

Goals and Learning Outcomes of Bachelor Studies

semester	department	ID		title	goal	learning outcome
1	industrial engineering	BSc-0506	obligatory	English 1	Achieving competence in oral and written communication by acquiring an appropriate level of active knowledge of English. Training students to use vocational literature in order to master the disciplines of their future profession and be able to follow their development in the world, as well as to use the knowledge of English for equal participation and accomplishment of contacts on the professional level.	Development of skills for active usage of the language in the situations of professional and business communication. Expanding and enriching the usage of vocational terminology and vocational vocabulary in general in oral and written form (abstracts, summaries, business letter), improving oral expression; acquisition and mastering of skills of using grammar structures characteristic for vocational language.
1	mathematics	BSc-0669	obligatory	Mathematics 1	The aim of the course Mathematics 1 is to introduce students to basics of the following topics: Vector algebra, matrices and determinants, system of linear equations, planes and lines in analytic geometry, differential calculus of real functions in one real variable, curves as hodographs of vector functions.	The main outcome from studying Mathematics 1 is improving the general education level, forming work habits and systematic in work, as well as developing professional strictness. Having mastered the curriculum of the course Mathematics 1, the student should understand the topics to the point of being able to solve specific problems and of successfully attending technical courses during continued studies.
1	mathematics	BSc-0670	obligatory	Essential	The main objective of this course is to	After successful completion of

programming in C introduce students to the use C as programming language. It will be especially prominent characteristic to use C in Mechanical Engineering, characterized by analysis of the data collected in real time. Students must be:

- familiar with the data types and data structures;
- identify common use of the programming language C;
- use basic commands and C, and with their help solve simple engineering problems;
- familiar with using C for the analysis of data characteristic of Mechanical Engineering;
- familiar with basic programming techniques, which are characterized not only C.

the course, students can:

- to recognize the possible use of C programming language to solve some problems in Mechanical Engineers.
- to gain basic knowledge of the principles of programming in C;
- to use the file.

1	mechanics	BSc-0001	obligatory	Mechanics 1	-to provide students knowledge of the fundamental principles of Statics -to enable students to master the reduction of system to the simple form and determining conditions of equilibrium of the force system -to prepare students for solving the problems in different engineering and scientific fields	-to enable students to solve efficiently the problems of Statics -to develop in students the ability to apply their knowledge to solve practical problems in high level technical courses which deal with the problems of Statics
1	physics and electrical engineering	BSc-0025	obligatory	Physics and Measurements	Understanding of basic physical concepts and laws. Aspects of practical application of these laws. Development of problem solving skills through examples from engineering practice and everyday life by applying basic physics laws. Introduction to main devices and methods of direct and indirect measurements in physics and techniques. Understanding of contemporary methods for measurement result processing.	Final outcome: 1) interconnection of different teaching units within the course and reviewing of general physical principles in different fields; 2) logical and critical reasoning while dealing with natural and technical phenomena; 3)utilization of dimensional analysis and methods for problem solving; 4)independent and team experimental work;

						5)estimation of measurement uncertainty.
1	strength of structures	BSc-0020	obligatory	Strength of materials	The aim of this course is to introduce students to the concepts of stress and strain, the relevant material properties and geometric characteristics of the cross sections. The core of this matter relates to the determination of stress and strain of an elementary loading types (axial loading, torsion, bending). The special attention is in the interpretation of the physicality of the problem, too.	By mastering the curriculum, the students receive the following skills: mastery of methods, procedures and processes of research; in-depth knowledge and understanding the concept of the strength theory; solving practical problems using scientific methods and procedures; linking basic knowledges from various fields with the aim of making it usable in practice and in various computer programs.
1	theory of machanisms and machines	BSc-0203	obligatory	CONSTRUCTIVE GEOMETRY AND GRAPHICS	The objectives of this course are to acquire knowledge for comprehending, constructive processing and modeling of the objects of three-dimensional space. Practicing and mastering the basic operations and methods for efficient geometric analysis and synthesis of various abstract and concrete forms can be considered as the study program objective. Moreover, particularly important goal of this course is the theoretical preparation and development of creative skills for effective use of modern software packages for three-dimensional modeling and design.	Mastering the program, students obtain and improve ability to use geometric operations and methods for creative observation and modeling of three-dimensional space. In addition, the adoption of the scheduled curriculum, a student acquires the knowledge and skills for effective visual communication in engineering practice.
2	engineering materials and welding, tribology, fuels and combustion	BSc-0035	obligatory	Engineering materials 1	The aim of this course is for students to become competent in the area of welding. This course is designed to provide information through theoretical lectures, computational classes and seminar papers, but also through	After fulfilling all the course requirements, a student is capable to solve concrete problems in the area of Engineering materials 1 using aquired knowledge, as well as to

				welding workshop practice. They should also develop appropriate academic skills needed for the profession and become informed with the specificity of each welding process and appropriate equipment.	comprehend possible consequences of the proposed solution. Throughout this course students would also develop the ability to combine acquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.	
2	industrial engineering	BSc-0405	obligatory	Fundamentals of Sociology and Economics	The aim of this subject is that students get know basic principles of fundamental social science, sociology and economics, and become able to understand the most important appearances and processes in modern societies, especially in societies within globalization. The aim is to more competencies for self and responsible taking part in processes of professional and public decisions. Topics covered in this course include sociology as science, culture, socialization, social groups, social organization, education, deviance, crime, class, inequality, race and ethnicity, gender, family, social change, technology and population. The course stresses the learned nature of human behavior as a shared product of the ongoing interaction of individuals and groups within the changing institutional structure we call society. Also, topics in Economics presents basic concepts and theories in many areas of contemporary economy. Topics covered in this class include key aspects of micro and macroeconomics.	By adopting of the programme of this course the students strengthen their own abilities to understand critically the most important controversies of development of all modern societies, especially of transitional ones, such as ours. Modern theoretical concepts and empirical methods are of special importance. The study specialization covers the themes of social integration, power, social change, the individual and society, as well as examining the social and economic basis of culture, beliefs, consciousness and general social development.
2	industrial	BSc-0489	obligatory	English 2	Achieving competence in oral and	Development of skills for active

engineering

written communication by acquiring a certain level of active knowledge of English. Training students to use vocational literature in order to master the disciplines of their future profession and be able to follow their development in the world, as well as to use the knowledge of English for equal participation and accomplishment of contacts on the professional level.

usage of the language in the situations of professional and business communication. Expanding and enriching the usage of vocational terminology and vocational vocabulary in general in oral and written form (abstracts, summaries, business letter), improving oral expression; acquisition and mastering of skills of using grammar structures characteristic for vocational language.

2	mathematics	BSc-0671	obligatory	Mathematics 2	The aim of the course Mathematics 2 is to introduce students to basics of the following topics: Indefinite and definite integrals and their applications, differential calculus of real-valued multi-variable functions (which depend on several independent real variables), first-order differential equations.	The main outcome from studying Mathematics 2 is improving the general education level, forming work habits and systematic in work, as well as developing professional strictness. Having mastered the curriculum of the course Mathematics 2, the student should understand the topics to the point of being able to solve specific problems and of successfully attending technical courses during continued studies.
2	mathematics	BSc-0016	obligatory	COMPUTING TOOLS	The student should learn the process of solving mathematical problems in the MATLAB program package. In addition, the student is familiarized with limitations of computational technique and error management in numerical procedures.	1. The student should be familiar with characteristics and specifics of the MATLAB program package. 2. He should master theoretical fundamentals of high-level computational tools. 3. He should master programming methods in the

						MATLAB package. 4. He should be familiar with limitations of computational technique.
2	strength of structures	BSc-0021	obligatory	The Base of the Strength of Constructions	The aim of this course is to introduce students to some complex loadings. The bending of the statically indeterminate beams, as well as torsion and buckling of an arbitrary cross sections are considering. Course shows the method of determining the equivalent stresses in a complex spatial loading of structures, that students later can use the computer programs based on Finite Element Method-FEM.	Mastering the program contemplated by this course, students acquire next skills: mastering of methods, procedures and processes of research in this field; application the knowledge in this practice; thorough knowledge and understanding of the discipline; solving practical problems using scientific and technical methods and procedures; the possibility of the proper use of computer programs based on Finite Element Method-FEM.
2	theory of machanisms and machines	BSc-0572	obligatory	Engineering Graphics	The goal of the course is that students master the skills necessary for successful viewing (and reading) of machine parts components technical drawings. The student should know all the rules and standards that are used for forming, dimensioning and defineing of the machine parts machining on the drawings.	The outcome of this course is the students' ability to model mechanical parts as well as their assemblies by the using of the software package SolidWorks. Moreoever, it is necessary to show the assemblies and parts on drawings with the appropriate sections so that they can be fully formally, dimension and machining defined.
3	engineering materials and welding, tribology, fuels and combustion	BSc-0036	obligatory	Engineering materials 2	The aim of this course is for students to become competent in the area of Engineering materials 2. They should also develop appropriate academic skills and creativity and master practical skills needed for the profession. This course is designed to provide information through theoretical lectures but also through	After fulfilling all the course requirements, a student is capable to solve concrete problems in the area of Engineering materials 2 using aquired knowledge, as well as to comprehend possible consequences of the proposed

				laboratory type (practical) exercises, computational classes and seminar papers students are responsible for writing.	solution. Throughout this course students would also develop the ability to combine acquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.
3	general machine design	BSc-0045	obligatory	Machine Elements 1 Introduce the students in solving of practical tasks in mechanical engineering. Teach students to understand components of mechanical systems, their functions, applications and variants of design solutions. Mastering the methods for calculation of operational safety, calculation of service life, and carrying capacity and also mastering the basics principles for machine elements design. Introduce the students to apply standards and other regulations in calculations and design of machine elements.	The student has acquired knowledge of the basic components of mechanical systems - Machine elements. He acquired skill in determining the basic design parameters of machine elements (material, dimensions, tolerance, service stress, endurance limits, the level of safety, caring capacity, etc.). The student is trained to choose a standard machine parts and assemblies and to build them in the wither structure of the mechanical system. It was introduced into the question of development (fundaments of design) of new machine parts and machine elements. Trained to deal with practical issues in mechanical engineering.
3	mathematics	BSc-0672	obligatory	Mathematics 3 The aim of the course Mathematics 3 is to introduce students to basics of the following topics: Linear differential equations of higher order, linear systems of differential equations, path and line integrals, multiple integrals, scalar and vector fields.	The main outcome from studying Mathematics 3 is improving the general education level, forming work habits and systematic in work, as well as developing professional strictness. Having mastered the curriculum of the course Mathematics 3, the student

					should understand the topics to the point of being able to solve specific problems and of successfully attending technical courses during continued studies.	
3	mechanics	BSc-0002	obligatory	Mechanics 2	<p>-to provide students knowledge of the fundamental principles of Kinematics and Particle Dynamics -to enable students to master the determination of motion, properties of motion of mechanical objects and determination the causes of motions -to prepare students for solving the problems in different engineering and scientific fields</p>	<p>-to enable students to solve efficiently the problems of Kinematics and Particle Dynamics -to develop in students the ability to apply their knowledge to solve practical problems in high level technical courses which deal with the problems of Kinematics and Particle Dynamics</p>
4	general machine design	BSc-0046	obligatory	Machine Elements 2	<p>Introduce the students in solving of practical tasks in mechanical engineering. Teach students to understand components of mechanical systems, their functions, applications and variants of design solutions. Mastering the methods for calculation of operational safety, calculation of service life, and carrying capacity and also mastering the basics principles for machine elements design. Introduce the students to apply standards and other regulations in calculations and design of machine elements.</p>	<p>The student has acquired knowledge of the basic components of mechanical systems - Machine elements. He acquired skill in determining the basic design parameters of machine elements (material, dimensions, tolerance, service stress, endurance limits, the level of safety, caring capacity, etc.). The student is trained to choose a standard machine parts and assemblies and to build them in the wither structure of the mechanical system. It was introduced into the question of development (fundaments of design) of new machine parts and machine elements. Trained to deal with practical issues in</p>

					mechanical engineering.	
4	general machine design	BSc-0714	obligatory	Mechanical Engineering Praxis	Introduction of the students about all mechanical fields which are the subject of studying in Mechanical faculty from the point o view of practical work in each particular field: Control Engineering, Biomedical engineering, Naval architecture, Aerospace engineering, Design in mechanical engineering, Railway mechanical engineering, Welding and welded structures, Engineering of biotechnical systems, Industrial engineering, Information technologies, Motor vehicles, Internal combustion engines, Food industry engineering, Production engineering, Process engineering and environment protection, Weapon systems, Thermal power engineering, Material handling, constructions and logistics, Thermal science engineering, Hydropower engineering, Computational Engineering	The students will be introduced about practical work in all fields which are the subject of studying in Mechanical faculty.
4	mechanics	BSc-0003	obligatory	Mechanics 3	-to provide students knowledge of the fundamental principles of Particle Dynamics and Mechanical System Dynamics -to enable students to master the basic theorems and laws of Mechanical System Dynamics, basic concepts of linear vibration of a particle and elements of Analytical Mechanics - to prepare students for solving the problems in different engineering and scientific fields	-to enable students to solve efficiently the problems of Particle Dynamics and Mechanical System Dynamics - to develop in students the ability to apply their knowledge to solve practical problems in high level technical courses which deal with the problems of Kinematics and Dynamics
4	thermomechanics	BSc-0372	obligatory	Thermodynamics B	Understanding and acquiring the fundamental thermodynamic principles and laws, and knowledge of	Qualifying for following and acquiring knowledge from appropriate scientific-applied

