FACULTY OF MECHANICAL ENGINEERING

THE OFFER STUDIES FOR FOREIGN STUDENTS IN THE FRAMEWORK OF THE ERASMUS PROGRAMME:

MECHANICAL ENGINEERING

THE OFFER OF SUBJECTS FOR AREA OF STUDY: **MECHANICAL ENGINEERING**

(MINIMUM NUMBER OF HOURS AND ECTS)

	Offer of Subjects in English	**Numbers of hours**	**ECTS**
1.	Modelling and Simulation of Processes	45	5
2.	Selected Control Systems	60	5
3.	Methods of Organizaing Production Processes	30	3
4.	Plastic Working	60	5
5.	Computer Aided Design AutoCAD	30	2
6.	Modelling and Simulation of Technological Processes	60	3
7.	Technical Thermodynamics	60	4
8.	Fluid Mechanics I	30	4
9.	Selected Topics of Strenght Materials	45	5
10.	Strength of Materials II	45	5
11.	Industrial Mechanics	75	6
12.	Fundamentals of Machine Design	60	4
13.	Technological Project	30	2
14.	Computer Aided Manufacturing AlphaCAM, SprutCAM, CATIA	45	3
15.	Welding Technology	60	4
16.	Quality Engineering	30	2
17.	Automated Transport and Storage	45	4
18.	Technical Means of Automation for Manufacturing Processes	30	2
19.	Control Systems Diagnostics of Machines	30	2

MODELLING AND SIMULATION OF PROCESSES

Course code: 06.1-WM-MiBM-AiOPP-P-06_15
Type of course: optional
Language of instruction: English
Director of studies: dr inż. Joanna Cyganiuk
Name of lecturer: dr inż. Joanna Cyganiuk

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	15	1	VI	Exam	
Class					
Laboratory	30	2		Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture	9	1	VI	Exam	
Class					
Laboratory	18	2		Grade	
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to familiarize students with the methods of mathematical and physical modeling as well as with methods and techniques of processes simulation. To familiarize students with the options of the use of the methods in modeling and simulation of processes like: production, transport, manipulation and machines automation occurring in these processes.

ENTRY REQUIREMENTS:

Mathematics, Physics, Engineering Mechanics, Fundamentals of Machine Design, Automation and Robotics, The ability to use basic computer tools,

COURSE CONTENTS:

The content of the lecture:

Basic concepts connected with modelling and simulation of processes: model, system, simulation, process. Model construction. Types of models and algorithms of modelling processes. Issues connected with mathematical and physical modelling and simulation of processes: data types and their collection, define parameters and variables, define a problem. Methods of formalization of description of process and object. Apparatus of dimensional analysis - theorem π. Modelling with the use of dimensional functions. Queuing models. Network models. Petri network. Scheduling. Computer tools in modelling and simulation of processes. The use of practical examples of modeling and simulation methods.

The content of the laboratory:

Create virtual models, dimensional analysis and simulation of appliances used in automation of production and transport processes. The use of queueing models – queueing systems with or without queue. The use of network models in analysis of automated production systems including Petri network. The use of operation planning schedules including automation and manufacturing processes.

TEACHING METHODS:

Lecturers are given with the use of multimedia technics. Work with specialist literature – textbooks, professional journals.

Laboratories are given with the use of computer software – methods: problem tasks, solution analysis. Individual and group job during the realization of laboratory exercises.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W12 **K_W16**	The student knows computational methods, basic tools and techniques of informatics needed in solving engineering tasks which are essential in modeling and processes simulation.
K_W22	The student has knowledge of the simulation and analysis of mechanical systems, automation, transport and manipulation appliances and production processes.
K_U08	The student can plan and carry out computer simulations, to interpret the results and to draw conclusions.
K_U09 **K_U13**	The student uses modern simulation and analytical computational methods for modeling and simulation of processes like engineering problems.
K_U15	The student can make a critical analysis of the way of functioning of processes of modeling and simulation including used in processes appliances, operations, and planning methods.
K_K04	The student can identify aims and priorities used for tasks set by him and others.
K_K06	The student can demonstrate the ingenuity and skill in selection of appropriate modeling and simulation methods, depending on considered problem.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Rules for the verification of learning outcomes are presented in the table below.

In the field of technical sciences	Knowledge, skills, competence
K_W12 ***K_W16*** ***K_W22***	The Exam Grade. Exam - oral, descriptive, test and more.
K_U08 ***K_U09*** ***K_U13*** ***K_U15*** ***K_K04***	The laboratory Grade is determined from lab reports.
K_K06	

To get a credit the student has to pass all course forms.

The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload of 142(126) hours, including work in the auditorium, participate in consultations and exam 62(49) hours.

Individual student work (preparation for: classes, test, study of literature; preparation: written work, project, presentation, report, speech, etc.) 80(77) hours.

RECOMMENDED READING:

1. Barker R., Longman C., Modelowanie funkcji i procesów, WNT, Warszawa 1996,
2. Kacprzyk J., Modelowanie i optymalizacja: metody i zastosowania, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2002,
3. Iwanik A., Misiewicz J. K., Wykłady z procesów stochastycznych z zadaniami. Cz. 1, Procesy Markowa, Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, Zielona Góra 2009,
4. Kasprzak W. Lysik B., Analiza wymiarowa: algorytmiczne procedury obsługi eksperymentu, WNT, Warszawa 1988.
5. Krupa Krzysztof, Modelowanie symulacja i prognozowanie, WNT, Warszawa 2008,
6. Starke P. H., Sieci Petri: podstawy, zastosowania, teoria, PWN, Warszawa 1987,
7. Zdanowicz R., Modelowanie i symulacja procesów wytwarzania, Wydawnictwo Politechniki Śląskiej, Gliwice 2007,

OPTIONAL READING:

1. Abramov S. A., Marinicev M. I., Polakov P. D., Metody analizy sieciowej w planowaniu i zarządzaniu, Wydawnictwo MON, Warszawa 1967,
2. Korzeń Z., Logistyczne systemy transportu bliskiego i magazynowania Tom II Projektowanie, modelowanie, zarządzanie, ILiM, Poznań 1998,
3. Modelowanie inżynierskie – czasopismo,
4. Oniszczuk W.: Metody modelowania, Wyd. Politechnika Białostocka, Białystok 1995,
5. Gnedenko B.V. Kovalenko I. N., Wstęp do teorii obsługi masowej, PWN, Warszawa1971.

SELECTED CONTROL SYSTEMS

Course code: 06.1-WM-MiBM-AiOPP-D-01_15
Type of course: compulsory
Language of instruction: English
Director of studies: dr inż. Joanna Cyganiuk
Name of lecturer: dr inż. Joanna Cyganiuk

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	II	Exam	
Class					
Laboratory	30	2		Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture	18	1	II	Exam	
Class					
Laboratory	18	1		Grade	
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to familiarize students with types of control systems, with control signals, and with the methods of implementation of control systems with the use of pneumatics, hydraulics, electronics and PLC controllers as well as with design and structure of control systems designed for actuators used in machines and appliances.

ENTRY REQUIREMENTS:

Manufacturing Automation, The ability to use basic computer tools,

COURSE CONTENTS:

The content of the lecture:

Basic terms: operation, control, system, operation and disturbance quantities, system state. Linear and nonlinear systems, logic circuits, controllers. Electric control systems - electric drives. Pneumatic control systems. Electro-pneumatic control systems. Hydraulic control systems. Electro-hydraulic control systems. Pneumohydraulic control systems. Programmable logic controllers – structure, operation principle, application. Applications of control systems – practical examples. Design electric, pneumatic, hydraulic, electro-pneumatic, electro-hydraulic, pneumohydraulic and electronic systems. Systems control – application of PLC controllers.

The content of the laboratory:

Construction of logic control systems, function minimization – simulation of logic systems work. Construction and work simulation of virtual pneumatic and electro-pneumatic systems for given work conditions, testing their operation. Construction and work simulation of virtual hydraulic and electro-hydraulic systems for given work conditions. Construction and realization of real systems - work testing. Programming PLC controllers.

TEACHING METHODS:

Lecturers are given with the use of multimedia technics. Work with specialist literature – textbooks, professional journals.

Laboratories are given with the use of computer software and laboratory stations– methods: problem tasks, solution analysis. Individual and group job during the realization of laboratory exercises.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W04	The student has structured and theoretically founded knowledge of the types and building control systems, including drive systems.
K_W07	The student knows the basic techniques, appliances and methods used in building control systems.
K_U08 K_U09	The student is able to plan, build, modernize, and perform a computer simulation of control systems. Can design control systems for given work parameters.
K_U13	The student has the necessary preparation to work in an industrial environment, and knows the safety rules associated with this work
K_U15 K_U16	The students can make a critical analysis of the way the self-designed control systems, know how and what equipment, appliances and components selected. He can suggest improvements and enhancements for the analyzed solutions.
K_K03	The student can interact and work in a group as well as independently, he can work as a leader or as a member of a larger group.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Rules for the verification of learning outcomes are presented in the table below.

In the field of technical sciences	Knowledge, skills, competence
K_W04	The Exam Grade.
K_W07	Exam - oral, descriptive, test and more.
K_U08 K_U09	The laboratory Grade is determined from lab reports.
K_U13	
K_U15 K_U16	
K_K03	
K_K04	

To get a credit the student has to pass all course forms.

STUDENT WORKLOAD:

The student workload of 125(128) hours, including work in the auditorium, participate in consultations and exam 75(72) hours.

Individual student work (preparation for: classes, test, study of literature; preparation: written work, project, presentation, report, speech, etc.) 50(56) hours.

RECOMMENDED READING:

1. Dębowski A., Automatyka - podstawy, WNT, Warszawa 2008r
2. Garbaciak A. Szewczyk K., Napęd i sterowanie hydrauliczne – podstawy projektowania układów, Politechnika Krakowska, Kraków 1988,
3. Olszewski M., Urządzenia i systemy mechatroniczne, REA, Warszawa 2009,
4. Pizon A., Hydrauliczne i elektrohydrauliczne układy sterowania i regulacji, WNT, Warszawa 1987r,
5. Szenajch W., Napęd i sterowanie pneumatyczne, WNT, Warszawa 2003,
6. Sidorowicz J., Napęd elektryczny i jego sterowanie, Wydawnictwo Politechniki Warszawskiej, Warszawa 1997,

OPTIONAL READING:

1. Automatyka – czasopismo,
2. Jabłoński W., Automatyka i sterowanie, Wydawnictwo Uczelniane ATR w Bydgoszczy, Bydgoszcz 1998r,
3. Garbacik A., Studium projektowania układów hydraulicznych, Ossolineum Wrocław 1997,
4. Napęd i sterowanie – czasopismo,

Węsierski Ł., Podstawy

METHODS OF ORGANIZAING PRODUCTION PROCESSES

Course code: 06.1-WM-MiBM-AiOPP-D-07_15
Type of course: compulsory
Language of instruction: Englishi
Director of studies: dr inż. Joanna Cyganiuk
Name of lecturer: dr inż. Joanna Cyganiuk

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Lecture	15	1	III	Exam	
Class	15	1			
Laboratory				Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture	9	1	III	Exam	
Class	9	1		Grade	
Laboratory					
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to familiarize students with production systems, parameters and indicators of production processes, with their control, management and productivity.

