# Ştefan cel Mare University of Suceava, România

## Faculty of Mechanical Engineering Mechatronics and Management

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## Faculty of Mechanical Engineering Mechatronics and Management


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|---|---|
| Field of study | *Industrial Engineering* |
| Name of the educational program | ***Machine Manufacturing Technologies;*** *Undergraduate* |

## Machine Manufacturing Technologies 3rd year

**USV.FIM.II.DD.05.01**
**Machine Elements 1 (Autumn/3)**
**3 hours per week; 14 weeks / 5th semester: 28C/14S; ECTS credits: 3**
This is the first part of machine elements course, concerning modelling, design, integration and best practices for use of machine elements such as shafts, hydrodynamic, hydrostatic and rolling bearings, keys, pins, cotters assembly methods and springs. For each type of elements a brief description, stresses, failure, recommended materials and calculus criteria is presented. These are reinforced by a substantial design project wherein students design a manual screw presses for bearing extraction.

**USV.FIM.II.DD.05.02**
**Machine Elements - Project (Autumn/3)**
**1 hour per week; 14 weeks /5th semester: 14P; ECTS credits: 2**
The project thematic proposes students to design a manual screw press for bearing extraction from shafts. Starting from a given bearing, several design stages are covered. The presses screw is first designed, followed by an axial bearing meant to reduce friction between the screw tip and the shaft end, the nut, the presses cross beam and the extractor arms. Several other driving, coupling and safety elements are also designed, such as the crank, bolts and safety bracket. At the end, based on the dimensioning and verification calculus, technical drawings are made for each of the studied machine elements as well as for the presses assembly.

**USV.FIM.II.DID.05.03**
**Fundamentals of cutting and surface generation (Autumn/3)**
4hours per week; 14 weeks / 5th semester: 28C/14L; ECTS credits: 4
The fundamentals of cutting, the physics and mechanics of the cutting process, generating theoretical and real surfaces on machine tools (elements regarding the structure of the technological system, the role of its components in the cutting process, the chip formation mechanism, plastic deformation phenomena, the heat released during the cutting process, friction, wear and lubrication on cutting, specific cutting forces and moments), theoretical concepts for generating surfaces on machine tools, methods of obtaining surfaces by backing-off, rolling, generating involute and complex surfaces.

**USV.FIM.II.DD.05.04**
**Industrial management (Autumn/3)**
4 hours per week; 14 weeks / 5th semester: 28C/14S; ECTS credits: 4
The course presents management processes and relationships within an organization, built in such a way as to achieve business success. It treats the systemic management issue, the management system being structured into five subsystems: organizational subsystem, information subsystem, decision subsystem, subsystem management methods and techniques management methods, as well as other components management subsystem of the management system. Each substitute is shown in contemporary approach, specifying the functions, activities and tasks in achieving the organization's strategic and tactical management objectives using various methods.

**USV.FIM.II.DD 05 05**
**Thermal treatments (Autumn/3)**
3 hours per week; 14 weeks / 5th semester: 28C/14L; ECTS credits: 3
What is heat Treating? Importance and Classifications. Fundamentals of Heat Treating of steel. Hardness and Hardenability. Furnace and Related Equipement for Heat Treating. Instrumentation and Control of Heat Treating Processes. Heat Treating of Carbon Steels. Heat Treating of Alloy Steels. Case Hardening of Steel. Flame and Induction Hardening. Heat Treating of Stailnless Steels. Heat Treating of Tool Steels. Heat Treating of Cast Irons. Heat Treating of Nonferrous Alloys. Assuring the Quality of Heat Treated Product.

**USV.FIM.II.DD.05.06**
**Cutting operations and cutting tools (Autumn/3)**
3 hours per week; 14 weeks / 5th semester: 28C/14L/14P; ECTS credits: 5
The role of the cutting tools in machine manufacturing; trends in their development; destination, structure and classification of the cutting tools; main types of the cutting tools; elements of calculation and construction for lathe cutting tool, broaches, drilling holes tools, mills, gear grinding tools and for combined tools.

**USV.FIM.II.DS.05.08**
**Plastics and composites pieces manufacture (Autumn/3)**
3 hours per week; 14 weeks / 6th semester: 28C/14L; ECTS credits: 3

Composite materials; Composite materials matrices; Metal and plastic composites solidification; Composite material with non-metal matrix; Composite and plastics materials properties; Plastic and composites quality control..

**USV.FIM.II. DS.06.09**
**Experimental techniques (Spring/3))**
3 hours per week; 14 weeks /2nd semester: 28C/14L; ECTS credits: 3
General problems on research. Getting metrology. Measurement experiment results.Classic and modern experiments; Classical methods for planning experiments; Complete factorial plans; Experimental plans and mathematical modeling of the studied phenomenon; Modern methods of experimental planning; Analysis of results variance; Conclusions on the study of a phenomenon / product through experimental plans method; Acquisition of data for the study of industrial phenomenon; Experimental plans and industrial practice; Roughness measurement and dependency factors or Length measurement and dependency factors; Mathematical modeling of practical applications; Conclusions.

**USV.FIM.II.DD.06.10**
**Machine Elements 2 (Spring/3)**
**3 hours per week; 14 weeks / 6th semester: 28C/14L; ECTS credits: 3**
This is the second part of machine elements course, concerning basics on classical design of mechanical parts, such as statics and dynamics of mechanical elements, failure criteria, tribology elements, reliability, mechanical choice criteria and so on. Also elements of mechanical transmissions construction and design (gears, belts transmissions, chain and belts variators, friction variators, chain transmission) are also presented.

**USV.FIM.II.DD.06.11**

**Machine Elements 2 - Project (Spring/3)**
**2 hours per week; 14 weeks /6th semester:28P; ECTS credits:** 2
Students must design a two stage (belts and gears) mechanical transmission system. Starting from a given material, several steps are followed so that the gear outputs an imposed torque and speed. The designed speed reducer must use single stage spur gears reducer and an external V belt transmission. The belt transmission, gears geometry and shafts dimensions are calculated. The shafts resistance to fatigue, vibration and strain are verified. All the gear's transmission elements must be calculated. The reducer gear housing must be designed and the thermal regime is verified. The projects must contain technical drawings for V belt pulleys, spur gears, shafts, gear housing, as well as for the speed reducer assembly.

