosion and oxidation TalbotD.,Talbot J., Corrosion Science and Technology, CRC 1998 Journals on-line
TEACHING METHODS: Multimedia lecture, discussion based on the student's presentations; Laboratory – practical experiments
ASSESSMENT METHODS: The received course with the mark based on partial marks from lecture and laboratory.
TEACHER (NAME, EMAIL CONTACT): Dr Eng. K.Majerski k.majerski@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Diagnostics of vehicles – M14

FACULTY: Mechanical Engineering	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: Lecture 15, Laboratory 30h	ECTS: 4 points
SEMESTER: Winter/Summer	CLASS LEVEL: 1 stage (Engineer), 2 stage (Master of Science)
MINIMAL NUMBER OF STUDENTS: 6* should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: No additional requirements

CONTENTS:
Lecture: Introduction to Car Technology, On Board Diagnostic description, Electronic Control Unit, Electronic Engine Control, Fuel Systems technology, Adaptive Engine Control, Injection, Sensors etc.
Laboratory: Wankel engine test bench, gasoline and hydrogen fuel supply, knocking combustion, Diesel engine test bench, Chassis dynamometer, On Board Diagnostic in passenger cars.

EFFECTS OF EDUCATION PROCESS: Students get the information about diagnostics of vehicles, on board diagnostics. They have practice during laboratory classes and can test the Wankel and Diesel engines on a special test bench. They have also practice in chassis dynamometer tests.

LITERATURE (OPTIONAL):

- John Heywood: Internal Combustion Engine Fundamentals,
- Lino Guzzella, Christopher H. Onder: Introduction to modeling and control of internal combustion engine systems,
- C. Baumgarten: Mixture formation in internal combustion engines,
- Kevin L. Hoag: Vehicular Engine Design, Powertrain
- Hermann Hiereth, Peter Prenninger: Charging the internal combustion engine, Powertrain

TEACHING METHODS: Students attend the lecture and have practice during the laboratory classes.

ASSESSMENT METHODS: Assessment depends on final course test/exam results

TEACHER (NAME, EMAIL CONTACT): Prof. Mirosław Wendeker, m.wendeker@pollub.pl, PhD Eng. Łukasz Grabowski, l.grabowski@pollub.pl, PhD Eng. Grzegorz Barański

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Differential Equations–M15

FACULTY: Faculty of Mechanical Engineering	CLASSTYPE: lecture and classes
NUMBEROFHOURS: 15+15	ECTS: 3
SEMESTER: Winter	CLASS LEVEL: Level 2 (Eng.)

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Derivatives and integrals calculus.

CONTENTS: First order linear differential equations and method of solution. Higher order linear differential equations with constant coefficients and methods of solution. Laplace transformation and it's properties. Application of the Laplace transformation to linear differential equations of order n with constant coefficients. Systems of linear differential equations with constant coefficients. Fixed points and linearization of nonlinear equations. Stability of fixed points. Some mechanical problems leading to differential equations.

EFFECTSOFEDUCATIONPROCESS: Student can recognize type of differential equations and apply appropriate method to solve it. Student can apply Laplace transformation to differential equations of constant coefficients. Student can define and discus the stability of fixed points. The Student can use the knowledge to solve some problems in engineering.

LITERATURE: : Fundamentals of Differential Equations: Kent Nagle, Edward Saff, Arthur Snider.

TEACHINGMETHODS: Lecture, Class, Interactive presentation.

ASSESSMENTMETHODS: Classes – written exam. Laboratory – reports

TEACHER(NAME,EMAILCONTACT): Ph.D Arkadiusz Syta, a.syta@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Electrical and electronic equipment of vehicles – M16

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: 15+15	ECTS: 2
SEMESTER: Winter	CLASS LEVEL: 1 stage (Engineer), 2 stage (Master of Science)

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: No additional requirements

CONTENTS:

1. Starter batteries: battery versions, battery maintenance, battery chargers.
2. Alternator system: alternator and voltage-regulator versions, overvoltage-procetcion devices, alternator circuity.
3. Starting systems: starter types, installation, operation and maintenance.
4. Ignition systems: distributorless ignition, ignition system testing.
5. Motronic engine management: system overview, fuel system, high-voltage ignition circuit, integrated diagnosis.
6. Electromagnetic compatibility and interference.
7. Safety,comfort and convenience systems, lighting systems.

EFFECTS OF EDUCATION PROCESS: Student get information about diagnostics of vehicles – electrical equipment.

LITERATURE (OPTIONAL):

Robert Bosch GmbH.: Automotive Electric/Electronic Systems. Stuttgart.

Robert Bosch GmbH.: Automotive Handbook. Stuttgart.

Crolla D.: Encycolpedia of Automotive Engineering. 6 Volume Set. Published by Wiley-Blackwell, 2015.

TEACHING METHODS: Students have practice during the laboratory classes.

ASSESSMENT METHODS: Assessment will depends on the level that student will reach.

TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng. M. Dziubiński m.dziubinski@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Engineering drawing I – M17

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Laboratory
NUMBER OF HOURS: 30	ECTS: 3
SEMESTER: Winter	CLASS LEVEL:
MINIMAL NUMBER OF STUDENTS: 6	
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS:	
CONTENTS: Introduction to projection idea. Definitions of projection elements. Monge projection. Sections and sectional views. Screw thread. Nuts, bolts, screw and washer. Worked examples in machine drawing. Limits and fits. Surface texture. Production drawings. CAD elements	
EFFECTS OF EDUCATION PROCESS: Student understand the concept of engineering graphics	
LITERATURE (OPTIONAL): Engineering Drawing and Design, Dawid A. Madsen	
TEACHING METHODS: Presentation, solving examples, projects	
ASSESSMENT METHODS: Solving problems in the class. Final exam.	
TEACHER (NAME, EMAIL CONTACT): PhD Eng. Jakub Gajewski j.gajewski@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Engineering drawing II – M18

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, project
NUMBER OF HOURS: L 15+P 30	ECTS: 4
SEMESTER: Summer	CLASS LEVEL:
MINIMAL NUMBER OF STUDENTS: 6	
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS:	
CONTENTS: Introduction to projection idea. Definitions of projection elements. Monge projection. Sections and sectional views. Screw thread. Nuts, bolts, screw and washer. Worked examples in machine drawing. Limits and fits. Surface texture. Production drawings. CAD elements	
EFFECTS OF EDUCATION PROCESS: Student understand the concept of engineering graphics	
LITERATURE (OPTIONAL): Engineering Drawing and Design, Dawid A. Madsen	
TEACHING METHODS: Presentation, solving examples, projects	
ASSESSMENT METHODS: Solving problems in the class. Final exam.	
TEACHER (NAME, EMAIL CONTACT): PhD Eng. Jakub Gajewski j.gajewski@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Sheet Metal Forming and Numerical Modeling – M19

FACULTY:Mechanical	CLASS TYPE:
NUMBER OF HOURS: 30	ECTS: 3
SEMESTER:winter / summer	CLASS LEVEL:

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: No
CONTENTS: Metal forming technologies with industrial applications (presentations), numerical modeling of metal forming processes by Finite Element Method (presentations and computer laboratories) Scope of subject: basics of sheet metal forming, problematic of stress, strain, strain rate, friction and materials for billets and tools; technologies of metal forming: drawing, extrusion technologies; process designing and numerical calculation of chosen technology with application of Deform3D FEM software.
EFFECTS OF EDUCATION PROCESS: knowledge of metal forming basics, theory and different metal forming technologies and basics of numerical modeling by Finite Element Method
LITERATURE (OPTIONAL): Metal Forming Technology (different authors), FEM (different authors)
TEACHING METHODS: presentations, computer laboratories and project
ASSESSMENT METHODS: oral exam or project presentations
TEACHER (NAME, EMAIL CONTACT): PhD Eng JarosławBartnicki, j.bartnicki@pollub.pl

Fluid Mechanics I – M20

FACULTY:MECHANICAL ENGINEERING	CLASS TYPE: LECTURE,EXERCISE AND LABORATORY
NUMBER OF HOURS:30+15+15	ECTS: 5
SEMESTER: WINTER/SUMMER	CLASS LEVEL: 1 STAGE (ENGINEER)
LANGUAGE OF INSTRUCTION: ENGLISH	
PREILIMINARY REQUIREMENTS:MATHEMATICS – BASIC OFANALYSIS, PARTIA AND ORDINARY DIFFERENTIAL EQUAITIONS; PHYSICS – BASIC LAWS	
CONTENTS: Basic mathematical notions. Characteristic properties of fluids. Mass forces, surface forces, pressure, Pascal's law. Static equilibrium state. Relative equilibrium state. Static fluid-surface interaction. Archimedes law, stability of flotation. Ideal fluid flows: the continuity equation, Euler equation of flow. The Bernoulli equation, applications. Characteristics of multi-dimensional viscous fluid flow. Navier-Stokes equation of flow. Steady frictional pipe flows.	
LITERATURE (OPTIONAL): INTRODUCTION TO FLUID MECHANICS BY Y. NAKAYAMA AND R. F. BOUCHER, BUTTERWORTH-HEINEMANN, OXFORD/ELSEVIER 2000	
TEACHING METHODS: LECTURE,COMPUTATIONAL TASKS,	
ASSESMENT METHODS: 4 COMPUTATIONAL TASKS + MULTI-CHOICE TEST/EXAM OF THEORY : LAB PRACTICES REPORT	
TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng. Tomasz Łusiak, t.lusiak@pollub.pl	

