LUBLIN UNIVERSITY OF TECHNOLOGY
MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

LUBLIN UNIVERSITY OF TECHNOLOGY
PL LUBLIN03

FACULTY OF MECHANICAL ENGINEERING (FME)

ERASMUS+ Courses Catalogue

for the academic year 2023/24

Prepared by the FME ERASMUS+ Teachers

Approved by:

DEPUTY DEAN FOR EDUCATION AND
INTERNATIONAL COOPERATION
Sylwester SAMBORSKI, Assoc. Prof. DSc Eng.

FME ERASMUS+ COORDINATOR
Marek BOROWIEC, Assoc. Prof. DSc Eng.

LUBLIN, March 2023

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

LIST OF COURSES WITH CODES

3D Software Engineering	M01
Engineering Project (New)	M02
Advanced Strength of Materials	M03
Modern Measurement Systems (New)	M04
Assembly technology	M05
Biomaterials	M06
Casting technology	M07
Structure condition and properties of materials	M08
Introduction to CNC Programming	M09
Combustion Engines and Hybrid Propulsion Systems	M10
Composite Materials	M11
Corrosion	M12
Diagnostics of vehicles	M13
Advanced Numerical Methods	M14
Introduction to Aviation (New)	M15
Machining Processes (New)	M16
Computer Aided Design of Industrial Tools (New)	M17
Sheet Metal Forming and Numerical Modeling	M18
Bulk Metal Forming and Numerical Modeling	M19
Fluid Mechanics I	M20
Fluid Mechanics II	M21
Fundamentals of Control Theory	M22
Fundamentals of machinery operation and maintenance	M23
General Mechanics I	M24
General Mechanics II	M25
Heat transfer	M26
Heat Treating of Metals and Alloys	M27
Hydraulics and hydraulic drives	M28
Introduction to Industrial Robotics	M29
Machine parts/elements I	M30
Machine parts/elements II	M31
Materials Engineering	M32
Materials selection and design	M33
Materials Testing Methods	M34
Basics of Metrology (New)	M35
Mechanical Vibrations	M36
Strength of Materials	M37
Mechatronics systems	M38
Modern welding and joining technology	M39
Numerical Simulation of Polymer Processing	M40
Polymer Materials	M41
Polymer Processing	M42
Surface engineering	M43
Theory of machines I	M44
Theory of Machines II	M45
Thermodynamics I	M46
Thermodynamics II	M47
Vehicle dynamics	M48

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

LIST OF COURSES WITH CODES –continued

Wear Mechanisms of Materials	M49
Materials Processing Technology	M50
Fundamentals of machine technology and manufacturing process design (New)	M51
Advanced CNC Programming (New)	M52
Computer Aided Manufacturing (CAM) (New)	M53
Numerical Simulations of Materials	M54
Aviation Propulsion System (New)	M55

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:

1. Duration of all courses is 1 semester.
2. Semester: winter and/or summer means that the same course repeats in winter and summer semester. Otherwise in the indicated semester ONLY.
3. The applying student can select up to 32 ECTS per semester.
4. Up to 33% of courses specified in Learning Agreement (LA) can be subjects offered by the other faculties of the Lublin University of Technology. Simultaneously, the number of points that can be gained at the other faculties of LUT should not exceed 12
5. Upon arrival the student is entitled to change up to 33% of courses listed in his/her Learning Agreement (LA). The "During the mobility" form must be delivered to the Coordinator no later than 14 days after the organizational meeting.
6. When the number of students applying for a course is less than specified in the catalogue, the faculty will have the right to cancel the course. In this case the student should amend his/her Learning Agreement.

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

3D Software Engineering – M01

ULTY: Mechanical Engineering	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: 15h+30h	ECTS: 4
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 in 3D Software Engineering. CAD systems. Rapid prototyping technology, 3D printing technology. Reserve engineering technology, 3D scanning technology.
Laboratory: 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, Generative shape Design modelling, 3D Scanning – practice, Processing of 3D scanning surfaces using Digitized Shape Editor module.

EFFECTS OF EDUCATION PROCESS:
Student with no experience in CAD systems will learn Catia v5 modeling (Part Modeling, Assembly Modeling, DMU Kinematics, Generative shape Design). 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 systems. 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):

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 Paweł Magryta MSc Eng., p.magryta@pollub.pl

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Engineering Project – M02

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Project
NUMBER OF HOURS: 30h project	ECTS: 2
SEMESTER: winter/summer	CLASS LEVEL: Level 1 (Engineer) / Level 2 (Master of Science)
MINIMAL NUMBER OF STUDENTS: 6	
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: passing at least 4 semesters of engineering studies	
CONTENTS: Engineering project is thought to cover a solution of a technical problem, important from the point of view of a student, in relation to his/her specific background and needs, in relation to studies at the university of origin. The project can be realized on cooperation with a tutor from the student's home institution. Engineering project cannot be identified with a thesis (neither engineering, nor master), but can partially fulfil the respective requirements.	
EFFECTS OF EDUCATION PROCESS: Student after the course will be able to state an engineering problem and solve it, using contemporary methods for calculations, numerical modelling or experimental testing.	
LITERATURE (OPTIONAL): Literature on practical aspects of mechanical engineering	
TEACHING METHODS: multimedial instruction, project (calculation, drawing etc.)	
ASSESSMENT METHODS: defense of the project	
TEACHER (NAME, EMAIL CONTACT): Sylwester Samborski, Assoc. Prof. DSc PhD Eng, s.samborski@pollub.pl Katarzyna Biruk-Urban Ph.D. Eng k.biruk-urban@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Advanced Strength of Materials – M03

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

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Modern Measurement Systems – M04

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, Laboratory and Project
NUMBER OF HOURS: 15 + 15 +15 +E	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Engineer) / Level 2 (Master of Science)
MINIMAL NUMBER OF STUDENTS: 8	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: Fundamental knowledge of mathematics, physics and computer science

CONTENTS: New trends in metrology; the concept of measurement system, its classification and basic definitions; basics of signal processing; characteristics of measuring sensors; surface layer metrology; implementation of measurements on coordinate measuring machine and measuring arm; 3D scanning techniques; metrological software for measurement design; computer aided systems for testing dimensional and shape accuracy; measurement of deformation of thin-walled structures (The course is compatible with M35).