**USV.FIM.II. DS. 06.12**
**Processing by cold plastic deformation (1) (Spring/3)**
3 hours per week; 14 weeks / 6$^{th}$ semester: 28C/14L; ECTS credits: 3
The structure of metals and alloys and its influence on plasticity; plastic deformation of single crystals and polycrystalline aggregates; plasticity conditions; the behaviour of materials at plastic deformation; cold plastic deformation laws; slide theory; material processing by cutting.

**USV.FIM.II.DD.06.13**
**Machine Tools (1) (Spring/3)**
3 hours per week; 14 weeks / 6$^{th}$ semester: 28C/14L; ECTS credits: 3
Objectives of course are to provide students with an understanding of Hydraulics of machine tools: component parts; speed adjustment using resistive and volume components; hidraulic circuits for principal structure work; hidraulic circuits for auxiliary structure; types and structures of leather, milling machines, boring machines, planing machines, slotting machines, broaching machines, grinding machines; gear machines.

**USV.FIM.II.DD.06.15**
**Mechanical vibrations (Spring/3)**
3 hours per week, 14 weeks/6-th semester: 28C/14L, ECTS credits: 3
Vector calculus elements. Matrix expressions for operations of vector algebra. Inertial characteristics of mechanical systems. Dynamical characteristics of mechanical systems. Basic theorems of dynamics for rigid bodies systems. Newton-Euler equations. Oscillating systems with one degree of freedom without and with damping. Forces oscillations, graphical representations, transmissibility, seismic systems' theory. Oscillating systems with 2 DOF, with finite number of DOF and continuous systems. Modelling of actual nonlinear oscillatory systems. Modelling of oscillatory systems occurring during metal cutting operations. Use of dedicated educational software for modelling and study of dynamical systems behaviour.

**USV.FIM.II.DS.06.16**
**Computer aided design of products – CAD systems (Spring/3)**
2 hours per week;14 weeks /6$^{th}$ semester: 28L;ECTS credits: 2
Autodesk Inventor overview, Creating 2D sketches, Creating solids from 2D sketches, Parametric solids editing, Creating swept type bodies, Creating loft-type bodies, Creating connections and edges, Creating holes and threads, Creating parts with thin walls; Adding components in assembly, Creating parts in the ensemble, Identifying the parts in the assembly, Controls and motion analysis, The interference determination.

**USV.FIM.II.DID.06.17**
**Practical training (Spring/3)**
90 hours 3 weeks / 6$^{th}$ semester; ECTS credits: 4
Practical activities enable the student to put into practice the theory and/or skills they are studying, often in a practical environment: field work, work placements, presentations, working in laboratories and workshops. Practical sessions allow learners to: demonstrate and extend their skills; collect specimens; carry out experiments; demonstrate their subject knowledge; apply theory in practice; demonstrate their awareness in applying health and safety regulations / *Practical activities on specific aspects on industrial engineering in different institutions/companies. Solving specific problems related with industrial engineering.*

## Machine Manufacturing Technologies 4 $^{th}$ year

**USV.FIM.II.DD.07.01**
**Quality Management (Autumn/4)**
3 hours per week;14 weeks /8$^{th}$semester: 28C/14S; ECTS credits: 4
The first part of the course deals with issues concerning definition, characteristics and quality indicators. There are also

summarized information referring to the structure of the quality management system (QMS), to its documentation, the related legislation that underlies the design, the implementation, the certification and the improvement of QMS. At the end of the course there can be found features of service quality management, quality management principles, elements of auditing quality and quality tools.

**USV.FIM.II.DS.07.02**
**Machine manufacturing technology 2 (Autumn/4)**
4 hours per week; 14 weeks / 7th semester: 28C/28L; ECTS credits: 4
Drilling technologies, Grinding technologies, Super finishing technologies, Tapping technologies, Manufacturing Technologies on aggregate machine-tools, Shaft class part manufacturing technology, Gear wheel manufacturing-technology , Technology for casing-class part manufacturing, Lever-class part manufacturing technology,, Bushing-class part manufacturing technology, Machine assembly process

**USV.FIM.II.DS.07.03**
**Machine manufacturing technology 3- project (Autumn /4)**
2 hours per week; 14 weeks /8th semester:28P; ECTS credits: 2
Product design analysis and workpiece material selection, Machining operation sequence planning, The calculation of minimum material stock, Calculation of machining parameters, Calculation of machining time, Calculation of the technical and economical process parameters, Logistics and technical documentation

**USV.FIM.II.DS.07.04**
**Processing by cold plastic deformation 2 (Autumn/4)**
4 hours per week; 14 weeks / 7th semester: 28C/14L; ECTS credits: 4
Processing by cold forming processes 2 shows cold bending, stamping, forming, volume pressing and assembly processes. In every process is studied the tension and the strain state applied on the workpiece material which is being processed, plus the calculus relations of power parameters. Also presented are technological calculations and factors that influence the quality and precision of the machined parts under these procedures. With every processing procedure, the required processing equipment is presented.

**USV.FIM.II.DD.07.05**
**Technological devices (Autumn/4)**
2 hours per week; 14 weeks / 7th semester: 28C/14L; ECTS credits: 4
The technological device (TD) – general facts, The bases of conception of TD, Construction of guidance elements, GE Construction of fasteners in devices F, Centering mechanism CM, Self-centered fastening mechanisms, Providing with devices of the technological system of processing, The technological system of measurement and control

**USV.FIM.II.DS.08.07**
**Robotization of technological processes (Spring/4)**
4 hours per week; 14 weeks /7th semester: 28C/28L/; ECTS credits 3
Robotics and its applications. The concept of robot; a history of robots. Industrial robots architecture.Geometric modelling and programming of industrial robots. Robot system and its components; design recommendations. The prehension device. Performance parameters of industrial robots. Programming languages used in industrial robotics. Industrial applications of robots.