Fluid Mechanics II – M21

FACULTY:MECHANICAL ENGINEERING	CLASS TYPE: LECTURE,EXERCISE
NUMBER OF HOURS:15+15	ECTS: 3
SEMESTER:SUMMER	CLASS LEVEL: 1 STAGE (ENGINEER)
LANGUAGE OF INSTRUCTION: ENGLISH	
PREILIMINARY REQUIREMENTS:MATHEMATICS – BASIC OFANALYSIS, PARTIA AND ORDINARY DIFFERENTIAL EQUAITIONS; PHYSICS – BASIC LAWS	
CONTENTS: Similitude and dimensional analysis, Lift and drag, The cascade wind tunnel, Flow rate measurements with orifices and nozzles, Flow rate measurement with Prandtl probe, Turbulent flow velocity profile measurements, Dimensional analysis law of similarity, Linear and local pressure losses in pipe flows, Hagen-Poiseuille law applications	
LITERATURE (OPTIONAL): INTRODUCTION TO FLUID MECHANICS BY Y. NAKAYAMA AND R. F. BOUCHER, BUTTERWORTH-HEINEMANN, OXFORD/ELSEVIER 2000	
TEACHING METHODS: LECTURE,COMPUTATIONAL TASKS,	
ASSESMENT METHODS: 4 COMPUTATIONAL TASKS + MULTI-CHOICE TEST/EXAM OF THEORY : LAB PRACTICES REPORT	
TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng. Tomasz Łusiak, t.lusiak@pollub.pl	

Fundamentals of Control Theory – M22

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture + Laboratory
NUMBER OF HOURS: 30 Lecture +30 Laboratory	ECTS: 5
SEMESTER: Winter/Summer	CLASS LEVEL: Basic
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: Scilab/Matlab	
CONTENTS: Introduction to control systems, dynamic linear systems, mathematical models, derivative equations, Laplace transform. Test signals, dynamic properties of typical systems. Analogue and digital systems, state-space equations. Block diagrams, transmittance of the system. Transmittance analysis – zeros, poles, dynamic system response. Stability of the system, frequency domain equations, frequency response, root locus. Nyquist and Bode plots. System compensation. Lead and lag compensation, pure time delay. PID Control, control quality, system performance, dynamic and static error. PID controller in practice, Ziegler-Nichols rules, digital PID controller. System identification techniques. Examples of control systems in industry.	
EFFECTS OF EDUCATION PROCESS: Student will get acquainted with fundamentals of formal knowledge and methods in the area of control theory and its applications. Student will learn to design simple control systems with PID controllers.	
LITERATURE (OPTIONAL): Bryan L. A., Bryan E. A.; Programmable Controllers Theory and Implementation ; Industrial Text Company; Marietta, Georgia; 1997; ISBN 0-944107-32-X Groover M.P.; Automation Production Systems and Computer-Integrated Manufacturing; Prentice Hall; Upper Saddle River 2001; ISBN 0-13-088978-4	
TEACHING METHODS: multimedial lecture, laboratory exercises	
ASSESSMENT METHODS: lecture: final exam	
TEACHER (NAME, EMAIL CONTACT): Radosław Cechowicz, PhD Eng.; r.cechowicz@pollub.pl; Krystian Łygas, MSc Eng. k.lygas@pollub.pl;	

Fundamentals of machinery operation and maintenance – M23

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture and laboratory
NUMBER OF HOURS: 15+15	ECTS: 3
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Eng)

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: None

CONTENTS:
Phases of the existence of a technical object. Types of activities in the process of using and maintenance. Operation and maintenance requirements placed on machines. The processes of degradation of machine parts. Failure and technical state of a technical object. Maintenance strategies. Reliability of a non-renewable and renewable elements. Reliability of complex objects. Legal requirements for placing of machinery on the market or putting into service. Preparation of instructions for machinery. Noise measurements. Experimental determination of basic performance parameters of a machine. Determination of reliability characteristics.

EFFECTS OF EDUCATION PROCESS: Student has knowledge of the principles of maintenance of machines and equipment, and the impact of the maintenance strategy for durability and reliability. Student is able to determine the basic reliability indicators and formulate service requirements placed on machines. Student is aware of the impact of the maintenance strategy to system efficiency and proper maintenance for the safety of people and the environment.

LITERATURE: Koszałka G., Ignaciuk P., Hunicz J.: Issues of machine and device operation and maintenance. Lublin Univ. of Technology, 2015.

TEACHING METHODS: lecture with the use of multimedia presentation. Practical execesise and discusion based on the student's raports.

ASSESSMENT METHODS: Lecture – written exam. Laboratory – reports

TEACHER (NAME, EMAIL CONTACT): Assoc. Prof. DSc. Eng. Grzegorz Koszałka; g.koszalka@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

GENERAL MECHANICS 1 – M24

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + classroom exercises + project
NUMBER OF HOURS: 30+15+0	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: intermediate

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: knowledge of maths and physics at an advanced level

CONTENTS: (1) Introduction to mechanics. Notations and units, vectors, Rectangular component of a vector. (2) Statics laws. Addition of vectors, the product and dot product of vectors. Particle and rigid body. (3) Newton's Laws. Coplanar concurrent forces system, resultant (equivalent) force of coplanar forces system. (4) Dry friction – Coulomb's model. (5) Coplanar concurrent forces system. Resultant force of 2D concurrent system. Conditions of equilibrium. (6) Moment of force. Couple of forces, resultant force of parallel system. (7) Coplanar forces system. Reduction of coplanar forces system to force and moment. Conditions of equilibrium. (8) Analysis of trusses. Analysis of joints and sections. (9) Rolling friction. Examples. (10) Spatial concurrent forces system. Resultant force of 3D system. Conditions of equilibrium. (11) Spatial forces system. Resultant force and moment of 3D system. Conditions of equilibrium. (12) Area moments of inertia. Rectilinear motion of particle.
(13) Velocity and acceleration. (14) Kinetics of particle. Formulation of dynamics problems, rectilinear motion, D'Alembert's principle and inertia forces. (15) Practical application of particle kinetics.

EFFECTS OF EDUCATION PROCESS: Students should gain an intermediate abilities to identify and to solve basic problems of mechanics

LITERATURE (OPTIONAL):
(a) Beer, Johnston, Mazurek, Kornwell: Vector Mechanics for Engineers; (b) Michael Spivak: Elementary Mechanics From a Mathematician's Viewpoint; (c) Giovanni Gallavotti: The Elements of Mechanics

TEACHING METHODS: classical and multimedial lectures + problem solving exercises under the teacher's guidance + self-contained problems consulted with the teacher

ASSESSMENT METHODS: lecture: final exam, classroom exercises: two written tests in a semester;

TEACHER (NAME, EMAIL CONTACT): Prof. DSc. PhD. Eng. Jerzy Warminski; j.warminskipollub.pl | DSc. PhD. Eng., Rafał Rusinek, r.rusinek@pollub.pl | DSc. PhD. Eng. Krzysztof Kęcik, k.kecik@pollub.pl | PhD. Eng. Marek Borowiec, m.borowiec@pollub.pl | MSc. Eng. Zofia Szmit., z.szmit@pollub.pl | PhD. Eng. Andrzej Weremczuk, a.weremczuk@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

GENERAL MECHANICS 2 – M25

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + classroom exercises + project
NUMBER OF HOURS: 30+15+0	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: intermediate

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: knowledge of maths and physics at an advanced level

CONTENTS: (1) Kinematics of particles: velocity and acceleration in rectangular, cylindrical, spherical and normal and tangential coordinates. (2) Motion of particles: rectilinear motion, relative motion. (3) Kinetics of particles: Newton's law of motion. Equations of motion. (4) Mass moment of inertia. (5) Work. Impulse. Momentum. Principle of work and energy, principle of impulse and momentum. (6) Angular momentum, angular impulse and momentum principle. (7) Kinetics of systems of particles. (8) Planar kinematics of rigid bodies: instantaneous centre of rotation. (9) Planar kinetics of rigid bodies. (10) Three dimensional kinematics of rigid bodies. (11) Three dimensional kinetics of rigid bodies. (12) Unbalanced rotors. (13) Theory of gyroscope. (14) Linear vibrations: introduction and free vibrations. (15) Linear vibrations: forced oscillations.

