Institute of Technical Sciences

Winter semester:

Module I Materials – Processing – Technology- Aplications

3D printing	30 ECTS
Microstructure and Mechanical Properties of Materials	
Molecular Physics. Laboratory Applications, Measurements, and Technology	
Production process management	
Protective properties of materials and applications	

Module II Material science education

Design and Manufacturing of the Materials	30 ECTS
Inquiry Based Science Education1	
Methodology of teaching natural sciences1	
Production process management	
Renewables for Dummies	

Summer semester:

Module I -Materials and technology

Design and Manufacturing of the Materials	30 ECTS
Microstructure and Mechanical Properties of Materials	
Molecular Physics. Laboratory Applications, Measurements, and Technology	
Production process management	
Renewable energy sources	

Module II - The science and knowledge of materials properties and manufacturing

Design and Manufacturing of the Materials	30 ECTS
Inquiry Based Science Education1	
Methodology of teaching natural sciences1	
Microstructure and Mechanical Properties of Materials	
Renewable energy sources	

Course card

Course title	Design and Manufacturing of the Materials

Semester (winter/summer)	summer	ECTS	6

Lecturer(s)	dr inż. I.Sulima, dr inż. P.Hyjek	

Department	Institute of Technology	

Course objectives (learning outcomes)

The aim of the course is to familiarize the student with the basic methods of producing utility materials, especially construction materials. The student participates in their production. He gets to know their advantages and disadvantages. Selects products and types of materials, designs individual alloys, and determines the correctness of the manufacturing method used. Selects types of powders, thickening methods, sintering methods and finishing processes for sintered materials. Acquaintance with knowledge about further processing and potential use of materials produced by casting and sintering.

Prerequisites

Knowledge	Basic knowledge about individual materials
Skills	The student is able to obtain bibliographic information, databases and external sources. He has the ability to self-study in order to improve and improve his professional competence
Courses completed	None

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

The student performs the subsequent steps necessary to produce the material, including cast and sintered material. During this task, the student will take into account the type of starting substrates/powders and the method of casting/ compaction of the molded part and the sintering process. Knows the basic casting/sintering methods and the influence of the temperature and pressure used during the manufacturing process. It produces castings and sintered materials. He can assess their quality.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student`s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x					x			

Assessment criteria	The final evaluation is based on the assessment of the individual task and the final written work (essay).

Comments	

Course content (topic list)

1. Classic methods of producing engineering materials.
2. Innovations in the production of utility and technologically advanced materials.
3. Design of alloys and composites.
4. Foundry technologies.
5. Powder Metallurgy.
6. Techniques for the production of input materials.
7. Procedures and proceedings during material production.
8. Powder compaction and sintering.
9. Secondary operations.
10. Assessment of the quality of the produced material.
11. Materials and selected applications.

Compulsory reading

1. Mikell P. Groover, Fundamentals of modern maufacturing, Materials,Processes,and Systems, JOHN WILEY & SONS, 2010
2. Materials and Manufacturing Processes, K. Kumar , H. Kalita , D. Zindani , J. P. Davim, Springer Nature Switzerland AG 2019
3. Powder Metallurgy (university textbook). Kateřina Skotnicová, Miroslav Kursa, Ivo Szurman. Technical University of Ostrava
4. Powder Metallurgy Technology, G. S. Upadhyaya, Cambridge International Science Publishing

Recommended reading

1. Materials and Manufacturing, Mark A. Atwater, 2019 McGraw-Hill Education
2. https://www.asminternational.org/documents/10192/1849770/Z05438L_Sample.pdf/4fee7b45-917b-4911-bc5d-bd8dac26e153
3. Manufacturing Processes By H.N. Gupta.pdf, https://soaneemrana.org/onewebmedia/Manufacturing%20Processes%20By%20H.N.%20Gupta.pdf

Course card

Course title	Inquiry Based Science Education

Semester (winter/summer)	winter and/or summer	ECTS	6

Lecturer(s)	dr hab. Roman Rosiek	

Department	Faculty of Exact and Natural Sciences	

Course objectives (learning outcomes)

Principles of design, implementation and evaluation of projects in physics teaching - To realize the basic phases of the design, realization and evaluation of projects in teaching physics and STEM - To accept project teaching in physics as a significant educational tool with an emphasis on pupil motivation and international dimension of communication and cooperation with the use of English.

Prerequisites

Knowledge	Basic knowledge of Physics and Mathematics
Skills	Basics of the implementation (creation, implementation and evaluation) of educational projects in physics education; choice of targets and contents, application of learning technologies (methods, forms and means) when the project teaching; develop English terminology in Physics education. Attitudes: accept a project teaching in physics as an important educational tool with an emphasis on pupil motivation.
Courses completed	Basic Physics and Mathematics courses at the graduate level.

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours	15		15				

Teaching methods:

Lectures, discussion, Students' presentations, Homeworks

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student`s presentation	Written assignment (essay)	Oral exam	Written exam	Other
						x		x	x	x	x		

Assessment criteria	A. Student knows all terms and concepts. Student can work without any assistance; his/her knowledge is creative and easily applied to a given problem. His/her contribution to a project work was done on time, fully functional, written using advanced techniques, and approved. B. Student knows all terms and concepts but needs a little help when describing a solution to a problem. A few problems with the project, apply only basic techniques of database design and user interface development. Some assistance is needed. C. Student knows all terms and concepts, however, his/her knowledge is fragmentary and the student often needs help while solving a problem. Delays with project preparation, database, and user interface design require assistance. D. Student does not know a number of terms and concepts; she/he did not reach a satisfactory level of knowledge in most fields. His/her part of the project is not completed or not done on time. The student needs a lot of assistance. F. Fail in all aspects.