**USV.FIM.II.DS .08.08**
**Computer assisted manufacturing – CAM systems (Spring /4)**
4 hours per week; 14 weeks / 8th semester: 28C/28P; ECTS credits: 3
Short history of computer aided manufacturing technologies, Computer assisted manufacturing technologies, Computer process control, Fundaments of computer assisted part of programming, Modelling and analysis, Direct numerical control, Computer supervision of manufacturing technologies, Operation level production systems, Computer asisted group technologies, Manufacturing cell design

**USV.FIM.II. DS.08.09**
**Processing by cold plastic deformation (3) – project (Spring/4)**
2 hours per week; 14 weeks / 8th semester:28P;ECTS credits: 2
Work-piece analysis; determination of the shape and dimensions of plan work-piece; analysis of division of the semi-finished product, determination of performance technology, calculation of forces and of the pressure center; design mould; instructions for installation, maintenance and operation; setting of standard time; calculation of production cost; labour protection instructions

**USV.FIM.II.DD.08.10**
**Technological devices - project (Spring/4)**
2 hour per week; 14 weeks / 7th semester:28P; ECTS credits: 2
Technological studies of the manufacturing workpiece; Establishing the workpiece orientation scheme; Establishing a scheme for fixing the workpiece; Establishing the clamping mechanism; Establishing the principle scheme of the device; Design the device assembly; Organological calculations and finalizing the drawings; Technical-economic explanatory memorandum; The device quality documents.

**USV.FIM.II.DS.08.11**
**Researching and elaborating graduation paper (Spring/4)**
2 hours per week; 14 weeks / 8th semester 56P; ECTS credits: 4
Analyzing the current state of the themes and existing solutions; Describing the new proposed solutions and the optimal variant; Justifying the chosen solution through organological, technological, electrical, electronic, hydraulic, or thermal calculations; Technical-economical assessment; Aspects regarding the development, installation, maintenance and exploiting of the equipment or device (if applicable)

**USV.FIM.II.DS.07.13**
**Reliability and maintenance (Spring/4)**
3 hours per week; 14 weeks / 7th semester: 28C/28S; ECTS credits: 4
This course familiarizes the students with the concept of reliability, maintainability and availability and their importance when dealing with the conception and exploitation of machine-tools and other technical equipments. It presents the reliability, maintainability and availability concepts, elements of probability theory and its application in reliability, reliability and reliability characteristics, reliability tests, technical issues of reliability theory, maintainability and maintainability characteristics, mentenace concept and issues, availability and availability characteristics, etc…

**USV.FIM.II.DS.07.15**
**Logistics (Autumn/4)**
**3 hours per weeks ; 14 weeks / semester: 28C/1L; ECTS credits: 4**
Logistics origin; Global supply chaine; Logistics processes: Material goods flow processes, The processes of information and decision-making, Inventory processes of material property, Logistics flows infrastructure ; The stage division of logisticss – delivery, production and distribution logistics;; Methods and tools useful in supply chain management .

**USV.FIM.II.DS.08.21**
**Processing technologies on machine tools with numerical control (Spring/4)**
4 hours per week; 14 weeks / 8th semester: 28C/28L; ECTS credits: 4
Computer numeric controlled, Technical and economical advantages of numerical control, Fundaments of numerical controlled machine tools, Numerical controlled machine tool structure, CNC programming

**USV.FIM.II. DS.08.23**
**Design of technologies on flexible manufacturing systems (Spring/4)**
3 hours per week; 14 weeks / 8th semester: 28C/14L/; ECTS credits: 3
Flexible Manufacturing System (FMS). Definition, structure, function. Degree of flexibility and automation of FMS. Specific structures of flexible manufacturing systems. Principles for integrated manufacturing. Integration of industrial robots in flexible manufacturing cells. The FMS implementation impact above the enterprise

## Faculty of Mechanical Engineering Mechatronics and Management

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|---|---|
| Field of study | *Mechatronics and Robotics* |
| Name of the educational program | ***Mechatronics*** *Undergraduate* |

## MECHATRONICS 1 st year

**USV.FIM.MR.DF.01.01**
**Mathematical analysis (Autumn/1)**
4 hours per week; 14 weeks/1st semester; 28C/28S; ECTS credits: 5
Basics of calculus: infinite series, differentiation and partial derivatives of functions of several variables, applications of differentiation, multiple integrals, line integrals, surface integrals, differential equations of first order.

**USV.FIM.MR.DF.01.02**
**Algebra, Analytical and Differential Geometry (Autumn/1)**
4 hours per week; 14 weeks /1st semester: 28C/28S; ECTS credits: 5
The course presents the most important concepts, results and mathematical methods in algebra, analytical and differential geometry useful in the perception of physical phenomena and other mathematical courses. An introduction in linear algebra (vector spaces, linear transformations, eigenvalues, quadratic forms, Euclidian spaces), analytical geometry in two or three dimensions, applications of calculus to the study of the geometry of curves and surfaces in Euclidean space.

**USV.FIM.MR.DD.01.03**
**Science and Engineering of Materials (Autumn/1)**
3 hours per week; 14 weeks /1st semester: 28C/14L; ECTS credits: 3
Definition and Classification of Materials. Properties of Materials. Crystal Structure of Metallic Materials. Solidification. Physico-chemical Constitution of Metallic Materials. Phase Diagrams of Alloys. Deformation and Fracture. Iron-Carbon Equilibrium Diagram. Steels and Cast Irons. Nonferrous Metals and Alloys. Sintered Metallic Materials. Polymeric Materials. Ceramic Materials. Composite Materials. Other materials used in technical.