				thermodynamic states and state changes of matters included in energy transformations processes. Understanding the principles of operation of thermal engines and refrigeration devices, and knowledge of fundamentals of the energy transfer by heat.	fields, and ability to synthesize and apply the gathered knowledge.	
5	fluid mechanics	BSc-0684	obligatory	Fluid mechanics B	<p>The goal of the course is to teach the student the basics and applications in science of fluid flow. The essence in that sense is good understanding of fundamental equations of fluid mechanics. That good understanding of the equations makes the process of finding the solution in particular engineering problems which are dealing with fluid flow much easier. Also another important goal of the subject is the teach the student the basics of experimental methods in fluid mechanics. This will be accomplished by the work in the laboratory.</p>	<p>Learning the topics from the course student will get the knowledge about basic principles in fluid mechanics and capabilities of analytical thinking, then how to apply the knowledge in practical work, and also to make the connection between various subjects from mechanical engineering.</p>
5	mathematics	BSc-0673	obligatory	Numerical methods	<p>The main goal of this subject is to introduce the students with the basics of the numerical and functional series theory and the theory of numerical computation, as well as to demonstrate some implementation of the numerical methods in Matlab.</p>	<p>Students gain knowledge about numerical and functional series, and their application in approximation. Subject of the study is number representation in computers, problems occurring during computation with approximate quantities, numerical methods for the solutions of linear and non linear equations, methods of interpolation, methods for numerical differentiation and integration as well as numerical</p>

					methods for the solution of ordinary differential equations. Knowledge is supported by practical introduction through Matlab.
5	production engineering	BSc-0065	obligatory	Manufacturing Technology	<p>Manufacturing technology is a science and engineering practice in mechanical engineering and industrial environment to obtain a finished product. The aim of the course is to develop creative skills, in students of all study specializations, for product design, design for manufacturing and maintenance of industrial equipment in industrial production.</p> <p>The student should acquire knowledge and develop skills needed for advanced critical and self-critical approach to technology design, manufacturing of finished parts and equipment and overhauling, manufacturing methods, solving of concrete problems by using scientific methods and procedures.</p>
6	control engineering	BSc-0041	obligatory	INTRODUCTION TO AUTOMATIC CONTROL	<p>Introduction to basic concepts in the field of Automatic Control and training for implementation and verification of acquired knowledge to specific physical systems and processes. Acceptance of some methodologies for analytical and experimental verification of the basic static and dynamic characteristics and parameters of the system. Learning basic MATLAB tools to help in calculation and simulation of all of the computational parts of this subject.</p> <p>Getting basic knowledge of the automatic control. Identify and use the methods needed for analysis and synthesis of the controllers as a part of the control system, as well as the whole automatic control system. For proper use of computers and MATLAB in solving the main problems of the control systems, as well as other engineering problems. To be analytical and / or experimentally investigated the basic dynamic and static characteristics of the system</p>
6	physics and electrical engineering	BSc-0026	obligatory	Electrical and electronic engineering	<p>The aim of the course is to familiarize the students with basic laws of electrical and electronics engineering and to develop their competence for acquisition of more advanced academic knowledge</p> <p>Having successfully mastered the teaching contents of Electrical and electronics engineering, the student should be able to qualitatively pursue</p>

					and practical skills in scientific, professional and applied areas of mechanical engineering relying on electrical and electronics engineering. The students are introduced into basic phenomena, devices and circuits encountered in electrical engineering, and scientific methods for their analysis and basic measurements.	his scientific career and profession, manipulate methods of analysis and measurements in electrical engineering, anticipate the solutions and perceive the outcomes, acquire the insight into research and practical methods in the fields he can adequately apply in concrete problem solving in mechanical engineering.
6		BSc-0361	obligatory	Final course with a report (B.Sc. work)		
3	aerospace engineering	BSc-0630	elective	Fundamentals of aerotechnics	The aim of this course is to introduce students to basic concepts in the field aerotechnics. The subject is presented in four integrated areas: aerodynamics, structures and construction, plant and equipment. In addition to popularize aviation, the aim of this course is to highlight the role of students in various fields aerotechnics mechanical engineering.	After passing the subjects the students are expected to understand the basic concepts and problems in the field of aerodynamics, structures, construction, aircraft engines and aircraft equipment. In doing so, it is expected that the student able to recognize and apply these disciplines of aviation technology in other areas.
3	control engineering	BSc-0723	elective	Fundamentals of biomedical engineering	Introducing students with fundamental similarities and differences of natural, biological and technical systems. Structural and functional basis of human organism. Physical and chemical methods and technics in diagnostics and therapy. Mastering basic knowledge's of theoretical and functional basis of instruments for measuring, apparatus and devices in biology and medicine. Basic maintain principles of biomedical devices and instrumentation.	After passing exam student is capable to understand systematic fundamentals human organism functioning, methods and techniques of diagnostics and therapy, principles of medical apparatus and devices functioning, as well as fundamentals of biomedical software engineering.

					Foundamentals of application information technologies in medicine.	
3	control engineering	BSc-0581	elective	Computer Control Systems	-This subject introduce candidate with basic principles of computer control systems. Also the candidate will be qualified to implement and verify presented theory to real computer control systems. -Candidate will be familiar with some metodologies for selecting components of various computer control systema. -Candidate will be familiar with real systems functionality as well as tuning of computer control systems.	-Introduction with basic principles of computer control systems that is necessary to modern engineer. -Introduction and use of various methods for control control systems analysis and synthesis. -Development of analytical and/or experimental methods of testing basic dynamic and static characteristics of control components and computer control systems.
3	engineering materials and welding, tribology, fuels and combustion	BSc-0054	elective	Fuel, Lubricants and Industrial Water	Fuel types. Stoichiometric combustion equations. Combustion temperature. Characterization of solid fuels, proximate and elemental analysis. Solid fuel origins, derivation, applications. Liquid fuels, origins, derivation, applications. Gaseous fuels, origins, derivation, applications. Lubricants, types and main characteristics, derivation, applications. Industrial water, types and properties. Essential characteristics of the water for use in industrial purposes. Problems in the use of natural waters. Water treatment for industrial applications.	Acquisition of basic knowledge about the concept of fuel, types and properties. Mastering the basic techniques of calculation of quantity and composition of the products of combustion and combustion temperature. Acquiring basic knowledge on the characterization of solid fuels, their origins, derivation and application. Basic knowledge of liquid and gaseous fuels, their origins, derivation and application. Basic knowledge about the types of lubricants, properties and application. Basic knowledge about water and preparation for use in industrial purposes.
3	general machine design	BSc-0660	elective	Fundamentals of product development	Convict students that the product development is the base of economic prosperity of society. Development of	Student, future mechanical engineer, is realized necessity for the new product

science, technology and social sense push over existing products and depots necessity for development of the new. Except of learning of existing mechanical systems, design by coping and maintenance learning, engineers have to introduce and have ability for the new technical systems which are basically different comparing to existing ones. They have to introduce with methodology of knowledge transformation in technical systems. The objective of the subject is to involve students in thinking process in this direction.

development, he is introduced with transformation process of knowledge into technical solution, with procedure of transformation, with fundamental postulates and effects of product realization. The areas of engineer creativity and effects are identified in relation with design coping of existing systems and learning to maintain these systems.

3	industrial engineering	BSc-0592	elective	Engineering economic analysis	Training students to be able to make timely and optimal business decisions, of which directly depend on the overall business results achieved. Most important decisions are taken based on the foregoing analysis and tests of overall conditions and results of their implementation, so it is necessary to introduce students to different models of analysis for the implementation of successful business management.	Mastering this program, student obtains the following general skills: analysis and synthesis and forecasting solutions and consequences; mastery of methods, procedures and processes of research; application of knowledge in practice. He also obtains the following subject-specific skills: solving practical problems using scientific methods and procedures, linking basic knowledge in various fields and their applications.
3	industrial engineering	BSc-0209	elective	Introduction to Industrial Engineering	Acquisition of knowledge for successful management of enterprises. Apart from necessary theoretical knowledge, concepts, methods and techniques for solving some practical problems in the area of industrial engineering are studied.	Thorough knowledge and understanding of the scientific area of industrial engineering. Solving concrete problems by using methods and techniques of industrial engineering. Linking basic knowledge from

						various areas and its application. Development of communication skills and cooperation with the environment. Use of information technologies to master knowledge of the appropriate area.
3	information technologies	BSc-0384	elective	Engineering communication	<ul style="list-style-type: none"> Understanding the importance and gaining ground skills in the preparation and execution of communication with different customers (management, professional services, colleagues and clients). Introduction to the creation, presentation and use of engineering documentation. Computer processing of documentation Identifying the basic functional units in companies, and learning about mutual communication these entities. Understanding the basic documents that characterize the activities of companies. Preparation for the Computer processing of these documents. 	The acquired knowledge enables listener: <ul style="list-style-type: none"> to prepare, create and display their own skills. to prepare, make and present a report on the accomplished work. to prepare, perform and manage the presentation, discussion. to recognize the basic functional units of the company, and to notice interdependent. to recognize the basic documentation of the company, and to prepare the basic documentation for computer processing.
3	mathematics	BSc-0543	elective	Introduction to Probability and Statistics	Introduction to techniques of probability theory, reliability theory, mathematical statistics and their most important application in technics. Introduction to techniques of regression analysis and stochastic modelling.	Training students for usage of probability theory, reliability theory and mathematical statistics in solving technical problems, as well as development of the capabilities for its own modeling of nondeterministic systems.
3	motor vehicles	BSc-0426	elective	Fundamentals of Motor Vehicles	Aims of this course include achieving of competences for conquering of basic specific knowledge and skills needed for overviewing and understanding of problems of motor vehicles, its functioning, basic systems, as well as	By conquering of this course, students achieve basic and course-specific capabilities, which are in function of analysis and synthesis of vehicle systems functioning, as well as

					vehicle`s drag and dynamic characteristics in particular environment conditions.	prediction of vehicle behaviour in characteristic conditions of moving.
3	production engineering	BSc-0573	elective	Biomedical Software Basics	Introducing students to the basic software packages for numerical analysis, data processing, mathematical modeling and graphical visualization of results. Solving specific problems in biomedical engineering and scientific practice.	Attending the course, students are trained for analyzing and processing data obtained from different measurements and numerical modeling of systems and processes.
3	railway mechanical engineering	BSc-0652	elective	Railway Systems	1. Introducing students with railway transport system as part of the overall transport system. 2. Introducing students with concept, characteristics and drive of vehicles and their interaction with railway infrastructure.	When course is finished student will get following: - basic knowledge of the railway transport, - specific knowledge of the conception and characteristics of railway vehicles and their interaction with railway infrastructure, - understanding of terms of the field of planning traffic, management of traffic, control of traffic and reliability, availability, maintenance and safety and costs of life cycle, - knowledge of the basic terms of national railway operator and way of functioning, - knowledge of the production process of railway vehicles and components.
3	thermomechanics	BSc-0668	elective	Steady state problems in heat transfer	Students will acquire theoretical and applied (practical) knowledge on steady state problems in heat transfer. Based upon the acquired knowledge they will be ready to recognise and solve the applied (practical) problems encountered in engineering practice, especially in the	After attending lectures, completing the pre-examination activities and successfully passing the exam, the students will be ready to perform thermal calculations of simple process engineering-, HVAC

					areas of process-, HVAC- and thermal power engineering. Students will acquire knowledge in steady state heat conduction, heat convection and heat transfer by boiling and condensation, heat exchanger design and radiation heat transfer.	engineering-, and thermal power engineering installations and single units. This course will give to the students a sound theoretical and applied (practical) basis for active participation in courses on related theoretical and applied engineering subjects in our school and elsewhere.
3	weapon systems	BSc-0210	elective	Introduction to Weapon Systems	The main objective of this course is to introduce students to the field of weapons systems. Students get basic knowledge in the field of defense technologies, and learn the classification, purpose, importance and basic principles underlying the modern weapon systems. Gain insight into the complexity and variety of weapons systems and get a clear overview of this multidisciplinary field.	Student gets the necessary basic knowledge of weapons systems that include classification, purpose and key principles of their action. By connecting the learning to previously acquired knowledge, a student has a complete overview of the field of weapon systems.
4	aerospace engineering	BSc-0429	elective	AERODYNAMIC CONSTRUCTIONS	The aim of this course is to introduce students to basic concepts in applied aerodynamics. The emphasis is on the aerodynamics of aircraft, but will consider the role in the construction of wind turbines, cars, etc. Concept of aerodynamic loads will be analyzed and its importance not only when it comes to aircraft parts, but also buildings, bridges, ect.	After passing the course student is expected to discuss the basic laws of aerodynamics and know how to apply them to solve practical problems. At the same time it is expected that student recognize problems, and implementation of these results in other areas of technics.
4	aerospace engineering	BSc-0398	elective	Skill praxis B - AV	The goal of this course is to introduce students to the process of design and construction aircraft technology, installation of aviation equipment and systems, process manufacturing aircraft	Successful completion of course students are introduced to: corresponding types of aircraft, analysis methods and procedures of design and construction of aircraft, aircraft