EFFECTS OF EDUCATION PROCESS: Student is familiar with new trends in metrology, has general knowledge on measurement systems, understands the concept of coordinate metrology. Student can: choose an appropriate measuring tool, use various measuring tools, plan the measurement using computer software, analyze complex measurement problems.

LITERATURE (OPTIONAL): Raghavendra N.V., Krishnamurthy L. Engineering Metrology and Measurements, Oxford University Press, 2013; Metrology and measurement (different authors); Journals on-line (e.g.: Measurement, Metrology, Metrology and Measurement Systems)

TEACHING METHODS: Lecture – multimedia presentations; Laboratory – practical exercises and discussions; Project - practical exercises and discussions (computer work)

ASSESSMENT METHODS: Lecture – final exam; Laboratory – laboratory reports; Project – individual project

TEACHER (NAME, EMAIL CONTACT): Magdalena Zawada-Michałowska, Ph.D. Eng.; m.michalowska@pollub.pl; Ewelina Kosicka, M.Sc. Eng. e.kosicka@pollub.pl

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Biomaterials – M06

FACULTY: MECHANICAL ENGINEERING	CLASS TYPE: Lecture and laboratory
NUMBER OF HOURS: 20 LECTURE + 10 LABORATORY	ECTS: 2
SEMESTER: winter, summer	CLASS LEVEL: Level 1 (eng.) or II (Msc.)
MINIMAL NUMBER OF STUDENTS: 8	
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	

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

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/Spring	CLASS LEVEL: Level 1 (Eng)
MINIMAL NUMBER OF STUDENTS: 8 should the number be smaller, the course may not be opened	

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. Heat treatment of metal alloys and castings. Finishing operations. Defects in castings. Characterization of ferrous and nonferrous casting alloys. Quality control of castings.

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 composites.

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; Krzysztof MAJERSKI, PhD Eng. k.majerski@pollub.pl

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Structure condition and properties of materials – M08

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, Laboratory
NUMBER OF HOURS: 30- lecture, 30 - laboratory	ECTS: 5
SEMESTER: winter and summer	CLASS LEVEL: 1 stage (Engineer), 2 stage (Master of Science)
MINIMAL NUMBER OF STUDENTS: 8 *should the number be smaller, the course may not be opened	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS:
Materials engineering – basics, physics – basics

CONTENTS:
- Causes of structural failure of materials – the source of manufacturing and exploitation
- Non-destructive methods: macroscopic observations, ultrasonic tests, phased array, thermography, microCT, other NDT methods
- Non-destructive of unusual materials and constructions – case studies
- Mechanical testing of materials
- Damage characterization and fractography analysis of materials
- The relations between damage and structure of materials

EFFECTS OF EDUCATION PROCESS:
- The student knows: physics phenomena in non-destructive tests, knowledge about NDT and mechanical tests methods of materials, relations between properties and structure
- The student can: select and design strategy for non-destructive testing of metals and composites, design the experimental tests of materials properties, can characterize the nature of damage of material
- The student understands: the role of the quality of the structure of materials and the needs for control of the structure. The student understands the importance of structure-properties relations.

LITERATURE (OPTIONAL):
Greenhalgh E., Failure analysis and fractography of polymer composites, 2009, Woodhead Publishing
ASM Handbook Vol.: 1,2,4-7,15,16,21
Hodgkinson J.M., Mechanical Testing of Advanced Fibre Composites, 2000, Woodhead Publishing

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): Ph. D. Eng. Patryk Jakubczak, p.jakubczak@pollub.pl

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Introduction to CNC Programming – M09

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Laboratory
NUMBER OF HOURS: 30	ECTS: 2
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Engineer) / Level 2 (Master of Science)
MINIMAL NUMBER OF STUDENTS: 6* if there are fewer participants, the course may not start	
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: Basic knowledge of machining.	
CONTENTS: Overview of CNC technology: 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, milling and turning technology, basic concepts, NC Program: structure of a NC program, code formatting, program verification techniques. CNC machine operation: coordinate systems used in CNC machines (axes, directions), zero point register, program zero point, absolute and incremental coordinate systems, inch and metric modes, basic machining operations, tools, plan of operations., communication to the operator, optional stop, block skip, thread cutting, active lathe tools. Part programming – documentation flow in a typical company, preparation for programming, program portability, tool path programming, offsets, tool programmable point, tool length, cutting speed, feed, interpolation, tool geometry and wear compensation, fixed cycles.	
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 CNC program, running the program in a machine simulator.	
LITERATURE (OPTIONAL): P. Smid, CNC Programming Handbook, Industrial Press Inc., ISBN: 0831131586, 2003	
TEACHING METHODS: Lecture with multi-medial contents, laboratory exercises with computer simulation	
ASSESSMENT METHODS: Activity during the classes, project evaluation, final test	
TEACHER (NAME, EMAIL CONTACT): dr inż Radosław CECHOWICZ (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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Composite Materials – M11

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: 30 – Lecture, 30 - Laboratory	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: I (eng.) or II (MSc)
Minimal Number of Students: 8	

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

Corrosion – M12

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture and laboratory
NUMBER OF HOURS: 30 lecture +15 laboratories	ECTS: 4
SEMESTER: WINTER/SUMMER	CLASS LEVEL: I
MINIMAL NUMBER OF STUDENTS: 8	

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):
Davis, J. R. Corrosion : Understanding the Basics Materials Park, Ohio : ASM International. 2000; Talbot D., Talbot J., Corrosion Science and Technology, CRC 1998; R. Winston H. Uhlig, Corrosion and Corrosion Control: An Introduction to Corrosion Science and Engineering2008, Journals on-line

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

ASSESSMENT METHODS: Final exam. Partial marks from lecture and laboratory.