**USV.FIM.MR.DF.01.04**
**Applied Informatics (Autumn/1)**
4 hours per week; 14 weeks/1st semester; 28C/28L; ECTS credits: 5
Operating Systems, architecture of the computer, the main aspects of Office package, the main concept of the algorithms and programming.

**USV.FIM.MR.DF.01 05**
**Chemistry (Autumn/1)**
3 hours per week; 14 weeks / 1st semester: 28C/14L; ECTS credits: 3
Introduction to Chemistry: definition, chemistry classifications, atom structure, Chemical bonds, General properties of substances (physical, mechanical, chemical, electrical and magnetic) solutions and disperse systems, industrial water, electrochemistry: electrolysis and laws of electrolysis, the chemical Power Sources, Corrosion and anticorrosive protection of metals and alloys, fuels and lubricants.

**USV.FIM.MR.DF.01.06**
**Computer - aided design 1 (Autumn/1)**
3 hours per week; 14 weeks /1st semester: 28C/14L; ECTS credits: 4
The objectives of this discipline are to provide students a clearer picture of bodies in space through a 2D representation using the projection method and vice versa. Descriptive geometry is a science of the drawing deals with the following main topics: Orthographic drawing; Projection systems; Dihedral and trihedral representation of the point, line and plane; Traces of straight line and plan; Straight line and plane in particular positions; Relative position two straight lines; Intersection between lines and/or planes; Folding line and rotation methods; True length of lines; Measurement of angles; Geometric representation of a prism, pyramid, cone and cylinder; Intersections of polyhedrons with lines and planes; Development drawing. Sections throught a pyramid, cone cylinder and sphere.

**USV.FIM.MR.DC.01.07**
**General economics (Autumn/1)**
2 hours per week; 14 weeks/1th semester: 28C; ECTS credits: 2
The Object and the Method of Economy. Economic Systems. Consumer Theory and Demand Theory. Production and Costs Theory. Supply Theory. Competition. Savings Investment, Unemployment. Currency Banks and the Money Market. The Financial (Capital) Market. Inflation. Macroeconomic Policies. Economic Growth and Development. Economic Integration.

**USV.FIM.MR.DC.01.08**
**Physical education (Autumn/1)**

1 hour per week; 14 weeks /1st semester: 14S; ECTS credits:2
In practical work find content specific learning units gymnastics, athletics, team sports. From basic gymnastics using specific means of health education and general harmonious physical development and training of athletic exercises of the body to maintain a sustained effort

**USV.FIM.MR.DC.01.09**
**English 1 (Autumn/1)**
2 hour per week, 28S: 14 weeks/ 1th semester, ECTS credits:2
Multiple general assessment test;An overview of main grammar issues, based on TOEFL and Cambridge tests - vocabulary reminder (at least 14 seperate seminars); Model Test 5, TOEFL Essential English; Structure and written expression; Vocabulary and Reading Comprehension (False friends approach);TOEFL Essentual English 6 – transition to technical terms; TOEFL 7 – Tenses; Sciemce and Technology; The Importance of the Research Theorist;The impact of technology on everyday life

**USV.FIM.MR.DID.02.10**
**Mechanics (Spring/1)**
5 hours per week, 28C/28S/14L: 14 weeks/ 2nd semester, ECTS credits 6
Vectors; Statics of particles; Equivalent systems of forces; Equilibrium of rigid bodies; Friction; Centers of gravity; Moments of inertia; Kinematics of particles; Relative motion; Kinematics of rigid bodies; Dynamics of particles; Dynamics of rigid bodies

**USV.FIM.MR.DF.02.12**
**Physics (Spring /1)**
4 hours per week; 14 weeks/2nd semester; 28C/28L; ECTS credits: 4
Overview of the main natural phenomena in terms of: mechanics, electromagnetism, optics, atomic physics and, quantum mechanics. Each domain shows the student's theoretical and experimental method to understand the main phenomena for the mechanical engineer.

**USV.FIM.MR.DF.02.13**
**Numerical Methods (Spring/1)**
4 hours per week, 28C/28L: 14 weeks/ 4th semester, ECTS credits 5
The course elaborates on the following main topics: basic notions in error theory, algorithms and representation of algorithms, numerical methods for solving algebraic and transcendental equations, numerical solution of systems of linear equations, numerical approximation of real functions, Lagrange interpolation, Newton interpolation polynomial, spline interpolation, regression approximation, derivation and numerical integration, numerical solution of differential equations, experimental data processing, implementation of algorithms in Mathcad..

**USV.FIM.MR.DC.02.14**
**Communication (Spring/1)**
2 hours per week; 14 weeks / 1st semester: 28S; ECTS credits: 2
Objectives of effective Communication; Barriers in Communication; Metacommunication - nonverbal communication; Message planning; Intra C, inter C, group C. and mass C; Communication as a transactional process; Negotiation and manipulative techniques; The interview, the CV/resume; Frequent mistakes in today's vernacular as a result of borrowings

**USV.FIM.MR.DF.02.15**
**Computer - aided design 2 (Spring/2)**
5 hours per week; 14 weeks / 2nd semester: 28C/28L; ECTS credits: 5
Drawing elements, Types of drawings, Projection, Sectioning, Dimensioning, Detail drawing, Assembly drawing

**USV.FIM.MR.DC.02.16**
**Physical education 2 (Spring/1)**
1 hour per week, 14S: 14 weeks/ 2nd semester, ECTS credits 2
In practical work find content specific learning units gymnastics, athletics, team sports. From basic gymnastics using specific means of health education and general harmonious physical development and training of athletic exercises of the body to maintain a sustained effort

**USV.FIM.MR.DC.02.17**
**Foreign language/English (Spring/1)**
2 hours per week; 14 weeks /2nd semester: 28 S; ECTS credits: 2
Subject: Foreign language, English. Tenses. Modality. Special nouns and gender. Quantifiers. Degrees of comparison. If clauses. Sequence of tenses. The passive voice. Reported speech. Gerund vs participle. Relative clauses. Disjunctive questions. New trends in using the infinitive. Building vocabulary. False friends. Structure and written expression. The impact of technology on everyday life. Transition from everyday words to technical terms. Global Trends and Best Practices in Mechatronics Product Lifecycle Management

## MECHATRONICS 2nd year

**USV.FIM.MR.DF.03.01**
**Special Mathematics (Autumn/2)**
4 hours per week; 14 weeks/3rd semester; 28C/28S; ECTS credits: 4
Basics about: systems of ordinary differential equations, linear partial differential equations, fields theory, derivative of a complex function of a complex variable, integration of complex functions and Cauchy theorems, series of analytical functions, Taylor series, Laurent series, residues theory, Laplace transform and its applications, trigonometric series, Fourier series.