Comments	

Course content (topic list)

1. The role of Inquiry-Based Learning in physics education
2. Planning Inquiry-Based Learning in STEM education
3. Psychological and pedagogical aspects of Inquiry-Based Learning in STEM education
4. Physics Inquiry-Based Learning principles
5. Preparation of Inquiry-Based Learning in physics education
6. Implementation of Inquiry-Based Learning in teaching STEM
7. Evaluation of Inquiry-Based Learning in physics education
8. An example of developing, implementing and evaluating Inquiry-Based Learning methods in physics education
9. Cross-curricular cooperation of teachers
10. Implementation and verification of Inquiry-Based Learning in science education

Compulsory reading

1. Yasseri, Dar; Finley, Patrick M.; Mayfield, Blayne E.; Davis, David W.; Thompson, Penny; Vogler, Jane S. (2018-06-01). "The hard work of soft skills: augmenting the project-based learning experience with interdisciplinary teamwork". Instructional Science. 46 (3): 457–488 R.Driver, E.Guesne, A.Tiberghien, Children's Ideas in Science

2. Greeno, J. G. (2006). Learning in activity. In R. K. Sawyer (Ed.), The Cambridge handbook of the learning sciences (pp. 79-96). New York: Cambridge University Press.

3. Perrault, Evan K.; Albert, Cindy A. (2017-10-04). "Utilizing project-based learning to increase sustainability attitudes among students". Applied Environmental Education & Communication. 17 (2): 96–105.

Recommended reading

Indicated by the lecturer scientific journals and articles

Course card

Course title	Methodology of teaching natural science

Semester (winter/summer)	winter and/or summer	ECTS	6

Lecturer(s)	dr hab. Roman Rosiek	

Department	Faculty of Exact and Natural Sciences	

Course objectives (learning outcomes)

The aim of the course is to familiarise the university student with selected theoretical and practical issues in natural sciences education, as well as selected concepts, theories and results of theoretical and empirical research on learning and teaching natural sciences subjects, including: basic instructional knowledge of natural science education; educational diagnosis; searching and applying common science concepts and methods within science education, STEM education issues: integration, coordination and interdisciplinary relations, STEM education in contemporary society; different approaches towards paradigms of science education; interdisciplinary relations in science; integrating scientific concepts; observation and experiments; solving scientific problems; research methods.

Prerequisites

Knowledge	Basic knowledge of Physics and Mathematics
Skills	Skills: analyse, search and apply integrating scientific content (concepts) in science education Attitudes: accept the importance of integrating the role of science in science and STEM education.
Courses completed	Basic Physics and Mathematics courses at the graduate level.

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours	15		15				

Teaching methods:

Lectures, discussion, Students' presentations, Discussing students' and pupils' written work, analysing textbooks, simulating extracts from school lessons, developing teachers' instructions and lessons' plans.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
						x		x	x	x	x		

Assessment criteria	A. Student knows all terms and concepts. Student can work without any assistance; his/her knowledge is creative and easily applied to a given problem. His/her contribution to a project work was done on time, fully functional, written using advanced techniques, and approved. B. Student knows all terms and concepts but needs a little help when describing a solution to a problem. A few problems with the project, apply only basic techniques of database design and user interface development. Some assistance is needed. C. Student knows all terms and concepts, however, his/her knowledge is fragmentary and the student often needs help while solving a problem. Delays with project preparation, database, and user interface design require assistance. D. Student does not know a number of terms and concepts; she/he did not reach a satisfactory level of knowledge in most fields. His/her part of the project is not completed or not done on time. The student needs a lot of assistance. F. Fail in all aspects.

Comments	

Course content (topic list)

1. Physics as a discipline and as a subject of study. Methodology of physics and methodology of physics education.
2. Objectives of physics teaching.
3. Language in physics teaching.
4. Students' cognitive difficulties. Construction of didactic sequences taking into account conceptual barriers.
5. Control and evaluation of learning results. Checking understanding.
6. Didactic analyses of selected sections and issues of physics. Integration tendencies in teaching science subjects.
7. Models in physics and in teaching physics.
8. Active methods in teaching physics. Informal physics teaching.
9. Teaching physics in different contexts
10. Solving tasks as an educational activity. Open tasks. Dimensional analysis.

Compulsory reading

4. A.B.Arons, A Guide to Introductory Physics Teaching
5. R.Driver, E.Guesne, A.Tiberghien, Children's Ideas in Science

Recommended reading

Indicated by the lecturer scientific journals and articles

Course card

Course title	Microstructure and Mechanical Properties of Materials		
Semester (winter/summer)	winter	ECTS	6
Lecturer(s)	dr hab. inż. I. Sulima prof. UKEN, dr inż. P. Hyjek		
Department	Institute of Technology (INT)		

Course objectives (learning outcomes)

The aim of the course is to familiarize the student with methods of examining the microstructure of engineering materials, including new research methods used to observe it using optical microscopy, laser microscopy and electron microscopy. The student observes the change in the microstructure of selected engineering materials after various thermal treatments, under the influence of deformation and observes microstructure defects. The student determines the impact of this change on the mechanical properties of engineering materials.

Prerequisites

Knowledge	Basic knowledge about individual materials
Skills	The student is able to obtain bibliographic information, databases and external sources. He has the ability to self-study in order to improve and improve his professional competence
Courses completed	None

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

The exercises are in the form of laboratory exercises and consultations. The student becomes familiar with the microstructure and principles of operation of selected observation and research devices. He then independently observes and tests mechanical properties. He constantly consults with the course leader about the method of research and the results/observations obtained.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x			x		x			

Assessment criteria	The final grade is based on the assessment of the completed individual task and the final written work (essay).

Comments	

Course content (topic list)

1. Research on the structure of the material.
2. Microstructural observations.
3. Optical microscopy.
4. Laser microscopy.
5. Electron microscopy.
6. Microstructural analysis.
7. Assessment of the properties of engineering materials.
8. Mechanical properties.
9. The influence of microstructure changes on the mechanical properties of the material.

Compulsory reading

1. W. D. Callister, JR. D. G. Rethwisch (2018) Materials Science and Engineering – An Introduction, Wiley, New York, Weinheim.
2. D. Brandon, W.D. Kaplan (2008) Microstructural Characterization of Materials, John Wiley & Sons, Ltd., West Sussex.
3. M.A. Meyers, K.K. Chawla (2009), Mechanical Behavior of Materials, Cambridge University Press, UK

Recommended reading

1. C.R. Brundle, C.A. Evans, S. Wilson, (1992) Encyclopedia of Materials Characterization – Surfaces, Interfaces, Thin Films, Butterworth-Heinemann, Stoneham, MA
2. M.A. White (2019), Physical Properties of Materials, CRC Press, Taylor & Francis Group
3. J. Pelleg (2013), Mechanical Properties of Materials, Solid Mechanics And Its Applications G.M.L. Gladwell, Springer

Course card

Course title	"Production process management"

Semester (winter/summer)	winter	ECTS	6

Lecturer(s)	Dr inż. Piotr Migo	

Department	Institute of Technical Sciences	

Course objectives (learning outcomes)

The aim of the course on production process management is to prepare students to understand and effectively apply key concepts, tools, and strategies related to managing production processes. This includes the selection of parameters for production processes, along with the configuration and supervision of production lines.