					components, methods of aircraft ground and flight testing; introduction to the factories technological production lines, quality control, safety systems organization, maintenance process.	technical regulations of safety and maintenance(JAR i FAR)etc.
4	agricultural engineering	BSc-0460	elective	Renewable and secondary resources	Understanding the theoretical foundations and engineering data which engineers need for the rational use of energy, design of appropriate solutions and efficient implementation of processes and work units and systems for useful valorisation of renewable and secondary energy sources, including the development of creative abilities and mastery of practical skills for specific job performance.	Qualifications of the theoretical and practical knowledge necessary to independently solve concrete theoretical and engineering tasks in a useful valorisation of renewable and secondary energy sources, including the application of knowledge in practice, solving practical problems using scientific methods and procedures and monitoring and implementation of innovations in the profession.
4	agricultural engineering	BSc-0500	elective	Skill Praxis B - IBS	Practical experience and students living in agricultural combines and factories of agricultural machinery and equipment, where the student will realize his professional career. Identifying the basic functions of the business system in the field of design, development and production, as well as the role and tasks of agricultural mechanical engineering in such a business system.	Students obtain practical experience on the way is the organization and functioning of the environment in which they will apply their knowledge in their future professional career. Student identifies models of communication with colleagues and business communications trends. Student identifies the core processes in the design, manufacture, maintenance of agricultural machinery and equipment in the context of his future professional competence. Establish the personal contacts and relationships that will be able to use at school or entering

						into future employment.
4	control engineering	BSc-0632	elective	Systems of Control	<ul style="list-style-type: none"> •Introduction in automatic control systems by illustrative examples. •Knowledge needed for proper understanding of digital control significance and diversity as well as getting of the basis for further deepening to the analyze and design methodologies and real time control . •Introduction to basic of of nonlinear systems and their characteristics. •Understanding of fuzzy approach to modeling phenomenon, process and systems, and control. •Basic components of control systems. Simulation of these components in Simulink. •Introduction in virtual instrumentation. Measurement and acquisitio by LabView. •Introduction in software packages for analysis of automatic control systems Matlab and Simulink. •Introduction in simulation and control of robotic systems. Example on software package and on real robotic system. 	<ul style="list-style-type: none"> •Knowledge necessary for basic overview of automatic control in mechanical engineering. •Knowledge and understanding of nonlinear problems and phenomena in the processes and plants, matematical description and analysis. •Knowledge and understanding of fuzzy set, fuzzy logic and fuzzy control theory •Knowledge needed for proper understanding of digital control significance and diversity as well as getting of the basis for further deepening to the analyze and design methodologies and real time control . •Introduction in design testing and control of automatic systems by digital computer.
4	control engineering	BSc-0724	elective	System Approach to Human Anatomy and Physiology	Introducing students to basic concepts and terms of physiology and anatomy. Systematic approach to studying human organism as a whole with special emphasis on the importance of a certain human organs as a space-time musculoskeletal system. The study of anatomical and tissue characteristics of individual organs and organ systems for the design of devices for diagnostics and rehabilitation. Basis for nano-fractal analysis of human organism.	After passing the exam the student is able to understand the basics of cell system, tissues, organs and human body functioning. Student is introduced to basic methods and techniques in the diagnosis and treatment of functional conditions of organs and subsystems of the human body is learned.
4	control	BSc-0725	elective	Skill Praxis B -	The goal of the course is introducing	With mastering the course

	engineering			BMI	students with operation and maintenance of instruments, apparatus and devices in different areas of medicine, especially in clinics and health centers. Professional practice should enable students to easier ad quicker master technical courses, especially in area of early diagnostics of skin cancer and melanoma, ophthalmology, refractive surgery, dentistry, obstetrics...	program, students get familiar with: 1. organizational problems of clinics, especially informational processes, databases 2. functioning and maintenance of instruments for measurements, apparatus, and devices for diagnostics and therapy 3. processes of maintenance of instrumentation, apparatus, and devices.
4	control engineering	BSc-0633	elective	Skill Praxis B - SAU	Practical experience and students stay in the environment in which the student will realize his professional career. Identifying the basic functions of the business system in the field of design, development and production, as well as the roles and tasks of mechanical engineering in such a business system.	Students obtain practical experience on how the organization and functioning of the environment in which they will apply their knowledge in their future professional career. Student identifies models of communication with colleagues and business information flows. Student identifies the core processes in the design, manufacture, maintenance, in the context of his future professional competence. Establish the personal contacts and relationships that will be able to use at school or entering into future employment.
4	engineering materials and welding, tribology, fuels and combustion	BSc-0483	elective	Skill Praxis B - ZZK	Objectives of this course are that students, after completing theoretical training, are prepared for their maximum involvement in practical training. Objective is that students become competent in the field of welding and gain appropriate academic skills, and also develop specific creative	By attending this course, provided by the curriculum of the subject, the student will be able to solve particular problems from practice, and to examine the possible consequences that may occur in case of bad solutions. The

					and practical skills that are needed in professional practice.	student will also able to link their knowledge from various fields and apply them in practice.
4	general machine design	BSc-0643	elective	Fundamentals of machine design	From the entire designers activity, here was separated only general significance - the basic design. It is being studied with the theoretical and practical aspects which gives the basic principles, methods and skills and thus develop a systematic and creative abilities of students. The matter in this subject is used further for design activities in each other specifically guidance.	Basic principles of design, the analysis of design phases and application of standardization, unification and typing. Meeting the conditions necessary for the construction of the basic parameters, such as: shape, size, selection of appropriate materials, prescribing tolerance etc. Modern calculations of strength, stiffness, safety, reliability and service life. Rational use of the load capacity of material.
4	general machine design	BSc-0482	elective	Skill Praxis B - DUM	Introducing the field of product development and design, particularly in terms of practical applications in mechanical engineering (functional, aesthetic, technological, market). Identifying the basic functions of design and its importance in product development, market competence and also in harmonization of technical solutions with environment. Consideration of the technological aspects of product development in mechanical engineering.	Practical experience in identifying characteristics of the product in mechanical engineering, functional, technological and aesthetic. Recognition of technology for realization of products, technologies for the development of functional properties and technologies for the development of aesthetic properties. Recognition of market and social needs for products. Recognition of the product life cycle phases in mechanical engineering: the development and design, technology implementation, operation and recycling.

4	general machine design	BSc-0715	elective	Skill Praxis B – MFB	Practical experience in ambient similar to the ambient where the graduated student - mechanical engineer will realize his own professional carrier. Recognizing the basic functioning of the business systems especially in domain of development, design and manufacturing of the mechanical systems.	Students can reach practical experiences about the organization and functioning the business systems that deal in mechanical engineering. Student may be introduced in business communication, design processes, development processes and manufacturing.
4	hydropower engineering	BSc-0623	elective	Skill Praxis B - HEN	The goal of professional practice is that students in addition to theoretical work within subjects at the faculty get to know and experience the jobs in factories, institutes, laboratories and similar commercial enterprises and thereby gain insight into the activities to be performed. During the practice, students must keep a diary in which they enter a description of the tasks performed, and write down their conclusions and observations. Following the practice, students must write a report that is to be discussed about with the subject teacher.	Observing the work practices a student acquires special knowledge of specific business enterprises, production facilities, public services and utilities and the like, so their theoretical knowledge can be applied to specific business practice. It is essential to acquire and develop a talent for communication and insight into professional ethics. Also the student has the ability to meet professional experts from whom they will get a good picture of how their knowledge can be usefully applied.
4	industrial engineering	BSc-0561	elective	Management of Production Processess	The aim of this course is to familiarize students with the basic characteristics of production processes, with special emphasis on small production companies. The first goal is formation and planning of the production process for a product through theoretical and practical preparation. Another objective of the course is theoretical and practical familiarization of students with the basic characteristics of enterprises functioning	After passing the course students should: be able to perceive the complexity and characteristics of production processes, to identify problems that may arise at the production processes and to be able to propose appropriate solutions for its improvement. Also after passing this course, students should be able for team work.

with respect to the all elements related to production processes.

4	industrial engineering	BSc-0039	elective	Business Management	The focus of analysis is the enterprise as production system, with complex internal and external environment. By simulation of realization of business ideas, the individual performances of every student will be shown. The aims of this study specialization is that students get know basic principles of the business in conditions of increasing competition both on local and international markets.	By get knowing of the content of Business Management the student will get know all the most important challenges, internal and external environment and other important conditions for own business undertaking. The higher level of knowledge and skills, as well as entrepreneurial features and competences necessary for successful leading of business, are expected. Writing of business plans is the opportunity to check to ability of potential entrepreneurs.
4	industrial engineering	BSc-0587	elective	Skill Praxis B - IIE	The aim of this course is introduction of students to the production processes and to acquire practical knowledge in the field of work organization in industrial enterprises. After taking this course, students will be familiar with the tasks of diagnosis and improvement the overall organization in the enterprises. Methods and techniques the students learn will be useful in everyday tasks of mechanical engineers.	By course mastering, the students get familiar with: 1. production processes in the enterprise, 2 internal transport, 3 terotechnological process 4. function of production planning, 5. the supply and storage of materials and others.
4	information technologies	BSc-0432	elective	Basic WEB projecting	Course objective: • To acquaint students with the importance and benefits of Web and Web programming. • To make students adopt some of the methodologies of data preparation for Web • To make students know the basic Web application to accept and display the data. • The creation, introduction	The acquired knowledge allows students: • to prepare, make and display their own skills, • to determine the functionality of the Web site, • to prepare and implement Web applications, • to prepare and implement a simple Web site, • working in a

					and use of the Web Site • Determining the functionality of your own web site	team, prepare and implement any Web site.
4	information technologies	BSc-0364	elective	Skill Praxis B - MIT	To provide students with practical experience of staying in an environment in which the student will realize his future career. Identifying the basic functions of information systems in the field of design, development and production software, as well as roles and tasks of mechanical engineering of information technology in such a business system.	Training students to apply previously acquired theoretical and practical engineering and scientific knowledge of information technology to solve specific practical engineering problems in the selected companies or Institutions. Activities to introduce students to selected companies or institutions, the manner of operation, management and engineering position and role of IT in their organizational structures.
4	internal combustion engines	BSc-0621	elective	Automotive engines design - introduction	The course enables the insight in engine working process fundamentals, engines types and classification and design of main engine elements and engine systems for fuel supply, cooling and lubrication. The course is indented for the students of IC engines group giving them the fundamentals for later more comprehensive study of engine design, and also for the students of other groups where basic knowledge of engine design is required.	Acquired theoretical and practical knowledge of the design of engine parts and systems train the students for practice in engine exploitation and maintenance in all technical field of engine application. Gained knowledge is the basic for deeper study during further Msc degree schooling with the aim to train the students for complex problems of the designing of engine parts, systems and the whole engines.
4	internal combustion engines	BSc-0698	elective	Skill Praxis B - MOT	Students will be acquainted with technological and manufacturing processes in IC engines and engines systems production, and also with specific activities during development and manufacturing. Also, the engines	Knowledge of manufacturing processes in production and operation facilities, which deals with IC engines and their systems, and their use, maintenance and repair

					use and maintenance, and repair processes will be considered.	processes.
4	material handling, constructios and logistics	BSc-0365	elective	Skill Praxis B - TKL	The goal of course is to acquaint students with the resources, machines and devices in the field of machinery used in various industries, especially in industry, construction, mining, transport, tourism, energy, process engineering, service industries.	With the successful completion of course students are introduced to: 1 Production processes in companies that produce or use mechines and devices for mechanization, 2 Intermittent and continuous internal transport.
4	motor vehicles	BSc-0427	elective	Vehicle Systems	Course objectives are to provide a comprehensive insight into the construction of motor vehicles. Providing knowledge related to constructive characteristics of systems, assemblies, and parts of motor vehicles as well as principles of their operation. Students should be able to understand the basic principles of motor vehicle systems operation, their basic tasks, and influence of construction solutions of motor vehicle systems on its overall behavior.	Course outcomes are development of student's abilities to understand construction of motor vehicles, the role, characteristics, and principles of motor vehicle systems operation. Critical analysis of operation of motor vehicles systems as well as ability to identify the influence of constructive characteristics of motor vehicle systems, assemblies, and parts on its overall functional characteristics. To be able to employ a range of skills focused on proposals related to redesign and improvement of constructive characteristics of motor vehicle systems, assemblies, and parts.
4	motor vehicles	BSc-0083	elective	Skill Praxis B - MOV	Aims of practice consider student's practical introduction in productive and technological procedures and processes in production of vehicles and other technical systems, and also in specific activities related to systems	With this practice, students in particular conditions (vehicle and other systems production, maintenance, testing and exploitation), acieve practical view in production segments of

					development and production, their testing, exploitation, maintenance, revitalization, etc.	elements, components and Vehicle systems, as well as problems of vehicle/systems mounting as a final product, their exploitation, maintenance and revitalization, according to plan and program of practice, defined related to real possibilities.
4	naval systems	BSc-0374	elective	Skill Praxis B - BRO	The student gains practical experience in the occupational environment where he will pursue his future career. He identifies essential functions of the business system in the domain of design, development and manufacturing as well as the role and tasks of a naval architect within such business system.	The student should gain practical experience in the way of organizing and functioning of the environment where he will apply the acquired expert knowledge, identify models of communication with his colleagues and business information flows, identify fundamental processes in design, manufacturing, maintenance within the context of his future competence, establish personal contacts and acquaintances he will make use of during his schooling, or when applying for job in the future.
4	process and environmental protection engineering	BSc-0081	elective	Introduction in process and environmental engineering	Process technique and environmental protection are associated with the request that the technical solutions make sense only when provide a sustainable development. Students get knowledge about the basic production processes and devices in industry and environmental protection measures during the work of these processes and apparatus. Visits are aimed at getting acquainted with real industrial plants and processes,	Understanding the terminology related to basic operation in processing industry and the problems related with environment. Acquiring the ability to analyze complex technological processes. Setting up the basic equations of balance. Solving concrete problems in engineering practice.