EFFECTS OF EDUCATION PROCESS: Students should gain an intermediate abilities to identify and to solve general problems of mechanics

LITERATURE (OPTIONAL):
(a) Beer, Johnston, Mazurek, Kornwell: Vector Mechanics for Engineers; (b) Michael Spivak: Elementary Mechanics From a Mathematician's Viewpoint; (c) Giovanni Gallavotti: The Elements of Mechanics; (d) R.C. Hibbeler: Engineering Mechanics

TEACHING METHODS: classical and multimedial lectures + problem solving exercises under the teacher's guidance + self-contained problems consulted with the teacher

ASSESSMENT METHODS: lecture: final exam, classroom exercises: two written tests in a semester;

TEACHER (NAME, EMAIL CONTACT): Prof. DSc. PhD. Eng. Jerzy Warminski; j.warminskipollub.pl | DSc. PhD. Eng., Rafał Rusinek, r.rusinek@pollub.pl | DSc. PhD. Eng. Krzysztof Kęcik, k.kęcik@pollub.pl | PhD. Eng. Marek Borowiec, m.borowiec@pollub.pl | MSc. Eng. Zofia Szmit., z.szmit@pollub.pl | PhD. Eng. Andrzej Weremczuk, a.weremczuk@pollub.pl

Heat Transfer – M26

FACULTY:MECHANICAL ENGINEERING	CLASS TYPE: LECTURE,EXERCISE
NUMBER OF HOURS: 30+30	ECTS: 4
SEMESTER: WINTER/SUMMER	CLASS LEVEL: 1 STAGE (ENGINEER)
LANGUAGE OF INSTRUCTION: ENGLISH	
PREILIMINARY REQUIREMENTS:MATHEMATICS – BASIC OFANALYSIS, PARTIA AND ORDINARY DIFFERENTIAL EQUAITIONS; PHYSICS – BASIC LAWS	
CONTENTS: Introduction to heat transfer: Fourier law, Newton law, Stefan-Boltzmann law. General heat conduction equation, steady 1D conduction through flat and cylindrical walls. Multi-layered walls, overall heat transfer coefficient, critical diameter of insulation. Rectangular fins, extended surfaces. Convection heat transfer: Similitude and dimensional analysis. Discussion of forced- and free-convection heat transfer formulae. Boiling heat transfer. Condensation heat transfer. Heat exchangers. Equimolar counter diffusion. Evaporation process in the atmosphere. Analogy between heat and mass transfer. Define Reynold's, Nusselt and Prandtl numbers. Sherwood and Schmidt numbers	
LITERATURE (OPTIONAL): HEAT TRANSFER HANDBOOK BY BEJAN A. AND KRAUS A. D., JOHN WILEY & SONS, 2003 HAND OF HEAT TRANSFER BY ROHSENOW W. M., HARTNETT J. P. AND CHO Y.I., MCGREW-HILL, 1998	
TEACHING METHODS: LECTURE,COMPUTATIONAL TASKS,	
ASSESMENT METHODS: 4 COMPUTATIONAL TASKS + MULTI-CHOICE TEST OF THEORY : LAB PRACTICES REPORT	
TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng. Tomasz Łusiak, t.lusiak@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Heat Treating of Metals and Alloys – M27

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE:
NUMBER OF HOURS: 30 L + 30 P	ECTS: 5
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Eng)

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: chemistry, physics, general materials engineering
CONTENTS: Principles of heat treating. Normalizing and annealing of steel. Quenching and tempering of steels. Thermomechanical processing of steel. Diffusion methods of surface hardening of steels. Carburizing of steel. Nitriding of steel. Other diffusion methods. Equipment for heat treating. Control of process parameters and effects. Heat treating of cast irons. Heat treating of tool steel. Heat treating of other steels and superalloys. Heat treating of nonferrous alloys. Heat treating of precious metals and alloys.
EFFECTS OF EDUCATION PROCESS: identify, formulate and solve engineering problems connected to heat treatment; understand the need and contribution of knowledge to the development of modern technology and society
LITERATURE (OPTIONAL):
TEACHING METHODS: combination of theory (lecture) and practice, group work and reporting, individual project work and investigation
ASSESSMENT METHODS: Lectures - final exam. Laboratory – mark for report
TEACHER (NAME, EMAIL CONTACT): Kazimierz Drozd, k.drozd@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Hydraulics and Hydraulic Drives M28

FACULTY: MECHANICAL ENGINEERING	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: 15 +15	ECTS: 3
SEMESTER: WINTER/SUMMER	CLASS LEVEL: 1

LANGUAGE OF INSTRUCTION: ENGLISH

PRELIMINARY REQUIREMENTS: general knowledge of math and physics

CONTENTS:
Hydraulics basic. Pressure and force. Pascal's law. Flow. Energy, work and power. Hydraulic systems. Basic systems. Color coding. Reservoirs. Strainers and filters. Accumulators. Circulatory systems. Leakage. Pumps. Classifications. Performance. Displacement. Slippage. Gear pumps. Vane pumps. Piston pumps. Pump operation. Hydraulics Actuators. Cylinders. Construction and Application. Maintenance. Hydraulic Motors. Valves. Pressure-Control Valves. Directional-Control Valves. Flow-Control Valves Flow-Control Valves. Valve Installation. Valve Failures and Remedies. Valve Assembly. Circuit Diagrams and Troubleshooting.

EFFECTS OF EDUCATION PROCESS: Student knows hydraulics (theory) and hydraulics drives

LITERATURE (OPTIONAL):
Hydraulics. Deere and Company Service Publications, Moline, Illinois. 1997.
Industrial Hydraulics Manual. Vickers Training Center, Rochester Hills, Michigan. 1993.
Exner H. [i inni]: *Basic Principles and Components of Fluid Technology. The Hydraulic Trainer, Volume 1*. Mannesmann Rexroth AG 1991.

TEACHING METHODS: Multimedial presentation. Discussion of case histories, laboratory

ASSESSMENT METHODS: Colloqium/exam, the criterion of inclusion at least 50% of points

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

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Industrial Discrete Control Systems – M29

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture + Laboratory
NUMBER OF HOURS: 30 Lecture +30 Laboratory	ECTS: 5
SEMESTER: Winter/Summer	CLASS LEVEL: Basic
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: none	
CONTENTS: Fundamental logic concepts connected to discrete control systems, Karnaugh maps, relays, sequential systems. Documentation of discrete control systems – electrical diagrams, logic diagrams, PLC program standards: ladder diagrams, statement list, IF - THEN logic. PLC controllers – presentation of selected models, technical parameters, principle of operation, programming interface. Discrete control systems with PLCs. PLC programming – timing and counting applications, timers, counters, impulse generators, process synchronisation, simple sequencer design. Numbers: binary and BCD notation, GRAY code, integers, negative numbers, variable range, overflow, binary operations. User interface functions, operator panels, operator panels design principles. Fail-safe programming techniques, manual and automatic mode, program execution control, emergency routines, system recovery after failure. Digital process control: ON/OFF control, PID control. SCADA systems, program serviceability, program documentation, remote maintenance	
EFFECTS OF EDUCATION PROCESS: Student will get acquainted with modern digital control systems and fundamentals of formal knowledge and methods behind digital control technology. Student will learn to write simple control programs, design and implement sequences typical for handling applications, use data from peripheral devices like counters, design a simple user interface for an industrial operator console (like touch panel).	
LITERATURE (OPTIONAL): M.D. Ercegovac, T. Lang, J.H. Moreno, Introduction to Digital Systems E.D. Sontag, Mathematical Control Theory: Deterministic Finite Dimensional Systems. L.A. Bryan, E.A. Bryan, Programmable Controllers Theory and Implementation	
TEACHING METHODS: multimedial lecture, laboratory exercises	
ASSESSMENT METHODS: lecture: final exam	
TEACHER (NAME, EMAIL CONTACT): Radosław Cechowicz, PhD Eng; r.cechowicz@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Machine Parts/Elements I – M30

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, exercise
NUMBER OF HOURS: 15 + 30	ECTS: 4
SEMESTER: Winter	CLASS LEVEL: I
MINIMAL NUMBER OF STUDENTS: 6	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge of mathematics and engineering drawing
CONTENTS: Introduction to design of machine elements; Properties of materials; Static stress; Varying stress; Fatigue; Design of permanent joints; Mechanical spring
EFFECTS OF EDUCATION PROCESS: Student understand the concept of machine design and know how to design permanent joints and springs.
LITERATURE (OPTIONAL): Richard Budynas, Keith Nisbett: Shigley's Mechanical Engineering Design. Mcgraw-Hill Series in Mechanical Engineering. ISBN-10: 0073529281
TEACHING METHODS: Presentation, solving examples on the blackboard
ASSESSMENT METHODS: Homework 10% Solving problems in the class 10 % Exam 80 %
TEACHER (NAME, EMAIL CONTACT): Ph.D. Eng. Łukasz Jedliński, l.jedlinski@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Machine Parts/Elements II – M31

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, exercise
NUMBER OF HOURS: 15 + 30	ECTS: 4
SEMESTER: Summer	CLASS LEVEL:
MINIMAL NUMBER OF STUDENTS: 6	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Finished course machine parts/elements 1
CONTENTS: Design of shafts; Screws and fasteners; Design of keys and splines; Rolling bearings; Spur and helical gears
EFFECTS OF EDUCATION PROCESS: Student know how to design nonpermanent joints, shafts, rolling bearings and gears.
LITERATURE (OPTIONAL): Richard Budynas, Keith Nisbett: Shigley's Mechanical Engineering Design. Mcgraw-Hill Series in Mechanical Engineering. ISBN-10: 0073529281
TEACHING METHODS: Presentation, solving examples on the blackboard
ASSESSMENT METHODS: Homework 10% Solving problems in the class 10 % Exam 80 %
TEACHER (NAME, EMAIL CONTACT): Ph.D. Eng. Łukasz Jedliński, l.jedlinski@pollub.pl

Materials Engineering – M32

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE:
NUMBER OF HOURS: 30 L + 30 P	ECTS: 5
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Eng)

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: general chemistry, general physics

CONTENTS: Atomic and molecular structures of materials. Mono and policrystals. Defects in materials. Diffusion. Mechanical properties of materials. Mechanisms of strengthening. Failure of engineering materials. Equilibrium phase diagrams. Phase transformations. Applications and processing of metals and alloys. Introduction to ceramic materials. Introduction to polymers. Introduction to composites. Other materials and properties.