Prerequisites

Knowledge	Eletronics , basic Automation and Regulatory.
Skills	
Courses completed	Electrical engineering, Electronics, Automation and machine drives, Fundamentals of Object-Oriented Programming

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

Lecture with demostration , labs, and Web Quest exercises

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student`s presentation	Written assignment (essay)	Oral exam	Written exam	Other
		X			X				X				

Assessment criteria	Assessment based on the evaluation of a practical project involving programming and implementation of a production line utilizing sorting mechanisms.

Comments	

Course content (topic list)

1. Introduction to Production Management:
   - Definition and goals of production management.
   - The role of production management in operational efficiency.
2. Basics of Automation in Production:
   - Concept of automation and its significance in production.
   - Types of automation systems.
3. Elements of Production Line Automation:
   - Components of production lines and their functions.
   - Integration of systems for coherence and efficiency.
4. Technologies for Controlling Production Processes:
   - Application of sensors, actuators, and other control technologies.
   - Process control in production.
5. Monitoring and Supervision Systems:
   - The role of monitoring systems in the production process.
   - Remote supervision of production lines.
6. Optimization of Production Processes:
   - Techniques for optimizing production processes.
   - Use of data analysis to identify areas for improvement.
7. Case Study: Designing an Automated Production Line:
   - Analysis of a case study related to designing and implementing an automated production line.
   - Challenges and benefits associated with implementing modern technologies.

Compulsory reading

Introduction to Operations and Supply Chain Management by
Cecil C. Bozarth, Robert B. Handfield
Automation, Production Systems, and Computer-Integrated Manufacturing by
Mikell P. Groover
PLC Programming using RSLogix 5000: Understanding Ladder Logic and the Studio 5000 Platform by
Nathan Clark

Recommended reading

Course card

Course title	3D Printing

Semester (winter/summer)	winter	ECTS	6

Lecturer(s)	Marcin Kowalski	

Department	Institute of Technology	

Course objectives (learning outcomes)

Introduce the basic concepts of 3D printing techniques and prepare the student to be an effective user of 3D printer and scanner.

Prerequisites

Knowledge	Basic knowledge of graphic engineering (CAD/CAE)
Skills	Basic computer skills.
Courses completed	Graphic engineering.

Course organization							
Form of classes	W (Lecture)	Group type					
		A	K	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours				15			

Teaching methods:

A combination of tutorials and laboratory work, supervised individual and group project work and self-study.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x	x	x	x					

Assessment criteria	Group and individual project work.

Comments	

Course content (topic list)

1. Basic concepts of 3D printing methods.
2. Filaments using in 3D printing.
3. Preparing the 3D printer for work.
4. Obtaining and preparing models for 3D printing.

Compulsory reading

1. Kloski L., Kloski N.: Make: Getting started with 3D printing, O'Reilly Media Inc. USA, 2016
2. Kaziunas France A.: Make: 3D printing, Maker Media, 2014

Recommended reading

1. Horvath J.: Mastering 3D printing, Apress 2014

Course card

Course title	Microstructure and Mechanical Properties of Materials

Semester (winter/summer)	winter	ECTS	6

Lecturer(s)	dr hab. inż. I. Sulima prof. UKEN, dr inż. P. Hyjek	

Department	Institute of Technology (INT)	

Course objectives (learning outcomes)

The aim of the course is to familiarize the student with methods of examining the microstructure of engineering materials, including new research methods used to observe it using optical microscopy, laser microscopy and electron microscopy. The student observes the change in the microstructure of selected engineering materials after various thermal treatments, under the influence of deformation and observes microstructure defects. The student determines the impact of this change on the mechanical properties of engineering materials.

Prerequisites

Knowledge	Basic knowledge about individual materials
Skills	The student is able to obtain bibliographic information, databases and external sources. He has the ability to self-study in order to improve and improve his professional competence
Courses completed	None

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

The exercises are in the form of laboratory exercises and consultations. The student becomes familiar with the microstructure and principles of operation of selected observation and research devices. He then independently observes and tests mechanical properties. He constantly consults with the course leader about the method of research and the results/observations obtained.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x			x		x			

Assessment criteria	The final grade is based on the assessment of the completed individual task and the final written work (essay).

Comments	

Course content (topic list)

1. Research on the structure of the material.
2. Microstructural observations.
3. Optical microscopy.
4. Laser microscopy.
5. Electron microscopy.
6. Microstructural analysis.
7. Assessment of the properties of engineering materials.
8. Mechanical properties.
9. The influence of microstructure changes on the mechanical properties of the material.

Compulsory reading

4. W. D. Callister, JR. D. G. Rethwisch (2018) Materials Science and Engineering – An Introduction, Wiley, New York, Weinheim.
5. D. Brandon, W.D. Kaplan (2008) Microstructural Characterization of Materials, John Wiley & Sons, Ltd., West Sussex.
6. M.A. Meyers, K.K. Chawla (2009), Mechanical Behavior of Materials, Cambridge University Press, UK

Recommended reading

4. C.R. Brundle, C.A. Evans, S. Wilson, (1992) Encyclopedia of Materials Characterization – Surfaces, Interfaces, Thin Films, Butterworth-Heinemann, Stoneham, MA
5. M.A. White (2019), Physical Properties of Materials, CRC Press, Taylor & Francis Group
6. J. Pelleg (2013), Mechanical Properties of Materials, Solid Mechanics And Its Applications G.M.L. Gladwell, Springer

Course card

Course title	Molecular Physics. Laboratory Applications, Measurements, and Technology		
Semester (winter/summer)	Winter	ECTS	6
Lecturer(s)	Krzysztof Ziewiec		
Department	Institute of technology		

Course objectives (learning outcomes)

Understanding the molecular physics, applications, measurements and technology. Gaining practical knowledge about measurements and processing.