TEACHER (NAME, EMAIL CONTACT): Dr Eng. Krzysztof Majerski k.majerski@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Diagnostics of vehicles – M13

FACULTY: Mechanical Engineering	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: Lecture 15, Laboratory 30h	ECTS: 4
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): PhD Eng.. Paweł Magryta, p.magryta@pollub.pl , PhD Eng. Łukasz Grabowski, l.grabowski@pollub.pl, PhD Eng. Grzegorz Barański

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Advanced Numerical Methods –M14

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	

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Introduction to Aviation – M15

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture
NUMBER OF HOURS: 30	ECTS: 3
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Engineer) ~~/ Level 2 (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: non

CONTENTS:

1. Flight as a physical phenomenon (forces acting on the aircraft, lift generation and thrust forces, aircraft control)
2. Aircraft classification (basic aircraft classification under aviation regulations, types, classes and types of aircraft, examples of structures, development trends in aeronautical structures)
3. Aviation law (history of the evolution of aviation law, Chicago Convention, ICAO International Civil Aviation Organisation, EASA European Aviation Safety Agency, Polish law - laws and regulations)
4. Responsibility and safety in aviation (aviation certification, initial and continuing airworthiness of aeronautical equipment, type certificates, design organisations, manufacturing and operating organisations, occurrence reporting, liability of persons working in aviation)
5. Flight crew (licensed personnel, principles and scope of training, how to obtain a licence and a certificate of competency, ratings, continuation of ratings)
6. Organisation of civil aviation (airspace zoning and division, aerodromes, aeronautical maps, radio communication in aviation, Civil Aviation Authority, Polish Air Navigation Services Agency, Commission for Aviation Accident Investigation, international organisations)
7. Fundamentals of flight planning (aviation meteorology: meteorological information and forecasts meteorological information and forecasts, consideration of weather in flight planning, routing, flight plan, flight reporting)

EFFECTS OF EDUCATION PROCESS:
Familiarisation with civil aviation issues in terms of law, technology and organisation.
Familiarisation with aviation-related terms.
Familiarisation with the principles of safety and responsibility in aviation.

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

LITERATURE (OPTIONAL):

1. Aviation law and Regulations;
2. Federal Aviation Administration „Aviation Maintenance Technician Handbook – General" FAA-H-8083-30A, 2018
3. Federal Aviation Administration „Aviation Maintenance Technician Handbook – Airframe" FAA-H-8083-31, 2012

TEACHING METHODS: Lectures

ASSESSMENT METHODS:. Exam

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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Machining Processes – M16

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture and laboratory
NUMBER OF HOURS: 15 lectures +15 laboratories	ECTS: 2
SEMESTER: winter/summer	CLASS LEVEL: Level 1 (Engineer) / Level 2 (Master of Science)
MINIMAL NUMBER OF STUDENTS: 6	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: passing at least 2 semesters of engineering studies

CONTENTS:
Lectures will be focused on the basics of cutting operations (turning, drilling, milling): kinematics, cutting parameters and tools. Lecture topics will also cover cutting layer geometry, tool wear, thermal phenomena and cutting fluids in the cutting process.
Laboratories will be in the form of practical classes during which turning, drilling and milling operations will be presented. Students will learn the kinematics of processes, the tools used and their geometry, cutting layer geometry etc. Based on the practical exercises, they will be able to analyze the results and make conclusions.

EFFECTS OF EDUCATION PROCESS:
Student after the course will be able to describe and define basic of cutting operations, such as turning, drilling, milling and analyze the results obtained during cutting and draw the conclusions.

LITERATURE (OPTIONAL):
M. C. Shaw "Metal cutting principles", Oxford University Press, 2005;
E. T. Trent, P. K. Wright "Metal cutting", Butterworth–Heinemann, 2000.

TEACHING METHODS: Multimedia lecture, Laboratory – practical experiments.

ASSESSMENT METHODS: Lecture – the received a course with the mark. Laboratory – reports.

TEACHER (NAME, EMAIL CONTACT): Katarzyna Biruk-Urban, PhD Eng. k.biruk-urban@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Computer Aided Design Of Cutting Tools – M17

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + project
NUMBER OF HOURS: 15+30	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Engineer) / Level 2 (Master of Science)
MINIMAL NUMBER OF STUDENTS: 8 * should the number be smaller, the course may not be opened	
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: Industrial tools – basics	
CONTENTS: Introduction: Construction and geometry of industrial tools. Principles of cutting tools selection from manufacturers' catalogs. Rules for selecting the type of machining and tool materials depending on the process. Cutting technological parameters. Introduction to solid modeling in the Solid Edge environment. Fundamentals of design cutting edge using CAD systems. Strength and geometric calculations of cutting tools, Overview of CNC machining processes.	
EFFECTS OF EDUCATION PROCESS: Student knows: the types of special cutting tools, the types of tools materials,. Student can: design cutting tool with all the necessary components, to determine the profile of the cutting edge using CAD methods (Solid Edge)	
LITERATURE (OPTIONAL): cutting tools (different authors) Journals on-line (for example: Matuszak, Jakub, and Marcin Barszcz. "Computer aided design of cutting tools." Advances in Science and Technology Research Journal 9.28 (2015)).	
TEACHING METHODS: multimedial lecture + self-contained computer project of cutting tool consulted with the teacher	
ASSESSMENT METHODS: lecture: final exam/test, project: project evaluation	
TEACHER (NAME, EMAIL CONTACT): PhD Eng Jakub Matuszak, j.matuszak@pollub.pl; PhD Eng Agnieszka Skoczylas, a.skoczylas@pollub.pl; PhD Eng Krzysztof Ciecieląg, k.ciecielag@pollub.pl;	