EFFECTS OF EDUCATION PROCESS: use the principles from chemistry and physics in engineering applications; identify, formulate and solve engineering problems connected to materials selection; understand and contribute to the challenges of a rapidly changing society

LITERATURE (OPTIONAL): M. Pytel .: The basic of material science. Cracow 2013. Library Sign: 173465.
John V.B.: Introduction to engineering materials. Macmillan 1983.
Lifshin E.: Characterization of Materials. Weinheim 1994.
Callister W., Rethwisch D.G.: Materials science and engineering. Wiley 2015, 2007
Frost B.R.T. (ed.): Phase Transformations in Materials. Weinheim 1992.
Jemioło S., Lutomirska M.: Mechanics and Materials. Warsaw 2013
Courtney T.H.: Mechanical Behavior of Materials. Boston 2000

TEACHING METHODS: combination of theory (lecture) and practice, group work and reporting, individual project work and investigation

ASSESSMENT METHODS: Lectures - final exam. Laboratory – mark for report

TEACHER (NAME, EMAIL CONTACT): Kazimierz Drozd, k.drozd@pollub.pl

Materials selection and design – M33

FACULTY: MECHANICAL ENGINEERING	CLASS TYPE: Lecture and laboratory
NUMBER OF HOURS: 30 LECTURES, 30 LABORATORY	ECTS: 4
SEMESTER: WINTER, SUMMER	CLASS LEVEL: 1
MINIMAL NUMBER OF STUDENTS: 8	
LANGUAGE OF INSTRUCTION: ENGLISH	
PRELIMINARY REQUIREMENTS: basic knowledge of the science of materials, knowledge of fundamental physico-chemical properties of materials; general knowledge of effort and state of stresses and the basis on calculations of strength; awareness of the role of knowledge of materials engineering in practice	
CONTENTS: **Lecture**: The importance of the selection of materials. Distribution and properties of structural materials. Price and availability of materials. Design stages, along with the selection of materials. Materials selection factors: commercial functions design, the shape of the elements, the process. Materials indices - evaluation, the meaning and use of the examples. Multicriterial selection. Rules for the process selection. Issues of Economics and eco-design in the selection of materials. Computer technology used in materials selection. **Laboratory**: Stages of design. Determination of objectives and design constraints. Basic strength issues in the engineering tasks. Establishing criteria to maximize the functionality of the product. Materials databases. Materials selection charts. The selection methods based on materials selection charts. Analysis of the resulting set of materials. Determination of materials indexes. Selection of materials with the use of indexes. Determination of the shape index. The use of shape index in the selection of materials. Issues of economics and ecology in the process of selection. The Process selection. Analysis of process parameters. Application of the process selection charts. Economics in processes to optimize the selection of materials. Optimization of material properties by controlling the phase structure, microstructure and the surface layer.	
EFFECTS OF EDUCATION PROCESS: The Student knows the rules of selection of materials with the use of materials indexes; Knows the rules technology selection; Knows the economic and eco-friendly criteria in the design process and the selection of materials; Can specify the objectives and constraints of the design task; Can analyze a set of materials using materials indexes, taking into account the shape of the product as well as economic and environmental criteria; It can make the process selection for implementation of a specific product; He can use a computer database in the process of the selection of materials and process; Recognizes the importance of optimum materials selection	
LITERATURE (OPTIONAL): Ashby M.F.: Materials Selection In Mechanical Design. Butterworth – Heinemann, Oxford 2000; Ashby M.F., Shercliff H., Cebon D.: Materials. Engineering, science, processing and design. Butterworth – Heinemann, Oxford 2007 Ashby M.F.: Materials and the environment. Butterworth – Heinemann, Oxford 2013	
TEACHING METHODS: **Lecture**: multimedia presentations and problems. **Laboratory**: a practical method based on observation and analysis, stimulate activity method associated with the practical operation of the students in order to resolve the problems. Classes at computer stations using CES EduPack software.	
ASSESSMENT METHODS: The Final Project, which requires the basic knowledge (Lecture) and practical skills (Laboratory).	
TEACHER (NAME, EMAIL CONTACT): Ph.D.Eng. Krzysztof Pałka, k.palka@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Materials Testing Methods – M34

FACULTY: MECHANICAL ENGINEERING, DEPARTMENT OF MATERIALS ENGINEERING	CLASS TYPE: Lecture and laboratory
NUMBER OF HOURS: 30-h LECTURE + 30-h LABORATORY	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1
MINIMAL NUMBER OF STUDENTS: 8	

LANGUAGE OF INSTRUCTION: ENGLISH

PRELIMINARY REQUIREMENTS: Basic knowledge of the science of materials, General knowledge of physics and chemistry; knowledge of fundamental physico-chemical properties of materials; engineering in practice;

CONTENTS: Structure of the materials and the method of structural studies. Distribution of research methods of structure and properties. Macroscopic and microscopic observations of proper and failure of choosing engineering structure. NDT techniques (ultrasonic including phase array; eddy currents); Scanning electron microscopy (SEM); Scanning Tunneling Microscope (STM); Transmission electron microscopy (TEM); Atomic force microscopy (AFM); Computer tomography (CT); Electron probe X-ray Analysis X-ray spectrometer for chemical analysis; Micro- and nano hardness; Auger Electron Spectrometer (AES); Methods of non- destructive testing of corrosion – MFL, TOFD, PIT, MAPSCAN; X-ray Diffractometer; Applications of the synchrotron radiation for materials. Destructive testing materials (strength tests, preparation of the samples). Analysis about the phenomena of failure the structures.

EFFECTS OF EDUCATION PROCESS: Student characterize the research methods used in materials engineering. Student distinguishes and describes the testing equipment. Student is able to plan research experiment for basic materials engineering.

LITERATURE (OPTIONAL): Freiman S.W., Mecholsky J.J.Jr.:" The Fracture of Brittle Materials. Testing and Analysis", John Wiley and Son, 2012; Cardarelli F.: "Materials Handbook", Spirnger, 2008; Kutz M.: "Handbook of Materials Selection", John Wiley and Son, 2002; Thorsten M. Buzug: Computed Tomography. Springer-Verlag Berlin Heidelberg, 2008; William N. Sharpe, Jr. (Editor): Handbook of Experimental Solid Mechanics. Springer Science+Business Media, LLC New York, 2008; Paul E. Mix: Introduction To Nondestructive Testing. John Wiley & Sons, Inc., Hoboken, New Jersey, 2005; C. H. Chen (Editor): Ultrasonic And Advanced Methods For Nondestructive Testing And Material Characterization. World Scientific Publishing Co. Pte. Ltd., 2007

TEACHING METHODS: Multimedia lecture, discussion based on the student's presentations; Laboratory – practical experiments and observations

ASSESSMENT METHODS: Lecture – presence on the 85% of the course, passing the practical exercises indicated by lecturer carried out during the course

TEACHER (NAME, EMAIL CONTACT):PhD. Eng. Krzysztof Pałka, k.palka@pollub.pl (winter), PhD. Eng. Monika Ostapiuk , m.ostapiuk@pollub.pl (summer)

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Measurements– M35

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture and laboratory
NUMBER OF HOURS: 15+30	ECTS: 3
SEMESTER: Winter/Summer	CLASS LEVEL: 1 (eng)

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Mathematics and physics – basics;
CONTENTS: International System of Units SI - basic concepts and definitions. ISO System of limits and fits. Fundamental statistic and error analysis - classification of error. Roughness, waviness and primary profile. Surface profile parameters. Inspection of dimensional and geometrical deviations - measurement uncertainty.
EFFECTS OF EDUCATION PROCESS: Student knows: the types of measurement methods, system of units SI. Student can: analyze the measuring process. Student sights problem of metrology in various constructions.
LITERATURE (OPTIONAL): Metrology and measurement systems (different authors) Journals on-line
TEACHING METHODS: Multimedia lecture, discussion based on the student's presentations; Laboratory – practical experiments
ASSESSMENT METHODS: Lecture – the received a course with the mark Laboratory – the received a course with the mark based on partial marks from reports.
TEACHER (NAME, EMAIL CONTACT): PhD Eng Mariusz Kłonica, m.klonica@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

MECHANICAL VIBRATIONS – M36

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + classroom exercises + project
NUMBER OF HOURS:30+15+0	ECTS: 4
SEMESTER: Winter	CLASS LEVEL: intermediate

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: knowledge of maths and physics at an advanced level

CONTENTS: (1) Introduction. Classification of vibrations, positive and negative effects of vibrations. Modelling of real systems, discrete and continuous systems. Stiffness and damping Characteristics. (2) Free vibrations. Natural frequency, differential equation of motion of linear systems. Equivalent stiffness of springs connected in parallel and series. Longitudinal, tensional and transverse vibration. (3) Dumped vibrations. Differential equation of motion, frequency of damped vibration with viscous damping. (4) Forced vibration. Forced vibrations of linear systems with viscous damping. Mechanical resonance. (5) Dumped vibrations with dry friction. Properties of models with dry friction. (6) Forced vibration by periodic and non-periodic forces. Fourier transformation, beating phenomenon. (7) Vibration isolation. Strategies for vibration isolation. (8) Free vibration of lumped mass systems with multi degrees of freedom. Problem formulation and vibration frequencies. (9) Free vibration of lumped mass systems with multi degrees of freedom. Vibrations frequencies and modes, eigenvalue problem. (10) Forced oscillations of a two degree of freedom forced system. Resonance and anti-resonance effect. Dynamical vibration absorber. (11) Vibrations of continuous systems. Longitudinal and torsional vibrations of rods. (12) Transverse vibrations of beams. (13) Plate vibrations. Equation of motion, frequencies and modes of vibration. (14) Parametric vibrations. Mathieu's and Hill's equation. (15) Nonlinear vibrations. Duffing equation.