**USV.FIM.MR.DD.03.02**
**Strength of materials 1 (Autumn/2)**
5 hours per week; 14 weeks /3rd semester: 28C/28S/14L; ECTS credits: 4
The object and problems of the strength of materials. The bodies' schematization. The loads schematization. Material mechanical properties. Fundamental criteria for computation. Inertia moments of plane areas. Diagrams for sectional efforts (Axial forces diagrams; diagrams of shear forces; Diagrams of bending moments). Elements of elasticity theory. Spatial stress state. Spatial strain state. Plane stress state. Plane strain state. Tension - compression of straight beams. Torsion of straight beams.

**USV.FIM.MR. DD.03.03**
**Mechanisms and machine elements (1) (Autumn/2)**
5 hours per week; 14 weeks /3rd semester: 28C/28S/14L; ECTS credits: 6
Mobility; degree of freedom, classification of mechanisms; planar, spherical, and spatial mechanisms; positional, velocity, and acceleration analysis; lower joint mechanisms vectorial loop method for planar kinematics; Hartenberg-Denavit convention; kinematics of spatial linkages; cam mechanisms; displacements diagram, characteristic geometrical parameters; cam profile tracing; pressure angle; minimum radius-of-

curvature; spur gears, fundamental law of toothed gearing; the manufacture of gear teeth; interference and undercutting; contact ratio; helical gears, contact of helical gear teeth; herringbone gears; crossed-axis helical gear; bevel gears; crown and face gears; hypoid gears; basics of worm and worm gears; mechanisms train.

**USV.FIM.MR.DD.03.04**
**Tolerances and dimensional control (Autumn/2)**
3 hours per week; 14 weeks /3rd semester: 28C/14L; ECTS credits: 4
This course familiarizes the students with the prescription and control of the dimensional and geometrical precision of the machine elements. It presents the dimensional and geometrical precision, dimensions' chains, basic notions concerning the dimensional and geometrical measurements and control, statistical control methods.

**USV.FIM.MR.DS.03.05**
**Materials Technology (Autumn/2)**
3 hours per week; 14 weeks/3rd semester; 28C/14L; ECTS credits: 4
Technological process; Alloy casting. Materials plastic deformation; Metallic materials welding; Cutting metal materials by thermal processes. Ceramic material processing technologies; Plastics processing technologies; Composite materials manufacturing technology; Nonconventional technologies.

**USV.FIM.MR.DC.03.08**
**Physical education and sport 3 (Autumn/2)**
1 hour per week, 14S: 14 weeks/ 3rd semester, ECTS credits 2
In practical work find content specific learning units gymnastics, athletics, team sports. From basic gymnastics using specific means of health education and general harmonious physical development and training of athletic exercises of the body to maintain a sustained effort

**USV.FIM.MR.DF.04.09**
**Mechanisms and machine elements (Spring/2)**
2 hours per week, 14 weeks/4-th semester: 28P, ECTS credits: 2
Project theme presentation, requirements and references. Structural analysis and graphical-analytical kinematics analysis for a linkage mechanism. Kinematical analysis of mechanisms with lower pairs using vector contour method. Kinetics-static analysis for lower pair mechanism. Design of a mechanism with rotating cam and translational follower with imposed law of motion. Cam's profile tracing using computer.

**USV.FIM.MR.DD.04.10**
**Strength of materials 2 (Spring/2)**
6 hours per week; 14 weeks /4th semester: 28C/28S/28L; ECTS credits: 5
Bending. Pure bending of straight beams. Naviers's formula. Tangential stresses in sections subject to simple bending. Juravski's formula. Deflections of straight beams subjected to bending. Energy methods in determining displacements. Castigliano's theorem. The theorem of Mohr and Maxwell. Veresceaghin's method. Statically indeterminate beams. Buckling beams. Dynamic action of forces. Fatigue of materials. Applications of elasticity theory.

**USV.FIM. MR.DD.04.11**
**Thermotechnics (Spring/2)**
6 hours per week 28C/28S/28L: 14 weeks/4th semester, ECTS credits 5
Basic Concepts and Definitions: Thermodynamic Systems and Surroundings, Types of Thermodynamic Systems, Thermodynamic Equilibrium, First Law of Thermodynamics: Energy, Potential Energy, Kinetic Energy, Specific Internal Energy, Specific Enthalpy, Work, Heat, Entropy, Ideal Gas, Thermodynamic systems and processes: Isochoric Process, Isobaric process, Isentropic Process, Polytropic Process, Throttling Process, Second Law of Thermodynamics, Methods of Thermodynamics, Third Law of Thermodynamics, Property diagrams and steam tables: Property Diagrams, Pressure-Temperature (P-T) Diagram, Pressure-Specific Volume (P-v), Diagram Pressure-Enthalpy (P-h) Diagram Enthalpy-Temperature (h-T), Diagram, Temperature-Entropy (T-s) Diagram, Enthalpy-Entropy (h-s) or Mollier Diagram, Steam Tables, The Wet Air, Gas Dynamics, Heat transfer terminology: Heat and Temperature, Heat and Work, Modes of Transferring Heat, Heat Flux, Thermal Conductivity, Log Mean Temperature Difference, Convective Heat Transfer Coefficient, Overall Heat Transfer Coefficient, Bulk Temperature, Conduction heat transfer, Convection heat transfer, Radiant heat transfer, Thermal machines.