					laboratory work, measurement methods, processes, design and construction processes and equipment.	
4	process and environmental protection engineering	BSc-0501	elective	Skill Praxis B - PTH	<p>Practical experience and a student lounge in the process industry companies in which the student will realize his professional career.</p> <p>Identifying the basic functions of the business system in the field of design, development and production, as well as the role of engineers and process engineering tasks in such a business system.</p>	<p>Students get practical experience on the organization and functioning of the environment in which they will apply their knowledge in their future professional career.</p> <p>Student identifies models of communication with colleagues and business information flows.</p> <p>The student recognizes the basic processes in the design, manufacture, maintenance, process systems in the context of his future professional competence.</p> <p>Students establish the personal contacts and relationships that will be able to use at school or entering into future employment.</p>
4	production engineering	BSc-0663	elective	Computer Graphics	<p>The objective of this course is that students: obtain fundamental knowledge and skills necessary for advanced application of computer graphics in various engineering activities; master theoretical and mathematical basics of computer graphics; gain necessary knowledge, skills and practical experiences in development of software applications based on computer graphics; understand basic functional principles and acquire knowledge for advanced usage of computer aided design tools.</p>	<p>The outcomes of the course are: fundamental knowledge in the field of computer graphics and the methods based on computer graphics; knowledge, skills and practical experiences in application of computer graphics principles in development of software applications; knowledge necessary for advanced application of computer aided design tools (e.g. design of freeform curves and surfaces);</p>

					knowledge, skills and practical experience in generation of realistic images in three-dimensional graphics and animation	
4	production engineering	BSc-0404	elective	Computer simulation and artificial intelligence	<p>The aim of the course is to develop student's ability to model and analyze real system using discrete event simulation along with application of models, analysis of simulation results and comparison of alternative solutions. Artificial intelligence will be understood through models, structure of intelligent agents and machine learning. By using of simulation and software tools students will get knowledge for application of artificial neural networks.</p>	<p>After the course the students will understand the power, characteristics and limitations of discrete event simulation and how it is applicable for analyses and development of manufacturing and other discrete systems. Students' abilities to implement the model in a computer system will be developed. Also students will be able to verify the model built, to evaluate and analyze the model output, to compare alternatives and to make appropriate suggestions for the real system. Students will be able to independently choose methods based on application of artificial neural networks for solving of engineering problems along with modelling of optimal structure. They will also have ability to use software for simulation of artificial neural networks, analysis and presentation of obtained results.</p>
4	production engineering	BSc-0580	elective	Advanced biomedical software	<p>Introducing students to software packages MATLAB and EXCEL at a higher level. Increasing knowledge gained in the course Fundamentals of biomedical software. Forming models of</p>	<p>Attending the course students become capable of processing and analysing data and forming biological systems and processes model.</p>

					biological systems in the Simulink software package. Introducing students to basic principles of processing, analysis and display of biological signals in these software packages.	
4	production engineering	BSc-0576	elective	Skill Praxis B - PRO	The aims are to acquaint students with the environment where production, technological and metalworking processes take place. Students of production engineering will acquire knowledge in the domain of production systems (machine systems, industrial robots, tools and tooling and measuring equipment), production and information technologies, storage of equipment, primary materials, organizational structure of some producing enterprises (visit to enterprises). Students gain experience in the domain of manufacturing technologies, machine tools, industrial robots, manufacturing automation, and use of computers in design, production and information-communication technologies.	Having successfully completed Skill Praxis, the student should gain practical knowledge of production technologies, machine tools, industrial robots, manufacturing automation, computer use in machine design, manufacturing and information-communication technologies.
4	railway mechanical engineering	BSc-0395	elective	Skill Praxis B - ZEM	1. Understanding the fundamentals of design of powered and non-powered rail vehicles 2. Acquire practical insight into the fundamental problems of service management of the rolling stock 3. Acquire practical insight into the basics of organization of the maintenance of rail rolling stock 4. Understanding the fundamentals of the production techniques and production processes that are used for rail vehicles	After the end of the course the student should be able to: 1. Recognize typical vehicles and their main assemblies of the vehicles existing on the practicing site. 2. Explain the main tasks of the plant where he/she was practicing. 3. Identify the main manufacturing or maintenance techniques and processes used at the practicing site.
4	theory of	BSc-0212	elective	Skill Praxis B -	1. Introduction to material science	Mastering the study program

	machanisms and machines			PRM	necessary for application in manufacturing of food processing machinery. 2. Practical application of knowledge in engineering graphics and solid-modeling. 3. Developing creative capabilities in students for designing food processing machinery, machines and systems with structural analysis and exploiting characteristics of food processing machines and plants.	the student obtains abilities: 1. Analysis of existing solutions and their effects 2. Adopting practical knowledge 3. Application of knowledge in practice 4. Knowing and understanding the problematic of technological steps in food processing manufacturing.
4	thermal power engineering	BSc-0406	elective	Introduction to Energetics	The aim is to obtain academic knowledge about the processes and equipment for exploitation of fossil fuels' primary energy, hydropower, nuclear power, geothermal, solar and wind energy, conversion and transformation of primary into secondary energy forms, such as heat, mechanical work, electricity, transport as well as distribution of energy and working fluid, energy storage, and utilization of energy in final consumption for heating, air conditioning and refrigeration.	Students acquire basic knowledge of technological systems, energy equipment and processes in thermal power plants, hydro power plants, boiler plants, nuclear power plants and heating systems, refrigeration and air conditioning systems. Students become familiar with the processes and technical solutions of turbomachinery, such as water turbines, steam and gas turbines, pumps, fans and compressors, as well as advanced methods and solutions for efficient energy consumption, environmental protection and analysis of macroenergy system.
4	thermal power engineering	BSc-0063	elective	Skill Praxis B - TEN	The aim of this course is to introduce students to the process of design and analysis of thermal power plants, processes and systems, power equipment manufacturing process, methods of calculation and analysis of mechanical and thermal loads of energy	The successful completion of course students are introduced to: the appropriate energy processes, major and minor technological systems, the spatial distribution of equipment, methods, process

					equipment, technological lines of production, quality control, organization of construction methods, maintenance schedules and technological systems at power plants, transportation, power equipment, modern methods of calculation.	analysis, measurement of process parameters, facilities management systems, etc.
4	thermal science engineering	BSc-0077	elective	Skill Praxis B - TTA	The aim of this course is to introduce students to the process of design and construction of HVAC systems, processes and systems, elements of the production process and HVAC systems equipment, methods of calculation used in the design of HVAC systems, introduction to the technological production lines in factories, quality control, work organization and systems maintenance.	By the successful completion of the course students are introduced to: the elements of HVAC installations, methods of process analysis and installations design, system operating parameters measurement etc.
4	weapon systems	BSc-0408	elective	Fundamentals of Weapon System Design	Students should have the basic knowledge of the general methods of weapons systems design. The goal is to provide students with an integrated overview of the most important fields of defense technology and appropriate methods of design and construction. The subject should serve as a basis for a thorough study of individual areas of weapons systems.	Students should obtain the basic knowledge of the general methods of weapons systems design. The goal is to provide students with an integrated overview of the most important fields of defense technology and appropriate methods of design and construction. The subject should serve as a basis for a thorough study of individual areas in the field of weapons systems.
4	weapon systems	BSc-0376	elective	Skill Praxis B - SIN	The course teaches the student to approach the practical activities of engineers through the practical work. The student gains an opportunity to apply into practice the knowledge and skills obtained by studying the theory.	Students will acquire practical knowledge in the field of weapons systems related to the fundamentals of design, the main production technologies, the organization of work,

					By that way students would gain insight into the technical and organizational aspects of work and their mutual relationship in companies or institutions.	methods of product testing and the like.
5	aerospace engineering	BSc-0610	elective	Aerodynamics	The aim is that after attended course in Aerodynamics, students become familiar with the basic laws of aerodynamics, and their application in solving practical problems. Specific issues and phenomena of compressible flow are analyzed. Students acquire knowledge about the design concepts of aircraft for different speed domains, as well as about the fundamentals of the road vehicle aerodynamics. Within the course, students also become familiar with the basics of experimental aerodynamics, and its application in aeronautical and non-aeronautical testing.	After accomplishing the course, students acquire knowledge in the domain of aerodynamics, with special attention paid on compressible flow domain, as well as the understanding of basic aircraft design schemes and automobile aerodynamics. They also gain knowledge about the basics of experimental aerodynamics, and its application not only in the domain of aviation, but also in other technical branches.
5	aerospace engineering	BSc-0648	elective	Mechanics of Flight	Introduce students to the basics of movement of aircraft in atmospheric and space flight. Students will learning the basis of performance, stability, controllability and manoeuvrability of aircraft.	Completed the planned curriculum students obtain sufficient theoretical and practical knowledge to be able to self-performance can be evaluated possibilities of modern aircraft and the limitations of flight options that resulting from it. In this course students will receive full sublimation and verification of previously acquired knowledge and skills that they get into the aviation study specialization from aerodynamic case.
5	aerospace engineering	BSc-0568	elective	Computational methods in aeronautics	Introducing students to the basics of computer applications in simulations and computations of aeronautical problems.	By mastering the curriculum a student gains specific skills: • thorough knowledge and

					The subject is organized so that several typical (model) problems are completely solved step-by-step from start to finish.	understanding of numerical methods • ability to use and apply basic numerical methods for solving ODE, finite difference and finite elements methods • correlation between fundamentals in mathematics, programming, mechanics, fluid mechanics and construction analysis
5	aerospace engineering	BSc-0617	elective	Introduction to engineering simulations	The students would be introduced to engineering simulations based on continuum mechanics. The students should acquire understanding of well posed problem through definition of boundary and initial conditions applied to certain physical phenomenon which characterize existence and uniqueness of the solution. Adoption of the specific type of additional conditions depending on the type of the problem, as well as selection of appropriate approximation for solution of the model problems would be presented to students. The students should gain skills for individual code development for model equations.	By mastering the curriculum the student will gain sufficient theoretical knowledge necessary to identify the problem type, number and type of boundary conditions in order to define well posed problem which is simulated. The student will be able to identify basic schemes for calculation of problems of certain type. The basic principles of programming for simulation of continuum should be adopted by the student. The structure of simulation software which consist of preprocessing, simulation and visualization should be perceived by the student.
5	aerospace engineering	BSc-0069	elective	Windturbines	Throughout this course student will learn about the principles, components and design of wind turbines, as well as regulation and dynamic balancing of the system. Acquiring the knowledge necessary for wind turbine blade design based on the aerodynamic and structural criteria, performance computation	Mastering the curriculum the student receives the following subject-specific skills: -thorough knowledge and understanding of different concepts of wind turbines and design methods; - skills needed for wind turbine and its parts selection according

					(power, coefficient of power, torque, aerodynamic characteristics of blades), calculation based on similarity theory and the topology definition of wind energy systems is the main aim of the subject.	to given operating conditions using scientific methods and procedures; - integration of fundamental knowledge in mathematics, programming, mechanics and fluid mechanics and application to design and calculations of wind turbines;
5	aerospace engineering	BSc-0539	elective	Theory of Elasticity	1. Introduction to stress analysis related to aircraft structures and it's application to practical airframe sizing and stress analysis. 2. Introduction to Experimental stress-strain analysis of airframe structures 3. Introduction to thin-walled constructions and composite material constructions 4. Introduction to modern numerical stress analysis applied to aircraft constructions, analysis and performance	1. mastering theoretical knowledge of aircraft structural analysis 2. application of theory to solve practical problems related to aircraft stress analysis 3. Understanding basic aircraft design solutions. 4. konwledge of modern methodology approach to solve problems related to design and stress analysis of aircraft components
5	agricultural engineering	BSc-0558	elective	Theory of Agricultural Machines and Equipment	1. Finding that a multidisciplinary approach can achieve optimal results in the design, maintenance and operation of agricultural machinery, appliances and equipment. 2. Master the theoretical foundations of working groups, aggregates terminal tractor agricultural machinery integrated systems of agricultural machinery. 3. Acquire practical knowledge and skills in solving practical engineering problems of agricultural machinery and equipment.	1. Fundamental knowledge of theories of agricultural machinery. 2. Synthesis theory of driving skills, connection and integrated system of agricultural machinery. 3. Skills of application of these skills in the field of design and operation of agricultural machinery. 4. Basic practical knowledge in the production of agricultural machinery, appliances and equipment.
5	agricultural engineering	BSc-0079	elective	Machines and Equipment for Food processing and Production	1. Master the theoretical foundations of machinery and equipment manufacturing and food processing; 2 Mastering the basic technological processes in food production and	1) A fundamental knowledge base of bio-technical systems engineering, production technology, the principles of machines and equipment for

					processing; 3 Introduction to basic principles of machine design, equipment and technological lines for manufacturing and food processing; 4 Acquire practical skills in analyzing the set of engineering problems and its solution multidisciplinary approach.	manufacturing and food processing, 2) Theoretical knowledge from theory and construction of machine-harvesting combines and equipment for processing into final products in the food, 3) Analysis and synthesis of design solutions for new technologies, machinery, equipment and technological lines, 4) Operation and maintenance of machinery and equipment, 5) acquisition of practical skills and application of acquired knowledge into practice.
5	control engineering	BSc-0590	elective	Automation Systems Programming	-Introduction to the basic applications of digital computers in automatic control. - Candidate will be familiar with basic statements of programming language C and programming package MATLAB. - Candidate will be able to make control software in programming language C. - This subject introduce candidate with the basic knowledge of programming package MATLAB and its applications in automatic control.	<ul style="list-style-type: none"> •Acquiring basic knowledge in programming language C. •Acquiring basic knowledge in programming package MATLAB. •Introducing and using methods for analysis and synthesis of control systems by mentioned programming packages.
5	control engineering	BSc-0595	elective	Digital systems	<ul style="list-style-type: none"> •Introducing with: number systems, Boolean algebra and binary logic, logic functions as well mastery of their usage and manipulation. • Mastering of: various types of logic circuits-LC and methods for their analysis and design. • Mastering of handling with integrated digital circuits and oscilloscope. 	<ul style="list-style-type: none"> • Proper understanding of the nature of digital computers and processes inside them. • Manipulating digital computers in hardware and software sense as a part of a digital control systems (DCS). • Using the methods of analysis and synthesis of LC. • Solving of computational nature problems