EFFECTS OF EDUCATION PROCESS: Students should gain an intermediate abilities to identify and to solve problems of mechanical vibrations

LITERATURE (OPTIONAL): (a) Meirovitch L., Fundamentals of Vibrations, McGraw-Hill international Ed., 2001. (b) Rao S.R., Mechanical Vibrations, 5th Ed., Prentice Hall, 2004.

TEACHING METHODS: classical and multimedial lectures + problem solving exercises under the teacher's guidance + self-contained problems consulted with the teacher

ASSESSMENT METHODS: lecture: final exam, classroom exercises: two written tests in a semester;

TEACHER (NAME, EMAIL CONTACT): Prof. DSc. PhD. Eng. Jerzy Warminski; j.warminskipollub.pl | DSc. PhD. Eng., Rafał Rusinek, r.rusinek@pollub.pl | DSc. PhD. Eng. Krzysztof Kęcik, k.kęcik@pollub.pl | PhD. Eng. Marek Borowiec, m.borowiec@pollub.pl | MSc. Eng. Zofia Szmit., z.szmit@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Strength of Materials – M37

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + classroom exercises + project
NUMBER OF HOURS: 15 + 15 + 15 + E	ECTS: 4
SEMESTER: winter/summer	CLASS LEVEL: intermediate

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: knowledge of maths and physics at an advanced level
CONTENTS: Introduction: basic notions. Simple loading cases: tension/compression, torsion, shear, bending – calculation of internal forces and deformation. Geometrical characteristics of cross-sections. Analysis of stress and strain state. Mohr circle. Tensor calculus fundamentals; index notation; transformation of stress and strain. Constitutive Laws. Equations of equilibrium. Combined loads; failure hypotheses. Deflections of beams, shafts and frames; statically indeterminate problems.
EFFECTS OF EDUCATION PROCESS: Students should gain an intermediate abilities to identify and to solve strength of materials problems
LITERATURE (OPTIONAL): J.M. Gere & B.J. Goodno: Mechanics of Materials, CENGAGE Learning, 2009; R.C. Hibbeler: Mechanics of Materials, Prentice Hall, 2011
TEACHING METHODS: multimedial lecture + problem solving exercises under the teacher's guidance + self-contained project consulted with the teacher
ASSESSMENT METHODS: lecture: final exam, classroom exercises: two written tests in a semester; project: defence
TEACHER (NAME, EMAIL CONTACT): Sylwester SAMBORSKI, Assoc. Prof. DSc Eng.; s.samborski@pollub.pl; | A. Teter, Assoc. Prof. DSc Eng., a.teter@pollub.pl | T. Kazmir, PhD Eng., t.kazmir@pollub.pl | J. Latalski, Assoc. Prof. DSc Eng., j.latalski@pollub.pl;

Mechatronics systems – M38

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: project
NUMBER OF HOURS: 30	ECTS: 2
SEMESTER: Winter/Summer	CLASS LEVEL: 1 stage (Engineer)
MINIMAL NUMBER OF STUDENTS: 10	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basics of mathematics, Mechanics – basic laws
CONTENTS: Programming, Sensors, Actuators, Computing Architectures, Using PC as computing Element, Data Acquisition and Instrumentation, Machine Vision, Artificial Intelligence, Mechatronic Systems Design.
EFFECTS OF EDUCATION PROCESS: Understanding significance of mechatronic design. Developing skills in mechatronic design.
LITERATURE (OPTIONAL): Introduction to Mechatronics and Measurement Systems, David G. Alciatore and Michael B. Histand, Mc Graw Hill, 2003. The LEGO MINDSTORMS NXT 2.0 Discovery Book.
TEACHING METHODS: LEGO Mindstorms NXT
ASSESSMENT METHODS: Project
TEACHER (NAME, EMAIL CONTACT): Ph.D. (Eng.) P. Filipek, p.filipek@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Bulk Metal Forming and Numerical Modeling – M39

FACULTY:Mechanical	CLASS TYPE:
NUMBER OF HOURS: 30	ECTS: 3
SEMESTER:winter / summer	CLASS LEVEL:

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: No
CONTENTS: Metal forming technologies with industrial applications (presentations), numerical modeling of metal forming processes by Finite Element Method (presentations and computer laboratories) Scope of subject: basics of bulk metal forming, cold, worm and hot forming conditions, problematic of stress, strain, strain rate, friction and materials for billets and tools; technologies of metal forming: rolling, forging; casting technologies; process designing and numerical calculation of chosen technology with application of Deform3D FEM software.
EFFECTS OF EDUCATION PROCESS: knowledge of metal forming basics, theory and different metal forming technologies and basics of numerical modeling by Finite Element Method
LITERATURE (OPTIONAL):Metal Forming Technology (different authors), FEM (different authors)
TEACHING METHODS: presentations, computer laboratories and project
ASSESSMENT METHODS: oral exam or project presentations
TEACHER (NAME, EMAIL CONTACT): PhD Eng JarosławBartnicki, j.bartnicki@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Modern welding and joining technology – M40

FACULTY: MECHANICAL ENGINEERING	CLASS TYPE: Lecture + laboratory
NUMBER OF HOURS: 30 hrs lecture, 15 hrs laboratory	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: 1
MINIMAL NUMBER OF STUDENTS: …. * should the number be smaller, the course may not be opened , six	
LANGUAGE OF INSTRUCTION: ENGLISH	
PRELIMINARY REQUIREMENTS: general knowledge of materials science, basic knowledge of physics and chemistry	
CONTENTS: Metallurgy of welding; Weldability of steels; Phenomena occurring in electric arc; Properties of gases and fluxes used in welding; Electrode materials; Welding equipment; Shielded arc methods- GMA, GTA, SAW; Welding with cored wires; Gas welding; Thermal spraying and pad welding, Laser welding; Electron beam welding; Cutting methods; Resistance, friction and flush welding techniques; Stir welding; Soldering; Welding of advanced materials- zirconium, titanium, light alloys, maraging and duplex steels; Joining methods of composites; Special techniques of joining metals with nonmetals; Metal to glass bonding; Bonding metals to semiconductors; Welding of polymers; Joining of carbides with steel; Adhesive technology and review of selected applications; Robotization and automatization of welding; Modelling of welding; Applied experimental methods.	
EFFECTS OF EDUCATION PROCESS: Knows the common and the modern methods applied to join materials. Student is able to choose joining technology and its parameters	
LITERATURE (OPTIONAL): R. O'Brien: Welding encyclopedia. American Welding Society. 18-th edition, Miami USA. W. Włosiński: The joining of advanced materials. Oficyna Wydawnicza Politechniki Warszawskiej 1999. J. R. Davies ed.: Handbook of thermal spray technology. ASM International 2004 J.E. Lancaster: Metallurgy of welding. Abignon Publishing, Cambridge 1999 L.-E. Lindgren: Computational welding mechanics: Thermomechanical and microstructural simulations. Woodhead Publishing 2007	
TEACHING METHODS: Lecture: mulimedial presentation, discussion of case histories. Laboratory: practical methods based on observation and analysis	
ASSESSMENT METHODS: Lecture: Colloquium/exam, the criterion of inclusion- at least 50% of points. Laboratory: Colloquium, the criterion of inclusion- at least 50% of points.	
TEACHER (NAME, EMAIL CONTACT): Tadeusz Hejwowski, PhD, DSC, Assoc. prof., t.hejwowski@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Nanomaterials – M41

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE:
NUMBER OF HOURS: 30 L + 30 P	ECTS: 5
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Eng)