**USV.FIM.MR.DID.04.12**
**Fluid Mechanics (Spring/2)**
5 hours per week 28C/14S/28L: 14 weeks/4th semester, ECTS credits 5
Introduction and fundamental concepts, fluid statics, Fundamental concepts used in fluid flow analysis, The energy equation, Inviscid incompressible fluid flow, Inviscid compressible flow, The momentum equation, Dimensional analysis and similitude, Incompressible viscous flow, Definition and classification of hydro-pneumatic machines.

**USV.FIM.MR.DD.04.13**
**Electrotechnics and electrical machines (Spring/2)**
4 hours per week; 14 weeks /4th semester: 28C/14L; ECTS credits: 4
Periodic electrical signals, Electrical circuits, Laws, theorems and methods of analysis of electrical circuits, Magnetic circuits, Electrical circuit analysis, Electrical transformer, Asynchronous electric machine, DC electric machine, Synchronous electric machine.

**USV.FIM.MR.DD.04.14**
**Electronics (Spring/2)**
3 hours per week; 14 weeks /4th semester: 28C/14L; ECTS credits: 3
Introduction in Electronics; Concepts of semiconductor physics; Pn junction; Semiconductor diodes; Types of diodes; Bipolar transistor; Field Effect Transistors; MOS transistor; Other devices with junctions; Optoelectronic semiconductor devices; Regime of switching semiconductor devices; Diode Circuits; Amplifiers; Reaction in amplifiers; Harmonic oscillators

**USV.FIM. MR.DC.04.15**
**Physical education 4 (Spring/2)**
1 hour per week, 14S: 14 weeks/ 4th semester, ECTS credits 1
In practical work find content specific learning units gymnastics, athletics, team sports. From basic gymnastics using specific means of health education and general harmonious physical development and training of athletic exercises of the body to maintain a sustained effort

**USV.FIM. MR.DD.04.16**
**Practical training (Spring/2)**
90 hours; 4th semester; ECTS credits: 4
Safety; Internship on vehicle mechatronics

# MECHATRONICS 3rd year

**USV.FIM. MR.DD.05.01**
**Data acquisition and virtual instrumentation (Spring/3)**
3 hours per week; 14 weeks / 6th semester: 28C/14L; ECTS credits: 3
Data acquisition denotes a branch of engineering that deals with collecting information from a number of sources numerical and/or analog, converting the data into a digital form, processing, storage and transmission of it, for example to a computer. Data processing may consist of simple operations, such as comparisons, up to complicated mathematical processing (integration, differentiation, mediation, Fourier transforms, etc.). In order to control a physical process is necessary to extract information about its development, using transducers. The electrical signal output from the transducer is converted into an electrical signal with different parameters (current, voltage, etc.) through conditioning circuits. It requires the conversion of analog signals into digital signals supported by numerical processing system. Digital signals are obtained by sampling data at any given time, the analog signals and convert these values as numerical one through analog digital converters. Virtual instruments can be a program written in the LabVIEW or in other programming languages.

**USV.FIM.MR.DS.05.02**
**Medical equipment (Autumn/3)**
3 hours per week, 28C/14L: 14 weeks/ 7th semester, ECTS credits 4
Introduction; parameters of medical devices and classifications; elements of medical instruments; cell potential; electrodes, sensors and transducers for medical equipment; equipment for cardiac investigation and treatment; cardiac valves ; equipment for investigation and treatment of respiratory system; surgical instruments; anaesthesia equipment, imaging: radiography, ultrasonic, MRI.

**USV.FIM.MR.DID.05.03**
**Automatic Systems – Fundamentals (Autumn/3)**
3 hours per week 28C/14L: 14 weeks/5th semester, ECTS credits: 3
Automatic linear systems (mathematical modeling, performance calculation, design concepts). Automated multivariable systems. Automated nonlinear systems. Automated adaptive systems. Automated optimal extreme systems.

**USV.FIM.MR.DD.05.04**
**Architecture of numerical computers (Autumn/3)**
3 hours per week; 14 weeks / 5th semester: 28C/14L; ECTS credits: 4
With the increasing use of numerical control of mechanical systems, it is necessary for mechanical engineering students to have a basic knowledge of microcontrollers and microprocessors and their associated interfaces with mechanical world.
The course subject content covers the basics of microcontroller and microprocessor: the CPU, memory, I/O, buses subsystems, basic operation of a microprocessor system (fetch and execute cycle), differences between microcontroller and microprocessor, the architecture of some typical microcontrollers (ATmega16, PIC16F877, INTEL 8051) and their features (block diagram and definitions of the pins, I/O port structure, memory organization, general purpose RAM, bit addressable RAM, register bank, special function registers, external memory, memory space mapping and decoding, bus control signals timing).

**USV.FIM. MR.DD.05.05**
**Digital Electronics (Autumn/3)**
3 hours per week 28C/14L: 14 weeks/5th semester, ECTS credits: 3
This course covers combinational and sequential logic circuits. Topics include number systems, Boolean algebra, logic families, medium scale integration (MSI) and large scale integration (LSI) circuits and other related topics. Upon completion, students should be able to construct, analyze, verify, and troubleshoot digital circuits using appropriate techniques and test equipment.

**USV.FIM.MR.DS.05.06**
**Robotics (Autumn/3)**
4 hours per week; 14 weeks /7th semester: 28C/28L/; ECTS credits 5
Robotics and its applications. The concept of robot; a history of robots. Industrial robots architecture.Geometric modelling and programming of industrial robots. Robot system and its components; design recommendations. The prehension device. Performance parameters of industrial robots. Programming languages used in industrial robotics. Industrial applications of robots.