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Sheet Metal Forming and Numerical Modeling – M18

FACULTY:Mechanical	CLASS TYPE: lecture
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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Bulk Metal Forming and Numerical Modeling – M19

FACULTY:Mechanical	CLASS TYPE: lecture
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

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, PARTIAL 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	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Fluid Mechanics II – M21

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, PARTIAL 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	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

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, digital PID controller. Robust control, IMC. System identification techniques. Examples of control systems in industry.	
EFFECTS OF EDUCATION PROCESS: Students will get acquainted with fundamentals of formal knowledge and methods in the area of control theory and its applications. Students will learn to design simple control systems.	
LITERATURE (OPTIONAL): K. J. Åström, R. M. Murray: Feedback Systems: An Introduction for Scientists and Engineers http://www.cds.caltech.edu/~murray/amwiki/Main_Page P. Dawkins,: Paul's Online Notes, http://tutorial.math.lamar.edu/	
TEACHING METHODS: multimedial lecture, laboratory exercises.	
ASSESSMENT METHODS: lecture: final exam	
TEACHER (NAME, EMAIL CONTACT): Radosław Cechowicz, PhD Eng.; r.cechowicz@pollub.pl;	

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

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. Legal requirements for placing of machinery on the market or putting into service.

Preparation of instructions for machinery. Noise measurements. Experimental determination of basic operational parameters of a machine. Determination of basic 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 exercises and discussions based on the student's reports.

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 I – M24

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + classroom exercises
NUMBER OF HOURS: 30 +15	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: intermediate
LANGUAGE OF INSTRUCTION: English	MINIMAL NUMBER OF STUDENTS: 8

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): PhD. Eng. Andrzej Weremczuk, a.weremczuk@pollub.pl

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

General Mechanics II – M25

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + classroom exercises + laboratory
NUMBER OF HOURS: 30+15+30	ECTS: 5
SEMESTER: Winter/Summer	CLASS LEVEL: intermediate
LANGUAGE OF INSTRUCTION: English	MINIMAL NUMBER OF STUDENTS: 8

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

CONTENTS of lectures: (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. (6) Principle of work and energy, principle of impulse and momentum. (7) Angular momentum, angular impulse and momentum principle. (8) Kinetics of systems of particles. (9) Planar kinematics of rigid bodies: instantaneous centre of rotation. (10) Planar kinetics of rigid bodies. (11) Three dimensional kinematics of rigid bodies. (12) Three dimensional kinetics of rigid bodies. (13) Unbalanced rotors.

CONTENTS of laboratory: (1) Introduction to mechanics in a laboratory. Measuring techniques, safety regulations, notations and units. (2) Determining the location of the center of mass. (3) Determination of mass moment of inertia with physical pendulum method. (4) Determination of friction coefficients. (5) Analysis of a coplanar forces system. (6) Determination of mass moment of inertia with elastic rod method. (7) Determination of mass moment of inertia with trifilar suspension method. (8) Investigation of uniformly accelerated rotational motion. (9) Determination of a screw efficiency coefficient using the principle of conservation of energy. (10) Forced vibrations of a one degree of freedom system.

EFFECTS OF EDUCATION PROCESS: Students should gain an intermediate abilities to identify and to solve general problems of mechanics. Students should gain an intermediate abilities to operate measuring tools and recognize the parts of theequipment that should be measured. Students will be able to use knowledge gained in the laboratory in any experiments involving mechanicalproblems.

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. : Laboratory exercises, discussions about the exercises, explanation of the mechanical phenomenon taken under consideration in particular exercises, 60% - laboratory reports, 40% short tests before every laboratory exercise.

TEACHER (NAME, EMAIL CONTACT): Krzysztof Kecik, Assoc. Prof. DSc Eng.; k.kecik@pollub.pl, Zofia Szmit, PhD Eng., z.szmit@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

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, PARTIAL 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	

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Heat Treating of Metals and Alloys – M27

FACULTY: Faculty of Mechanical Engineering	**CLASS TYPE: Lecture, laboratory**
NUMBER OF HOURS: 30 – lecture, 30 - laboratory	**ECTS: 5**
SEMESTER: Winter/Spring	**CLASS LEVEL: Level 1 (Eng)**
MINIMAL NUMBER OF STUDENTS: 8 * should the number be smaller, the course may not be opened	

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): International Journal of Heat and Mass Transfer (on-campus access); Haasen P. (ed.): Phase Transformations in Materials. Weinheim 1991. (FME library); Muller K.A.: Structural phase transitions. Springer 1981 (library), ASM Handbook (online)

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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Introduction to Industrial Robotics – M29

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, Laboratory
NUMBER OF HOURS: 30 lecture + 30 laboratory	ECTS: 5
SEMESTER: Winter / Summer	CLASS LEVEL: Introductory
MINIMAL NUMBER OF STUDENTS: 6 * should the number be smaller, the course may not be opened	
LANGUAGE OF INSTRUCTION: English	
PRELIMINARY REQUIREMENTS: None	
CONTENTS: Introduction to industrial robotics: terminology, robotics classification, workspace, tools, equipment, applications. Planning of motion trajectories: methods, calculations in Cartesian space and in the machine coordinate system. Applied robotics: programming languages, presentation of the selected programming environments, offline modeling, offline simulation and programming, load assessment, component wear planning, tool selection and of auxiliary equipment, cooperation with the environment, data exchange, safety procedures planning and scheduling of tasks in robotic systems - methods of process optimization. Fundamental logic concepts connected to discrete control systems, Karnaugh maps, relays, sequential systems. Documentation of discrete control systems – electrical diagrams, logic diagrams, ladder diagrams, discrete control systems with PLCs. PLC programming, sequential tasks, numbers: binary and BCD notation, GRAY code, integers, negative numbers, variable range, overflow, binary operations. Digital process control: ON/OFF control, PID control. Program serviceability, remote maintenance	
EFFECTS OF EDUCATION PROCESS: Students acquire knowledge on: the use of robotized manufacturing cells, currents trends in industrial automation, the general rules of design of automated manufacturing cells, programming of industrial controllers (PLC). Skills: Students can select an appropriate robot for a typical task (palletizing, welding, assembly) and design/select tools and robot movements, and can write a simple sequential program for a PLC controller.	
LITERATURE (OPTIONAL): Craig JJ (2005) Introduction to Robotics - Mechanics and Control. Pearson Education International, Upper Saddle River, NJ 07458 Murray RM et al. (1994) A Mathematical Introduction to Robotic Manipulation. CRC Press; Documentation of RobotStudio (ABB) and RoboGuide (Fanuc)	
TEACHING METHODS: Lecture, Laboratory exercises	
ASSESSMENT METHODS: Assessment of laboratory exercises, 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: 8	