ENTRY REQUIREMENTS:

Elective Economic Subject

COURSE CONTENTS:

The content of the lecture:

Basic notions, manufacturing systems and processes, Parameters of production processes. Types, forms and variants of the organization of production. Duty of production, possibilities and production reserves. Production control and planning. Rules of the control of production flow. Methods of intercellular and intracellular production flow control. Modern methods of production control. Production management. Methods and techniques of organization and

management. Styles of management. Information in management. Rating of productivity - notions and indicators. Factors improving productivity.

The content of the classes:

Ordering vertexes in operation networks. Calculations in the network activities. PERT networks - calculations. Production costs. Determining the size of the production batch. The parameters of work and work means: machine and worker. Parameters of workstation: output parameters– simple and complex. Output parameters: production cycle: serial, serial-parallel and parallel run of details creating. Production stock in progress – determination. Determining types of production. Calculations of parameters of details and details in operation. Scheduling work in a company. Preparation of parameters for production scheduling - calculations. Develop work schedules for machines and workers. Linear programming.

TEACHING METHODS:

Lecturers are given with the use of multimedia technics. Work with specialist literature – textbooks, professional journals.

Classes are given with the use of computer software and in the written way. Individual and group job during the realization of classes exercises.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W08	The student has knowledge necessary to understand determinants of organizational and non-technical engineering activities related to the production processes and the knowledge of how to consider determinants in engineering practice.
K_W09	The student has a basic knowledge of the methods of organizing production processes, determining production and economic indicators related to running a production.
K_U09	The student can use analytical and computer methods to formulate and solve problems of organization of production processes.
K_U08 K_U16	The student can identify and choose appropriate indicators describe the production process in the range of production organization, he can interpret the results and draw conclusions. He can also suggest improvements and enhancements to existing organizational solutions in the manufacturing plant.
K_U10	The student can integrate knowledge of the field of science relevant to Mechanical Engineering, and taking into account non-technical aspects.
K_U14	The student can identify factors affecting the economic aspect of making decision- in a manufacturing company.
K_K03	The student can interact and work in a group as well as independently, he can work as a leader or as a member of a larger group.
K_K04	The student can properly determine priorities for implementation of tasks specified by themselves or others.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Rules for the verification of learning outcomes are presented in the table below.

In the field of technical sciences	Knowledge, skills, competence
K_W08	The Exam Grade. Exam - oral, descriptive, test and more.
K_W09	
K_U09	The classes Grade is determined from written test.
K_U08 K_U16	
K_U10	
K_U14	
K_K03	
K_K04	

To get a credit the student has to pass all course forms.

THE FINAL GRADE RECEIVED BY THE STUDENT IS THE ARITHMETIC MEAN OF THE ABOVE GRADES.

WORKLOAD:

The student workload of 60(60) hours, including work in the auditorium, participate in consultations and exam 35(30) hours.

Individual student work (preparation for: classes, test, study of literature; preparation: written work, project, presentation, report, speech, etc.) 25(30) hours.

RECOMMENDED READING:

1. Brzeziński M., Organizacja i sterowanie produkcją: projektowanie systemów produkcyjnych i procesów sterowania produkcją, Agencja Wydawnicza Placet, Warszaw 2002,
2. Rogowski A., Podstawy organizacji i zarządzania produkcją w przedsiębiorstwie, CEDEWU, Warszawa 2010,
3. Pająk E., Zarządzanie produkcją –produkt, technologia, organizacja, WNT, Warszawa 2007,
4. Pasternak K., Zarys zarządzania produkcją, PWE, Warszawa 2005,

OPTIONAL READING:

1. Durlik I., Inżynieria zarządzania, cz. II – Strategia i projektowanie systemów produkcyjnych, Placet, Warszawa 2005,
2. Karpiński T., Inżynieria produkcji, WNT, Warszawa 2004,
3. Zarządzanie Przedsiębiorstwem – czasopismo.

PLASTIC WORKING

Course code: 06.1-WM-MiBM-TM-P-03_15
Type of course: compulsory
Language of instruction: English
Director of studies: dr inż. Joanna Cyganiuk
Name of lecturer: dr inż. Joanna Cyganiuk, dr inż. Paweł Schlafka

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	VI	Exam	
Class					
Laboratory	30	2		Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture	18	2	VI	Exam	
Class					
Laboratory	18	2		Grade	
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to familiarize students with mechanisms of plastic deformation, with types of metal forming, with features of materials, semi-finished products and products made with the use of metal forming methods, with machines and appliances used for shaping products as well as with practical examples of using of metal forming.

ENTRY REQUIREMENTS:

Materials Science, Production Engineering-Waste-free Machining, Fundamentals of Machine Design

COURSE CONTENTS:

The content of the lecture:

Fundamentals of plastic flowing of isotropic bodies. Mechanism of plastic deformation. Phenomena accompanying plastic deformations. Factors affected on the value of yield stress. Separation of deforming material. Cold working. Hot working. Semi-hot working. Rolling: shaping metal sheets and flat materials. Methods of sheet metal forming: cutting, blending, shaping products with non-developable shape. Processes of drawing down solids: broaching, upsetting, hobbing, shaping in dies, burnishing and die forging. Examples of correct and incorrect structure of elements shaped with metal forming methods. Mechanical properties of deformed materials. Calculations: forces, stresses, deformations, etc., Machines and appliances used in metal forming.

The content of the laboratory:

Mechanical presses construction. Mechanism of changing stroke of eccentric presses. Setting and fastening of tools on presses and hammers. Deformation of metals and alloys – changing of crystallographic structure and mechanical features of deformed materials. Cutting in machines on presses – determining basic technological cutting parameters. Assessment of metal sheets usability for pressing process. Bending processes - determining of springing angle. Rolling – rolling reduction. Upsetting – determining of limiting deformation factor during upsetting, influence of heat treatment on upsetting. Structure of forging hammers – determining of impact energy of drop forging hammer. Open die forging – determining of temperature range of hot working. Direct extrusion of sleeves in cold working.

TEACHING METHODS:

Lecturers are given with the use of multimedia technics. Work with specialist literature – textbooks, professional journals.

Laboratories are given with the use of didactic stations and technological machines, methods: problem tasks, solution analysis. Individual and group job during the realization of laboratory exercises.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W09	The student has knowledge of the proper design of finished product, shaped with metal forming methods.
K_W10 K_W13	The student has detailed knowledge in metal forming including types, shaping methods and appliances.
K_U09	The student can use analytical methods for formulate and solve engineering tasks.
K_U15	The student can make critical evaluate of the selection methods of metal forming and of shaped objects structure.
K_U16	The student is able to identify and formulate specification of simple practical engineering tasks in correctly design of elements shaped with metal forming methods and in selection of metal forming technology.
K_U17	The student can assess of usefulness of metal forming methods, tools and appliances for making products with determined shapes, and chose correct methods, tools and appliances.
K_K04	The student is able to appropriately prioritize tasks and targets.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Rules for the verification of learning outcomes are presented in the table below.

In the field of technical sciences	Knowledge, skills, competence
K_W09	The Exam Grade. Exam - oral, descriptive, test and more.
K_W10 K_W13	
K_U09	The laboratory Grade is determined from lab reports.
K_U15	
K_U16	
K_U17	
K_K04	

To get a credit the student has to pass all course forms.

The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload of 138(140) hours, including work in the auditorium, participate in consultations and exam 88(68) hours.

Individual student work (preparation for: classes, test, study of literature; preparation: written work, project, presentation, report, speech, etc.) 50(72) hours.

RECOMMENDED READING:

1. Erbel S., Kuczyński K., Marciniak Z., Obróbka plastyczna, PWN, Warszawa 1986,
2. Erbel S., Kuczyński K., Olejnik L., Technologia obróbki plastycznej Laboratorium, Oficyna Wydawnicza P.W., Warszawa 2003,
3. Gorecki W., Inżynieria wytwarzania i przetwórstwa płaskich wyrobów metalowych, Wydawnictwo Politechniki Śląskiej, Gliwice 2006,
4. Kajzer S., Kozik R., Wusatowski R., Wybrane zagadnienia z procesów obróbki plastycznej metali - Projektowanie technologii, Wydawnictwo Politechniki Śląskiej, Gliwice 19977,
5. Marciniak H., Projektowanie procesów technologicznych - Obróbka plastyczna metali, Wydawnictwo Politechniki Wrocławskiej, Wrocław 1983,
6. Sińczak J., procesy przeróbki plastycznej. Podstawy teoretyczne i wykonawstwo ćwiczeń, Wyd. naukowo-techniczne, Kraków 20017,
7. Wasiunyk K.: Kucie Matrycowe. WNT Warszawa 1988,
8. Weroński W., Obróbka plastyczna – Technologia, Wydawnictwo Politechniki Lubelskiej, Lublin 1991,
9. Ziółkiewicz B., Nonckiewicz B., Ciupik L., Mstowski J.; Laboratorium z podstaw obróbki plastycznej. Skrypt WSI-Zielona Góra 1978,

OPTIONAL READING:

1. Ciupik L., Hejmej S., Mstowski J., Techniki Wytwarzania-Obróbka Plastyczna Laboratorium. Materiały pomocnicze WSI-Zielona Góra 1987,
2. Frączyk A., Mazur. P., Technologia metali i tworzyw sztucznych, Wydawnictwo Uniwersytetu Warmińsko-Mazurskiego, Olsztyn 2000,Mechanik – czasopismo,Nonckiewicz-Steliga B., Mstowski J., Steliga M.; Teoria obróbki plastycznej Laboratorium. Materiały pomocnicze WSI-Zielona Góra 1987,
5. Obróbka plastyczna metali – czasopismo,

COMPUTER AIDED DESIGN AUTOCAD

Course code: 06.1-WM-MiBM-TM-P-10_15

Type of course: ocompulsory

Language of instruction: English

Director of studies: dr inż. Joanna Cyganiuk

Name of lecturer: dr inż. Joanna Cyganiuk
dr inż. Paweł Schlafka

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Lecture			VI		
Class					
Laboratory	30	2			
Seminar					
Workshop					
Project					
Part-time studies					
Lecture			VI		
Class					
Laboratory	18	2			
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to familiarize students with creating of three-dimensional models and prototypes of technological tools and appliances, with calculation of prototypes, with the analysis of their producibility (in terms of work), with possibilities of design of virtual model and with giving them right features as well as with possibilities of automatic technical documentation generation.

ENTRY REQUIREMENTS:

Engineering Mechanics, Mechanics of materials, Fundamentals of Machine Design, Construction Notation, Production Engineering, Computer Aided Design.

COURSE CONTENTS:

The content of the laboratory:

Introduction to computer aided design. Tools and functions of modules. Conception project. Work with digital model. Creating three-dimensional models of objects (virtual equivalents). Three-dimensional structure of tools prototypes. Three-dimensional structure of appliances prototypes. Work with model (material, features, calculations). Automatic generation of simple three-dimensional models. Visual reflection of the virtual prototype (rendering). Generation of technical documentation. Prototype analysis. Model producibility - structural changes. Three-dimensional structure of tools prototypes. Three-dimensional structure of appliances prototypes.