						related to the analysis and synthesis of LC, in "off line" mode, by means of digital computers. • Analysis and design of real physical LC.
5	control engineering	BSc-0726	elective	Fundamentals of optics, optical aids and devices	To familiarize students with the phenomena of light, the basics of geometric optics, the phenomenon of aberration and radiation, the detectors, and the working principle of the lasers and thermography and its applications in biomedical engineering.	Mastering the skills related to optics, light, detectors, lasers and thermography a student acquires the ability to understand and design the device. The student is qualified to participate in the design and manufacture of contact lenses, eyeglass lenses and optical and optoelectronic instrument. The student will have basic knowledge regarding the working principle of lasers and their application in ophthalmology.
5	engineering materials and welding, tribology, fuels and combustion	BSc-0536	elective	Conventional welding processes	The aim of this course is for students to become competent in the area of welding. This course is designed to provide information through theoretical lectures, computational classes and seminar papers, but also through welding workshop practice. They should also develop appropriate academic skills needed for the profession and become informed with the specificity of each welding process and appropriate equipment.	After fulfilling all the course requirements, a student is capable to solve concrete problems in the area of Conventional welding processes using acquired knowledge, as well as to comprehend possible consequences of the proposed solution. Throughout this course students would also develop the ability to combine acquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.
5	engineering materials and	BSc-0038	elective	Fuel and Combustion	Fuel types. Stoichiometric combustion equations. Combustion temperature.	Acquisition of basic knowledge of fuels, their types and

welding,
tribology, fuels
and combustion

Lubricating materials, the basic phenomena of friction and wear, division of lubricants and their properties. Industrial water, types and properties. Fundamentals of thermodynamics of the combustion process, general terms, material and energy balance of the process. Fundamentals of chemical statics and kinetics of thermal processes. Physical and physical-chemical phenomena in the combustion process. Environmental aspects of combustion.

characteristics. Mastering the basic techniques of calculation of quantity and composition of the products of combustion and combustion temperature. Acquisition of basic knowledge about the processes of friction and wear, the types and characteristics of lubricants. Acquiring basic knowledge on types of water, their properties and preparation of water for industrial use. Mastering the techniques of calculation of material and energy balance of the combustion process. Acquiring knowledge about the impact of combustion products on the environment.

5	engineering materials and welding, tribology, fuels and combustion	BSc-0730	elective	Combustion	Fundamentals of thermodynamics of the combustion process, general terms, material and energy balance of the process. Fundamentals of chemical statics and kinetics of thermal processes. Physical and physical-chemical phenomena in the combustion process. Specific features of combustion of solid, liquid and gaseous fuels. Combustion appliances. Environmental aspects of combustion.	Mastering the techniques of calculation of material and energy balance of the combustion process. Mastering the techniques of flame investigation. Acquiring knowledge on the control of the combustion efficiency. Acquiring knowledge about the impact of combustion products on the environment.
5	engineering materials and welding, tribology, fuels and combustion	BSc-0518	elective	Friction and Wear of Materials	The student attending this course should: <ul style="list-style-type: none"> • Comprehend the significance of friction, wear and lubrication (tribology keywords) and the problems connected with it, the field of construction and maintenance of mechanical parts and systems; • Master the fundamental 	Based on the mastered knowledge the student is qualified to: <ul style="list-style-type: none"> • Solves the complex tribological problems, with multi-disciplinary approach, in order to ensure the high reliability of machinery

					<p>knowledge of materials friction and wear process in order to decide the merits of the choice of materials for the construction and tribological components; • Solve problems related to the prevention of wear and competently decide on techniques to improve tribological properties of materials.</p>	<p>and equipment; • Critically analyze the designed constructions from the standpoint of friction and wear, assessing possible effects on the reliability; • Propose the solutions for reduction of energy and materials dissipation in the machines.</p>
5	engineering materials and welding, tribology, fuels and combustion	BSc-0517	elective	Tribology	<p>The student attending this course should:</p> <ul style="list-style-type: none"> • Comprehend the significance of friction, wear and lubrication (tribology keywords) and the problems connected with it, the field of construction and maintenance of mechanical parts and systems; • Master the fundamental knowledge in these areas of tribology in order to decide the merits of the choice of materials and lubricants for the construction and tribological components; • Solve problems related to the prevention of wear and competently decide on techniques to improve tribological properties of materials and lubrication technologies. 	<p>Based on the mastered knowledge the student is qualified to:</p> <ul style="list-style-type: none"> • Solves the complex tribological problems, with multi-disciplinary approach, in order to ensure the high reliability of machinery and equipment; • Critically analyze the designed constructions from the standpoint of friction and wear, assessing possible effects on the reliability; • Use methods for solving problems of mechanical parts and systems lubrication, including the selection of lubricants as a structural element; • Propose the solutions for reduction of energy and materials dissipation in the machines.
5	engineering materials and welding, tribology, fuels and combustion	BSc-0368	elective	Basic of welding B	<p>The aim of this course is for students to become competent in the area of welding. This course is designed to provide information through theoretical lectures, computational classes and seminar papers, but also through welding workshop practice. They should</p>	<p>After fulfilling all the course requirements, a student is capable to solve concrete problems in the area of Basic of welding B using acquired knowledge, as well as to comprehend possible</p>

also develop appropriate academic skills needed for the profession and become informed with the specificity of each welding process and appropriate equipment.

consequences of the proposed solution. Throughout this course students would also develop the ability to combine acquired knowledge with other areas of material and engineering sciences and to apply it to practical problems.

5	general machine design	BSc-0088	elective	Shape Modelling	The aim is to introduce students to the understanding of space and geometric forms in 3D environment. Intention is also understanding the topology types of machine parts, such as methodology of forming a 3D model as a starting point for the development of forms of machine parts and assemblies. Learning and exercising of procedures and tools developed for manipulating forms, parameter changes and optimum shape to achieve optimal solutions in machine design modeling.	The student is trained to create all kinds of model forms of machine parts using CATIA software. It is completely trained to parametrically vary the shape and form parts, to optimize the form and combine them to compose the assembly. Student has acquired knowledge that the application of CATIA tool optimizes the shape and adjust the properties of this form. The student is also familiar with basics of using modules for simulation and structural analysis.
5	general machine design	BSc-0048	elective	Machine Design	Introducing students to the procedure of synthesis of machine systems and then introducing with multidisciplinary approach combined of engineering design, industrial and aesthetic design. The development of creative abilities of students, learning methodologies and procedures for mechanical systems creation and the development of a personal sense for alignment of features (functional and aesthetic) with the environment, living and working environment.	The student is introduced to the procedure of abstract thinking and generating ideas, developing new methodologies of principal and conceptual solutions. Trained to choose the parameters and dimensions of machine parts and systems, to choose and use of restrictions: functional, technological, aesthetic, ergonomic, and others. Trained to coordinate parameters of machine parts

						with the limits, developing the shape, dimensions, etc.
5	hydropower engineering	BSc-0442	elective	Pumps and fans	Mastering knowledge of engineering applications of pumps and fans as machines for raising of fluid energy. Capacity to work in practice on energy installations, as well as design of installations that include a pump or blower as a built-in element with its function.	Knowledge of types and designs of pumps and fans. Knowledge of the energy parameters and energy balancing. Knowledge of similarity theory to implement the dimensionless parameters - characteristic performance factors. Knowledge of methods of the system working point determination. Knowledge of the energy characteristics of pumps/fans and their significance in establishment of operating regimes of pumps/fans, as well as in their regulation. Knowledge of the pump cavitation characteristics and operating characteristics change for fans working with density other than air.
5	industrial engineering	BSc-0602	elective	Production and Operations Management 1	The aim of this course is to acquire knowledge and practical skills in the field of theory and practice of the production management. Mechanical engineers after taking this course are trained to perform diagnostics and to apply methods for raising the general level of enterprise organization and rationalization of operations and production. Methods and techniques for production and operations management are useful in everyday tasks of mechanical engineers.	Upon successful completion of this course, student acquires the following professional skills and are able for: 1. Diagnosing the state of the organization of the company, 2. Organizational structure design, 3. Rationalization of production and operations processes in the company and 4. Analysis of the success rate of an enterprise. After completion of the course students also demonstrate an awareness and an appreciation of the importance of the

						operations and production management to the sustainability of an enterprise and are trained to use methods and techniques of production and operations management.
5	industrial engineering	BSc-0075	elective	Industrial ergonomics	The aim of this course is the acquisition of basic academic knowledge in the field of industrial ergonomics, which can be used for designing, evaluation and improvement of system man - machine - environment. Students should acquire specific practical skills that include an integrated ergonomic approach for the purpose of a comprehensive settlement of various engineering problems.	By mastering of industrial ergonomics program, the student acquires the ability to solve all aspects of the various engineering problems by applying science-based ergonomic methods, techniques and recommendations. It is expected that acquired knowledge students can use in daily work and practice, bearing in mind that in almost all branches of industry there is a need for designing, which includes the human factor.
5	information technologies	BSc-0070	elective	WEB projecting in mechanical engineering	Course objective • Understand the importance of Web sites in Mechanical Engineering, • The creation, introduction and use of Web projects, • Determining the functionality of Web projects, • Preparing your own Web projects, • Understanding and preparing the necessary documentation for the implementation of Web projects in Mechanical Engineering	The acquired knowledge allows the: • prepare, make and display your own skills, • determine the functionality of all the specifications on the Web, • prepare, perform and manage the designing of Web presentations, • determine the technology of designing Web sites, • recognize the requirements of the local machinery industry for Web presentations, • create a necessary documentation of Web project, • implement and collect Web project.

5	information technologies	BSc-0614	elective	Information integration of business functions	<ul style="list-style-type: none"> • Design and management of digital integrated business companies / factory, according to the business performance of integrated company, • Acquiring knowledge, skills and competencies of the information and functional integration of the company, • Integration of engineering, production and business activities • Learn about the business performance of integrated company, • Training to use commercial software for production management, • Implementation of new information and communication technologies. 	<p>The acquired knowledge to the student:</p> <ul style="list-style-type: none"> • Understand the operation of an integrated business enterprise / factory, • Applies new information and communication technology, • Critically observe production systems and business processes, • Plans computerized activities, processes and systems, • Approves new methods of learning and design, • Develop cognitive traits of creative engineers in computer science, • Participates in project teams of students and experts • Is able to conduct business discussions with business partners.
5	internal combustion engines	BSc-0699	elective	Industrial Compressors	<p>Acquiring basic knowledge on industrial compressors. Increased knowledge of thermodynamics through the study of compression of real gases, gas mixtures and moist gases, and the study of actual working cycles of reciprocating compressors. Expansion and acquisition of new knowledge in the field of Engineering, through the study of basic structural elements, systems and auxiliary equipment of reciprocating compressors. Developing skills for the design of reciprocating compressors, selection, testing, installation and maintenance in service.</p>	<p>Understanding of complex real working cycle of reciprocating compressors working with real gases; Understanding of complex structural design of such machines. Development of critical thinking which leads to sound understanding of cause-effect relationship between working cycle and machine design; Ability to design and accomplish selection, testing, installation and maintenance of reciprocating compressors in service.</p>
5	internal combustion engines	BSc-0613	elective	Internal combustion engines	<p>The aims of the course are to provide a comprehensive insight into the subject matter of Internal Combustion Engines (theoretical operating cycle, real</p>	<p>Acquired theoretical and practical knowledge of Internal Combustion Engines. The ability to link fundamental engineering</p>

					operating cycle, engine systems, engine operating characteristics). It is intended for students of the Internal Combustion Engines study specialization as an in-depth introduction into studies of specific areas of Internal Combustion Engines, as well as for students of study specializations which require knowledge of Internal Combustion Engines as a power unit (Motor vehicles, Naval Architecture, Railway Mechanical Engineering, and Material Handling, Constructions and Logistics).	branches of thermodynamics, fluid mechanics, mechanics, strength of materials etc. into a complex unit such as engine. The ability of competent approach to engine selection, organization of exploitation and maintenance. Acquisition of solid base for tackling specific problems, design and construction of Internal Combustion Engines.
5	material handling, constructios and logistics	BSc-0095	elective	Fundamentals of steel structures	Basic goals of this course are: 1) introduction to logical principles in design and calculation of steel structures in mechanical engineering, 2) development of student creative skills in design of characteristic structural systems throughout phases of idealization, parameterization and calculation	Students will obtain appreciation of structural behavior as essential part of the structural designer's background. They are qualified to comprehend basics of analysis of structural systems. Also, students are introduced to phases of design and involved in projects in structural systems in mechanical engineering.
5	mathematics	BSc-0674	elective	Object oriented programming with java	The aim of this course is to provide an overview of the theoretical foundations of object oriented design. Using Java, theoretical concepts gain practical implementation, which enables understanding of practical and theoretical aspects of object oriented programming.	The audience of this course will acquire basic theoretical knowledge in object oriented design. In addition, students will gain practical knowledge about object oriented programming in Java. Students are going to use NetBeans and Java SE environment for completing their projects. Practical skills learned should be applicable in any practical computational task in mechanical engineering. Also, Java has strong integration