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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

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: 8	

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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Materials Engineering – M32

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture, laboratory
NUMBER OF HOURS: 30 – lecture, 30 - laboratory	ECTS: 5
SEMESTER: Winter/Spring	CLASS LEVEL: Level 1 (Eng)

MINIMAL NUMBER OF STUDENTS: 8 * should the number be smaller, the course may not be opened

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): Callister W., Rethwisch D.G.: Materials science and engineering (pp. 30, 81, 150). Wiley 2015 (FME library); Narayanaswami R.: Materials characterization. Singapore 2015 (FME library); Jemioło S., Lutomirska M.: Mechanics and materials. Warsaw 2013 (FME library); Pytel M.: The basic of material science. Cracow 2013; Czichos H., Tetsuya S., Leslie S.: Springer handbook of materials measurement methods. Berlin 2006 (FME library); 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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

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 * the course will not open if the number of students is smaller	
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 materials selection. Properties of structural materials, price and availability. Design stages, along with the selection of materials. Materials indices: function, objective, constraints and free variables. Selection including the shape. Processing. Multicriterial selection. Issues of economics and eco-design in the materials selection. Computer technology used in materials selection. Laboratory: Stages of design. Determination of objectives and design constraints. Establishing criteria to maximize the functionality of the product. Materials databases. Materials selection charts. The selection method. Analysis of the resulting set. Determination of materials indices. The use of indices in the materials selection process. Determination of the shape index. The use of shape indices in the selection process. Issues of economics and ecology. Optimization of material properties by controlling the phase structure, microstructure and the surface layer.	
EFFECTS OF EDUCATION PROCESS: The Student knows the rules of materials selection with the use of materials indices; knows the rules of processing selection; knows the economic and eco-friendly criteria in the design process; can specify the objectives and constraints of the design task; can analyze a set of materials using materials indices, can apply the shape of the product as well as economic and environmental criteria in materials selection process; can make the process selection for implementation of a specific product; can use a computer database in the materials selection and its processing	
LITERATURE (OPTIONAL): Ashby M.F.: Materials Selection In Mechanical Design. Butterworth – Heinemann, Oxford 2011; 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	

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Materials Testing Methods – M34

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, laboratory
NUMBER OF HOURS: 30 – Lecture, 30 - Laboratory	ECTS: 5
SEMESTER: winter, summer	CLASS LEVEL: LEVEL 1 (eng.) , Level 2 (MSc).
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 testing, x-ray tomography); 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: The received a course with the mark based on partial marks from laboratory. Final exam

TEACHER (NAME, EMAIL CONTACT): PhD. Eng. Monika Ostapiuk , m.ostapiuk@pollub.pl

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Basics of Metrology– M35

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture and laboratory
NUMBER OF HOURS: 15 lectures +15 laboratories	ECTS: 3
SEMESTER: winter/summer	CLASS LEVEL: Level 1 (Engineer) / Level 2 (Master of Science)
MINIMAL NUMBER OF STUDENTS: 6	

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: analyse 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. Final exam.
Laboratory – the received a course with the mark based on partial marks from reports.

TEACHER (NAME, EMAIL CONTACT): Mariusz Kłonica, PhD Eng. m.klonica@pollub.pl

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Mechanical Vibrations – M36

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + classroom exercises + laboratory
NUMBER OF HOURS: 30+15+30	ECTS: 5
SEMESTER: Winter/Summer	CLASS LEVEL: intermediate
LANGUAGE OF INSTRUCTION: English	MINIMAL NUMBER OF STUDENTS: 8

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

CONTENTS of lectures: (1) Introduction. Classification of vibrations, positive and negative effects of vibrations. Modelling of real systems, discrete and continuous systems. Equivalent stiffness of springs connected in parallel and series. (2) Free vibrations. Natural frequency, differential equation of motion of linear systems. Longitudinal, tensional and transverse vibration. (3) Damped 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) Damped vibrations with dry friction. Properties of models with dry friction. (6) Vibration isolation, the active vibroisolation. (7) Free vibration of lumped mass systems with multi degrees of freedom. Differential equations of motion in matrix approach. Vibrations frequencies and modes in multi degrees of freedom systems. (8). Numerical approach in modelling of multi degrees of freedom systems (9) Forced oscillations of a two degree of freedom system. Resonance and anti-resonance effect. Dynamical vibration absorber. (10) Vibrations of continuous systems. Analysis of a string vibrations. (11) Transverse vibrations of beams. Longitudinal and torsional vibrations of rods. (12) Plate vibrations. Equation of motion, frequencies and modes of vibration.

CONTENTS of laboratories: (1) Introduction to mechanical vibrations in a laboratory. Measuring techniques, safety regulations, notations and units. (2) Natural oscillation investigation in an experiment with oscillating rigid beam. (3) Damped oscillation investigation in an experiment with oscillating rigid beam. (4) Forced vibrations of a one degree of freedom system. (5) Investigation of uniformly accelerated rotational motion. (6) Dynamic balancing of rotating elements. (7) Resonance investigation in a kinematically excited system. (8) Recording of resonance curves with damping.