Prerequisites

Knowledge	Basic knowledge of Physics and Chemistry
Skills	Understanding basic knowledge gained in previous education
Courses completed	Physics and Chemistry

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

Lectures and laboratory tasks include: Molecular Physics, Physics of heating and remelting of metal charge, methods of heating. Physical phenomena used for contact, non-contact temperature measurements and thermography. Phase transformations, the influence of crystallization processes on the microstructure of castings. Manufacturing and processing of metals. Manufacture of castings, melt spinning of metallic glasses, metal rolling, welding techniques. Welding and joining methods.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x					x		x	

Assessment criteria	Written exam based on lectures and recommended handbooks

Comments	

Course content (topic list)

Physics of heating and remelting of metal charge, methods of heating. Physical phenomena used for contact, non-contact temperature measurements and thermography. Phase transformations, the influence of crystallization processes on the microstructure of castings. Manufacturing and processing of metals. Manufacture of castings, melt spinning of metallic glasses, metal rolling, welding techniques. Welding and joining methods.

Compulsory reading

Materials Science and Technology, Pacific Northwest National Laboratory 1994 Donald R. Askeland, The Science and Engineering of Materials, ISBN: 978-0-412-53910-7 (Print) 978-1-4899-2895-5 (Online) Roger Timings, Fabrication and Welding Engineering, 2008 Roger Timings, Published by Elsevier Ltd. ISBN: 978-0-7506-6691-6 The Ultimate Infrared Handbook for R&D Professionals, FLIR, https://www.flir.eu/discover/rd-science/the-ultimate-infrared-handbook-for-rnd-professionals/

Recommended reading

John Snell, IR Scanning Handbook. Infrared Thermography,. Temperature Measurement, and Repair Priorities. PowerTest 2002. (NETA Annual Technical Conference).

Course card

Course title	"Production process management"		
Semester (winter/summer)	winter	ECTS	6
Lecturer(s)	Dr inż. Piotr Migo		
Department	Institute of Technical Sciences		

Course objectives (learning outcomes)

The aim of the course on production process management is to prepare students to understand and effectively apply key concepts, tools, and strategies related to managing production processes. This includes the selection of parameters for production processes, along with the configuration and supervision of production lines.

Prerequisites

Knowledge	Eletronics , basic Automation and Regulatory.
Skills	
Courses completed	Electrical engineering, Electronics, Automation and machine drives, Fundamentals of Object-Oriented Programming

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

Lecture with demostration , labs, and Web Quest exercises

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
		X			X				X				

Assessment criteria	Assessment based on the evaluation of a practical project involving programming and implementation of a production line utilizing sorting mechanisms.

Comments	

Course content (topic list)

8. Introduction to Production Management:
   - Definition and goals of production management.
   - The role of production management in operational efficiency.
9. Basics of Automation in Production:
   - Concept of automation and its significance in production.
   - Types of automation systems.
10. Elements of Production Line Automation:
    - Components of production lines and their functions.
    - Integration of systems for coherence and efficiency.
11. Technologies for Controlling Production Processes:
    - Application of sensors, actuators, and other control technologies.
    - Process control in production.
12. Monitoring and Supervision Systems:
    - The role of monitoring systems in the production process.
    - Remote supervision of production lines.
13. Optimization of Production Processes:
    - Techniques for optimizing production processes.
    - Use of data analysis to identify areas for improvement.
14. Case Study: Designing an Automated Production Line:
    - Analysis of a case study related to designing and implementing an automated production line.
    - Challenges and benefits associated with implementing modern technologies.

Compulsory reading

Introduction to Operations and Supply Chain Management by
Cecil C. Bozarth, Robert B. Handfield
Automation, Production Systems, and Computer-Integrated Manufacturing by
Mikell P. Groover
PLC Programming using RSLogix 5000: Understanding Ladder Logic and the Studio 5000 Platform by
Nathan Clark

Recommended reading

Course card

Course title	Protective properties of materials and applications

Semester (winter/summer)	winter	ECTS	6

Lecturer(s)	Dr hab. inż. Iwona Sulima, prof UP Dr inż. Paweł Hyjek	

Department	Institute of Technology	

Course objectives (learning outcomes)

The aim of the course is to present basic issues regarding the properties of materials that determine their use in modern technologies. Students learn about the technical aspects of the importance of engineering materials and practical methods for determining their physical, strength and wear properties.

Prerequisites

Knowledge	Basic knowledge about materials
Skills	The student is able to obtain bibliographic information, databases and external sources. He has the ability to self-study in order to improve and improve his professional competence.
Courses completed	None

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

Classes are conducted in the form of consultations and laboratory exercises. Students participate in density, hardness and friction and wear tests of selected engineering materials. They evaluate the designated properties and select the possibilities of using the selected material.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x					x			

Assessment criteria	The final evaluation is based on the assessment of the individual task and the final written work.
Comments	

Course content (topic list)

1. Engineering materials, availability, protective properties and surface.
2. The demand for engineering materials and their technical significance in the modern world in various areas of human activity.
3. Basic methods of testing material properties.
4. Criteria for selecting engineering materials for selected applications.
5. Material fatigue.
6. Friction, abrasion and wear. Tribological wear of materials.
7. Modern materials problems.

Compulsory reading

1. Ashby M. F., Johnson K., Materials and Design, Elsevier Ltd. Oxford, 2014
2. Bolton W., Materials for Engineers and Technicians, Taylor & Francis, 2020
3. Hutchings I., Philip Shipway, Tribology: Friction and Wear of Engineering Materials 2nd Edition, Butterworth-Heinemann; London, 2017

Recommended reading
1. Jones D. R. H.,l Engineering Materials 1, Fifth Edition:, , Elsevier Ltd. Oxford, 2018
2. Ashby M., Materials Selection in Mechanical Design, Elsevier Ltd. Oxford, 2017

Course card

Course title	Design and Manufacturing of the Materials

Semester (winter/summer)	summer	ECTS	6

Lecturer(s)	dr inż. I.Sulima, dr inż. P.Hyjek	

Department	Institute of Technology	

Course objectives (learning outcomes)

The aim of the course is to familiarize the student with the basic methods of producing utility materials, especially construction materials. The student participates in their production. He gets to know their advantages and disadvantages. Selects products and types of materials, designs individual alloys, and determines the correctness of the manufacturing method used. Selects types of powders, thickening methods, sintering methods and finishing processes for sintered materials. Acquaintance with knowledge about further processing and potential use of materials produced by casting and sintering.