						support in many software packages used in mechanical engineering, as the most important we mention Matlab, such that knowledge of Java should increase flexibility in their usage.
5	mechanics	BSc-0086	elective	Biomechanics of locomotor system	To introduce students to the application of fundamental principles and laws of biomechanics to understand and study human locomotor system (HLS) - prediction of functional motion / movement, human posture. The formation of the corresponding models of HLS, the possibility of simulations based on them in order to confirm the experimental data, its application to rehabilitation purposes. It allows the potential cooperation with experts in medicine, sports, etc. or work in specialized clinical institutions.	The student acquires the ability to analyze problems and solutions the ability to predict biomechanical problems of the human locomotor system (HLS) using scientific methods and procedures as well as computer technology and equipment. Linking the basic knowledge of mechanics, physics, anatomy, physiology with application in biomechanics HLS. Implementation of the laws and the principles of mechanics to anatomical structures; a description of how structure affects on the musculoskeletal human movement, motion; analysis of selected mechanisms of injury and performance of mechanisms.
5	motor vehicles	BSc-0710	elective	Vehicle Dynamics	Aims of this course are offering of overall insight in problems of vehicle dynamics, firstly in specific items of wheel – surface contact. This course is intended to students of study specialization for Motor Vehicles, and represent an introduction to later considerations of theory of vehicle dynamics. Students are also getting knowledge about	By conquering of this course, students achieve general and specific capabilities, that are in function of analysis and characteristics of wheel – surface contact. Students also achieve basic qualification for competent approach to selection and compatibility of engine and

					incorporating of engine, transmission and driving characteristics into one unit, which is the base for all future activities within study specialization.	transmission, as well as for finding solutions of particularly problems, with using of scientific tools, methods and procedures.
5	motor vehicles	BSc-0504	elective	Vehicles Safety	Course objectives are to provide knowledge, skills, and competencies relating to safety-related vehicle systems and fundamental understanding of their operation and performance. Students should be able to understand and solve complex engineering issues in order to increase motor vehicles safety as the most important requirement imposed to automotive industry.	Course outcomes are development of student's abilities to understand safety – related vehicles systems in terms of their synergistic influence on active, passive, and catalytic safety of motor vehicles. Critical understanding of safety – related vehicle systems and possible uncertainty, ambiguity, and limits in their operation and performance as well as how these may affect driver – vehicle – road safety. Ability to locate, analyse, interpret, criticise, and report on scientific information related to vehicle safety. To be able to employ a range of skills and techniques focused on implementation of solutions for different engineering problems in the field of vehicles safety.
5	naval systems	BSc-0693	elective	Buoyancy and Stability of Ship 1	To cover the basic knowledge of Naval Architecture connected to ship form, ship buoyancy, stability, and ship hydrostatic calculations (hydrostatic curves and stability). Buoyancy and stability is one of the basic professional courses hence taught in all the departments (faculties) with courses in	Practical knowledge in ship line plan drawing, and in the basic hydrostatic calculations (hydrostatic curves, stability cross curves, righting arm). Ability in solving and analysis of practical engineering tasks connected to ship buoyancy and

					naval architecture.	stability.
5	naval systems	BSc-0071	elective	Ship Structures 1	The aims of the course are to explain the requirements that hull structure has to meet, and as a result, to gain essential understanding of its general conception, to familiarize the student with the hull structural members to the design details level, to develop student skills to practically apply standard engineering methods used for steel hull structure scantling definition.	A thorough knowledge of general concept and structural members of the welded steel ship hull. The student should be able to practically apply rules for building ships by various classification societies.
5	physics and electrical engineering	BSc-0662	elective	Biophysics	Introducing students to biophysics fundamentals with emphasis on cell and molecular biology; representation of structure and functions of the bio-systems using descriptive, mathematical and physical modeling. Through physical modeling student is going to learn uses of methods of thermodynamics, kinetics, classical and quantum physics. Through mathematical modeling student could learn theory of information, quantum logic and mathematical description of the system. Student is thus equipped with wide knowledge which can be applied in clinical and scientific research institutions.	Student acquires ability to analyze and model biosystems using different approaches: descriptive, mathematical and physical. Student has mastered necessary knowledge of molecular and cell biology, processing of measurement results and informational technology.
5	process and environmental protection engineering	BSc-0087	elective	Mechanical Design of Process Equipment	Objective of the course is that students acquire academic skills and academic competencies for selection and calculation of strength of high or low pressure vessels, apparatus and equipment. By performing students' projects, they acquire creative and specific practical skills that qualify them to perform professional work in the field of process equipment design. Through	By successful completion of the study program student acquires the following skills: analysis, synthesis and prediction of solutions and consequences; development of critical thinking and self-critical approach; application of knowledge in practice; professional ethics; correlation of knowledge from

					the laboratory experiments and exercises, students gain knowledge of testing and exploiting process equipment.	different fields and their applications; development of skill and proficiency in the use of knowledge in field of process equipment.
5	process and environmental protection engineering	BSc-0620	elective	Fundamentals of risk engineering and fire safety	Introduce students to: risk analysis, risk management and risk engineering, regulations on fire prevention, preventive fire protection, fire extinguishers, firefighting tactics and equipment to fire fighting and smoke removal for installation.	Students will be familiar with risk analysis, risk management and risk engineering, as well as with modern fire-fighting procedures and technical measures of preventive fire protection.
5	process and environmental protection engineering	BSc-0650	elective	Processes and equipment in environmental engineering	Students get knowledge about the technical basis of environmental management. The main goal is to master the skills to recognize problems that occur in the work of industrial and power plants. Laboratory exercises aimed at introduction to laboratory work, the methods of measurement, process control.	Successful completion of the study program the student receives general abilities that are used for professional quality performance. Get ability to analyze complex technological processes and their impact on the environment. Setting up the basic equations of balance.
5	production engineering	BSc-0066	elective	Production technology and metrology	The aims of the course are to acquaint students with theoretical and applied knowledge and regularities in the treatment processes and metrological systems in production engineering, using systemic approach. This knowledge helps production engineers to manage treatment and metrological processes in the quality management system.	The student should acquire theoretical and practical knowledge for production technologies and metrology to be able to independently solve engineering problems in the respective field. This is the reason why the course focuses on acquisition and application of fundamental engineering knowledge of production technologies and metrology.
5	production engineering	BSc-0664	elective	CAD/CAM SYSTEMS	1.Awareness that efficiency of computer use in engineering activities can be accomplished only through integrated	1.Fundamental knowledge of computer use in the area of product geometrical modeling

					systems, such as CAD/CAM systems used in the area of product design and design of manufacturing technology 2. Mastery of theoretical foundations of contemporary CAD/CAM systems structure and operation 3. Acquisition of practical knowledge about using CAD/CAM systems and numerically controlled machine tools programming	2. Fundamental knowledge of computer use in design of manufacturing technology 3. Fundamental knowledge of computer use in numerically controlled machine tools programming 4. Skill to apply contemporary CAD/CAM systems in product design and design of manufacturing technology 5. Practical experience in preparing programs for numerically controlled machine tools
5	railway mechanical engineering	BSc-0098	elective	Theory of Traction	Knowledge acquiring in designing, production and exploitation of railway vehicle, in designing of rail tracks as well as the organization of railway traffic. Introducing students with: - The Forces acting on railway vehicle - Calculation methods for traction, resistance and braking force and the velocity, using modern computer tools. - The methods for determination of optimal movement conditions of railway vehicles - Ways of solving practical problems related to the movement of railway vehicles and rail tracks configuration.	Understanding and ability to apply knowledge acquired in: - Calculation of traction, resistance and braking forces and the velocity, using compatible computer software, - Defining Task and compositional functionality of railway vehicles, - Using of adequate regulations and standards in the field of traction at railway vehicles.
5	theory of mechanisms and machines	BSc-0655	elective	Mechanism Design	Mastering the necessary knowledge and develop creative skills to design and construct mechanisms within machinery and equipment. Mastering some of the software programs for construction of a concrete mechanism (machinery and equipment), and analyze their work in order to eliminate deficiencies.	Successful completion of the study program the student receives the following subject-specific skills: understanding problems in the theory of mechanisms and machines; solving concrete problems by using scientific methods and use

						of appropriate software.
5	thermal science engineering	BSc-0090	elective	Steam Boiler Basics	Reaching the competence and academic skills and methods for it's acquiring. Developing creative capabilities and mastering the specific practical skills. Goals determine the specific results which should be achieved within the subject. Goals also represent basis for control of the achieved results. Activities in this subject are in accordance with basic tasks and goals of the study program.	Student acquires specific capabilities which are needed for carrying out professional activities: analysis, synthesis and anticipating the results and consequences; use of knowledge from different areas for solving specific problems.
5	thermal science engineering	BSc-0073	elective	Pipelines	Achieving of competence and academic skills as well as methods for their acquisition. The development of creative abilities and practical skills which are essential to the profession. Objectives are concrete and achievable and in full accordance with the defined basic tasks and objectives of the study program.	Student acquires subject-specific skills that are functional quality performance of professional activities: analysis, synthesis and forecasting solutions and consequences, in-depth knowledge and understanding of the profession, connecting of basic knowledge in various fields and their application to solve specific problems, monitoring and implementation of innovations, skills for development and the use of knowledge.
5	thermomechanics	BSc-0215	elective	Applied Thermodynamics	Going through the thermodynamic analysis, students should gain a basic theoretical and professional knowledge about devices and facilities that are used in area of thermo-technique, thermo-energetic and processes engereering, as well as to gain knowledge of the physical phenomena that take place with the processes in steam turbines, gas turbines, refrigeration systems, systems	Creating the skills for recognizing, understanding and analysing of thermodynamic problems and gaining knowledges and skills necessary to carry out the common thermodynamic calculations simpler thermo-mechanical devices and facilities that are used in the area of thermo-

					for drying different materials and air conditioning systems.	technique, thermo-energetic and processes engereering. These gains skills will be a necessary base of knowledge for active attend lectures on other scientific- professional and professional-application subjects.
5	weapon systems	BSc-0092	elective	Fundamentals of Projectiles Propulsion	Introducing students to the basics of projectile propulsion, including classic and rocket propulsion. Study of fundamental processes that occur during firing in the gun barrel and in the rocket motor chamber. Influence of characteristics of propellants on firing processes. Setting up a system of equations describing these processes and methods for solving the system. Application of propulsion software packages. Design of propellant systems.	Mastering the calculation of basic parameters of interior ballistics and rocket propulsion. Knowledge of principles and basic equations of the propulsion. Capability to work with application software for propulsion systems modeling. Fundamentals for subsequent detailed study of various types of propulsion.
5	weapon systems	BSc-0686	elective	Flight Mechanics of Projectiles	Introducing students to the fundamentals of flight mechanics, including aerodynamics, and its tasks. Setting up basic equations of flight dynamics and principles of the solutions. Basic knowledge about the forces and moments acting on the projectile during flight. The behavior of the projectile in the path regarding to: the stability of missiles, missile control principles. Application of software packages for the mechanics of flight. The application of flight mechanics: a preliminary design of weapons, firing tables, fire control systems, control software.	Knowledge of principles and fundamental equations of flight mechanics of projectiles. Ability to work with application software for the calculation of aerodynamic coefficients and flight mechanics of missiles. Basic knowledge of stability and the principles of control of missiles.
6	aerospace engineering	BSc-0053	elective	Aircraft propulsion and systems	Subject task is to introduce students with aircraft equipment and power	By the subject student gets knowledges and understandings

					systems, their functions, structures and basic principals. Subject enables global introduction of students into all aircraft and power systems, and its integrity.	about existing aircraft and power systems of various types. These knowledges enables understanding of aircraft and power systems if they are oriented to other aeronautical fields, or to further specialization in this aeria.
6	aerospace engineering	BSc-0541	elective	Structural Analysis of Flying Vehicles	1. introduction to problems and moder solution methods in stress analysis related to aircraft structures and their implentation in solving real structural problems. 2. introduction to experimantal stress analysis of aircraft structures. 3. introduction to thin-walled structures and composite meaterials. 4. introduction to computer modeling and simulation of aircraft structures	1. mastering basic theoretical knowledge in structural analysis. 2. application of aquired knowledge in solving real world problems. 3. understanding basic aircraft design principles. 4. understanding modern approach in solving structural problems in aircraft airframe design.
6	aerospace engineering	BSc-0253	elective	Design and Aircraft Production Technology	To introduce students to process of modeling of aircraft components and to teach them to understand and to apply necessary technologies to produce these components. Students are taught to skills which connect typical loads with typical design solutions. Besides theoretical knowledge necessary to model aircraft students will be taught also to use modern design software tool.	Understanding of airplane structure, and relationship between elements. Understanding of aerodynamic, flight mechanic, propulsion influences on aircraft design. Understanding of manufacturing process and surface protection. Mastering modern software tool used to design assemblies and aircraft.
6	aerospace engineering	BSc-0635	elective	Light and Composite Aircraft Structures	The goal of this course is to acquaint students with the properties of composite materials used for making aircraft structures, composite manufacturing technologies as well as the specifics of their implementation and exploitation in aeronautics.	After completing the course, a student is familiar with the philosophy of design, manufacturing technologies and specifics of protection, exploitation and maintenance of composite aircraft structures. Acquired theoretical knowledge

and practical skills, students can effectively apply in the construction of composite aircraft parts and their analysis. Within practical training students learn the basics of modern software packages intended for the modeling and calculation of composite parts.