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. Laboratory exercises, discussions about the exercises, explanation of the mechanical phenomenon taken under consideration in particular tests.

ASSESSMENT METHODS: lecture: final exam, classroom exercises: two written tests in a semester; 60% - laboratory reports, 40% short tests before every laboratory exercise.

TEACHER (NAME, EMAIL CONTACT): Marek Borowiec Assoc. Prof. DSc Eng, m.borowiec@pollub.pl, Ph.D. (Eng.). Zofia Szmit, z.szmit@pollub.pl

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

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	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

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Mechatronics Systems – M38

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: project
NUMBER OF HOURS: 45	ECTS: 3
SEMESTER: Winter/Summer	CLASS LEVEL: 1 stage (Engineer)
MINIMAL NUMBER OF STUDENTS: 8	
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.) Przemysław Filipek, p.filipek@pollub.pl	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Modern welding and joining technology – M39

FACULTY: MECHANICAL ENGINEERING	CLASS TYPE: Lecture + laboratory
NUMBER OF HOURS: 30h lecture, 15h laboratory	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: 1
MINIMAL NUMBER OF STUDENTS: 8 * should the number be smaller, the course may not be opened	
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; Resitance, 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: Final 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

Numerical Simulation of Polymer Processing – M40

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 exam, computer lab exercises: simple project of injection molding simulation

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

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Polymer Materials – M41

FACULTY: Mechanical Engineering	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 testing and the construction and operation of instrumnts and measuring tools. Preparing students for the correct application of testing methods in the engineering work and practical knowledge of selected methods of polymer materials testing.

LITERATURE (OPTIONAL): Garbacz T.: Research methods of polymer materials. Workbook. Lublin 2014; 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, reports.

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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Polymer Processing – M42

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): Ph.D., Eng. Aneta Tor – Świątek, a.tor@pollub.pl;

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Surface Engineering – M43

FACULTY: Faculty of MECHANICAL ENGINEERING	CLASS TYPE: Lecture + laboratory
NUMBER OF HOURS: 30 - lecture, 30 - laboratory	ECTS: 5
SEMESTER: winter/summer	CLASS LEVEL: 1
MINIMAL NUMBER OF STUDENTS: 8	
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 technologies; Significance and properties of surface; Surface phenomena and surface 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 barier coatings; Hardfacing of engine valves; Coatings resistant to erosion-corrosion; Simulation methods used 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 properties of the superficial layer, knows methods used to study properties of coatings, knows methods applied to produce a superficial layer with desired properties. Student knows criteria used in a 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: multimedial presentation, discussion of case histories. Laboratory: practical methods based on observation and analysis	
ASSESSMENT METHODS: Lecture: 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

Theory of Machines I – M44

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

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Theory of Machines II – M45

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

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Thermodynamics I – M46

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	

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Thermodynamics II – M47

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	

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Vehicle Dynamics – M48

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: lecture + classroom exercises + laboratory
NUMBER OF HOURS: 15+15+15	ECTS: 4
SEMESTER: Winter/Spring	CLASS LEVEL: Level 1 (Engineer), 2 level (Master of Science)

LANGUAGE OF INSTRUCTION: English
PRELIMINARY REQUIREMENTS: Basic knowledge of physics
CONTENTS: Vehicle definition and basic scheme. Mechanics of the wheel with tire. Drive train. Suspension system. Driving behavior of single vehicles: velocities, accelerations, applied and generalized forces and torques, equations of motion.
EFFECTS OF EDUCATION PROCESS: The student has knowledge of the dynamics of vehicle movement. The student is able to name forces and torques acting on a vehicle in motion. The student understands the principles of the wheel's influence on the road. He knows the basic equations of vehicle motion. The student is able to determine the speed and acceleration of a vehicle.
LITERATURE (OPTIONAL): Georg Rill: Road Vehicle Dynamics: Fundamentals and Modeling Massimo Guiggiani: The Science of Vehicle Dynamics: Handling, Braking, and Ride of Road and Race Cars
TEACHING METHODS: classical and multimedia lectures ; Laboratory – practical experiments
ASSESSMENT METHODS: Lecture – final exam. Exercise – written test. Laboratory – reports
TEACHER (NAME, EMAIL CONTACT): Mariusz KAMIŃSKI, PhD Eng., mariusz.kaminski@pollub.pl

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Wear Mechanisms of Materials – M49

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, laboratory, project
NUMBER OF HOURS: 15 lectures, 15 laboratory, 15 project	ECTS: 4
SEMESTER: Winter/Spring	CLASS LEVEL: Level 1 (Engineer), 2 level (Master of Science)
MINIMAL NUMBER OF STUDENTS: 8 should the number be smaller, the course may not be opened	

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, surface modification processes and sprayed 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 properties of materials. Students study methods for friction and wear control and damage mitigation..

LITERATURE (OPTIONAL): Gwidon Stachowiak, Andrew W Batchelor, Engineering Tribology, Elsevier 2005.
Gwidon W. Stachowiak Wear: Materials, Mechanisms and Practice, Wiley, 2005
On-line journals, books and laboratory instructions 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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Materials Processing Technology – M50

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, laboratory
NUMBER OF HOURS: 30 - lecture, 30- laboratory	ECTS: 5
SEMESTER: Winter/Spring	CLASS LEVEL: Level 1 (Engineer), 2 level (Master of Science)

MINIMAL NUMBER OF STUDENTS: 8 should the number be smaller, the course may not be opened

LANGUAGE OF INSTRUCTION: English

MINIMAL NUMBER OF STUDENTS: 8 should the number be smaller, the course may not be opened

CONTENTS: Introduction to materials processing technology. Processing techniques used in manufacturing components from metals and other materials including metal matrix composites. Principles of metallurgy, ferrous and nonferrous metallurgy. Solidification and crystallization. Casting technologies. Joining techniques, welding, sintering, brazing, and pressure welding. Additive manufacturing, robotic overlay welding. Surface engineering and coatings deposition via thermal spraying and physical processes. Materials nonuniformities evaluation and testing of the materials properties.