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: chemistry, physics, materials engineering
CONTENTS: Nanofabrication technology. How to achieve the nanometr length scale. Bottom-up technologies. Top-down technologies. Photolitography. Molecular beam epitaxy. Multidisciplinary nature of nanoscience and nanotechnology – areas of chemistry, phisics, material science, molecular biology. Examples of nanoscience phenomena. Comparison of bulk material and quantum mechanical properties. Contemporary and anticipated applications of nanomaterials. Integrated circuits. Quantum computing. Smart materials. Microelectromechanical systems. Modern optoelectronic materials. Bioengineering.
EFFECTS OF EDUCATION PROCESS: develop analytical skills; learn to critique and analyze science papers; consider fabrication, manufacturing, and societal issues as they apply to the nanomaterials; understand the various components neccessary for multidisciplinary engineering technology
LITERATURE (OPTIONAL): classic and current journal papers in Nature, Science, Nanoscience, Applies Physics Letters, Optoelectronics Review Shahinpoor M., Schneider H-J.: Intelligent materials. Cambridge 2008
TEACHING METHODS: combination of theory (lecture) and practice, group work and reporting, individual project work and investigation
ASSESSMENT METHODS: Lectures - final exam. Laboratory – mark for report
TEACHER (NAME, EMAIL CONTACT): Kazimierz Drozd, k.drozd@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Non-ferrous metals – M42

FACULTY: Mechanical Engineering, Department of Materials Engineering	CLASS TYPE: lecture and laboratory
NUMBER OF HOURS: 20h lecture+10h laboratory	ECTS: 2
SEMESTER: Winter/Summer	CLASS LEVEL: 1
MINIMAL NUMBER OF STUDENTS: 6	

LANGUAGE OF INSTRUCTION: Polish and English
PRELIMINARY REQUIREMENTS: Materials engineering – basics; knowledge of fundamental physico-chemical properties of materials;
CONTENTS: Lecture: Elementary knowledge. Definitions and classification of non- ferrous metals. Properties in different non-ferrous metals. Aluminium, Cobalt, Copper, Gold, Magnesium, Nickel, Platinum, Silver, Titanium and Zinc-metallurgy of these materials. Structure and properties of light and heavy alloy. Alloy hardness testing. Deformation and recrystallization of aluminum alloys. Laboratory: Structure and properties of aluminium alloys. Structure and properties of titanium. Structure and properties of cobalt. Structure and properties of copper. Selected hardness tests. Bearing alloys and low-melting. Deformation and recrystallization of aluminum alloys.
EFFECTS OF EDUCATION PROCESS: Student knows the main type of materials, common tests to measure, properties and applying of non-ferrous metals.
LITERATURE (OPTIONAL): Journals on-line and papers ed. at LUT
TEACHING METHODS: Discussion, exposition, multimedia lecture; Laboratory – practical experiments (e.g. microscopic observation or hardness tests)
ASSESSMENT METHODS: Lecture –a course with the final mark; Laboratory – a course with the final mark based on partial marks from list of presence.
TEACHER (NAME, EMAIL CONTACT): PhD. Eng. Monika Ostapiuk, m.ostapiuk@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Numerical Simulation of Polymer Processing – M43

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + exercises in the computer lab
NUMBER OF HOURS:15+30	ECTS: 4
SEMESTER: Winter	CLASS LEVEL: intermediate

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: basic knowledge about polymer processing and the ability to using engineering programs

CONTENTS: Principles of injection molding process. Basic information about simulation and numerical modelling of polymer processes. Stages of computer simulation of injection molding. Preparing of FEM model of injection molding part. Preparing of runner system. Description of the numerical model of polymer. Simulation of filling phase. Simulation of packing phase. Simulation of cooling phase. Analysis of shrinkage, warpage and deformation. Analysis of other results of simulation of injection molding.

EFFECTS OF EDUCATION PROCESS: Students gain the ability to perform the simulation of injection molding process using engineering software Cadmould 3D-F and the analysis of its results.

LITERATURE (OPTIONAL):

1. Beaumont J. P., Sherman R., Nagel R. F.: Successful Injection Molding: Process, Design, and Simulation. Carl Hanser Verlag, Munich 2002.
2. Rosato D. V., Rosato D. V., Rosato M. G.: Injection Molding Handbook. Kluwer Academic Publisher, Norwell 2000.
3. Zhou H.: Computer Modeling for Injection Molding: Simulation, Optimization, and Control. John Wiley & Sons Inc., Hoboken 2013.
4. Cadmoul 3D-F. User's Manual. Simcon 2012 (digital version).

TEACHING METHODS: multimedial lecture + exercises in computer lab under the teacher’s guidance

ASSESSMENT METHODS: lecture: final test/exam, computer lab exercises: simple project of injection molding simulation

TEACHER (NAME, EMAIL CONTACT): Tomasz Jachowicz, PhD Eng.; t.jachowicz@pollub.pl

Non-destructive testing of materials – M44

FACULTY: Mechanical Engineering	CLASS TYPE: Lecture, project
NUMBER OF HOURS: 15+15	ECTS: 2
SEMESTER: winter/summer	CLASS LEVEL: Level 1 (Eng), Level 2 (MSc)
MINIMAL NUMEBER OF STUDENTS: 7	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS:
Basic knowledge of physics. Elementary knowledge of materials science.

CONTENTS:
1. Causes of structural failure, need for NDT. 2. NDT methods:: 2a. macroscopic observations, 2b. ultrasonic tests, 2c. phased array, 2d. thermography, 2e. microCT. 2f. other NDT methods. 3. Analysis of NDT results. 4. Structural health monitoring 5. NDT of unusual materials and constructions – case study.

EFFECTS OF EDUCATION PROCESS:
Using of physics phenomena in tests of materials, theory about non-destructive methods, practical using of non-destructive testing of metals and composites, knowledge about tests methods of different materials. Non-destructive tests in aerospace

LITERATURE (OPTIONAL):

TEACHING METHODS: Lecture – presentations, Laboratory – practice work at tests stands

ASSESSMENT METHODS: Closed test at the end of curse.

TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng. Patryk Jakubczak, p.jakubczak@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Polymer materials – M45

FACULTY: Mechanical Enginnerring	CLASS TYPE: lectures, laboratory
NUMBER OF HOURS: 15+15	ECTS: 3
SEMESTER: Winter/Summer	CLASS LEVEL: I level
MINIMAL NUMER OF STUDENTS: 8	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Basic knowledge about structure and properties of engineering materials

CONTENTS: Introducing classes. Industrial safety training, rules of credit, schedule of classes. Basics of obtaining, construction, structure and properties of polymers. Additives. Preparation, types, properties and application of the main polymer materials. Determination of hardness of plastics in glassy and high-elastic state. Methods of hardness calculation. Influence of plastic type on hardness obtained by ball indentation and Shore method. Impact resistance research. Influence of plastic type on notched impact resistance without noched impact resistance and relative impact resistance. Determination of standard and bulk density. Methods of density calculation of solid and cellular plastics. Influence of plastic type on standard, bulk and apparent density. Determination of bendig strength. Influence of plastic type on static bendig strength and deflection angle. Research of tribological properties. Influence of plastic type on abrasive wear. Determination of use temperatures. Determination of deflection and softening temperature of plastics.

EFFECTS OF EDUCATION PROCESS: Acquire basic knowledge about methods of polymer processing and the construction and operation of machines and processing tools. Preparing students for the correct application of processing methods in the engineering work and practical knowledge of selected methods of polymer materials processing.

LITERATURE (OPTIONAL): Barnes M.D. (et al.): Polymer physics and engineering. Springer, Berlin 2001; Sperling L.H.: Introduction to physical polymer science. John Wiley & Sons, New York 1992; Progelhof R.C., Throne J.L.: Polymer engineering principles: properties, processes and tests for design. Hanser Verlag, Munich 1993; Tadmor Z., Brown R.: Handbook of polymer testing : physical methods. Marcel Dekker, Inc., New York 1999.

TEACHING METHODS: Lectures with modern teaching aids - multimedia projector, computer presentations. Laboratory classes - demonstrations of selected instruments and measuring activities with explanations and descriptions with explanations and descriptions.

ASSESSMENT METHODS: Lectures - written exam. Laboratory classes - presence, positive grade of theoretical part each exercise and reports.