Prerequisites

Knowledge	Basic knowledge about individual materials
Skills	The student is able to obtain bibliographic information, databases and external sources. He has the ability to self-study in order to improve and improve his professional competence
Courses completed	None

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

The student performs the subsequent steps necessary to produce the material, including cast and sintered material. During this task, the student will take into account the type of starting substrates/powders and the method of casting/ compaction of the molded part and the sintering process. Knows the basic casting/sintering methods and the influence of the temperature and pressure used during the manufacturing process. It produces castings and sintered materials. He can assess their quality.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x					x			

Assessment criteria	The final evaluation is based on the assessment of the individual task and the final written work (essay).

Comments	

Course content (topic list)

12. Classic methods of producing engineering materials.
13. Innovations in the production of utility and technologically advanced materials.
14. Design of alloys and composites.
15. Foundry technologies.
16. Powder Metallurgy.
17. Techniques for the production of input materials.
18. Procedures and proceedings during material production.
19. Powder compaction and sintering.
20. Secondary operations.
21. Assessment of the quality of the produced material.
22. Materials and selected applications.

Compulsory reading

5. Mikell P. Groover, Fundamentals of modern maufacturing, Materials,Processes,and Systems, JOHN WILEY & SONS, 2010
6. Materials and Manufacturing Processes, K. Kumar , H. Kalita , D. Zindani , J. P. Davim, Springer Nature Switzerland AG 2019
7. Powder Metallurgy (university textbook). Kateřina Skotnicová, Miroslav Kursa, Ivo Szurman. Technical University of Ostrava
8. Powder Metallurgy Technology, G. S. Upadhyaya, Cambridge International Science Publishing

Recommended reading

4. Materials and Manufacturing, Mark A. Atwater, 2019 McGraw-Hill Education
5. https://www.asminternational.org/documents/10192/1849770/Z05438L_Sample.pdf/4fee7b45-917b-4911-bc5d-bd8dac26e153
6. Manufacturing Processes By H.N. Gupta.pdf, https://soaneemrana.org/onewebmedia/Manufacturing%20Processes%20By%20H.N.%20Gupta.pdf

Course card

Course title	Inquiry Based Science Education

Semester (winter/summer)	winter and/or summer	ECTS	6

Lecturer(s)	dr hab. Roman Rosiek	

Department	Faculty of Exact and Natural Sciences	

Course objectives (learning outcomes)

Principles of design, implementation and evaluation of projects in physics teaching - To realize the basic phases of the design, realization and evaluation of projects in teaching physics and STEM - To accept project teaching in physics as a significant educational tool with an emphasis on pupil motivation and international dimension of communication and cooperation with the use of English.

Prerequisites

Knowledge	Basic knowledge of Physics and Mathematics
Skills	Basics of the implementation (creation, implementation and evaluation) of educational projects in physics education; choice of targets and contents, application of learning technologies (methods, forms and means) when the project teaching; develop English terminology in Physics education. Attitudes: accept a project teaching in physics as an important educational tool with an emphasis on pupil motivation.
Courses completed	Basic Physics and Mathematics courses at the graduate level.

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours	15		15				

Teaching methods:

Lectures, discussion, Students' presentations, Homeworks

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
						x		x	x	x	x		

Assessment criteria	A. Student knows all terms and concepts. Student can work without any assistance; his/her knowledge is creative and easily applied to a given problem. His/her contribution to a project work was done on time, fully functional, written using advanced techniques, and approved. B. Student knows all terms and concepts but needs a little help when describing a solution to a problem. A few problems with the project, apply only basic techniques of database design and user interface development. Some assistance is needed. C. Student knows all terms and concepts, however, his/her knowledge is fragmentary and the student often needs help while solving a problem. Delays with project preparation, database, and user interface design require assistance. D. Student does not know a number of terms and concepts; she/he did not reach a satisfactory level of knowledge in most fields. His/her part of the project is not completed or not done on time. The student needs a lot of assistance. F. Fail in all aspects.

Comments	

Course content (topic list)

1. The role of Inquiry-Based Learning in physics education
2. Planning Inquiry-Based Learning in STEM education
3. Psychological and pedagogical aspects of Inquiry-Based Learning in STEM education
4. Physics Inquiry-Based Learning principles
5. Preparation of Inquiry-Based Learning in physics education
6. Implementation of Inquiry-Based Learning in teaching STEM
7. Evaluation of Inquiry-Based Learning in physics education
8. An example of developing, implementing and evaluating Inquiry-Based Learning methods in physics education
9. Cross-curricular cooperation of teachers
10. Implementation and verification of Inquiry-Based Learning in science education

Compulsory reading

6. Yasseri, Dar; Finley, Patrick M.; Mayfield, Blayne E.; Davis, David W.; Thompson, Penny; Vogler, Jane S. (2018-06-01). "The hard work of soft skills: augmenting the project-based learning experience with interdisciplinary teamwork". Instructional Science. 46 (3): 457–488 R.Driver, E.Guesne, A.Tiberghien, Children's Ideas in Science

7. Greeno, J. G. (2006). Learning in activity. In R. K. Sawyer (Ed.), The Cambridge handbook of the learning sciences (pp. 79-96). New York: Cambridge University Press.

8. Perrault, Evan K.; Albert, Cindy A. (2017-10-04). "Utilizing project-based learning to increase sustainability attitudes among students". Applied Environmental Education & Communication. 17 (2): 96–105.

Recommended reading

Indicated by the lecturer scientific journals and articles

Course card

Course title	Methodology of teaching natural sciences		
Semester (winter/summer)	winter and/or summer	ECTS	6
Lecturer(s)	dr hab. Roman Rosiek		
Department	Faculty of Exact and Natural Sciences		

Course objectives (learning outcomes)

The aim of the course is to familiarise the university student with selected theoretical and practical issues in natural sciences education, as well as selected concepts, theories and results of theoretical and empirical research on learning and teaching natural sciences subjects, including: basic instructional knowledge of natural science education; educational diagnosis; searching and applying common science concepts and methods within science education, STEM education issues: integration, coordination and interdisciplinary relations, STEM education in contemporary society; different approaches towards paradigms of science education; interdisciplinary relations in science; integrating scientific concepts; observation and experiments; solving scientific problems; research methods.