TEACHING METHODS:

Laboratories are given with the use of computer software – methods: problem tasks, solution analysis. Individual and group job during the realization of laboratory exercises.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W09 K_W11	The student has knowledge in the area of design and computer aided design of virtual prototypes of parts of appliances and machines with taking into consideration their manufacturing technology.
K_U13	The student is able to use modern computer techniques in solving engineering tasks in the field of machine design.
K_U15	The student can make a critical analysis of virtual prototypes of technological appliances and tools.
K_U16	The student is able to identify and make specification of simple practical engineering tasks in the field of three-dimensional virtual design and prototyping of technological machines and appliances.
K_U18	The student can create design of a virtual prototype of a simple appliance, typical for process of technological design with the use of appropriate computer software.
K_K04	The student is able to correctly identify priorities for implementation of actions determined by others or by him.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Rules for the verification of learning outcomes are presented in the table below.

In the field of technical sciences	Knowledge, skills, competence
K_W09 K_W11	The laboratory Grade is determined from lab reports.
K_U13 K_U15 K_U16 K_U18	
K_K04	

To get a credit the student has to pass the laboratory.

STUDENT WORKLOAD:

The student workload of 60(60) hours, including work in the auditorium, participate in consultations and exam 30(28) hours.

Individual student work (preparation for: classes, test, study of literature; preparation: written work, project, presentation, report, speech, etc.) 30(32) hours.

RECOMMENDED READING:

10. Malinowski M., Babirecki W., Belica T., Materiały pomocnicze z podstaw systemu CAD AutoCAD 2000 GB/PL, Uniwersytet Zielonogórski, Zielona Góra 2002 (preskrypt),
11. Matthews B., Autocad 2000 3d f/x, Helion, Gliwice 2001,
12. Pikoń A., AutoCad 2007, Helion, Gliwice 2007,
13. Bobkowski G., Biały W., AutoCAD 2004 i AutoCAD Mechanical 2004 w zagadnieniach technicznych, WTN, Warszawa 2004,

OPTIONAL READING:

6. Babiuch M., AutoCAD 2000PL, Ćwiczenia praktyczne, Helion, 2000,
7. Chlebus E., Techniki komputerowe CAx w inżynierii produkcji, WNT, Warszawa 2000,
8. CAD/CAM/CAE – czasopismo,

MODELLING AND SIMULATION OF TECHNOLOGICAL PROCESSES

Course code: .1-WM-MiBM-TM-P-13_15
Type of course: compulsory
Language of instruction: English
Director of studies: dr inż. Joanna Cyganiuk
Name of lecturer: dr inż. Joanna Cyganiuk

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Lecture	30	2	VI	Grade	
Class					
Laboratory	30	2		Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture	18	2	VI	Grade	
Class					
Laboratory	18	2		Grade	
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to familiarize students with the methods of mathematical and physical modeling as well as with methods and techniques of processes simulation. To familiarize students with the options of the use of the modelling and simulation techniques for technological processes.

ENTRY REQUIREMENTS:

Mathematics, Physics, Engineering Mechanics, Fundamentals of Machine Design, Construction Notation, Operation of Machines

COURSE CONTENTS:

The content of the lecture:

Basic concepts connected with modelling and simulation of processes: model, system, simulation, process. Model construction. Types of models and algorithms of modelling processes. Issues connected with mathematical and physical modelling and simulation of processes: data types and their collection, define parameters and variables, define a problem. Issues: apparatus of dimensional analysis, modelling with the use of dimensional functions. Methods of formalization of description of process and object. Queuing models. Network models. Petri network. Scheduling. Modelling of tools and appliances with the use of FEM. Practical examples of using discussed modelling methods for technological processes like: shaping products and organization processes involving with manufacturing preparation and production. Computer tools in modelling and simulation of processes.

The content of the laboratory:

Create virtual models, dimensional analysis and simulation of appliances used in metal working. The use of queueing models – queueing systems with or without queue. The use of FEM in modelling of tools and elements used in shaping. The use of network models in analysis of work centers including Petri network. Scheduling - planning of working and shaping appliances for chosen products.

TEACHING METHODS:

Lecturers are given with the use of multimedia technics. Work with specialist literature – textbooks, professional journals.

Laboratories are given with the use of computer software – methods: problem tasks, solution analysis. Individual and group job during the realization of laboratory exercises. Presentation of solutions, discussion about obtained solutions and possibilities of its modernizations.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W12 **K_W16**	The student knows computational methods, basic tools and techniques of informatics needed in solving engineering tasks which are essential in modeling and technological processes simulation.
K_W22	The student has an elementary knowledge of the modelling and simulation as well as analysis of mechanical systems, appliances working and shaping material, processes manufacturing and technological designing.
K_U08	The student is able to plan and carry out computer simulations, to interpret the results and to draw conclusions.
K_U09 **K_U13**	The student uses modern simulation and analytical computational methods for modeling and simulation of processes like engineering problems.
K_U15	The student can make a critical analysis of the way of functioning of processes of modeling and simulation including used in processes appliances, operations, and planning methods.
K_K04	The student is able to identify aims and priorities used for tasks set by him and others.
K_K06	The student is able to demonstrate the ingenuity and skill in selection of appropriate modeling and simulation methods, depending on considered problem.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

Rules for the verification of learning outcomes are presented in the table below.

In the field of technical sciences	Knowledge, skills, competence
K_W12 K_W16	The lecture grade is based on written tests.
K_W22	
K_U08	The laboratory Grade is determined from lab reports.
K_U09 K_U13	
K_U15	
K_K04	
K_K06	

To get a credit the student has to pass all course forms.

STUDENT WORKLOAD:

The student workload of 90(90) hours, including work in the auditorium, participate in consultations and exam 65(56) hours.

Individual student work (preparation for: classes, test, study of literature; preparation: written work, project, presentation, report, speech, etc.) 25(34) hours.

RECOMMENDED READING:

1. Barker R., Longman C., Modelowanie funkcji i procesów, WNT, Warszawa 1996,
2. Kacprzyk J., Modelowanie i optymalizacja: metody i zastosowania, Akademicka Oficyna Wydawnicza EXIT, Warszawa 2002,
3. Kasprzak W. Lysik B., Analiza wymiarowa: algorytmiczne procedury obsługi eksperymentu, WNT, Warszawa 1988.
4. Krupa Krzysztof, Modelowanie symulacja i prognozowanie, WNT, Warszawa 2008,
5. Milenin A., Podstawy metody elementów skończonych, Wydawnictwo AGH, Kraków 2010,
6. Starke P. H., Sieci Petri: podstawy, zastosowania, teoria, PWN, Warszawa 1987,
7. Zdanowicz R., Modelowanie i symulacja procesów wytwarzania, Wydawnictwo Politechniki Śląskiej, Gliwice 2007,

OPTIONAL READING:

1. Abramov S. A., Marinicev M. I., Polakov P. D., Metody analizy sieciowej w planowaniu i zarządzaniu, Wydawnictwo MON, Warszawa 1967,
2. Gnedenko B.V. Kovalenko I. N., Wstęp do teorii obsługi masowej, PWN, Warszawa1971,
3. Modelowanie inżynierskie – czasopismo,
4. Oniszczuk W.: Metody modelowania, Wyd. Politechnika Białostocka, Białystok 1995,
5. Zienkiewicz, O.C.; Taylor, R.L , Finite Element Method (5th Edition) Volume 1 - The Basis, Elsevier, Oxford 2000,
6. Zienkiewicz, O.C.; Taylor, R.L. Finite Element Method (5th Edition) Volume 2 - Solid Mechanics y; Elsevier, Oxford 2000,

TECHNICAL THERMODYNAMICS

Course code: 06.1-WM-MiBM-P-38_15

Type of course: compulsory

Language of instruction: Polish

Director of studies: Dr hab. inż. Anna Walicka, prof. UZ

Name of lecturer: Dr inż. Paweł Jurczak

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	30	2	IV	Exam	
Class	15	1		Grade	
Laboratory	15	1		Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture	18	2	V	Exam	
Class	9	1		Grade	
Laboratory	9	1		Grade	
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to familiarize students with the methodology of solving technical problems on the basis of the law of thermodynamics and knowledge and ability to solve problems of heating problems occurring in mechanical engineering.

ENTRY REQUIREMENTS:

Knowledge of mathematics and physics at level of education in high school

COURSE CONTENTS:

Basic notions of thermodynamics. Principle of mass conservation, principle of substance quantity conservation. The first law of thermodynamics. Equation of state for ideal and semi-ideal gases. Characteristic changes of ideal and semi-ideal gases. The second law of thermodynamics. Steams and their transformation. Moist gases. Real gases. Gas mixtures. Combustion. Heat transfer. General information about engines and thermal devices. Reciprocating compressors and centrifugal. Reciprocating internal combustion engines. Thermodynamic cycles. Steam engines. Steam and gas turbines. Jet engines. Refrigerators and heat pumps. Non-conventional sources of energy, energy conversion. Devices for processing direct heat into electricity. The phase transformations. Basics chemical thermodynamics modeling of nonequilibrium and non-stationary processes. Elements of the theory of heat transfer.

CLASS

Solving classes based on lectures and source materials

LABORATORY

Laboratory topics:

- Thermometers, scales thermometric. Temperature measurement - scaling thermocouple.
- Measurements of pressure.
- Measurements of viscosity of selected substances. Study of the effect of temperature on the rheological properties of the liquid.
- Measurement of humidity.
- Determination of the heat of combustion of solid fuels. Determination of calorific value of liquid fuels.
- Examination of the composition of the gas - definition of excess air ratio.
- Study the efficiency of reciprocating compressor - indicator diagram,
- Correction exercises, tests.

TEACHING METHODS:

Lectures with audiovisual aids. Solving classes. Working with the book. Group work in laboratory classes.

LEARNING OUTCOMES:

In the field of technical sciences	**Knowledge, skills, competence**
K_W02	has knowledge of thermodynamics, including the knowledge needed to understand and use the description of physical phenomena in the manufacturing design and operating of mechanical systems
K_W07	has an elementary knowledge of technical thermodynamics necessary to understand the construction and operating of mechanical equipment
K_U01	The student can obtain information from literature, databases and other sources, in English or another foreign language; able to integrate the information, make their interpretation, as well as draw conclusions and formulate and justify opinions
K_U14	can use the measuring equipment used in problems of mechanics and mechanical engineering as well as methods for estimating measurement errors
K_K03	can interact and work in a group, adopting different roles

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W02, K_W07	Written exam, written test, the defense laboratory reports.
K_U01	Discussion during the presentation developed laboratory reports.
K_U14	Examination of laboratory reports
K_K03	The division into teams and determine the different roles of team members, assign tasks to individuals, check and evaluate the results of the study, a discussion with the team about teamwork: the position, role, impact.

Lecture

positive evaluation of the test

Class

positive evaluation of the test

Laboratory

received positive ratings of reports carried out laboratory

Evaluation of the course is getting positive ratings from all forms: Lecture, Class, Laboratory

The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload is 100 hours, including work in the auditorium 64 (40) hours, individual work 36 (60) hours, preparing for classes and study reports 20 (20) hours, revising for tests 10 (25) hours. Work with the literature 6 (25)
Total hours of practical classes: 52 (42) which corresponds to 2 ECTS
Total hours of lessons with a teacher: 64 (40) which corresponds to 2 ECTS

RECOMMENDED READING:

1. Gumiński K.: Termodynamika, PWN, Warszawa, 1986,
2. Ochęduszko S., Szargut J., Górniak H., Guzik A., Wilk S.: Zbiór zadań z termodynamiki technicznej, PWN, Warszawa 1975
3. Staniszewski B.: Termodynamika, PWN, Warszawa 1986.
4. Szargut J. : Termodynamika, PWN, Warszawa 2000.
5. Tuliszka E. : Termodynamika techniczna, PWN, Warszawa 1978.