6	aerospace engineering	BSc-0544	elective	FEM Analysis	Understanding and mastering the process of solving engineering problems using finite elements method and modern software tools. Furthermore, the aim of this course is to develop personal and professional skills of the students along with the development of analysis methodology and solving engineering problems.	After accomplishing the course, a student is capable of working in modern work environments. With learned skills student can implement his theoretical and practical knowledge in engineering practice, achieving a high degree of effectiveness. This knowledge encourages further improvement for students.
6	agricultural engineering	BSc-0538	elective	Biosystem Engineering	1. Master the theoretical foundations of engineering in food production; 2 Introduction to the basic stages of the life cycle of machinery/equipment for food production; 3. Getting to know limitations and specific engineering in food production; 4. Introduction to basic principles of engineering in food production; 5. Acquire practical skills in analyzing the set of engineering problems and its solving multidisciplinary approach.	1) A thorough understanding of basic principles of engineering, manufacturing and food processing, 2) Basic knowledge on life cycle analysis machinery/equipment manufacturing and food processing, 3) Analysis and synthesis of design solutions and acquiring methods of optimization; 4) Connect the basic engineering knowledge and achievement synergetic effect, 5) introduction to development trends in the development and manufacture of machinery/equipment

						manufacturing and food processing.
6	agricultural engineering	BSc-0461	elective	Drying and Hygrothermal processes	Understanding the theoretical foundations and engineering data from field and hygrothermal drying process, which engineers need for the rational use of energy, design of appropriate solutions and efficient implementation of processes and work units and systems, including the development of creative abilities and mastery of practical skills for specific job performance.	Qualifications of the theoretical and practical knowledge necessary to independently solve concrete theoretical and engineering tasks in a given area, which involves applying knowledge in practice, solving practical problems using scientific methods and procedures and monitoring and implementation of innovations in the profession.
6	control engineering	BSc-0675	elective	Process modeling	Student should be familiar with basic principle and steps of mathematical modeling of objects and processes. To be capable to form basic balance equations which describes non-stationary states of objects and processes which, after suitable choice of state variables, manipulated and control variables as well as disturbances variables enables one to form adequate and non-unique state space representations of objects and processes for the needs of further analyzing or synthesis.	To be familiar and to be capable to use the basic principle of mathematical modeling applied to: dynamics of material handling, flow processes, flow-thermal processes, machine dynamics, traffic and transportation dynamics and contemporary plants existing in area of general energetic. Moreover it is expected to be capable to perform elementary analysis of their transient response characteristics from the above mentioned list of objects and processes.
6	engineering materials and welding, tribology, fuels and combustion	BSc-0262	elective	Repair Welding and Surfacing	The aim of this course is to provide students with an introductory knowledge of the reparation of machine parts and construction, and the ability to solve concrete problems. This course is designed to provide information through theoretical lectures but also through	After fulfilling all the course requirements, a student has knowledge to recognize different aspects of damage of machine parts and constructions, as well as prescribe the technology of

					laboratory type (practical) exercises, computational classes and seminar papers students are responsible for writing. Throughout this course students would also develop teamwork skills and the ability to combine knowledge from different areas of material and engineering sciences.	their reparation.
6	engineering materials and welding, tribology, fuels and combustion	BSc-0251	elective	Fuel and Industrial Water	Fuel types. Stoichiometric combustion equations. Combustion temperature. Characterization of solid fuels, proximate and elemental analysis. Solid fuel origins, derivation, applications. Liquid fuels, origins, derivation, applications. Gaseous fuels, origins, derivation, applications. Industrial water, types and properties. Essential characteristics of the water for use in industrial purposes. Problems in the use of natural waters. Water treatment for industrial applications.	Acquisition of basic knowledge about the concept of fuel, types and properties. Mastering the basic techniques of calculation of quantity and composition of the products of combustion and combustion temperature. Acquiring basic knowledge on the characterization of solid fuels, their origins, derivation and application. Basic knowledge of liquid and gaseous fuels, their origins, derivation and application. Basic knowledge about water and methods of preparation for industrial application.
6	engineering materials and welding, tribology, fuels and combustion	BSc-0557	elective	Foundations of biomaterials	The aim of this course is to introduce students to different types of biomaterials and their properties with the goal of understanding and studying the possibility of using biomaterials in human organism. Special attention is devoted to the appearance of damage and failure of biomaterials which are in contact with or are within human body, as well as consequences due to these processes. This course enables possible collaborations between experts in the	Attending this course student will develop abilities of all encompassing analysis of the problem of the contact between the artificial biomaterial and living organism, and the potential to predict optimal choice of biomaterial using scientific methods as well as present-day lab equipment. Due to this course a student will also develop the ability to combine

					fields of material science and medicine, more particularly it enables work with specialized clinics and laboratories that conduct research and engineering of biomaterials.	knowledge from different areas of material science, biology, physics, mechanics and physiology together with learned biomedical engineering.
6	engineering materials and welding, tribology, fuels and combustion	BSc-0492	elective	Design and testing of welded structures	After having completed the course, along with the theory and practical classes (through problems and calculation exercises, seminars etc.), the student acquires the proper academic knowledge and skills in the field of weld design, and stress state analysis of the welded structure. Also, candidates will be familiar with the modern testing and inspection techniques applied to welded structures in service.	Having mastered the material of the course, envisaged through the course programme, the student is capable of solving real problems dealing with the welded structure calculations and testing, and is able to perceive eventual effects that may result in the case of poor solutions, or that are the consequences from fatigue and damage of the material. The student is then also capable of connecting the knowledge acquired in this field with other fields, and to successfully apply it in practice.
6	engineering materials and welding, tribology, fuels and combustion	BSc-0371	elective	Tribotechnique	The student attending this course should: <ul style="list-style-type: none"> • Master the fundamental knowledge in the areas of lubricants and lubrication; • Comprehend the significance of failures from the technical and economic aspects; • Master the skills to evaluate the failure according to the established cause-consequence classifications; • Comprehend the issue of establishing a diagnostic of machine condition and monitoring programme; • Increase the availability and productivity of the equipment through a clearly defined technical strategy and to make competent decisions on it. 	Based on the mastered knowledge the student is qualified to: <ul style="list-style-type: none"> • Conducts an analysis of the problems connected with maintenance and competently decides on the maintenance program in the tribotechnique area; • Selects and uses the modern methods for condition-diagnostic and condition-monitoring of the tribological systems; • Make conclusions, based on monitoring results, about ways how to prevent the failure; •

						Carry-out all the maintenance measures in tribotechnology domain and systematically introduce them into the working practice with the aim to reduce the losses due to friction and wear.
6	fluid mechanics	BSc-0347	elective	Hydraulics and pneumatics	This course aims to teach students basic knowledge of hydraulics and pneumatics. First of all they need to learn to read schemes of hydraulic oil and pneumatic systems. In addition to this the audience of this course should be familiar with basic elements of all systems, with their functionality, place and role in hydraulic oil and pneumatic systems. Besides this, the aim of this course is to teach listeners the basics of calculations of elements, circuits and systems in general.	The students listened to and passed this course will be able to read correctly each scheme of oil hydraulic or pneumatic system. In addition to understanding the scheme they will be able to accurately determine functionality of given system. Also, they will be able to independently calculate existing oil hydraulics and pneumatics systems in stationary regimes.
6	general machine design	BSc-0636	elective	Machine elements failure analysis	1. Achieving basic knowledge on machine elements failure analysis based on application of design principles, analytical procedures, numerical tools, appropriate measuring techniques and diagnostic methods. 2. Understanding dominant machine elements failure (MEF) modes in terms of design and operational conditions. 3. Mastering the basics of analytical and empirical procedures for identifying MEF. 4. Mastering the basics of practical problems solving (MEF prediction and prevention, elimination of their causes and consequences).	At the end of the course student should be able to: 1. define and classify types of machine elements failures, 2. to connect causes of machine element failure with properties of its design, application and operational conditions 3. to make a proper choice of means and methods of machine elements failure diagnostics, 4. to propose measures to prevent machine elements failures, 5. to make appropriate report on analyzed machine element failure.
6	hydropower	BSc-0050	elective	Basic of	1.Introduction of theoretical knowledge	1. Gaining basic knowledge

	engineering			Turbomachinery	of fluid flow in turbomachinery. 2.Studying of energy and exploitation characteristics of turbomachinery and their application in mechanical systems. 3. Obtaining of practical skills application of pumps and fans in power systems.	about the exchange of energy in turbomachinery. 2. Reaching the methods of choice of turbomachinery according to the energy system. 3. Understanding the control and the energy efficiency of turbomachinery. 4. Obtaining practical experience of turbomachinery exploitation.
6	industrial engineering	BSc-0412	elective	Business Production Information Systems	Acquisition of knowledge for applying computers in business-production systems, so as to carry out computerization of all information flows in the system and in the system-environment interaction. Within the framework of such approach, attention is directed to information systems design. Also, the aim is to master specific, highly professional skills of using specialized software tools for business-production systems management. Decision-making support systems and expert systems are studied.	The student develops the following abilities: understanding the place and role of information systems in business-production systems, design of information systems, scanning and analysis of the existing information flows and critical perception of their advantages and deficiencies. Acquisition of knowledge needed for application in solving problems of production-business systems.
6	industrial engineering	BSc-0414	elective	Maintenance management	Perception of position and cost of maintenance within life cycle of technical systems. Acquaint ion with parameters which affect design of maintenance organization. Practical determination and analyze of technical system reliability. Acquaint ion with standard malfunctions, methods for condition monitoring as well as with equipment for condition monitoring. Overwhelm with methods for determination of replacement and repair strategies, maintenance costs	Curriculum overcome enables overwhelm with necessary knowledge and skills (models, optimization procedures, monitoring and measure equipment, basics of computer systems – business solutions) for implementation in maintenance organizations of complex technical systems.

					and inventory optimization. Acquaint ion with possibilities of maintenance system optimization and application of computer systems – business solutions.	
6	information technologies	BSc-0529	elective	Software engineering 1	<ul style="list-style-type: none"> Acquisition of basic skills in the preparation of projects related to software development are important for small and medium-sized companies. Using some simple CASE tool for the design of some parts of the software. The acquisition of skills which overcome the barriers to collaboration in teams to write and implement software. 	<ul style="list-style-type: none"> to participate in the software team as a team member with special knowledge related to mechanical engineering, to notice problems in the design and determine the problematic processes that can influence and some numerical mark on the project, to prepare all the necessary data for modeling of certain parts of the software, to prepare vallide documentation for software, to participate in the implementation of the software with the contractor.
6	information technologies	BSc-0259	elective	Database Design	<p>Course objective:</p> <ul style="list-style-type: none"> Analysis of problems in the creation of a set, data collection, database. Step-by-step accepting the methodology of logical and physical design and the database. Analysis of selected problems typical for company business. Accurate and clear introduction to the DBMS and SQL. 	<p>The achieved knowledge allows:</p> <ul style="list-style-type: none"> identified the real object data that becomes information, obtained data at the basic level get systematized and logical prepar, logical data prepared at the basic level get copied to database, obtain informations from existing database using a higher level base of SQL.
6	internal combustion engines	BSc-0658	elective	Hybride Powertrain Systems	<p>Coverage and adoption of basic theoretical knowledge on IC Engines, Electric & Hydraulic Drive and variety of Hybrid Powertrain Systems and Fuel Cells, their perspectives and potential applications. Acquaintance with the terms of Renewable and Non-Renewable</p>	<p>Understanding of basic principles of operation and modes of application of IC Engines, Pure Electric Drives and Hybrid Powertrain Systems. Developing capabilities to model, calculate and analyze</p>

					Energy resources and perspectives of utilization of Bio-Fuels, Alcohols and Hydrogen. Developing skills to analyze and evaluate different concepts of conventional and hybrid powertrain systems regarding fuel economy. Developing skills to make simple models of Powertrain Systems components in order to simulate and evaluate powertrain system behavior during driving cycles.	Power Losses in Vehicle Powertrain System, to determine required Performance of Powertrain System, to evaluate potentials of Fuel Economy Improvement by application of Hybrid Powertrain/Regenerative Braking System.
6	internal combustion engines	BSc-0700	elective	Operation and overhaul of engines	Expanding knowledge in the basic problems of engine exploitation, typical failures and overhaul process. Practical application of the gained knowledge on actual physical object. Expanding knowledge in On- Board diagnostics with modern engines. Gaining knowledge of general structure and realization of major overhaul and major overhaul operations. Training for the diagnostics of the cause and type of wear of basic engine parts. Expanding knowledge in the methods of the service of engine in exploitation.	General specifications: Application of engineer approach in analysis of machine and devices failures. General structure and realization of maintenance of machines and devices and their overhaul. Ability to analyze and establish the cause of engine failure. Application of OBD ("on-board") procedures with modern vehicles. Ability to organize and supervise engine maintenance and major overhaul process.
6	material handling, constructios and logistics	BSc-0044	elective	Elements of Construction and Mining Machines	Basic course goals (objectives): 1) introducing students with specificities of working process, design, modeling and calculation of construction and mining machines and appliances. 2) mastering practical skills which are necessary for selection, design and calculation of construction and mining machines.	Mastering the curriculum student gains (acquires): 1) general skills which can be used in engineering practice (analysis, synthesis and anticipation of solution and consequences; development of critical approach) 2) specific skills (use of knowledge gain in fundamental academic fields on solving of concrete problems in field of construction and mining

						machines).
6	material handling, constructios and logistics	BSc-0264	elective	Material Handlig Equipment	The basic goal of this subject is to introduce students into the fundamentals of intralogistics (material handling equipment in intralogistics) and to enable achieving practical skills in engineering education and professional work such as are analysis of duty cycle of material handling equipment, selection, sizing and calculation of material handling equipment as elements of material handling and conveying machines.	Mastering the curriculum students obtain general abilities that can be applied in engineering practice: knowledge and principles of material handling equipment, selection of parameters, the size and computer modeling of material handling equipment and the ability for calculating and solving concrete problems in practice.
6	mathematics	BSc-0591	elective	Computer modeling and animation	The aim of this course is to provide an overview of the theoretical basis of computer modeling using 3D Studio MAX, to present some of the practical aspects of computer modeling, as well as to provide the necessary knowledge to create animations in mechanical engineering.	The audience of this course will acquire basic theoretical knowledge of computer modeling and animation. In addition, students will be provided practical knowledge of computer modeling using 3D Studio MAX. Students will make presentations of various 3D models. The knowledge acquired can be applied to any type of computer modeling in mechanical engineering, and may also be used in making and animation in mechanical engineering.
6	mechanics	BSc-0012	elective	Theory of Mechanical Vibrations	It is necessary to enable the students to independently form and solve linear differential equations of motion of mechanical models of real objects oscillatory moving in different areas of mechanical engineering.	A learning basic concepts and methods of linear theory of vibrations with an arbitrary finite number of degrees of freedom and elastic bodies with one-dimensional mass distribution, using appropriate computer tools.