Prerequisites

Knowledge	Basic knowledge of Physics and Mathematics
Skills	Skills: analyse, search and apply integrating scientific content (concepts) in science education Attitudes: accept the importance of integrating the role of science in science and STEM education.
Courses completed	Basic Physics and Mathematics courses at the graduate level.

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours	15		15				

Teaching methods:

Lectures, discussion, Students' presentations, Discussing students' and pupils' written work, analysing textbooks, simulating extracts from school lessons, developing teachers’ instructions and lessons’ plans.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
						x		x	x	x	x		

Assessment criteria	A. Student knows all terms and concepts. Student can work without any assistance; his/her knowledge is creative and easily applied to a given problem. His/her contribution to a project work was done on time, fully functional, written using advanced techniques, and approved. B. Student knows all terms and concepts but needs a little help when describing a solution to a problem. A few problems with the project, apply only basic techniques of database design and user interface development. Some assistance is needed. C. Student knows all terms and concepts, however, his/her knowledge is fragmentary and the student often needs help while solving a problem. Delays with project preparation, database, and user interface design require assistance. D. Student does not know a number of terms and concepts; she/he did not reach a satisfactory level of knowledge in most fields. His/her part of the project is not completed or not done on time. The student needs a lot of assistance. F. Fail in all aspects.

Comments	

Course content (topic list)

1. Physics as a discipline and as a subject of study. Methodology of physics and methodology of physics education.
2. Objectives of physics teaching.
3. Language in physics teaching.
4. Students' cognitive difficulties. Construction of didactic sequences taking into account conceptual barriers.
5. Control and evaluation of learning results. Checking understanding.
6. Didactic analyses of selected sections and issues of physics. Integration tendencies in teaching science subjects.
7. Models in physics and in teaching physics.
8. Active methods in teaching physics. Informal physics teaching.
9. Teaching physics in different contexts
10. Solving tasks as an educational activity. Open tasks. Dimensional analysis.

Compulsory reading

9. A.B.Arons, A Guide to Introductory Physics Teaching
10. R.Driver, E.Guesne, A.Tiberghien, Children's Ideas in Science

Recommended reading

Indicated by the lecturer scientific journals and articles

Course card

Course title	Microstructure and Mechanical Properties of Materials

Semester (winter/summer)	summer	ECTS	6

Lecturer(s)	dr hab. inż. I. Sulima prof. UKEN, dr inż. P. Hyjek	

Department	Institute of Technology (INT)	

Course objectives (learning outcomes)

The aim of the course is to familiarize the student with methods of examining the microstructure of engineering materials, including new research methods used to observe it using optical microscopy, laser microscopy and electron microscopy. The student observes the change in the microstructure of selected engineering materials after various thermal treatments, under the influence of deformation and observes microstructure defects. The student determines the impact of this change on the mechanical properties of engineering materials.

Prerequisites

Knowledge	Basic knowledge about individual materials
Skills	The student is able to obtain bibliographic information, databases and external sources. He has the ability to self-study in order to improve and improve his professional competence
Courses completed	None

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

The exercises are in the form of laboratory exercises and consultations. The student becomes familiar with the microstructure and principles of operation of selected observation and research devices. He then independently observes and tests mechanical properties. He constantly consults with the course leader about the method of research and the results/observations obtained.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x			x		x			

Assessment criteria	The final grade is based on the assessment of the completed individual task and the final written work (essay).

Comments	

Course content (topic list)

1. Research on the structure of the material.
2. Microstructural observations.
3. Optical microscopy.
4. Laser microscopy.
5. Electron microscopy.
6. Microstructural analysis.
7. Assessment of the properties of engineering materials.
8. Mechanical properties.
9. The influence of microstructure changes on the mechanical properties of the material.

Compulsory reading

7. W. D. Callister, JR. D. G. Rethwisch (2018) Materials Science and Engineering – An Introduction, Wiley, New York, Weinheim.
8. D. Brandon, W.D. Kaplan (2008) Microstructural Characterization of Materials, John Wiley & Sons, Ltd., West Sussex.
9. M.A. Meyers, K.K. Chawla (2009), Mechanical Behavior of Materials, Cambridge University Press, UK

Recommended reading

7. C.R. Brundle, C.A. Evans, S. Wilson, (1992) Encyclopedia of Materials Characterization – Surfaces, Interfaces, Thin Films, Butterworth-Heinemann, Stoneham, MA
8. M.A. White (2019), Physical Properties of Materials, CRC Press, Taylor & Francis Group
9. J. Pelleg (2013), Mechanical Properties of Materials, Solid Mechanics And Its Applications G.M.L. Gladwell, Springer

Course card

Course title	Renewable energy sources

Semester (winter/summer)	summer	ECTS	6

Lecturer(s)	Marcin Jasiński	

Department	Institute of technical sciences	

Course objectives (learning outcomes)

This course provides an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application. The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as fuel cells, thermoelectrics, solar, biomass (conversions), wind power, geothermal, and hydro.

Prerequisites

Knowledge	Basic knowledge of Physics and Chemistry
Skills	Understanding basic knowledge gained in previous education
Courses completed	Physics and Chemistry

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours				15			

Teaching methods:

This course is intended to introduce students to the whole area of energy sustainability and renewable energy technologies. The student will explore this area by systematically reviewing main renewable energy technologies. Student will develop your own ability to apply this knowledge practically in the laboratory.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x			x				x	

Assessment criteria	Written exam based on lectures and recommended handbooks

Comments	

Course content (topic list)

1. Fuel cells
2. Thermogenarators
3. Solar energy
4. Hydropower
5. Wind energy
6. Heat pumps

Compulsory reading

Schaeffer, John. 2007. Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living (30th anniversary edition). Gaiam.
Vielstich, Wolf. 2003. Handbook of Fuel Cells: Fundamentals, Technology, Applications, 4 Volume Set (ISBN: 978-0-471-49926-8)

Recommended reading
Boyle, Godfrey. 2004. Renewable Energy (2nd edition). Oxford University Press, 450 pages (ISBN: 0-19-926178-4).