OPTIONAL READING:

1. Fodemski T. i inni : Pomiary cielne, cz. I, Podstawowe pomiary cieplne, WNT, Warszawa 2001.
2. Wiśniewski S.: Termodynamika techniczna, WNT, Warszawa 2004.
3. Mały poradnik mechanika. Tomy 1-2, WNT, Warszawa 2005.
4. Madejski J.: Termodynamika techniczna, Wyd. Politechniki Rzeszowskiej, Rzeszów 2000.
5. Ochęduszko T.: Termodynamika stosowana, WNT, Warszawa 1993.

REMARKS:

FLUID MECHANICS I

Course code: 06.1-WM-MiBM-P-16

Type of course: compulsory

Language of instruction: Polish

Director of studies: Dr hab. inż. Anna Walicka, prof. UZ

Name of lecturer: Prof. dr hab. inż. Edward Walicki;
Dr hab. inż. Anna Walicka, prof. UZ;
Dr inż. Paweł Jurczak,
Dr inż. Jarosław Falicki

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	30	2	IV	Exam	
Class	15	1		Grade	
Laboratory	15	1		Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture	18	2	IV	Exam	
Class	9	1		Grade	
Laboratory	9	1		Grade	
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to familiarize students with the methodology of solving technical problems on the basis of the law of fluid mechanics and knowledge and ability to solve simple problems of flow occurring in mechanical engineering.

Celem przedmiotu jest zapoznanie studentów z metodyką rozwiązywania problemów technicznych w oparciu o prawa mechaniki płynów oraz znajomość i umiejętność rozwiązywania prostych zagadnień przepływowych występujących w budowie maszyn.

ENTRY REQUIREMENTS:

Knowledge Mathematics I

COURSE CONTENTS:

Introduction. Division of fluids. Fundamental definitions for gases and liquids. Model of a fluid, fluid element definition. Physical properties of fluids. Fluid statics. Fluid pressure on a curved wall. Swimming and stability of floating bodies. Archimedes' principle. Stability of fully immersed body in a liquid. Stability of bodies floating on a free surface. Kinematics of fluids. Definition of fields, types of fields, operators of the field. Elements of tensor calculus. Differential equation of a fluid element thorium. Acceleration of a fluid element. Differential equation of a line current fluid element. Analytical methods for the study of fluid motion: method of Lagrange, Euler's method. Cauchy's and Helmholtz's theorem – deformation of the fluid element. Fluid dynamics. The principle of conservation of mass – continuity equation. The principle of conservation of momentum - momentum equation. The principle of conservation of moment of momentum – moment of momentum equation. The principle of conservation of energy – the energy equation. Constitutive equations. Closed system of equations describing the motion of viscous and heat conducting fluid. Navier and Stokes equation. General properties of inviscid fluid motion and non-conductive heat. Two general integrals of the Euler equation. Bernoulli's equation. Flat potential fluid motion. The function of current, velocity potential. Rotational motion of the fluid. Simplified forms of Navier and Stokes equation. Special integrals of Navier and Stokes equations. The theory of similarity of flow phenomena; criteria of similarity. Turbulent flows. The theory of a boundary layer. Fluid flow in closed channels. Bernoulli's equation for real flows. Coefficient of linear losses and coefficient of local losses. Fluid flow in open channels. Elements of the theory of rotating machinery. Elements of fluid dynamics. Elements of a perfect gas dynamics.

CLASS

Solving classes based on lectures and source materials

LABORATORY

Laboratory topics:

- The test a liquid outflow from the tank.
- Measurement of a coefficient of linear losses..
- Calibration of the Poncelet vessel.
- Study of the characteristics of a pump.
- Course of energy lines and pressure lines along the pipeline.
- The free surface of a liquid in a vessel rotating about a vertical axis..
- Determination of the critical Reynolds number,
- Correction exercises, tests.

TEACHING METHODS:

Lectures with audiovisual aids. Solving classes. Working with the book. Group work in laboratory classes

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W07	has knowledge of the stress analysis of basic mechanical structures
K_U01	has an elementary knowledge of the principles of workpiece design and mechanical equipment constructions
K_U14	The student can obtain information from literature, databases and other sources, in English or another foreign language; able to integrate the information, make their interpretation, as well as draw conclusions and formulate and justify opinions
K_K01	can use the measuring equipment used in problems of mechanics and mechanical engineering as well as methods for estimating measurement errors
K_K03	The student can understand the importance and the need of lifelong education and is able to organize the learning process of others

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W07	Written exam, written test, the defense laboratory reports.
K_U01	Discussion during the presentation developed laboratory reports.
K_U14	Examination of laboratory reports
K_K01	Discussion in the classroom
K_K03	The division into teams and determine the different roles of team members, assign tasks to individuals, check and evaluate the results of the study, a discussion with the team about teamwork: the position, role, impact.

Lecture

positive evaluation of the test

Class

positive evaluation of the test

Laboratory

received positive ratings of reports carried out laboratory

Evaluation of the course is getting positive ratings from all forms: Lecture, Class, Laboratory

The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload is 150 hours, including work in the auditorium 73 (51) hours, individual work 72 (99) hours, preparing for classes and study reports 39 (45) hours, revising for tests 25 (27) hours. Work with the literature 15 (18)
Total hours of practical classes: 82 (78) which corresponds to 3 ECTS
Total hours of lessons with a teacher: 73 (51) which corresponds to 3 ECTS

RECOMMENDED READING:

1. Walicki A., Walicki E., Ratajczak M., Mechanika Płynów. Wprowadzenie teoretyczne do laboratorium. 2002, Oficyna Wydawnicza Uniwersytetu Zielonogórskiego,
2. Walicki A., Walicki E., Ratajczak M., Mechanika Płynów. Materiały pomocnicze do ćwiczeń laboratoryjnych. 2003, Oficyna Wydawnicza Uniwersytetu Zielonogórskiego,
3. Bukowski J., Kijkowski P., Kurs mechaniki płynów, PWN, Warszawa 1980,
4. Gryboś R., Podstawy mechaniki płynów PWN, Warszawa 1989,
5. Prosnak W.J., Mechanika płynów, PWN, Warszawa 1970,
6. Kazimierski Z., Orzechowski Z., Mechanika płynów, Politechnika Łódzka, Łódź 1993.
7. Rumianowski A., Zbiór zadań z mechaniki płynów nieściśliwych z rozwiązaniami, PWN, Warszawa 1978,
8. Gołębiewski C., Łuczywek E., Walicki E., Zbiór zadań z mechaniki płynów, PWN, Warszawa 1980.

OPTIONAL READING:

REMARKS:

SELECTED TOPICS OF STRENGHT MATERIALS

Course code: 06.1-WM-MiBM-P-20_15

Type of course: optional

Language of instruction: Polish

Director of studies: Dr hab. inż. Anna Walicka, prof. UZ

Name of lecturer: Dr inż. Paweł Jurczak;
Dr inż. Dariusz Michalski.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	IV	Exam	
Class					
Laboratory	15	1		Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture	9	1	VII	Exam	
Class					
Laboratory	9	1		Grade	
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to familiarize the students problem-solving methodology and complex analysis of the strength found in mechanical engineering.

ENTRY REQUIREMENTS:

Strenght of Materials I, Mechanics I, Mathematics I

COURSE CONTENTS:

LECTURE

Extended scope of the news of item in addition to the strength of materials. Reminder issues related to the types of supports flat and spatial systems. Calculation of the reactions of supports from the equilibrium equations (flat and spatial systems). Use the principle of virtual works to calculate the support reactions and internal forces in rigid systems. Graphs of internal forces. The characteristics of geometric cross-sections. Determination of beam deflection. Shear stresses distributions in cross-sections of beams subjected to irregular bending. Torsion of thin-walled beams with open and closed profiles. Application of hypotheses of strength to the sizing of beams and beam systems. loads complex. The use of hypotheses of strength to determine the material effort. Determination of displacement of beams and beam systems applying the principle of works correlation. Tasks statically determinable. Solving of the systems statically indeterminable. Use the continuity equations to solve statically indeterminable beam systems. Considerations for disks and plates. Thin-walled and thick-walled shell. Membrane stresses in thin and axisymmetric shells. Application of variational theorems of elasticity to approximate solving beams, discs and plates. Limit load beam and girder. Calculation of critical loads. Analysis of selected complex structures.

LABORATORY

Laboratory topics:

- Measurement of Young's modulus by extensometric method,
- Measurement of Young's modulus by method of retaining extensometry
- Diagonal bending,
- Examination of the compression of rod buckling
- Examination of a circular ring strain
- Correction exercises, tests.

TEACHING METHODS:

Lectures with audiovisual aids. Solving classes. Working with the book. Group work in laboratory classes

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W06	has knowledge of the stress analysis of basic mechanical structures
K_W09	has an elementary knowledge of the principles of workpiece design and mechanical equipment constructions
K_W10	has detailed knowledge of selected tasks related to the field of mechanical engineering
K_U01	The student can obtain information from literature, databases and other sources, in English or another foreign language; able to integrate the information, make their interpretation, as well as draw conclusions and formulate and justify opinions
K_U14	can use the measuring equipment used in problems of mechanics and mechanical engineering as well as methods for estimating measurement errors
K_K03	can interact and work in a group, adopting different roles

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W06, K_W09 K_W10	Written exam, written test, the defense laboratory reports.
K_U01	Discussion during the presentation developed laboratory reports.
K_U14	Examination of laboratory reports
K_K03	The division into teams and determine the different roles of team members, assign tasks to individuals, check and evaluate the results of the study, a discussion with the team about teamwork: the position, role, impact.

Lecture

positive evaluation of the test

Laboratory

received positive ratings of reports carried out laboratory

Evaluation of the course is getting positive ratings from all forms: Lecture, Laboratory

The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload is 100 hours, including work in the auditorium 56 (38) hours, individual work 44 (62) hours, preparing for classes and study reports 35 (36) hours, revising for tests 15 (21) hours. Work with the literature 4 (15)
Total hours of practical classes: 44 (43) which corresponds to 2 ECTS
Total hours of lessons with a teacher: 56 (38) which corresponds to 2 ECTS

RECOMMENDED READING:

1. Niezgodziński M. E., Niezgodziński T., Wytrzymałość materiałów, 1979 PWN wyd. XI,
2. Rżysko J., Statyka i wytrzymałość materiałów , 1979 PWN,
3. Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, 1984 WNT,

OPTIONAL READING:

1. Gubrynowiczowa J., Wytrzymałość materiałów, 1968 PWN.
2. Banasiak M., Grossman K., Trombski M., Zbiór zadań z wytrzymałości materiałów, 1998, PWN.

REMARKS:

STRENGTH OF MATERIALS II

Course code: 06.1-WM-MiBM-P-19_15
Type of course: optional
Language of instruction: Polish
Director of studies: Dr hab. inż. Anna Walicka, prof. UZ
Name of lecturer: Dr inż. Paweł Jurczak
Dr inż. Dariusz Michalski.