**USV.FIM.MR. DD.05.07**
**Mechanisms and machine elements (2) (Spring/3)**
**4 hours per week 28C/14S/14L: 14 weeks/5th semester, ECTS credits: 4**
This is the second part of machine elements course, concerning modelling, design, integration and best practices for use of machine elements such as shafts, hydrodynamic, hydrostatic and rolling bearings, keys, pins, cotters assembly methods and springs. For each type of elements a brief description, stresses, failure, recommended materials and calculus criteria is presented. Basics on classical design of mechanical parts, such as statics and dynamics of mechanical elements, failure criteria, tribology elements, reliability, mechanical choice criteria and so on are also covered. These are reinforced via laboratory experiences and a substantial design project wherein students design a two steps (belts and gears) mechanical transmission system.

**USV.FIM.MR. DD.05.08**
**Mechanisms and machine elements 2 – project (Spring/3)**
**2 hours per week;14 weeks /5 th semester:28P; ECTS credits: 2**
Students must design a two stage (belts and gears) mechanical transmission system. Starting from a given material, several steps are followed so that the gear outputs an imposed torque and speed. The designed speed reducer must use single stage spur gears reducer and an external V belt transmission. The belt transmission, gears geometry and shafts dimensions are calculated. The shafts resistance to fatigue, vibration and strain are verified. All the gear's transmission elements must be calculated. The reducer gear housing must be designed and the thermal regime is verified. The projects must contain technical drawings for V belt pulleys, spur gears, shafts, gear housing, as well as for the speed reducer assembly.

**USV.FIM.MR. DS.06.09**
**Experimental techniques (Spring/3)**
3 hours per week; 14 weeks /2nd semester: 28C/14L; ECTS credits: 3
General problems on research. Getting metrology. Measurement experiment results.Classic and modern experiments; Classical methods for planning experiments; Complete factorial plans; Experimental plans and mathematical modeling of the studied phenomenon; Modern methods of experimental planning; Analysis of results variance; Conclusions on the study of a phenomenon / product through experimental plans method; Acquisition of data for the study of industrial phenomenon; Experimental plans and industrial practice; Roughness measurement and dependency factors or Length measurement and dependency factors; Mathematical modeling of practical applications; Conclusions.

**USV.FIM. MR.DD.06.10**
**Power Electronics (Spring/3)**
3 hours per week; 14 weeks /6th semester: 28C/14L; ECTS credits: 3
Overview of the semiconductor devices that are used in power electronic devices. Diodes ,Schottky Diodes
Thyristors , Power Bipolar Junction Transistors, MOSFETs ,Insulated Gate Bipolar Transistors . Operation of circuits used in power electronic devices: Voltage Stabilizer, Switching DC Voltage Source, Rectifiers, Uncontrolled Single-Phase Rectifiers , Uncontrolled and Controlled Rectifiers, Inverters, Choppers, Modulation Strategies, Pulse Width Modulation . Applications for power electronics, including motor drives, mechatronic applications.

**USV.FIM. MR.DS.06.11**
**Manufacturing technologies and equipments (Spring/3)**
3 hours per week; 14 weeks / 6th semester: 28C/14L; ECTS credits: 3
This course introduces students to the manufacturing industry by giving them knowledge about the design and fabrication of mechanical products using a variety of processes, tools, and equipments. Provides basic knowledge of various manufacturing processes and materials. The course covers processes involving cutting tools, machine tools, measuring, and inspection and provides knowledge of manufacturing procedures and industry standard roles in manufacturing settings.

**USV.FIM. MR.DD.06.12**
**Mechanical System Dynamics (Spring/3)**
3 hours per week; 14 weeks / 6th semester: 28C/14L; ECTS credits: 3
Notion of mechanical and mechatronical system; inertial characteristics of a systems; mass and inertia matrix tensor; degree of freedom of a system; systems with finite and infinite degree of freedom; kinematical parameters of a dynamical systems; velocity and angular velocity; dynamical characteristics; force and torque; work, energy and power; component of mechanical systems; actuators; dumping elements; elastic elements; characteristics of electrical systems; Newton-Euler motion equations for a rigid body; Lagrange's Equation of second kind; vibrations in mechanical system; mathematical model of a mechanical system; ordinary linear differential equation; solution of homogenous and non-homogenous ordinary differential equation; solution of linear differential equation with constant coefficient, characteristic equation; Laplace transform; transfer function; dynamic stability; poles and stability criteria..

**USV.FIM.MR.DD.06.13**
**Computer Aided Graphics (Spring/3)**
3 hours per week; 14 weeks / 6th semester: 14C/28L; ECTS credits: 3
Introduction to AutoCAD, Drawing convention, Interfacing with AutoCAD, Drawing objects, Creating a new drawing, Drawing, editing, hatching, dimensioning commands, 2D applications

**USV.FIM. MR.DD.06.14**
**Drive Systems (Spring/3)**
2 hours per week; 14 weeks / 6th semester: 14C/14L; ECTS credits: 2
This course introduces basic concepts of drive systems, different types of drives used in mechatronics and the main aspects taken into account in the choice of drive systems based on areas of use, and applications. The hydraulic section covers introductory elements on fluid power, hydraulic systems and components, as well as basic fluid-related measurements. Hydraulic circuit designs including electro-hydraulics circuits are also covered. In the pneumatics section, students will be able to approach basic pneumatic problems using gas laws, as well as to identify and explain the role of various pneumatic components. For the pneumatic circuit design section, students will be able to design and analyse basic and multiple pneumatic circuits as well as electro-pneumatic circuits. The electric drives section covers servo and stepper motors.

**USV.FIM. MR.DD.06.15**
**Practical training (Autumn/3)**
90 hours / 6th semester: ECTS credits: 4
Machining precision technologies; assembly technologies of mechatronical elements; measuring and control devices; measurement accuracy improvements.