TEACHER (NAME, EMAIL CONTACT): Ph.D., Eng. Aneta Tor – Świątek, a.tor@pollub.pl; Ph.D., Eng Bronisław Samujło, b.samujlo@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Polymer Processing – M46

FACULTY: Mechanical Enginnering	CLASS TYPE: lectures, laboratory
NUMBER OF HOURS: 15+15	ECTS: 3
SEMESTER: Winter/Summer	CLASS LEVEL: I and II level
MINIMAL NUMER OF STUDENTS: 8	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge about structure and properties of polymer materials
CONTENTS: Lectures - Theoretical basis of polymer processing. Processability. Plasticization. Plasticizing units for processing machines. Methods of polymer materials processing – welding, porosity techniques, activation, extrusion and varieties, injection molding and varieties, pressing, laminating, casting, bonding, metallization of plastics, chemical improvement. Laboratory classes – melt flow rate, welding process, pressing, injection molding, blow film extrusion, profiles extrusion, rotational molding.
EFFECTS OF EDUCATION PROCESS: Acquire basic knowledge about methods of polymer processing and the construction and operation of machines and processing tools. Preparing students for the correct application of processing methods in the engineering work and practical knowledge of selected methods of polymer materials processing.
LITERATURE (OPTIONAL): Tadmor Z., Gogos C.G.: Principles of polymer processing. Wiley-Interscience, Hoboken 2006; Sabu T., Yang W.: Advances in polymer processing. Woodhead Publishing, Boca Raton CRC Press, Oxford 2009; White J.L., Potente H.: Screw extrusion – science and technology. Hanser Gardner Publications, Cincinnati 2003; Sikora J.W.: Selected problems of polymer extrusion. Lublin University of Technology, Lublin 2008; Osswald T.A., Lih-Sheng T., Gramann P.J.: Injection molding handbook. Hanser Gardner Publications, Cincinnati 2002
TEACHING METHODS: Lectures with modern teaching aids - multimedia projector, computer presentations. Laboratory classes - demonstrations of selected machines, tools and equipment with explanations and descriptions.
ASSESSMENT METHODS: Lectures - written exam. Laboratory classes - presence, positive grade of theoretical part each exercise and reports.
TEACHER (NAME, EMAIL CONTACT): Prof. Ph.D, Sc.D., Eng. Janusz W. Sikora, janusz.sikora@pollub.pl; Ph.D, Sc.D., Eng. Tomasz Klepka, t.klepka@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Powder metallurgy – M47

FACULTY: MECHANICAL ENGINEERING	CLASS TYPE: Lecture
NUMBER OF HOURS: 15	ECTS: 2
SEMESTER: Winter/Summer	CLASS LEVEL: 1
MINIMAL NUMBER OF STUDENTS: …. * should the number be smaller, the course may not be opened , six	
LANGUAGE OF INSTRUCTION: ENGLISH	
PRELIMINARY REQUIREMENTS: general knowledge of materials science, basic knowledge of physics and chemistry	
CONTENTS: Principle of powder metallurgy. Advantages of technology. Atomization methods. Chemical routes of powder production. Mechanical milling and alloyig Formation and consolidation. Pressing methods Sintering methods. Mass transfer in sintering. Finishing of sinters Plasma spray deposition . Metal injection moulding Laser and microwave sintering Advances in nanocomposite technology Bulk materials for machining tools. Metallic hollow sphere materials Selected applications of sintered materials	
EFFECTS OF EDUCATION PROCESS: Student knows powder metallurgy, potent applications of sintered parts, advantages and disadvantages of technology	
LITERATURE (OPTIONAL): 1) ASM Handbook, vol. 2 Properties and selection, ASM 2005 2) ASM Handbook vol. 7 Powder Metallurgy, ASM 2005 3) Cahn The coming of materials science. Pergamon Press 2001	
TEACHING METHODS: Multimedial presentation. Discussion of case histories	
ASSESSMENT METHODS: Colloqium/exam, the criterion of inclusion at least 50% of points	
TEACHER (NAME, EMAIL CONTACT): Tadeusz Hejwowski, PhD, DSC, Assoc. prof., t.hejwowski@pollub.pl	

Fatigue and Failure of Materials and Structures – M48

FACULTY: MECHANICAL ENGINEERING	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: 15 LECTURES + 15 LABORATORY	ECTS: 4
SEMESTER: WINTER, SUMMER	CLASS LEVEL: 1
MINIMAL NUMBER OF STUDENTS: 6	
LANGUAGE OF INSTRUCTION: ENGLISH	
PRELIMINARY REQUIREMENTS: Materials engineering – basics; mechanics of materials – basics; mathematics – intermediate	
CONTENTS: **Lecture:** Introduction to the problem of materials fatigue; History of fatigue; Fatigue test methods; Fatigue diagrams; Prediction methods of materials fatigue and failure; Theoretical models describing materials degradation; Mechanisms of fatigue initiation; Fatigue crack growth; **Laboratory:** Fatigue crack growth tests; Determination of fatigue crack growth rate; Determination of Paris diagrams; Describing fatigue behavior by mathematical models.	
EFFECT OF EDUCATION PROCESS: Student knows history and reason of fatigue degradation of materials; knows fundamentals of fatigue degradation and mathematical models to predict fatigue degradation of materials and structures, knows fatigue diagrams, fatigue laws and models used in industry,	
LITERATURE: A.P. Vassilopoulos, Fatigue life prediction of composites and structures, Woodhead Publishing in Materials CRC Press, 2010 R. Jones, Mechanics of Composite Materials, Second Edition, Taylor and Francis, 1999 T.L. Anderson, Fracture Mechanics – Fundamentals and Applications, Third Edition, Taylor and Francis, 2005	
TEACHING METHODS: Multimedia lecture, discussion, exposition; Practical experiments (determination of fatigue curves); application of fatigue models to predict fatigue degradation of materials and structures	
ASSESSMENT METHODS: Lecture – final test; Laboratory – Assessment of the results reports	
TEACHER (NAME, EMAIL CONTACT): Konrad Dadej PhD. Eng. k.dadej@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Surface engineering – M49

FACULTY: MECHANICAL ENGINEERING	CLASS TYPE: Lecture + laboratory
NUMBER OF HOURS: 30 hrs lecture, 15 hrs laboratory	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: 1
MINIMAL NUMBER OF STUDENTS: …. * should the number be smaller, the course may not be opened , six	
LANGUAGE OF INSTRUCTION: ENGLISH	
PRELIMINARY REQUIREMENTS: general knowledge of materials science, basic knowledge of physics and chemistry	
CONTENTS: Scope of surface engineering; Development of surface engineering; Current status of surface engineering technology; Significance and properties of surface; Surface phenomena and layers; Superficial layer, its properties and effect on component durability; Scope of tribology; Wear mechanisms; Methods of tribological testing; Fundamentals of lubrication technology; Coating methods, types of coatings; Galvanic methods of coating deposition; Vacuum technology and its applications in surface engineering; Advances in burnishing technology and practical effects; Deposition of coatings from chemical phase; PVD methods and their application; Electron beam technology; Ion implantation; Selected thermo-chemical treatments- boriding, nitriding, carburizing; Pack cementation methods; Thermal barrier coatings, Hardfacing of engine valves, Coatings resistant to erosion-corrosion; Simulation methods applied in surface engineering; Nanostructured coatings; Experimental methods used to assess properties of superficial layer.	
EFFECTS OF EDUCATION PROCESS: Student understands a virtue of superficial layer. Knows methods used to evaluate the properties of the superficial layer. Knows methods used to study properties of coatings Knows methods applied to produce the superficial layer with desired properties. Student knows criteria used in selection of surface engineering technologies and their parameters.	
LITERATURE (OPTIONAL): T. Burakowski and T. Wierzchoń: Surface engineering of metals. CRC-Press 1999 L. Pawlowski: The science and engineering of thermal spray coatings. John Wiley & Sons 2008 J. R. Davies ed.: Handbook of thermal spray technology. ASM International 2004	
TEACHING METHODS: Lecture: mulimedial presentation, discussion of case histories. Laboratory: practical methods based on observation and analysis	
ASSESSMENT METHODS: Lecture: Colloquium, the criterion of inclusion- at least 50% of points Laboratory: Colloquium/exam, the criterion of inclusion- at least 50% of points.	
TEACHER (NAME, EMAIL CONTACT): Tadeusz Hejwowski, PhD, DSC, Assoc. prof., t.hejwowski@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Theory of Machines I – M50

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, laboratory
NUMBER OF HOURS: 15 + 30	ECTS: 4
SEMESTER: Winter	CLASS LEVEL: I
MINIMAL NUMBER OF STUDENTS: 6	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge of mathematics
CONTENTS: Introduction to theory of machines and mechanism. Kinematics and mechanisms. Position and displacement. Velocity. Acceleration. Gear trains
EFFECTS OF EDUCATION PROCESS: Student know how to analyse typical mechanisms
LITERATURE (OPTIONAL): Uicker J. J., Pennock G. R., Shigley J. E.: Theory of machines and mechanisms. Oxford University Press 2011.
TEACHING METHODS: Presentation, computers with CAE software
ASSESSMENT METHODS: Solving problems in the class 15 % Exam 85 %
TEACHER (NAME, EMAIL CONTACT): Ph.D. Eng. Łukasz Jedliński, l.jedlinski@pollub.pl

Theory of Machines II – M51

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, laboratory
NUMBER OF HOURS: 15 + 30	ECTS: 4
SEMESTER: Summer	CLASS LEVEL: I
MINIMAL NUMBER OF STUDENTS: 6	

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Knowledge of mechanisms, knowledge of statics and knowledge of math at an advanced level
CONTENTS: Introduction to static force analysis of mechanism, kinematic analysis of mechanism, dynamic force analysis of mechanism, mechanical vibration of single degree of freedom systems, balancing of rigid rotors, flywheel design.
EFFECTS OF EDUCATION PROCESS: Balance dynamic forces in machines, understand basic concepts related with vibrations, gain basic knowledge about vibrations, imagine and analyze dynamic force in machines.
LITERATURE (OPTIONAL): Uicker J. J., Pennock G. R., Shigley J. E.: Theory of machines and mechanisms. Oxford University Press 2011.
TEACHING METHODS: Presentation, computers with CAE software
ASSESSMENT METHODS: Solving problems in the class 15 % Exam 85 %
TEACHER (NAME, EMAIL CONTACT): Ph.D. Eng. Łukasz Jedliński, l.jedlinski@pollub.pl