6	motor vehicles	BSc-0052	elective	Vehicle performance	Primary goal of this subject is to provide knowledge on modern vehicles characteristics, introduce students to basic principles of vehicle performance determination, terramechanics and vehicle dynamic characteristics calculation using modern theoretical-experimental methods.	1. Acquirement of theoretical-experimental knowledge in the field of power transmission design. 2. Mastering the contemporary methods in the field of power transmission design. 3. Training of students for computer aided power transmission system design through practical examples.
6	motor vehicles	BSc-0540	elective	Vehicle Design 1	Vehicle Design is a complex process, concerned with powertrain, aerodynamics, environmental impact, ergonomics, legislation, materials, production, safety and technology. Course objective is to provide an understanding of the design process of motor vehicles regarding: a) basic requirements being imposed to vehicle and its systems, assemblies, sub – assemblies, and parts, b) influences of vehicle components design on its overall performance, time and cost development, quality of use, and recycling process c) legislation related to the specific vehicle categories. This course aims to develop the broad range of students' skills and knowledge to be able to understand, recognize, and solve complex issues in vehicle design as a part of challenging automotive industry.	Course outcomes are development of student's abilities to: a) understand the process of a vehicle design, its relation to design of vehicle systems as well as to be able to design the process to meet desired vehicle/systems characteristics, b) be aware of contemporary issues in vehicle design, c) be able to access various technical information sources, d) be able to function in the team, e) identify key issues, formulate and apply technical knowledge to solve engineering problems related to vehicle design, f) develop written and oral communication skills, g) understand how to use the techniques, skills and modern engineering tools for problems resolving.
6	naval systems	BSc-0694	elective	Ship Systems	To cover the basic knowledge of Marine Engineering connected to ship piping and pumping systems.	Ability in basic design, calculations and analysis of ship piping and pumping systems: bilge, ballast, emergency,

						heeling, sanitary, tanker, firefighting systems, etc.
6	naval systems	BSc-0058	elective	Ship Equipment	The aims of the course are to familiarize students with: 1) basic ship equipment, both with the one found on each ship and with a special one found on some types of ships; 2) essential characteristics of various ship types; 3) regulations concerning ship equipment; 4) the expected development of ship types and their equipment.	Having successfully mastered the teaching contents of Ship equipment, the student should demonstrate fundamental knowledge about: 1) ship equipment; 2) various types of ships and their essential characteristics; 3) the expected development of ship equipment and ship types etc.
6	physics and electrical engineering	BSc-0250	elective	Electronics	The aim of the course is to familiarize the students with basic laws of electronics and to develop student competence for acquisition of more advanced academic knowledge and practical skills in scientific, professional and applied areas of mechanical engineering relying on electronics. The student is introduced into basic devices and circuits encountered in contemporary electronics and scientific methods for their analysis and measurement.	Having successfully mastered the teaching contents of electronics, the student should be able to qualitatively pursue his scientific career and profession, manipulate methods of analysis and measurements in electronics, anticipate the solutions and perceive the outcomes, acquire understanding of research and practical methods in the fields he can adequately apply in concrete problem solving in mechanical engineering.
6	physics and electrical engineering	BSc-0030	elective	Electronics and biomedical measurements	Introducing to fundamentals of Electronics, the most common electron components and circuits. Presentation of the basic medical measurements and diagnostically methods. The focus is on the operation of standard biomedical equipment with brief description of device construction. The subject educates engineers to improve still existing and develop new biomedical	By attending the course, students will be educated to understand and analyze problems concerned with operation and usage of basic biomedical instrumentation and equipment. This course educate students to connect basic principals of electronics, physics and medicine and to practically

					devices.	implement them into modern medical equipment.
6	process and environmental protection engineering	BSc-0082	elective	Pipeline and fittings	Objective of the course is that students acquire academic skills and academic competencies for selection and calculation of pipelines and pipeline fittings. By performing students' projects, they acquire creative and specific practical skills that qualify them to perform professional work in the field of pipeline design. Through the laboratory experiments and exercises, students gain knowledge of testing and exploiting process equipment.	By successful completion of the study program student acquires the following skills: analysis, synthesis and prediction of solutions and consequences; development of critical thinking and self-critical approach; application of knowledge in practice; professional ethics; correlation of knowledge from different fields and their applications; development of skill and proficiency in the use of knowledge in field of pipelines and pipeline fittings.
6	process and environmental protection engineering	BSc-0033	elective	Equipment in process industry	Analyzing complex technological processes and their breakdown into individual operations. Understanding the basic operations in process industry. Acquiring basic knowledge of mechanical, hydromechanical, thermal, diffusion, chemical and biological operations. Understanding the basics of transport of fluids and solids, as well as supporting operations in every technological process. Equipment for Unit Operations.	Ability of analyzing complex processes in process industry. Acquisition of basic concepts about the characteristics of the equipment used for mechanical, hydro, thermal, diffusion, chemical and biochemical operations. Understanding the role of additional equipment in process industry.
6	production engineering	BSc-0043	elective	Machine tools	1. Step-by-step perception of concepts and themes related to machine tools. 2. Acquisition of basic knowledge about machine tool primary motion configuration for cutting and deformation processing and configuration of feed motions. 3. Studies of machine tool structures, guides	1. Ability to manage in the machine tools environment and preparing them for work. 2. Know-how to configure primary and feed motions of machine tools. 3. Ability to design and perform the experiment to test a machine

					foundations and machine tools testing. 4. Studying and practicing the control and programming of numerically controlled machine tools and making a report on acquired knowledge.	tool and to identify the machining process. 4. Know-how to program numerically controlled machine tools. 5. Knowledge about the step-by-step concept of machine tools and their selection for a certain type of processing.
6	production engineering	BSc-0056	elective	Shipbuilding Technology	To acquire theoretical and practical knowledge of shipbuilding technology, starting from the concept acquisition, calculations and testing, working out of building technology, protection and testing of the ship. To perceive the importance of team-work and cooperation based on arriving at optimal solution.	Fundamental knowledge of machining systems. Ability to design technology of ship structural members. Ability to apply the concepts of modular design and assembly technology. Basic practical experience in realizing the shipbuilding technology.
6	production engineering	BSc-0032	elective	TOOLS AND FIXTURES	Acquisition of theoretical and practical knowledge of design, computations and constructions of clamping fixtures, sheet-metal processing tools, metal pressure casting tools, forming and shaping plastics tools and forging tools, all this based on modern technologies and optimal solution.	1.Fundamental knowledge of tools and fixtures as a sub-system of the processing system. 2. Know-how to approach to the design process. 3. Thorough knowledge and understanding of the design process of processing technology and shaping. 4. Basic practical experience acquisition in industrial production of tools and fixtures.
6	railway mechanical engineering	BSc-0227	elective	Fundamentals of Rail Vehicles	1. Understanding the basic rail vehicles assembling units 2. Acquiring the knowledge necessary to understand functioning of the basic structural units 3. Training for the application of acquired knowledge to solve practical problems, especially in the field of the maintenance of railway vehicles.	At the end of the course the student should be able to: 1. Explain the functional and structural differences between basic types of rolling stock. 2. Explain the tasks and functioning of the main assemblies of rail vehicles. 3.

					Identify actions required to resolve typical failures in operation and in the maintenance of the rail vehicles. 4. Apply appropriate regulations and standards in the design and maintenance of railway vehicles. 5. Apply basic computer tools to construct and calculate simple assemblies of rail vehicles.
6	railway mechanical engineering	BSc-0388	elective	Life cycle of Railway Vehicles	<p>1.Introduction to basic concepts important for understanding the life cycle of railway vehicles 2.Acquiring knowledge necessary to understand the issues of the life cycle of railway vehicles 3.Training for the application of acquired knowledge in solving practical problems in the design, use and maintenance of railway vehicles</p> <p>Upon completion of the course student should be able to:</p> <p>1.Explain the basic concepts related to the life cycle of railway vehicles. 2.Explain the tasks and functioning related to railway vehicles components for achieving the set goal. 3.Perform appropriate tasks related to the life cycle of railway vehicles. 4.Apply appropriate regulations and standards. 5.Apply appropriate computational tools and to be able to make appropriate decisions.</p>
6	theory of machanisms and machines	BSc-0228	elective	Basic Technological Operations in Food Industry	<p>1. Acquisition of basic knowledge of physical and chemical changes in materials that are processed during the technological process in the food industry. 2. Understanding the basic concepts necessary for rezumevanje matter in the field of food technology. 3. The division of the basic technological operations encountered in the food industry, primarily in the mill and</p> <p>1. Analysis of existing solutions and their effects 2. prektičnih adoption of knowledge 3. application of knowledge in practice 4. knowledge and understanding of issues in the food process industry 5. solving process, examples of food 6. connect knowledge from different fields and their</p>

					bakery and confectionery, dairy, slaughter-mesarskoj and fruit-vegetable industry	application 7. monitoring and implementation of innovations in the profession.
6	theory of machanisms and machines	BSc-0252	elective	Hidraulic and Pneumatic Mechanisms and Piping	Acquisition of all necessary knowledge for the development and calculation of pneumatic and hydraulic installations. Presentation of all symbols for both fields. The use of hydraulic and pneumatic components as a drive for modern machines in different branches. Using pneumatics as factory energy. Regulations and standards for the development of the central pneumatic distribution.	At the end of this course the student should be able to interpret the pneumatic and hydraulic schemes. To be able to design mechanisms and electro pneumatic systems for synchronization of machines. It also should be able to design hydraulic mechanisms, i.e. driving systems for machines and devices.
6	thermal science engineering	BSc-0029	elective	Basic of Refrigeration	Achieving of competence and academic skills as well as methods for their acquisition. The development of creative abilities and practical skills which are essential to the profession. Objectives are concrete and achievable and in full accordance with the defined basic tasks and objectives of the study program.	Student acquires subject-specific abilities that are essential for the quality of professional activities: analysis, synthesis and prediction of solutions and consequences; application of knowledge in practice; linking the basic knowledge in various fields with their application to solve specific problems.
6	thermal science engineering	BSc-0646	elective	Heating technique fundamentals	Acquiring knowledge and skills in the field of heating technology - the impact of climate parameters and conditions of comfort, heating bodies, additional elements and equipment, types and mechanisms of heat transfer; acquiring knowledge of methods for calculation of heat losses according to different standards and use these methods when developing main mechanical project of central heating systems.	Students acquire specific skills and knowledge in heating technology: they are familiar with elements of central heating systems; familiar with heat losses calculation methods and can apply them in practice. Student can connect basic knowledge and apply it to solve concrete problems in the technique of heating.
6	thermomechanics	BSc-0532	elective	Basics of Heat	Students shall gain knowledge in heat	After completing the course,

Transfer

transfer - scientific discipline that is fundamental for design of devices and plants in process engineering, thermal engineering and power engineering. Students shall study steady-state and transient heat conduction, forced and free heat convection as well as boiling and condensation heat convection; also study radiation heat transfer as well as influence of all these phenomena upon the climate changes and global warming.

passing quizzes and tests and successfully passing the final exam, students shall be able to perform, themselves, thermal calculations of simple thermal engineering plants and unitary devices. Result of the course is also acquiring basic knowledge that enable active participation in related theoretical and applied courses.

6	weapon systems	BSc-0057	elective	Classical Armament Design	Introducing students to the basics of construction of artillery weapons, small arms, automatic cannons, armoured vehicles and tanks. The study of basic tactical - technical requirements, processes that occur during firing, and the principles of operation, determining the structural solutions of certain systems. Analysis of individual structural elements of different classical armament systems.	Mastering the basic principles of the design of classical armament systems. Qualification for the calculation of basic parameters of processes that determine the design of individual systems. The basis for the later detailed study of artillery and automatic weapons design.
6	weapon systems	BSc-0254	elective	Missile weapon design	Goal of subject is to achieve competitive academic knowledge and skills in the analyzes and syntheses of the main missiles and rocket system performances. Also, goal is to realize knowledge about special missile and rocket performances, as the special flight vehicle and ballistic object, with their distinguishing features, applicable for weapon or ammunition syntheses comparing with other types of weapon and projectiles. Student or applicant developing creative capabilities, in the directed mechanical engineering, skills for the basic professional orientation of	Student achieve possibilities of analyzes and syntheses for the expert solutions of weapon missile and rocket systems, project, design, feasibility and other study approaches integrations. Output includes methodology and proceedings of specific research knowledge of mathematics, mechanics, propulsion , propellants and its software applications in missiles systems design. Student developing critical approach of weapon missiles system and

weapon design engineering. Theoretical applications and practical examples of missile, rockets diversification and integration design cases is the knowledge goal of student creative course work, as the bachelor basic knowledge of weapon designers.

design and possibility to employ knowledge in practical work also, in information exchanging about relevant references. Also, understand principal performances of missiles and rocket weapon systems and differences its design differences and applied different technologies and branches of research in this area.