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					5
Lecture	30	2	IV	Exam	
Class					
Laboratory	15	1		Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture	9	1	VII	Exam	
Class					
Laboratory	9	1		Grade	
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to introduce students to problem-solving methodology and analysis of the strength found in mechanical engineering

ENTRY REQUIREMENTS:

Strength of Materials I, Technical Mechanics I, Mathematics.

COURSE CONTENTS:

LECTURE

Determination of beam bending deformations. Analytical method for determining of a bending line of beams. The Clebsch method. The method of secondary loads. Stability of the compressed rods. Elastic buckling of straight bars. Euler's formula. Tetmajer and Johnson- Ostenfeld formulas. Slender rods compression and bending. Beams on elastic fundation. Strongly curved rods bending. Issues a static indeterminable bending. Single and multi-span beams. The equation of three moments. Statically indeterminable frame. Energy methods. Clapeyron system. Elastic energy in the tension, torsion or bending of the rods. Calculation of deformations using the Castigliano theorem. Menabrea's theorem. Calculation of statically indeterminable beams and frames using the Menabrea's theorem. Bending of plates. Cylindrical bending of plates. Two mutually perpendicular pure bending of plates. Differential equation of a circularly symmetric plate. Bending of rectangular plates. Spherical, cylindrical and conical tank. The stresses in thick-walled tanks. The Lamé task.

LABORATORY

Laboratory topics:

- Measurement of the Young modulus by extensometric method,
- Measurement of the Young modulus by method of retaining extensometry
- Diagonal bending,
- Examination of the compressed rod buckling
- Examination of a circular ring strain
- Correction exercises, tests.

TEACHING METHODS:

Lectures with audiovisual aids. Solving classes. Working with the book. Group work in laboratory classes

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W06	has knowledge of the stress analysis of basic mechanical structures
K_W09	has an elementary knowledge of the principles of workpiece design and mechanical equipment constructions
K_W10	has detailed knowledge of selected tasks related to the field of mechanical engineering
K_U01	The student can obtain information from literature, databases and other sources, in English or another foreign language; able to integrate the information, make their interpretation, as well as draw conclusions and formulate and justify opinions
K_U14	can use the measuring equipment used in problems of mechanics and mechanical engineering as well as methods for estimating measurement errors
K_K03	can interact and work in a group, adopting different roles

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W06, K_W09 K_W10	Written exam, written test, the defense laboratory reports.
K_U01	Discussion during the presentation developed laboratory reports.
K_U14	Examination of laboratory reports
K_K03	The division into teams and determine the different roles of team members, assign tasks to individuals, check and evaluate the results of the study, a discussion with the team about teamwork: the position, role, impact.

Lecture

positive evaluation of the test

Laboratory

received positive ratings of reports carried out laboratory

Evaluation of the course is getting positive ratings from all forms: Lecture, Laboratory

STUDENT WORKLOAD:

The student workload is 100 hours, including work in the auditorium 56 (38) hours, individual work 44 (62) hours, preparing for classes and study reports 35 (36) hours, revising for tests 15 (21) hours. Work with the literature 4 (15)
Total hours of practical classes: 44 (43) which corresponds to 2 ECTS
Total hours of lessons with a teacher: 56 (38) which corresponds to 2 ECTS

RECOMMENDED READING:

4. Walicka A, Walicki E, Michalski D, Jurczak P, Falicki J., Wytrzymałość materiałów / T. 1: Podręcznik akademicki. Teoria, wzory i tablice do ćwiczeń laboratoryjnych. - Zielona Góra : Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, 2008
5. Walicka A, Walicki E, Michalski D, Jurczak P, Falicki J., Wytrzymałość materiałów T. 2: Ćwiczenia laboratoryjne – Materiały pomocnicze. - Zielona Góra : Oficyna Wydawnicza Uniwersytetu Zielonogórskiego, 2008.
6. Niezgodziński M. E., Niezgodziński T., Wytrzymałość materiałów, 1979 PWN wyd. XI,
7. Gubrynowiczowa J., Wytrzymałość materiałów, 1968 PWN.
8. Banasiak M., Grossman K., Trombski M., Zbiór zadań z wytrzymałości materiałów, 1998, PWN.

OPTIONAL READING:

1. Rżysko J., Statyka i wytrzymałość materiałów , 1979 PWN,
2. Jakubowicz A., Orłoś Z., Wytrzymałość materiałów, 1984 WNT,

REMARKS:

INDUSTRIAL MECHANICS

Course code: 06.1-WM-MiBM-P-14_15
Type of course: compulsory
Language of instruction: Polish
Director of studies: Dr hab. inż. Anna Walicka, prof. UZ
Dr inż. Paweł Jurczak
Name of lecturer: Dr inż. Dariusz Michalski;

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					6
Lecture	30	2	II	Exam	
Class	15	1		Grade	
Laboratory	15	1		Grade	
Seminar					
Workshop					
Project					
Part-time studies					
Lecture	18	2	IV	Exam	
Class	9	1		Grade	
Laboratory	9	1		Grade	
Seminar					
Workshop					
Project					

COURSE AIM:

The aim of the course is to familiarize students problem-solving methodology based on the laws of mechanics and the knowledge and ability to solve complex problems of statics and kinematics.

ENTRY REQUIREMENTS:

Knowledge of mathematics and physics

COURSE CONTENTS:

LECTURE

The basic notions and the principles of statics. Plane and spatial arrangement of convergent forces. Equilibrium plane and spatial arrangement of convergent forces. The basis of reduction of arrangement forces; moment of a force relative to point and axis, parallel forces, pair of forces and its moment, equilibrium reduction of pairs of forces. The plane arrangements of strengths without friction (reduction of plane arrangement of forces, equilibrium of any plane arrangement of forces equilibrium of an arrangement consisting of rigid bodies). Friction and friction laws. Arbitrary spatial arrangement of forces. Reduction of spatial arrangement of forces. Arrangement of parallel forces in space. Masses centres. Theorem of the Pappus - Guldin. Basic notions of kinematics. The kinematics of point: description of movement of a point, velocity and acceleration, average and instantaneous velocity, average and instantaneous acceleration, straight motion, curvilinear and circular, tangential and normal acceleration. The basic notions of movement of rigid body (methods for determining the velocities of points, progressive and rotational movement). The folded movement (the velocity and the acceleration in folded movement, the Coriolis acceleration on the surface of the Earth). The plane movement (method of determining the velocity and the accelerations in plane movement).

CLASS

Solving classes based on lectures and source materials

LABORATORY

Laboratory topics:
- Determination of the static coefficient of friction,
- Determination of the characteristics and spring stiffness,
- Stroboscopic method of measuring the frequency of periodic motion,
- Determination of the mass moment of inertia of a rigid body,
- Measurement of the bearing friction torque of the electric motor rotor,
- Determination of the kinetic coefficient of friction by means of self-excited vibration ,
- Determination of the characteristics and stability of springs,
- Correction exercises, tests.

TEACHING METHODS:

Lectures with audiovisual aids. Solving classes. Working with the book. Group work in laboratory classes

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W02	has knowledge of physics, including the fundamentals of mechanics, including the knowledge needed to understand and use the description of physical phenomena in the manufacturing design and operating of mechanical systems
K_W05	has ordered knowledge with strong theoretical underpinnings in the area of statics of rigid bodies systems, kinematics and dynamics of rigid bodies, as well as knowledge of the vibration area
K_U01	The student can obtain information from literature, databases and other sources, in English or another foreign language; able to integrate the information, make their interpretation, as well as draw conclusions and formulate and justify opinions
K_U14	can use the measuring equipment used in problems of mechanics and mechanical engineering as well as methods for estimating measurement errors
K_K03	can interact and work in a group, adopting different roles

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W02; K_W05	Written exam, written test, the defense laboratory reports.
K_U14	Examination of laboratory reports
K_K01	Discussion in the classroom
K_K03	The division into teams and determine the different roles of team members, assign tasks to individuals, check and evaluate the results of the study, a discussion with the team about teamwork: the position, role, impact.

Lecture

positive evaluation of the test

Class

positive evaluation of the test

Laboratory

received positive ratings of reports carried out laboratory

Evaluation of the course is getting positive ratings from all forms: Lecture, Class, Laboratory

The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload is 150 hours, including work in the auditorium 73 (51) hours, individual work 72 (99) hours, preparing for classes and study reports 39 (45) hours, revising for tests 25 (27) hours. Work with the literature 15 (18)
Total hours of practical classes: 82 (78) which corresponds to 3 ECTS
Total hours of lessons with a teacher: 73 (51) which corresponds to 3 ECTS

RECOMMENDED READING:

1. Misiak J., Mechanika ogólna – Statyka i kinematyka, 1993 WNT wydanie IV
2. Leyko J., Mechanika ogólna. t. I, 1980 PWN wydanie VII,
3. J. Nizioł, Metodyka rozwiązywania zadań z mechaniki, WNT, Warszawa 2002
4. Walicki E., Smak T., Falicki J., Mechanika. Wprowadzenie teoretyczne do laboratorium. 2005, Oficyna Wydawnicza Uniwersytetu Zielonogórskiego,
5. Walicki E., Smak T., Falicki J., Mechanika. Materiały pomocnicze do ćwiczeń laboratoryjnych. 2005, Oficyna Wydawnicza Uniwersytetu Zielonogórskiego

OPTIONAL READING:

1. Leyko J., Zbiór zadań z mechaniki ogólnej. t. I, 1978 PWN wydanie IV
2. Misiak J., Zadania z mechaniki ogólnej. Statyka, 1994 WNT wydanie V
3. Misiak J., Zadania z mechaniki ogólnej. Kinematyka, 1994 WNT wydanie V,

REMARKS:

FUNDAMENTALS OF MACHINE DESIGN

Course code: 06.1-WM-MiBM-P-22_15

Type of course: **COMPULSORY**

Language of instruction: **POLISH**

Director of studies: **DR INŻ. MAREK MALINOWSKI**

Name of lecturer: dr inż. Marek Malinowski, dr inż. Daniel Dębowski, dr inż. Izabela Gabryelewicz,

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	**30**	**2**	II	Exam	
Class	**-**	**-**			
Laboratory	**-**	**-**			
Seminar	**-**	**-**			
Workshop	**-**	**-**			
Project	**30**	**2**		Grade	
Part-time studies					
Lecture	**24**	**3**	III	Exam	
Class	**-**	**-**			
Laboratory	**-**	**-**			
Seminar	**-**	**-**			
Workshop	**-**	**-**			
Project	**24**	**3**		Grade	

COURSE AIMS:

To provide an opportunity to students to learn:,

Fundamentals of mechanical design, Design methodology, Design factor and factor of safety, allowable stresses, fatigue, Contact stresses, Failures resulting from static loading, Fatigue failure

resulting from variable loading, Design of bolted, welded connections. Design of shafts and shaft components, Shaft resonance, Bearings, drive systems, Gears, fundamentals of engineering optimization, fundamentals of modeling and simulation, expert systems. CAD systems. Development and machine design projects and reports.