Thermodynamics I – M52

FACULTY: Mechanical Engineering	CLASS TYPE: lecture, exercises and laboratory
NUMBER OF HOURS: 30+15+15	ECTS: 5
SEMESTER: Winter	CLASS LEVEL: 1 stage (Engineer)
MINIMAL NUMBER OF STUDENTS: 6	
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: Mathematics – basics of analysis and ordinary differential equations; Physics – basics	
CONTENTS: Basic notions, thermodynamic state parameters and functions. Ideal gas laws. Semi-ideal gas model. Ideal gas mixtures. Real gases and vapors. Internal energy, heat, heat capacity, work, enthalpy. First law of thermodynamics: closed system, open system. Reversible/irreversible processes, entropy and second law of thermodynamics. Characteristic processes of ideal and semi-ideal gases. Carnot cycle. Heat engines, thermal cycles. Basic state parameters measurements. Humid air, Mollier diagram and its applications. Basics of combustion process and flue gas analysis. Thermodynamic analysis applications. Optional content: General thermodynamics and third law, thermodynamic properties of gasses, thermodynamic properties of vapors, compressed air, combustion machines, vapor cycles, vapor machines and turbines, cooling cycles and heat pump.	
EFFECTS OF EDUCATION PROCESS: Student knows: description of state of thermodynamic systems and description of thermodynamic processes, and is able to give statements of basic thermodynamic laws and equations. Student can: effectively solve basic problems of thermodynamics and take measurements of basic thermodynamic properties.	
LITERATURE (OPTIONAL): Thermodynamics. An Engineering Approach 3rd ed., Yunus A. Cengel, Michael A. Boles. McGraw Hill 1998.	
TEACHING METHODS: multimedia lecture + problem solving exercises under the teacher's guidance, laboratory practices	
ASSESSMENT METHODS: Lectures and exercises - written exam. Laboratory classes – presence + lab practices reports	
TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng. M. Gęca, m.geca@pollub.pl, Ph. D. Eng. T. Łusiak t.lusiak@pollub.pl	

Thermodynamics II – M53

FACULTY: Mechanical Engineering	CLASS TYPE: lecture, exercises and laboratory
NUMBER OF HOURS: 30+15+15	ECTS: 5
SEMESTER: Summer	CLASS LEVEL: 1 stage (Engineer)
MINIMAL NUMBER OF STUDENTS: 6	
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: Students should have knowledge of mathematics, physics and thermodynamics I.	
CONTENTS: Second law analysis of systems exergy, irreversibility, Gas power cycles Otto, Diesel, Gas power cycles Stirling, Ericsson, Gas power cycles Brayton air-standard cycles, Vapor power cycles Rankine cycle, Vapor power cycles reheat and regenerative Rankine cycles, Vapor power cycles combined power cycles, Refrigerators and heat pumps vapor-compression refrigeration cycle, Properties of gas mixtures gas-vapor mixtures, Psychrometric properties air-conditioning processes, Chemical reactions first and second law analysis of reacting systems, Chemical reactions fuels and combustion, Chemical and phase equilibrium.	
EFFECTS OF EDUCATION PROCESS: Students: 1. Conduct calculations and interpret the results of basic thermal processes. 2. Retrieve information from literature and databases and other sources and to interpret and use in calculations. 3. Measure the basic parameters of the heat. 4. He can draw and interpret measurement results. 5. They have practice during laboratory classes and can measure basic thermodynamics parameters. 6. The student uses appropriate methods and apparatus for research.	
LITERATURE (OPTIONAL): Thermodynamics. An Engineering Approach 3rd ed., Yunus A. Cengel, Michael A. Boles. McGraw Hill 1998.	
TEACHING METHODS: multimedia lecture + problem solving exercises under the teacher's guidance, laboratory practices	
ASSESSMENT METHODS: Lectures and exercises - written exam. Laboratory classes – presence, lab practices reports	
TEACHER (NAME, EMAIL CONTACT): Ph. D. Eng. M. Gęca, m.geca@pollub.pl, Ph. D. Eng. T. Łusiak t.lusiak@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Materials for power industry and aeronautics – M54

FACULTY: Faculty of Mechanical Engineering	**CLASS TYPE: Lecture, project**
NUMBER OF HOURS: 15 lectures, 15 project	**ECTS: 2**
SEMESTER: Winter/Summer	**CLASS LEVEL: Level 1 (Engineer), 2 level (Master of Science)**

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: General knowledge about materials science and technology

CONTENTS:
The power and aeronautics industries – current status and development of materials and criteria for the selection of materials. Operation of the flow engines, steam- and gas turbines, gas turbine. Jet aircraft engines, engine types, development. Classification of materials for energy systems and aeronautics. Materials for fossil fuel power plants. Production of the clean energy. Wrought nickel-, iron- and cobalt-base superalloys. Superalloys for turbine blades and application of welding technology. Heat-resistant coatings: diffusion coatings, MCrAlY and TBC. Titanium and aluminum alloys. Structural intermetallics. Materials for fission- and fusion reactors. Metal- and ceramic matrix composites. Oxide dispersion strengthened (ODS) alloys.

EFFECTS OF EDUCATION PROCESS: This course helps students develop an understanding meaning of proper materials selection for power industry and aeronautics applications. Students acquire knowledge of advanced materials properties. They understand the

LITERATURE (OPTIONAL): Literature accessible from Scopus and Elsevier databases.

TEACHING METHODS: Combination of theory and practice, group work and reporting, individual project work and investigation

TEACHING METHODS: Final exam based on compilation of theory or homework assignments; students' reports, test or project evaluation

TEACHER (NAME, EMAIL CONTACT): Mirosław SZALA, PhD Eng, m.szala@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Wear mechanisms of materials – M55

FACULTY: Faculty of Mechanical Engineering	**CLASS TYPE: Lecture, laboratory, project**
NUMBER OF HOURS: 15 lectures, 15 laboratory, 15 project	**ECTS: 4**
SEMESTER: Winter/Summer	**CLASS LEVEL: Level 1 (Engineer), 2 level (Master of Science)**

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: General knowledge about materials science and mechanics of materials

CONTENTS:
Tribology as a branch of materials engineering and materials science. Classification of surface damage. Abrasive wear. Solid particle erosion. Cavitation erosion. Liquid impingement erosion. Slurry erosion. Fretting wear. Rolling contact wear. Sliding and adhesive erosion. Corrosive wear. Oxidationl wear. Thermal fatigue. Selected laboratory characterization techniques. Friction and wear of components. Materials for friction and wear applications. Surface treatments and coatings for friction and wear control.

EFFECTS OF EDUCATION PROCESS: Students acquire knowledge of wear mechanisms of engineering materials. They understand the relationship between operational condition and structure of materials. Students learn methods for friction and wear control.

LITERATURE (OPTIONAL):
On-line journals available at Lublin University of Technology.

TEACHING METHODS: Combination of theory and practice, group work and reporting, individual project work and investigation

TEACHING METHODS: Final exam based on compilation of theory or homework assignments; students’ reports, test or project evaluation

TEACHER (NAME, EMAIL CONTACT): Mirosław SZALA, PhD Eng, m.szala@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Welding metallurgy – M56

FACULTY: Faculty of Mechanical Engineering	**CLASS TYPE: Lecture, laboratory**
NUMBER OF HOURS: 15 lectures, 15 laboratory	**ECTS: 3**
SEMESTER: Winter/Summer	**CLASS LEVEL: Level 1 (Engineer), 2 level (Master of Science)**

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: General knowledge about materials science and basics of welding processes

CONTENTS:

Fundamentals of welding. Phisical metallurgy. Fusion welding processes, heat flow in welding, chemical reactions in welding, fluid flow and metal evaporation in welding, residual stresses, distortion, and fatigue. Brazed or solidered joint. Weld metal solidification, post-solidification phase transformations, chemical ınhomogeneities, solidification cracking. Post-heat theratment of weldment. Weldablility and welding metallurgy of steels, aluminium alloys, nickel-base alloys and stainless steels. Weldability testing and inspection process. Quality control in welding.

EFFECTS OF EDUCATION PROCESS:

This course helps students develop an understanding of basic metallurgical principles related to welding processes. Students acquire knowledge of welding metallurgy aspects. They understand the relationship between welding technology, parameters and structure of materials. Students learn methods for weldment properties control.

LITERATURE (OPTIONAL):

John C. Lippold. Welding metallurgy and weldability. Hoboken : A John Wiley & Sons, Inc., cop. 2015.

John C. Lippold, Samuel D. Kiser, John N. DuPont. Welding Metallurgy and Weldability of Nickel-Base Alloys. John Wiley & Sons, 2011

Raymond J. Sacks, Edward R. Bohnart.Sacks, Raymond J.. Welding : principles and practices. Boston : McGraw-Hill Higher Education, 2005

TEACHING METHODS: Combination of theory and practice, group work and reporting, individual project work and investigation

ASSESSMENT METHODS: Final exam based on compilation of theory or homework assignments; students' reports, test or project evaluation

TEACHER (NAME, EMAIL CONTACT): Mirosław SZALA, PhD Eng, m.szala@pollub.pl