Course card

Course title	Design and Manufacturing of the Materials

Semester (winter/summer)	summer	ECTS	6

Lecturer(s)	dr inż. I.Sulima, dr inż. P.Hyjek	

Department	Institute of Technology	

Course objectives (learning outcomes)

The aim of the course is to familiarize the student with the basic methods of producing utility materials, especially construction materials. The student participates in their production. He gets to know their advantages and disadvantages. Selects products and types of materials, designs individual alloys, and determines the correctness of the manufacturing method used. Selects types of powders, thickening methods, sintering methods and finishing processes for sintered materials. Acquaintance with knowledge about further processing and potential use of materials produced by casting and sintering.

Prerequisites

Knowledge	Basic knowledge about individual materials
Skills	The student is able to obtain bibliographic information, databases and external sources. He has the ability to self-study in order to improve and improve his professional competence
Courses completed	None

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

The student performs the subsequent steps necessary to produce the material, including cast and sintered material. During this task, the student will take into account the type of starting substrates/powders and the method of casting/ compaction of the molded part and the sintering process. Knows the basic casting/sintering methods and the influence of the temperature and pressure used during the manufacturing process. It produces castings and sintered materials. He can assess their quality.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student`s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x					x			

Assessment criteria	The final evaluation is based on the assessment of the individual task and the final written work (essay).

Comments	

Course content (topic list)

23. Classic methods of producing engineering materials.
24. Innovations in the production of utility and technologically advanced materials.
25. Design of alloys and composites.
26. Foundry technologies.
27. Powder Metallurgy.
28. Techniques for the production of input materials.
29. Procedures and proceedings during material production.
30. Powder compaction and sintering.
31. Secondary operations.
32. Assessment of the quality of the produced material.
33. Materials and selected applications.

Compulsory reading

9. Mikell P. Groover, Fundamentals of modern maufacturing, Materials,Processes,and Systems, JOHN WILEY & SONS, 2010
10. Materials and Manufacturing Processes, K. Kumar , H. Kalita , D. Zindani , J. P. Davim, Springer Nature Switzerland AG 2019
11. Powder Metallurgy (university textbook). Kateřina Skotnicová, Miroslav Kursa, Ivo Szurman. Technical University of Ostrava
12. Powder Metallurgy Technology, G. S. Upadhyaya, Cambridge International Science Publishing

Recommended reading

7. Materials and Manufacturing, Mark A. Atwater, 2019 McGraw-Hill Education
8. https://www.asminternational.org/documents/10192/1849770/Z05438L_Sample.pdf/4fee7b45-917b-4911-bc5d-bd8dac26e153
9. Manufacturing Processes By H.N. Gupta.pdf, https://soaneemrana.org/onewebmedia/Manufacturing%20Processes%20By%20H.N.%20Gupta.pdf

Course card

Course title	Microstructure and Mechanical Properties of Materials

Semester (winter/summer)	summer	ECTS	6

Lecturer(s)	dr hab. inż. I. Sulima prof. UKEN, dr inż. P. Hyjek	

Department	Institute of Technology (INT)	

Course objectives (learning outcomes)

The aim of the course is to familiarize the student with methods of examining the microstructure of engineering materials, including new research methods used to observe it using optical microscopy, laser microscopy and electron microscopy. The student observes the change in the microstructure of selected engineering materials after various thermal treatments, under the influence of deformation and observes microstructure defects. The student determines the impact of this change on the mechanical properties of engineering materials.

Prerequisites

Knowledge	Basic knowledge about individual materials
Skills	The student is able to obtain bibliographic information, databases and external sources. He has the ability to self-study in order to improve and improve his professional competence
Courses completed	None

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

The exercises are in the form of laboratory exercises and consultations. The student becomes familiar with the microstructure and principles of operation of selected observation and research devices. He then independently observes and tests mechanical properties. He constantly consults with the course leader about the method of research and the results/observations obtained.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student's presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x			x		x			

Assessment criteria	The final grade is based on the assessment of the completed individual task and the final written work (essay).

Comments	

Course content (topic list)

1. Research on the structure of the material.
2. Microstructural observations.
3. Optical microscopy.
4. Laser microscopy.
5. Electron microscopy.
6. Microstructural analysis.
7. Assessment of the properties of engineering materials.
8. Mechanical properties.
9. The influence of microstructure changes on the mechanical properties of the material.

Compulsory reading

10. W. D. Callister, JR. D. G. Rethwisch (2018) Materials Science and Engineering – An Introduction, Wiley, New York, Weinheim.
11. D. Brandon, W.D. Kaplan (2008) Microstructural Characterization of Materials, John Wiley & Sons, Ltd., West Sussex.
12. M.A. Meyers, K.K. Chawla (2009), Mechanical Behavior of Materials, Cambridge University Press, UK

Recommended reading

10. C.R. Brundle, C.A. Evans, S. Wilson, (1992) Encyclopedia of Materials Characterization – Surfaces, Interfaces, Thin Films, Butterworth-Heinemann, Stoneham, MA
11. M.A. White (2019), Physical Properties of Materials, CRC Press, Taylor & Francis Group
12. J. Pelleg (2013), Mechanical Properties of Materials, Solid Mechanics And Its Applications G.M.L. Gladwell, Springer

Course card

Course title	Molecular Physics. Laboratory Applications, Measurements, and Technology		
Semester (winter/summer)	summer	ECTS	6
Lecturer(s)	Krzysztof Ziewiec		
Department	Institute of technology		

Course objectives (learning outcomes)

Understanding the molecular physics, applications, measurements and technology. Gaining practical knowledge about measurements and processing.

Prerequisites

Knowledge	Basic knowledge of Physics and Chemistry
Skills	Understanding basic knowledge gained in previous education
Courses completed	Physics and Chemistry

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

Lectures and laboratory tasks include: Molecular Physics, Physics of heating and remelting of metal charge, methods of heating. Physical phenomena used for contact, non-contact temperature measurements and thermography. Phase transformations, the influence of crystallization processes on the microstructure of castings. Manufacturing and processing of metals. Manufacture of castings, melt spinning of metallic glasses, metal rolling, welding techniques. Welding and joining methods.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x					x		x	

Assessment criteria	Written exam based on lectures and recommended handbooks

Comments	

Course content (topic list)

Physics of heating and remelting of metal charge, methods of heating. Physical phenomena used for contact, non-contact temperature measurements and thermography. Phase transformations, the influence of crystallization processes on the microstructure of castings. Manufacturing and processing of metals. Manufacture of castings, melt spinning of metallic glasses, metal rolling, welding techniques. Welding and joining methods.