PREREQUISITIES:

- Technical drawing, Materials Science I

COURSE CONTENTS:

Lecture contents

Fundamentals of mechanical design, Design methodology, Design factor and factor of safety, allowable stresses, fatigue, Contact stresses, Failures resulting from static loading, Fatigue failure resulting from variable loading, Design of bolted, welded connections. Design of shafts and shaft components, Shaft resonance, Bearings, drive systems, Gears, fundamentals of engineering optimization, fundamentals of modeling and simulation, expert systems. CAD systems. Development and machine design projects and reports.

Project contents

Project no.1 - Frame, Project no. 2 – lifting device with screw mechanism. Analytical engineering calculations, technical documentation.

Laboratory contents

Laboratory – see course: Computer Aided Design AutoCAD I

TEACHING METHODS:

Audiovisual aids. Working with books. Individual work of each student in the development of a computational part of a task.

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_W09	has an elementary knowledge of the principles of workpiece design and mechanical equipment constructions
K_W14	has basic knowledge on developments in the design, manufacturing and operating of machines
K_U15	The student can critically analyze and evaluate the functioning of the existing solutions in terms of construction and operation of machinery, in particular equipment, objects, systems, processes and services
K_U16	can identify and formulate the specification of simple tasks of practical engineering in the design, technology and operation of machines

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	**The method of the learning outcomes assessment**
K_W09 K_W14	Exam
K_U15 K_U16	grade based on results of two projects arithmetic mean of all grades

STUDENT WORKLOAD:

The student workload of 60 hours, including work in the auditorium 60(24+24) hours, individual work and read the literature 45 (45) hours, projects preparation 10 (10) hours, analysis and solution of task problem - project 37 (46) hours. Total hours of practical classes: 110 (110) which corresponds to 4 ECTS Total hours of lessons with a teacher: 63 (44) which corresponds to 2 ECTS.

Total hours of practical classes: 66 (72) which corresponds to 3 ECTS Total hours of lessons with a teacher: 61 (40) which corresponds to 2 ECTS.

RECOMMENDED READING:

1. Pr. zbiorowa pod red. M. Dietrycha, Podstawy Konstrukcji Maszyn, T. 1,2,3, Warszawa WNT, 1995.
2. Osiński Z., Bajon W., Szucki T., Podstawy konstrukcji maszyn, PWN, 1986.
3. Seria PKM: Podstawy konstrukcji maszyn (ponad 20 tomów), PWN.

OPTIONAL READING:

1. Kurmaz L. i inni. Podstawy konstrukcji maszyn. Projektowanie, PWN, Warszawa 1999.
2. Rutkowski A., Części maszyn, WSiP, 2007.
3. M. Malinowski, W. Babirecki, T. Belica, Materiały pomocnicze z podstaw systemu CAD AutoCAD 2000 GB/PL, Uniwersytet Zielonogórski, Zielona Góra 2002 (preskrypt).
4. Mirosław Babiuch, AutoCAD 2000PL, Ćwiczenia praktyczne, Helion, 2000.

TECHNOLOGICAL PROJECT

Course code: 06.1-WM-MiBM-TM-P-14_15
Type of course: Compulsory
Language of instruction: Polish
Director of studies: dr inż. Ryszard Gorockiewicz
dr inż. Paweł Schlafka
Name of lecturer: dr inż. Ryszard Gorockiewicz
dr inż. Mariusz Michalski

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Lecture			VII		
Class					
Laboratory					
Seminar					
Workshop					
Project	30	2		Grade	
Part-time studies					
Lecture			VII		
Class					
Laboratory					
Seminar					
Workshop					
Project	18	2		Grade	

COURSE AIMS:

The aim of the course is to acquire the skills of the design process using the basic machinery manufacturing.

PREREQUISITIES:

Fundamentals of machine design, materials science, engineering, manufacturing, metrology and measurement systems.

COURSE CONTENTS:

Lecture content.

The development process of the machine selected using the techniques: casting, machining and forming, depending on the needs of the heat treatment. The project scope includes the following topics: design manufacturability analysis, determine the size of the party, performance drawing a blank, the setting of the initial order of the operations process, the calculation of the parameters of the process, the exact development process, establishing the necessary machines, tools and fixtures, tools and measuring instruments and process parameters , setting time standards for specific operations, the development of technical documentation.

TEACHING METHODS:

Working with professional literature. individual project

LEARNING OUTCOMES:

In the field of technical sciences	Knowledge, skills, competence
K_U17, K_U18	He can design a technological process of manufacturing of machine parts using appropriate methods, machinery and tools.
K_K01	Understand the importance and need for learning throughout life Able to interact and work in a group, taking in the different roles
K_K03	He can design a technological process of manufacturing of machine parts using appropriate methods, machinery and tools

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_U17, K_U18	Evaluation of the project
K_K01, K_K03	Project Assignment

The project - provided credit is to get a positive assessment of the project

STUDENT WORKLOAD:

The student workload of 75 (75) hours, including work in the auditorium of thirty (18) hours, consult 8 (0) hours, working alone 37 (57) hours, including the development of the project 32 (50) hours, to prepare for classes 5 (7) hours. Total hours of practical classes: 75 (75) which corresponds to 3 ECTS. Total hours of lessons with a teacher: 38 (18), which corresponds to 2 ECTS

RECOMMENDED READING:

1. L.A. Dobrzanski: Fundamentals of materials science and materials science. WNT, Warsaw 2002.
2. J. Barcik, M. Kupka, A. Wala: Metal Technology, Ed. Univ. Silesia, Katowice 2000
3. W. Olszak: Machining. WNT Warsaw 2008.
4. M. Perzyk: Casting, Ed. WNT, Warsaw 2004
5. L. Przybylski: Strategy selection tools modern machining conditions. Cracow University of Technology, Cracow 2000.

OPTIONAL READING:

1. Engineer's Guide. "Machining" Volume 1 Ed. WNT, Warsaw, 1991
2. Engineer's Guide "Welding", Ed. WNT, Warsaw 1993
3. T. Karpinski.: "Production Engineering", Ed. WNT, Warsaw 2004

REMARKS:

Workloads in parentheses are the numbers for part time studies

COMPUTER AIDED MANUFACTURING
ALPHA CAM, SPRUT CAM, CATIA

Course code: 06.1-WM-MiBM-P-35_15 Alpha CAM
06.1-WM-MiBM-P-36_15 Catia
06.1-WM-MiBM-P-37_15 Sprut CAM

Type of course: Compulsory

Language of instruction: Polish, Russian

Director of studies: Dr inż. Mariusz Jenek

Name of lecturer: Dr inż. Mariusz Jenek,
Dr inż. Albert Lewandowski

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					3
Lecture	-	-	V	-	
Class	-	-		-	
Laboratory	45	3		Grade	
Seminar	-	-		-	
Workshop	-	-		-	
Project	-	-		-	
Part-time studies					
Lecture	-	-	V	-	
Class	-	-		-	
Laboratory	27	3		Grade -	
Seminar	-	-		-	
Workshop	-	-		-	
Project	-	-		-	

COURSE AIMS:

The purpose of this course is to present the principles of software development for numerically controlled machines.

PREREQUISITES

Manufacturing engineering - machining

COURSE CONTENTS:

The rules for creating software for numerically controlled machines. Machining methods, and numerical control machine tools. Correction tools, machine reference points. Introduction to the program. The development of processes using a computer program selected.

TEACHING METHODS:

Lectures with audiovisual aids. Working with the book. Group work in laboratory classes.

LEARNING OUTCOMES:

K_W11	has knowledge of computer-aided design, manufacturing and operating of machinery and mechanical equipment
K_W14	has basic knowledge on developments in the design, manufacturing and operating of machines
K_W16	knows the basic methods, techniques and tools required to solve simple tasks in the field of construction engineering, technology, manufacturing and operating of machinery
K_U01	student can obtain information from literature, databases and other sources, in English or another foreign language; able to integrate the information, make their interpretation, as well as draw conclusions and formulate and justify opinions
K_U12	can make a preliminary economic analysis of engineering activities undertaken in the design, manufacturing and operating of machines
K_U18	can – according to the specifications – design and implement a simple device, object, system or process, typical for the process of design, technology and operation of machines, using appropriate methods, techniques and tools
K_K02	can understand the non-technical aspects of the mechanical engineer actions, its validity and effects, including the impact on the environment and the responsibility for decisions accepted

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W11 K_W14 K_W16 K_U01 K_U12 K_U18 K_K02	prepared project

A passing grade in laboratory part comprises positive evaluation of reports based on each laboratory class, attendance and initiative on the part of the student.

STUDENT WORKLOAD:

The student workload of 100 hours, including work in the auditorium 55 (37) hours, individual work 45 (60) hours.
Total hours of practical classes: 45 +10+10+20 = 85 (27 +10+20+30 = 87) which corresponds to 4 ECTS
Total hours of lessons with a teacher: 55 which corresponds to 4 ECTS

RECOMMENDED READING:

[1] AlphaCAM – podręcznik użytkownika

[2] AlphaCAM – materiały dydaktyczne do ćwiczeń

OPTIONAL READING:

[3] M.Feld – Podstawy projektowania procesów technologicznych typowych części maszyn. WNT. Warszawa 2000.

REMARKS:

WELDING TECHNOLOGY

Course code: 06.1-WM-MiBM-TM-P-04_15

Type of course: Optional

Language of instruction: Polish

Director of studies: Dr inż. Ryszard Gorockiewicz

Name of lecturer: Dr inż. Ryszard Gorockiewicz, Dr inż. Paweł Schlafka

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	30	2	VII	Exam	
Class					
Laboratory	15	1		Grade	
Seminar					
Workshop					
Project	15	1		Grade	
Part-time studies					
Lecture	18	2	VII	Exam	
Class					
Laboratory	9	1		Grade	
Seminar					
Workshop					
Project	9	1		Grade	

COURSE AIMS:

The aim of the course is to provide students with basic knowledge of welding processes, selection of optimum bonding technology, methods, quality control of welded joints..

PREREQUISITIES:

Manufacturing engineering, materials science, Principles of TBM.

COURSE CONTENTS:

Lecture content. Morphology welded, soldered and welded. Call quality control methods, as well as safety rules. Structure and properties of bonded joints. Weldability of metals. Arc welding. Electric welding without the use of the arc. Gas welding and cutting. Electric welding. Soldering and brazing. Welding related processes: spray metallizing. surface hardening. review
and criteria for the selection of optimal bonding technology (welding, soldering, thermal cutting). Mechanization and automation in welding. Welding stresses and strains. Design Basics bonded connections. Welding of non-compliance
and evaluation of the quality of welded joints. The project comprised of the weld metal of more than 1 m in lengh.
..

TOPICS LABORATORY:

1. Effect of pre-heating on the structure of welded carbon and alloy steel
2. Construction of macro and micro weld
3. Manual arc welding
4. Semi-automatic welding in gas-shielded
5. Monitoring and classification rules welds
6. Welding and brazing

TEACHING METHODS:

Llectures with audiovisual aids. working with professional literature. individual and team execution of laboratory exercises. execution of the project.