EFFECTS OF EDUCATION PROCESS: Course covers the processing techniques used in manufacturing components from metals and other materials. They understand the relationship between processing technology and properties of materials. Students learn methods for castings, weldments and metallic and ceramic coatings quality control

LITERATURE (OPTIONAL):
On-line journals, books and laboratory instructions 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 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

Fundamentals of machine technology and manufacturing process design – M51

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture, Laboratory and Project
NUMBER OF HOURS: 15 + 15 + 15	ECTS: 4
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Engineer) / Level 2 (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: General, basics knowledge of cutting, machining, machine technology, technological machines	
CONTENTS: 1. Machine familiarisation (Lathe familiarisation and Familiarisation with milling machine), e.g. Complete machine, Control Panel, Longitudinal slide, Cross slide, Spindle head, Tailstock, Switch cabinet, Components (e.g. Main switch, Clamping pressure display, Chip basin: Coolant lubricant basin). 2. Machine set-up: Setting up the machine (Switching on, Manual movement, Tool compensation, Workpiece zero point), Programing (Write, edit, operate a program). 3. CNC basics: Geometry (e.g. Coordinate systems, Points on workpiece, Absolute, incremental, polar dimension), Technology (speed, cutting rate, feed), Programming (Program structure, header, Addresses, Motion commands, Cutter radius compensation, Tool offsets, Cycles, subroutines). 4. Manufacturing process and its features. Structure of the technological process of machining, components of the process. Construction and technological documentation. Technology of structures in machining. Principles of technological process design. Typical technological processes of basic machine components. Types of semi-finished products. Types of fixed elements (tools and workpieces).	
EFFECTS OF EDUCATION PROCESS: The student knows basic terms in the field of machine technology, has knowledge about the principles of engineering design and design of technological processes of machining. The student is able to design a technological process of manufacturing basic machine components. Getting to know, understanding the basics of construction machines, machine familiarisation, machine set-up and CNC basics.	
LITERATURE (OPTIONAL): Programming of numerically controlled machines (different authors), Machine technology (different authors), Journals on-line	
TEACHING METHODS: Combination of theory (lecture) and practice (laboratory/ project), group work and reporting, individual reports/projects or presentations	
ASSESSMENT METHODS: Lectures - final exam. Laboratory / project – mark for report or presentation, the received a course with the mark based on partial marks.	
TEACHER (NAME, EMAIL CONTACT): Ireneusz Zagórski, PhD Eng., i.zagorski@pollub.pl, Jarosław Korpysa, MSc Eng., j.korpysa@pollub.pl	

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Advanced CNC Programming – M52

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Laboratory
NUMBER OF HOURS: 30	ECTS: 2
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Engineer) / Level 2 (Master of Science)
MINIMAL NUMBER OF STUDENTS: 6* if there are fewer participants, the course may not start	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: General, basic knowledge of cutting, machining, machine technology and mechanical engineering

CONTENTS: Students will be introduced to the standard terminologies of dialogue CNC programming including: conventions, processes, operations, design and operational characteristics of key hardware components, programming techniques, applications, merits and demerits of CNC machines. The content of the subject includes: fundamentals of CNC milling, familiarization of control panel, advanced content of CNC programming in Heidenhain, functions of CNC dialogue programming, workpiece, tool and coordinate system setting. Part programming techniques in Heidenhain dialogue programming: definition of the tool approach and departure positions relative to the milled contour, linear and circular interpolation definition in cartesian and polar coordinates, definition of allowances – roughing and finishing operations, program transformations – subroutines, mirroring, datum shift, scaling, rotation, presets, probe cycles. Operation of the machine tool - theoretical basics with practical presentation. Preparation of a complete machining program for a 3-axis milling machine tool. Part machining based on programs prepared by students.

EFFECTS OF EDUCATION PROCESS: Students will know the advanced features in CNC dialogue programming in Heidenhain system. Students will know the specific functions of CNC dialogue programming and programming techniques. Students will know machining and probing cycles required to manufacture and quality control finished part. Students will be able to design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work.

LITERATURE (OPTIONAL): Programming of numerically controlled machines (various authors), Journals on-line, Heidenhain TNC 640 Handbook

TEACHING METHODS: Combination of theory (lecture) and practice (project), individual programming exercises, discussion.

ASSESSMENT METHODS: Laboratory – final project. Project will include complete CNC program made with Heidenhain dialogue programming.

TEACHER (NAME, EMAIL CONTACT): MSc. Eng. Kamil Anasiewicz k.anasiewicz@pollub.pl

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Computer Aided Manufacturing (CAM) – M53

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Laboratory
NUMBER OF HOURS: 30	ECTS: 2
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Engineer) / Level 2 (Master of Science)
MINIMAL NUMBER OF STUDENTS: 6* if there are fewer participants, the course may not start	

LANGUAGE OF INSTRUCTION: English

PRELIMINARY REQUIREMENTS: General, basic knowledge of cutting, machining, machine technology and mechanical engineering

CONTENTS: The subject focuses on the introduction of modern computer-aided manufacturing technologies. Students will develop practical knowledge and understanding of the applications, underlying technological principles and limitations of these technologies through tutorials and students made projects. Contents of the subject includes: fundamentals of CAM software, overview of machining processes, familiarization of basic functions of CAM software, programming skills for computer numerical control (CNC) machines, fixture concepts, design and milling operation setup, CAM cycles. Preparation of production documentation for the operator.