Compulsory reading

Materials Science and Technology, Pacific Northwest National Laboratory 1994

Donald R. Askeland, The Science and Engineering of Materials, ISBN: 978-0-412-53910-7 (Print) 978-1-4899-2895-5 (Online)

Roger Timings, Fabrication and Welding Engineering, 2008 Roger Timings, Published by Elsevier Ltd. ISBN: 978-0-7506-6691-6

The Ultimate Infrared Handbook for R&D Professionals, FLIR, https://www.flir.eu/discover/rd-science/the-ultimate-infrared-handbook-for-rnd-professionals/

Recommended reading

John Snell, IR Scanning Handbook. Infrared Thermography,. Temperature Measurement, and Repair Priorities. PowerTest 2002. (NETA Annual Technical Conference).

Course card

Course title	"Production process management"

Semester (winter/summer)	summer	ECTS	6
Lecturer(s)	Dr inż. Piotr Migo		
Department	Institute of Technical Sciences		

Course objectives (learning outcomes)

The aim of the course on production process management is to prepare students to understand and effectively apply key concepts, tools, and strategies related to managing production processes. This includes the selection of parameters for production processes, along with the configuration and supervision of production lines.

Prerequisites

Knowledge	Eletronics , basic Automation and Regulatory.
Skills	
Courses completed	Electrical engineering, Electronics, Automation and machine drives, Fundamentals of Object-Oriented Programming

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours			15				

Teaching methods:

Lecture with demostration , labs, and Web Quest exercises

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
		X			X				X				

Assessment criteria	Assessment based on the evaluation of a practical project involving programming and implementation of a production line utilizing sorting mechanisms.

Comments	

Course content (topic list)

15. Introduction to Production Management:
    - Definition and goals of production management.
    - The role of production management in operational efficiency.
16. Basics of Automation in Production:
    - Concept of automation and its significance in production.
    - Types of automation systems.
17. Elements of Production Line Automation:
    - Components of production lines and their functions.
    - Integration of systems for coherence and efficiency.
18. Technologies for Controlling Production Processes:
    - Application of sensors, actuators, and other control technologies.
    - Process control in production.
19. Monitoring and Supervision Systems:
    - The role of monitoring systems in the production process.
    - Remote supervision of production lines.
20. Optimization of Production Processes:
    - Techniques for optimizing production processes.
    - Use of data analysis to identify areas for improvement.
21. Case Study: Designing an Automated Production Line:
    - Analysis of a case study related to designing and implementing an automated production line.
    - Challenges and benefits associated with implementing modern technologies.

Compulsory reading

Introduction to Operations and Supply Chain Management by
Cecil C. Bozarth, Robert B. Handfield
Automation, Production Systems, and Computer-Integrated Manufacturing by
Mikell P. Groover
PLC Programming using RSLogix 5000: Understanding Ladder Logic and the Studio 5000 Platform by
Nathan Clark

Recommended reading

Uniwersytet Komisji Edukacji Narodowej w Krakowie

Erasmus+

Course card

Course title	Renewable energy sources		
Semester (winter/summer)	summer	ECTS	6
Lecturer(s)	Marcin Jasiński		
Department	Institute of technical sciences		

Course objectives (learning outcomes)

This course provides an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application. The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as fuel cells, thermoelectrics, solar, biomass (conversions), wind power, geothermal, and hydro.

Prerequisites

Knowledge	Basic knowledge of Physics and Chemistry
Skills	Understanding basic knowledge gained in previous education
Courses completed	Physics and Chemistry

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours				15			

Teaching methods:

This course is intended to introduce students to the whole area of energy sustainability and renewable energy technologies. The student will explore this area by systematically reviewing main renewable energy technologies. Student will develop your own ability to apply this knowledge practically in the laboratory.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x			x				x	

Assessment criteria	Written exam based on lectures and recommended handbooks

Comments	

Course content (topic list)

7. Fuel cells
8. Thermogenarators
9. Solar energy
10. Hydropower
11. Wind energy
12. Heat pumps

Compulsory reading

Schaeffer, John. 2007. Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living (30th anniversary edition). Gaiam.
Vielstich, Wolf. 2003. Handbook of Fuel Cells: Fundamentals, Technology, Applications, 4 Volume Set (ISBN: 978-0-471-49926-8)

Recommended reading

Boyle, Godfrey. 2004. Renewable Energy (2nd edition). Oxford University Press, 450 pages (ISBN: 0-19-926178-4).

Course card

Course title	Renewables for Dummies

Semester (winter/summer)	winter	ECTS	6
Lecturer(s)	Marcin Jasiński		
Department	Institute of technology		

Course objectives (learning outcomes)

This course provides an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application. The class will explore society's present needs and future energy demands, examine conventional energy sources and systems, including fossil fuels and nuclear energy, and then focus on alternate, renewable energy sources such as fuel cells, thermoelectrics, solar, heat pumps, wind power, and hydro.

Prerequisites

Knowledge	Basic knowledge of Physics and Chemistry
Skills	Understanding basic knowledge gained in previous education
Courses completed	

Course organization							
Form of classes	W (Lecture)	Group type					
		A (large group)	K (small group)	L (Lab)	S (Seminar)	P (Project)	E (Exam)
Contact hours				30			

Teaching methods:

This course is intended to introduce students to the whole area of energy sustainability and renewable energy technologies. The student will explore this area by systematically reviewing main renewable energy technologies. Student will develop your own ability to apply this knowledge practically in the laboratory.

Assessment methods:

	E – learning	Didactic games	Classes in schools	Field classes	Laboratory tasks	Individual project	Group project	Discussion participation	Student' s presentation	Written assignment (essay)	Oral exam	Written exam	Other
					x			x				x	

Assessment criteria	Written exam based on lectures and recommended handbooks
Comments	

Course content (topic list)

13. Fuel cells
14. Thermogenarators
15. Solar energy
16. Hydropower
17. Wind energy
18. Heat pumps

Compulsory reading

Schaeffer, John. 2007. Real Goods Solar Living Sourcebook: The Complete Guide to Renewable Energy Technologies and Sustainable Living (30th anniversary edition). Gaiam.
Vielstich, Wolf. 2003. Handbook of Fuel Cells: Fundamentals, Technology, Applications, 4 Volume Set (ISBN: 978-0-471-49926-8)

Recommended reading
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