EFEKTY KSZTAŁCENIA:

In the field of technical sciences	Knowledge, skills, competence
K_W10	He has detailed knowledge of the morphology of welded, soldered and welded, structure and properties of bonded joints and weldability of metals and their alloys, welding stresses and strains.
K_W16	Knows the basic methods and techniques of welding (arc welding, electric welding without the use of an arc, gas welding), welding, soldering and brazing. He knows the related welding processes: metal spraying, surface hardening and the criteria for selection of optimal bonding technology, as well as the basis of design of welded joints, imperfections and evaluate the quality of welded joints.
K_U16	Able to develop terms and conditions of the weld.
K_K01	Understand the importance and need for learning throughout life
K_K02	Understand the non-technical aspects of the mechanical engineer, the validity and effects, including the impact on the environment
K_K03	Able to interact and work in a group, taking in the different roles

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below.

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W10, K_W16	Exam
K_K01, K_K02, K_K03	Assessment of student preparation for laboratory and a report
K_K03	Laboratory reckoning
K_U16	Completion of the project

Lecture - positive evaluation of the written exam. Final rating depends on the evaluation of the test, the activity in the classroom.

The laboratory-provided credit is to get positive ratings from all the exercise. Final rating depends on the ratings of the partial report and oral responses in class activities. The project - provided credit is to get a positive assessment of the project.

STUDENT WORKLOAD:

The student workload of 100 (100) hours, including work in the auditorium 60 (36) hours, exam 2 (2), stand-alone 38 (62) hours, including preparation for classes and study reports, 11 (20) hours, to draft 5 (10), prepare for the exam from the lecture 20 (20) hours, read the literature on the subject 2 (12).
Total hours of practical classes: 46 (48), which corresponds to 2 ECTS.
Total hours of lessons with a teacher: 62 (38), which corresponds to 2 ECTS.

BASIC READING:

1. Lecture materials
2. Advisory Engineer - Welding, Edited by Prof. J. Pilarczyk, Vol 1, WNT, Warsaw 2003
3. S. Butnicki: "Weldability of steel and fragility." WNT, Warsaw 1979
4. E. Cleaver, "Metallurgy and Metallography of welds." AGH, Kraków 1985
5. E. Cleaver, "Weldability of steel." Fotobit, Kraków 2002
6. A. KLIMPEL, A. Szymanski "Quality control in the welding industry." Publisher Silesian Technical University, Gliwice, 1992.
7. Z. Pawłowski, "Destructive testing". Warsaw 1988
8. EN 26520 - Classification of imperfections in welded joints of metal with an explanation.
9. Guide to Technology laboratory of permanent joints

OPTIONAL READING:

1. K Przybyłowicz: „Metallurgy". WNT, Warsaw 1999
2. L.A. Dobrzanski : "The basics of metallurgy materials science." WNT, Warsaw 1996
3. L.A. Dobrzanski: Fundamentals of materials science and materials science". WNT, Warsaw 2002
4. J. Barcik, M. Kupka, A. Wala: „Metal Technology", Ed. Univ. Silesia, Katowice 2000

REMARKS:

The list of student load in parentheses are the numbers for extramural studies**.**

QUALITY ENGINEERING

Course code: 06.1-WM-MiBM -AiOPP-P-11_15
Type of course: Optional
Language of instruction: Polish
Director of studies: dr inż. Edward Tertel
Name of lecturer: dr hab. inż. Piotr Kuryło, prof. UZ
dr inż. Edward Tertel

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Lecture	15	1	VII	Exam	
Class	-	-			
Laboratory	15	1		Grade	
Seminar	-	-			
Workshop	-	-			
Project	-	-			
Part-time studies					
Lecture	9	1	VII	Exam	
Class	-	-			
Laboratory	9	1		Grade	
Seminar	-	-			
Workshop	-	-			
Project	-	-			

COURSE AIMS:

To acquaint students with the basic terms in the field of quality assurance and quality management. Knowledge of methods and the evaluation procedures of the quality evaluation of products, services and activities. Understanding the basic concepts of quality management. Acquaint with the ISO9OOO quality standards, industry standards. Discussion of basic procedures for implementing and maintaining quality management systems.

PREREQUISITIES:

Mathematics, Metrology, Elements of statistics, the ability to use fundamental IT-tools.

COURSE CONTENTS:

Lecture content.

The concept of quality and its definitions. Fundamental factors affecting the quality of production processes. Aspects and criteria for evaluation of the quality. The concept of quality and its definitions. Fundamental factors affecting the process and quality of production processes. Aspects and criteria for evaluation of the quality. Reliability, reliability functions. Quality systems according to the ISO series of standards, ISO 9000: basics and terminology. Quality management according to the DIN EN ISO 9001. The quality system documents. The implementation of quality management systems. Quality of processes, quality of work, quality of products quality of service. TQM - Total Quality Management objectives, concept and implementation. Six sigma - quality management by measurement of efficiency. The basic principles of Six Sigma, the implementation of the system, the use of statistical methods. Selected quality management tools.

Laboratory content:

Evaluation of the quality of the selected product. Determination of the reliability function for selected devices. Mapping process flow for a given production task. Elements of QMS documentation in accordance with DIN EN ISO 9001 - discussion, comparative assessment. The use of selected quality management tools. Six sigma - determining of the Six Sigma quality measure for specific products/processes. Statistical Measures of Quality in the Six Sigma, setting short-term and long-term capability of the process.

TEACHING METHODS:

Lectures with audiovisual aids. Working with the books and journals.

Individual and group work in laboratory classes. Presentation of solutions, discussion of the obtained solutions.

LEARNING OUTCOMES:

The reference to the learning outcomes of the field of study	Knowledge, skills, competence
K_W18,	Is able to define basic concepts of quality of and quality management
K_W18	He can name the standards of ISO9000 family of standards, and give a short description of their subject matter. Is able to characterize elements of the QMS documentation in accordance with ISO9001. Can apply the requirements of ISO9000 to create a quality management system documentation.
K_W18	Is able to characterize the basic principles of quality management. Can describe the basic concepts of quality management, explain the basic differences and similarities.
K_U11 K_U15	He can carry out an evaluation of the quality of the product by choosing appropriate evaluation criteria. Properly interprets the results.
K_U17	Can apply and implement the basic tools of quality management.
K_K02	Is aware of the consequences, both good as well as poor quality of products and processes.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W18 K_K02	Exam, audit work Assessment of of the course is determined on the basis of ratings for audit work (weight = 0.4) and exam (weight = 0.6).
K_U11	Assessment of the laboratory is based on: the laboratory exercises and

K_U15 K_U17 K_K02	reports/programs resulting from the execution of all exercises to be exercised.

To get a credit the student has to receive all passing grades.
The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload of 70 (70) hours, including work in the auditorium 30 (18) hours, consultations 3 (1) hours, , participations in the exam **2 (2)** hours, and individual work 35 (49) hours, including: preparation for classes and preparation of reports and audit work 30 (36) hours, preparation for exam 5 (13) hours.

Total hours of practical classes: 48 (46) which corresponds to 2 ECTS.
Total hours of lessons with a teacher: 35 (21) which corresponds to 1 ECTS

RECOMMENDED READING:

1. Hamrol Adam, Mantura Władysław: Zarządzanie jakością. Teoria i praktyka, Wydawnictwo Naukowe PWN, 2006
2. Hamrol Adam: Zapewnianie jakości w procesach wytwarzania, Wydawnictwo Politechniki Poznańskiej, Poznań, 1995
3. Praca zbiorowa, red. Tabor Adam, Zając Andrzej, Rączka Marek: Zarządzanie jakością Tom I – Jakość i systemy zapewnienia jakości, Tom II –Jakość w procesach wytwarzania – podręcznik dla studentów wyższych szkół technicznych. Kraków 2000
4. M. Urbaniak: Zarządzanie Jakością. Teoria i praktyka, Wyd. Difin, Warszawa 2004,
5. M. Urbaniak: Systemy zarządzania w praktyce gospodarczej, Wyd. Difin, Warszawa 2006.
6. Normy ISO serii 9000,

OPTIONAL READING:

1. Miesięczniki: Problemy Jakości, Normalizacja.

REMARKS:

Workloads in parentheses are the numbers for part time studies.

AUTOMATED TRANSPORT AND STORAGE

Course code: 06.1-WM-MiBM-AiOPP-P-09_15
Type of course: Optional
Language of instruction: Polish
Director of studies: dr inż. Edward Tertel
dr hab. inż. Piotr Kuryło, prof. UZ
Name of lecturer: dr inż. Edward Tertel
dr inż. Joanna Cyganiuk

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					4
Lecture	15	1	VII	Exam	
Class	-	-			
Laboratory	30	2		Grade	
Seminar	-	-			
Workshop	-	-			
Project	-	-			
Part-time studies					
Lecture	9	1	VII	Exam	
Class	-	-			
Laboratory	18	2		Grade	
Seminar	-	-			
Workshop	-	-			
Project	-	-			

COURSE AIMS:

Acquainting students with the problems in the field of materials handling and storage, with particular reference to the automation of these processes. Discussion of the problems of packaging and loading units as elements allowing automation. Acquainting students with equipment to enable automated handling and storage - the principles of selection of equipment as well as selected aspects of their operation.

PREREQUISITIES:

Technological processes Automation and Robotics.

COURSE CONTENTS:

Lecture content.

The essence of logistics, definitions, origin, the essence of logistics management, the system approach and the process approach in logistics. Characteristics and tasks of the transportation systems. The strategic importance of internal transport. Packaging. Loading units. The dimensional systems of packaging and loading units. Characteristics of machinery and equipment used in the technological transport - automated machines. The use of automated transport trucks in the storage transport. Interoperability in the transport processes. Warehouse Infrastructure, automated warehouse. Transport and storage process automation. Compatibility with automated high-storage warehouse.

Laboratory content:

Packaging design and selection of the dimensions of loading units. Identification of the basic operational, quality and logistics indicators in robotic manipulation of unit loads. Determining of the Cartesian pneumatic manipulator workspace in the implementation of handling functions. Determination of the basic parameters of the selected handling equipment. Load manipulation in the automated picking process of loading units - functions and parameters. Determination of the functional parameters of cargo storage equipment – warehouses.

TEACHING METHODS:

Lectures with audiovisual aids. Working with the journals.

Individual and group work in laboratory classes. Presentation of solutions, discussion of the obtained solutions.

LEARNING OUTCOMES:

The reference to the learning outcomes of the field of study	Knowledge, skills, competence
K_W18,	Is able to define basic concepts of logistics
K_W18	He can classify and describe main tasks of the handling and storage systems.
K_W18	He can name and give a short description of infrastructure elements of handling and storage, with particular reference to automation.
K_W18	Is able to define notion of packaging, classify of packaging, explain the basic functions of packaging and characterize the packaging dimensional system.
K_U18	He can select/design the infrastructure elements for the specific logistics task in the field of automated storage and handling.
K_U18	Can design the collective packaging and form of the unit load for a given product and use the appropriate method of storage.
K_U15 K_U18	He can analyze the possibility of automation in the processes of storage and handling
K_U10 K_K02	Is conscious of the importance of logistics in the economy.
K_K01	Sees rapid development of logistic infrastructure, especially in terms of automated equipment and is aware of the need to tracking changes in this area.

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below:

The reference to the learning outcomes of the field of study	**The method of the learning outcomes assessment**

K_W18,	Exam, audit work Assessment of of the course is determined on the basis of ratings for audit work (weight = 0.4) and exam (weight = 0.6).
K_U10 K_U15 K_U18 K_K01 K_K02	Assessment of the laboratory is based on: the laboratory exercises and reports/programs resulting from the execution of all exercises to be exercised.