EFFECTS OF EDUCATION PROCESS: Students will be able to design a manufacturing process for an industrial component by interpreting 3D part model / part drawings with use of CAM technology through programming, setup, and ensuring safe operation of CNC machine tool. Students will be able to design and validate technological solutions to defined problems and communicate clearly and effectively for the practical application of their work. Students will be able to apply the concepts of machining for the purpose of selection of appropriate machine tool, machining parameters, select appropriate cutting tools for CNC milling and turning. Students will learn to create the technical documentation for selection of suitable manufacturing technologies as well as manufacturing documentation for CNC machine tool system for operations using appropriate 3-axis/multi-axis CNC technology.

LITERATURE (OPTIONAL): Computer Control of Manufacturing Systems; CAM machining methods (various authors), Journals on-line, CAM software tutorials

TEACHING METHODS: Combination of theory (lecture) and practice (project), individual programming exercises, discussion.

ASSESSMENT METHODS: Laboratory – final project. Project will include complete CNC program made with CAM software including 3D workpiece, clamping, tool, toll paths, cutting parameters, workshop documentation.

TEACHER (NAME, EMAIL CONTACT): MSc. Eng. Kamil Anasiewicz k.anasiewicz@pollub.pl

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Numerical Simulations of Materials – M54

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: 15 LECTURES + 30 LABORATORY	ECTS: 3
SEMESTER: WINTER, SUMMER	CLASS LEVEL: 1
MINIMAL NUMBER OF STUDENTS: 8	

LANGUAGE OF INSTRUCTION: ENGLISH

PRELIMINARY REQUIREMENTS: Materials engineering – basics; mechanics of materials – basics;

CONTENTS:
Lecture: Introduction to ABAQUS/CAE (Computer Aided Engineering) software. Introduction to the numerical simulations of engineering materials such ceramics, polymers, metals and composites; boundary conditions in numerical simulations; mathematical material models; mechanical and thermal loadings; contacts; introduction to modeling of material failure; defining failure criteria.
Laboratory: Introduction to ABAQUS/CAE software. Modeling of material response due to thermal and mechanical loadings; defining boundary conditions; defining material properties for ceramics, polymers, metals and composites; defining contact between two materials; simulations including material failure

EFFECTS OF EDUCATION PROCESS: Students knows methods of numerical simulation of engineering materials and structures in ABAQUS CAE software. Students can perform simple numerical simulation. Students are aware of the material models and their assumptions applied in numerical simulations. Obtain skills of the discretization of engineering structures, defining material properties, contacts, and boundary conditions in ABAQUS software. Students are able to analyze obtained result with selection of particular history output of the simulations.

LITERATURE (OPTIONAL):
ABAQUS 6.14 Documentation. Dassault Systemes Simulia Corp. 2014. Providence, RI, USA.
J.N. Reddy - An Introduction to the Finite Element Method, Third Edition. McGraw-Hill Education; 3 edition, 2005
E.J. Barbero - Finite Element Analysis of Composite Materials Using ABAQUS. CRC Press, Taylor & Francis Group, 2013
H. Ataei, M.Mamaghani - Finite Element Analysis Applications and Solved Problems using Abaqus®, Create Space, 2017

TEACHING METHODS: Multimedia lecture, discussion, exposition. Working on the computers in ABAQUS/CAE software.

ASSESSMENT METHODS: Assessment of the numerical simulation results, Assessment of the results reports, partial colloquia

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

LUBLIN UNIVERSITY OF TECHNOLOGY MECHANICAL ENGINEERING FACULTY

POLITECHNIKA LUBELSKA

FACULTY OF MECHANICAL ENGINEERING - LUBLIN UNIVERSITY OF TECHNOLOGY PL LUBLIN03

Aviation Propulsion Systems– M55

FACULTY: Faculty of Mechanical Engineering	CLASS TYPE: Lecture and Laboratory
NUMBER OF HOURS: 30 +15 +15	ECTS: 5
SEMESTER: Winter/Summer	CLASS LEVEL: Level 1 (Engineer), 2 level (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: knowledge of physics, mechanics, thermodynamics

CONTENTS:
Operating conditions of aircraft propulsion systems. Classification of aircraft propulsion systems and their applications. Principle of operation, basic design, components, classification and design variations of aviation propulsion systems: piston, turbine and jet engines, propeller, rotor and transmission power units. Propulsion systems of helicopters, airframes and vertical take-off and landing aircraft. Design analysis of selected aircraft power units. Calculation of energy flow and loads in selected power units.
Study of the design of selected power units. Development of the characteristics of a selected power unit.

EFFECTS OF EDUCATION PROCESS: Familiarity with aircraft propulsion systems classification. Familiarity with the fundamentals of aircraft propulsion systems. Familiarity with the theoretical basis of operation of major components of aircraft propulsion systems. Ability to identify and describe aircraft propulsion system components. Ability to carry out basic aircraft propulsion system calculations.

LITERATURE (OPTIONAL):
J.B. Heywood, Internal Combustion Engine Fundamentals, McGraw Hill, 1988.
Aviation Maintenance Technician Handbook – Powerplant. FAA-H-8083-32. U.S. Department of Transportation Federal Aviation Administration
Mattingly J., Heiser W., Pratt D.: Aircraft Engine Design, American Institute of Aeronautics and Astronautics, Education Series, Inc. 1801 Aleksander Bell Drive, Reston, VA20191-4344, 2002. Gunston, B.: The Development of Piston Aero Engines. Haynes Publishing; 2 edition 2006. ISBN 978-1852606190
Rodriquez, Ch. L.: Propellers for Aircraft Maintenance Technician EASA Module 17A, Aircraft Technical Book, 2016. ISBN 9781941144367.

TEACHING METHODS: multimedia lecture + laboratory experiments+ self-contained project consulted with the teacher. Students attend the lecture and have practice during the laboratory and project classes. Construction analysis laboratory. Computational exercises.

ASSESSMENT METHODS: lecture: final exam; project: discussion

TEACHER (NAME, EMAIL CONTACT): PhD Eng. Michał Jan Gęca, m.geca@pollub.pl