To get a credit the student has to receive all passing grades.
The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload of 125 (125) hours, including work in the auditorium 45 (27) hours, consultations 3 (1) hours, participations in the exam 2 (2) and individual work 75 (95) hours, including: preparation for classes and preparation of reports and audit work 50 (70) hours, preparation for the exam 20 (25) hours.

Total hours of practical classes: 88 (87) which corresponds to 3 ECTS.
Total hours of lessons with a teacher: 45 (27) which corresponds to 2 ECTS

RECOMMENDED READING:

1. Coyle J., Bardi E., Langley J., Zarządzanie logistyczne, PWE, 2002
2. Sarjusz-Wolski Z., Skowronek C., Logistyka, CIM, Warszawa 1995
3. Korzeń Zb., Logistyka w transporcie towarów, 1998
4. Korzeń Zb., Logist. syst. transp. bliskiego i magaz. 1998

OPTIONAL READING:

1. Logistyka– dwumiesięcznik.
2. Logistyka a jakość – dwumiesięcznik
3. Nowoczesny magazyn - dwumiesięcznik
4. http://www.logistyka.net.pl/
5. http://nm.pl/

REMARKS:

Workloads in parentheses are the numbers for part time studies.

TECHNICAL MEANS OF AUTOMATION FOR MANUFACTURING PROCESS

Course code: 06.1-WM-MiBM-P-56_15
Type of course: Compulsory
Language of instruction: Polish
Director of studies: dr hab. inż. Piotr Kuryło, prof. UZ
Name of lecturer: dr hab. inż. Piotr Kuryło, prof. UZ
dr inż. Edward Tertel

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Lecture	15	1	III	Grade	
Class	-	-			
Laboratory	15	1		Grade	
Seminar	-	-			
Workshop	-	-			
Project	-	-			
Part-time studies					
Lecture	9	1	III	Grade	
Class	-	-			
Laboratory	9	1			
Seminar	-	-			
Workshop	-	-			
Project	-	-			

COURSE AIMS:

Acquainting students with the basic methods and tools of manufacturing processes automation. Learning the basic technical means used in automation. To familiarize students with the tools and methods of controlling the operation of the automated systems. Acquaint students with the various aspects of the implementation of automation.

PREREQUISITIES:

Automation and robotics, the ability to use basic computer tools.

COURSE CONTENTS:

Lecture content.

The essence of automation, definitions: automation, control. The manufacturing process, automation in the production processes, the degree of automation, the areas of automation in the manufacturing systems. Methods of automation, the desirability and limitations in automation. Computerization in the manufacturing systems. Pneumatic and hydraulic means of automation. Actuators, control valves, logical elements, hydraulic and pneumatic equipment. Design methods of hydraulic and pneumatic control systems, hydraulic and pneumatic diagrams. Basics of robotics. Review of the structures and applications of robots, industrial robots, mobile robots. The robots degrees of freedom, the robot workspace, robots communication with the environment, sensors, effectors, actuators, control. Numerical control. PLCs. Basics of construction, phase of controller cycle, the main areas of application.

Laboratory content:

Basic methods for the implementation of an automatic cycle of the actuator. Implementation of the basic logic functions: OR, AND, NOT using the basic elements of pneumatics. Control of automated working pneumatic/hydraulic actuators - combinational and sequential systems. PLC programming using the FBD (Function Block Diagram). ARM1 manipulator control..

TEACHING METHODS:

Lectures with audiovisual aids. Working with the journals. Individual and group work in laboratory classes. Presentation of solutions, discussion of the obtained solutions.

LEARNING OUTCOMES:

The reference to the learning outcomes of the field of study	Knowledge, skills, competence
K_W08,	Is able to define the basic concepts of automation. Is able name the technical means used in automation and briefly describe them
K_W08 K_W16	Can describe the basic methods of automated control systems.
K_U17 K_U18	Can design and build a simple automatic control system for pneumatic and hydraulic actuators
K_U07 K_U08 K_U18	Is able design a PLC program control and test/simulate it. Is able to create and test the software that controls industrial robot manipulator model.
K_U10 K_K02	Is aware of the consequences of implementation of automation, sees both positive as well as negative aspects of automation.
K_K03	Is able interact in a group

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

The verification methods for learning outcomes are presented in the table below:

The reference to the learning outcomes of the field of study	The method of the learning outcomes assessment
K_W08, K_W16 K_U10 K_K02	Written test

K_U07 K_U08 K_U10 K_U17 K_U18 K_K02 K_K03	Assessment of the laboratory is based on: the laboratory exercises and reports/programs resulting from the execution of all exercises to be exercised.

To get a credit the student has to receive all passing grades.
The final grade received by the student is the arithmetic mean of the above grades.

STUDENT WORKLOAD:

The student workload of 60 (54) hours, including work in the auditorium 30 (18) hours, and individual work 30 (46) hours, including: preparation for classes and preparation of reports and audit work 20 (30) hours, preparation for the written test 10 (16) hours.

Total hours of practical classes: 35 (39) which corresponds to 1 ECTS.
Total hours of lessons with a teacher: 30 (18) which corresponds to 1 ECTS

RECOMMENDED READING:

1. Chorowski B., Werszko M. Mechaniczne Urządzenia Automatyki Wydawnictwo Naukowo-Techniczne, Warszawa 1990 i nowsze
2. Honczarenko J., Roboty przemysłowe budowa i zastosowanie, WNT, Warszawa 2004
3. Mikulczyński, Tadeusz.: Automatyzacja procesów produkcyjnych, Warszawa : Wydawnictwa Naukowo-Techniczne, 2006.
4. Kowalowski H.: Automatyzacja dyskretnych procesów przemysłowych. WNT, Warszawa 1981
,

OPTIONAL READING:

1. Pomiary, Automatyka, Robotyka – miesięcznik.
2. http://www.automatyka.pl
1. http://automatykab2b.pl/

REMARKS:

Workloads in parentheses are the numbers for part time studies.

CONTROL SYSTEMS DIAGNOSTICS OF MACHINES

Course code: 06.1-WM-MiBM-EM-P-03_15

Type of course: eligible

Language of instruction: Polish

Director of studies: Dr hab. inż. Władysław Papacz, prof UZ

Name of lecturer: Dr hab. inż. Władysław Papacz, prof UZ

Form of instruction	Number of teaching hours per semester	Number of teaching hours per week	Semester	Form of receiving a credit for a course	Number of ECTS credits allocated
Full-time studies					2
Lecture	15	1	VI	grade	
Class	-	-			
Laboratory	15	1		grade	
Seminar	-	-			
Workshop	-	-			
Project					
Part-time studies					
Lecture	9	1	VI	grade	
Class	-	-			
Laboratory	9	1		grade	
Seminar	-	-			
Workshop	-	-			
Project	-	-			

COURSE AIMS:

The aim of the course is to introduction students with the diagnostic elements and technical facilities during construction, technology, construction and operation.

PREREQUISITES:

Metrology, Fundamentals of Machine Design and Operation, Construction Record

COURSE CONTENTS:

Substantive content. Sources of technical diagnostics. Signs and symptoms of technical diagnostics. Thermal vibroacoustic diagnostics. Diagnostic models of objects. Diagnostic experiments. Computer aided diagnosis. Diagnosing anthropotechnical systems. Organizational and economic aspects of technical diagnostics. Diagnostics components, sub-assemblies and machines selected industries.

TEACHING METHODS:

Lectures with audiovisual aids. Working with books, standards and individual work in the development of design issues.

LEARNING OUTCOMES:

K_W03	has a basic knowledge of the chemistry needed to understand and describe the phenomena occurring in the manufacturing and operating of machines
K_W13	has knowledge of engineering materials, their investigation and shaping technologies
K_W14	has basic knowledge on developments in the design, manufacturing and operating of machines
K_W16	knows the basic methods, techniques and tools required to solve simple tasks in the field of construction engineering, technology, manufacturing and operating of machinery
K_U07	The student can use information and communication technologies relevant to the tasks related to the design, manufacturing and operating of machinery
K_U14	can use the measuring equipment used in problems of mechanics and mechanical engineering as well as methods for estimating measurement errors
K_K02	can understand the non-technical aspects of the mechanical engineer actions, its validity and effects, including the impact on the environment and the responsibility for decisions accepted
K_K07	can the social role of an engineer and participates in communicating credible information and opinions about technological developments in the field of engineering, construction and machines operation

LEARNING OUTCOMES VERIFICATION AND ASSESSMENT CRITERIA:

RULES FOR THE VERIFICATION OF LEARNING OUTCOMES ARE PRESENTED IN THE TABLE BELOW.

The reference to the learning outcomes of the field of study	**The method of the learning outcomes assessment**	**The reference to the learning outcomes of the field of study**
student has a basic knowledge of the chemistry needed to understand and describe the phenomena occurring in the manufacture and operation of machines	K_W03	grade
The student has knowledge of engineering materials, their research and technology development	K_W13	grade
The student has a basic knowledge on developments in the design, manufacture, construction and operation of machines	K_W14	grade
know the basic methods, techniques and tools required to solve simple tasks in the field of construction engineering, technology, manufacturing and maintenance of machinery	K_W16	grade
able to use information and communication technologies relevant to the tasks related to the design and operation of production machinery	K_U07	report of the exercises
can use the measuring apparatus used in problems of mechanics and	K_U14	report of the

mechanical engineering as well as methods for estimating measurement errors		exercises
understand the non-technical aspects of the mechanical engineer, the validity and effects, including the impact on the environment and consequently the responsibility for decisions	K_K02	report of the exercises
understand the social role of the engineer and is involved in the transmission of reliable information and views on technological developments in the field of engineering, construction and operation of machines	K_K07	report of the exercises

Lecture - subject to completion of the lecture is to provide a positive evaluation of the three written responses to questions regarding basic issues subject.
Laboratory - Laboratory provided credit is a credit report from each class
In evaluating the questions of the lecture, the following guidelines:

For grade 2	For grade 3	For grade 4	For grade 5
The student did not understand the question, can not properly be answered	Replies contain only basic information without supporting diagrams, charts, etc.	Replies include information presented in the classroom, but not fully complete or with minor errors	Replies contain complete information presented in the classroom and their own perception of the problem

STUDENT WORKLOAD:

The student workload of 60 hours, including work in the auditorium 30 (16) hours, working alone 30 (44) hours, including preparation for classes and study reports, 20 (44) hours, to prepare for the test 10
Total hours of practical classes: 35 (41), which corresponds to 2 ECTS
Total hours of lessons with a teacher: 30 (18) which corresponds to 1 ECTS

RECOMMENDED READING:

1. Laber S. Diagnostyka elementów maszyn. Praca przygotowana do druku. Uniwersytet Zielonogórski 2008;
2. Cempel Cz., Tomaszewski F.: Diagnostyka maszyn. Przykłady zastosowań. Wyd. MCNEMT. Radom 1992;

OPTIONAL READING:

1. Cholewa W., Kazimierczak J.: Diagnostyka techniczna maszyn - przetwarzanie cech sygnałów. Wyd. Politechnika Śląska. Gliwice 1995.

REMARKS:

LIST OF LABORATORIES FOR PART TIME STUDENTS IS SELECTED FROM THE LIST ABOVE.

WORKLOADS IN PARENTHESES ARE THE NUMBERS FOR PART TIME **STUDIES**