**USV.FIM. MR.DS.05.16**
**Biomechanics (Autumn/3)**
3 hours per week; 14 weeks / 5th semester: 28C/28L; ECTS credits: 5
Laws of motion; Skeletal tree; Bone, cartilage and ligaments; Joints of the human body; Contact Forces in Static Equilibrium; Leavers; Muscle Force in Motion; Moment Arm and Joint Angle; Center of gravity; General dynamics theorems; Conservation of linear momentum; Center of mass and its motion; bodies in planar motion; Angular velocity, angulat acceleration; Angular momentum; Conservation of angular momentum; Instantaneous center of rotation; Aplications to human body dynamics.

## MECHATRONICS 4th year

**USV.FIM.MR.DID.07.01**
**Robotics 2 (Autumn/4)**
4 hours per week; 14 weeks /7th semester: 28C/28L/; ECTS credits 5
Robotics and its applications. The concept of robot; a history of robots. Industrial robots architecture. Geometric modelling and programming of industrial robots. Robot system and its components; design recommendations. The prehension device. Performance parameters of industrial robots. Programming languages used in industrial robotics. Industrial applications of robots.

**USV.FIM. MCT.DID.07.02**
**Equipments and Manufacturing Technologies in**

**Mechatronics (Autumn/4)**
3 hours per week; 14 weeks /7th semester: 28C/14L/; ECTS credits: 3
Production processes. Technological processes, Machine manufacturing workpieces, Fundaments in designing mounting devices, Cutting processes, Machine tool structure and kinematic chain, Physical characterization of cutting processes, Tools, Process accuracy, Surface quality, , Process for mounting a workpiece for machining, Manufacturing process design, CNC manufacturing processes and computer aided manufacturing, Nonconventional machining, Machine assembly process

**USV.FIM.MR.DS.07.04**
**Automotive mechatronics (Autumn/4)**
4 hours per week; 14 weeks /7th semester: 28C/28L/; ECTS credits: 5
*Evolution of electronics in automobiles*: emission laws, introduction to Euro I to VI standards, Equivalent Bharat Standards, Work, Power, Efficiency, Operating conditions, Charge, *Sensor and actuators:* Working principle and characteristics of Airflow rate, Engine crankshaft angular position, Hall effect, Throttle angle, temperature, exhaust gas oxygen sensors – study of fuel injector, exhaust gas recirculation actuators, stepper motor actuator, vacuum operated, *Charging systems:* Working and design of charging circuit diagram, Alternators, Requirements of starting system, Starter motors and starter circuits, I*gnition systems:* Ignition fundamentals, Electronic ignition systems, Programmed Ignition, Distribution less ignition, Direct ignition, Spark Plugs. *Electronic fuel Control:* Basics of combustion, Engine fuelling and exhaust emissions, Electronic control of carburetion, Petrol fuel injection – K, KE, L, L3,LH, MONO Jetronic, Motronic, Diesel fuel injection, *Engine control systems*: cooling systems, exhaust systems.

**USV.FIM.MR.DD.07.05**
**Programmable machines (Autumn/4)**
4 hours per week; 14 weeks /7th semester: 28C/28L/; ECTS credits: 5
The course offers an introduction to PLCs (Programmable Logic Controllers). Topics include various processor units, numbering systems, memory organization, relay type devices, timers, counters, data manipulators, and programming. Programming principles, Ladder Logic and Grafcet diagrams are also covered. PLCs are currently employed in multiple industrial and commercial processes. Mechatronics engineers can be expected to be able to install, troubleshoot, program & modify PLCs and PLC controlled systems. The intent of this course is to have students develop the basic technician level skills required by industry.

**USV.FIM.MCT.DS.07.13**
**RELIABILITY AND MAINTENANCE (Autum/4)**
3 hours per week; 14 weeks /1st semester (autumn): 28C/14S; ECTS credits: 3
Subject descriptive: This course familiarizes the students with the concept of reliability, maintainability and availability and their importance when dealing with the conception and exploitation of machine-tools and other technical equipments. It presents the reliability, maintainability and availability concepts, elements of probability theory and its application in reliability, reliability and reliability characteristics, reliability tests, technical issues of reliability theory, maintainability and maintainability characteristics, availability and availability characteristics, etc…

**USV.FIM.MR.DS.07.15**
**Smart materials and structures (Autumn/4)**
3 hours per week; 14 weeks/8th semester; 28C/28L; ECTS credits: 5
Piezoceramics, Piezopolymers, Electrostrictive ceramics, Magnetostrictives, Shape memory alloys, Electro rheological fluids, Magneto rheological fluids, Actuators and sensors

**USV.FIM.MR.DD.08.08**
**Mechatronic Systems (Spring/4)**
4 hours per week; 14 weeks /8st semester: 28C/28L; ECTS credits: 4
According to the original definition of mechatronics that the Yasakawa Electric Company proposed and the definitions that have since appeared, many engineering products designed and manufactured in the last thirty years that integrate mechanical and electrical systems can be classified as mechatronic systems. Discipline aims at combining the knowledge gained in mechatronics basis, electronics and mechanical engineering, in order to obtain mechatronic systems and application development complex interdisciplinary. In the discipline "Mechatronic Systems" will be studied what are the main categories of mechatronic systems and how to simulate or realize them. The knowledge gained can be applied in the design or operation of mechatronic systems.

**USV.FIM.MR.DS.08.07**
**Technologies for numerically controlled machines (Spring/4)**
4 hours per week; 14 weeks /8st semester: 28C/28L; ECTS credits: 4
Focuses on application of the Computer Numerical Control (CNC) systems used in today's manufacturing environment. This course teaches students the fundamentals of computer numerical control (CNC) machining. Students will learn how to program a CNC machine using manual G/M code programming.

# Ştefan cel Mare University of Suceava, România
## Faculty of Mechanical Engineering Mechatronics and Management

| | |
|---|---|
| Field of study | *Mechanical Engineering* |
| Name of the educational program | ***Mechanical Engineering*** |

## Mechanical Engineering 1 st year

**USV.FIM.IM.DF.01.01**
**Mathematical analysis (Autumn/1)**
4 hours per week; 14 weeks/1st semester; 28C/28S; ECTS credits: 5
Basics of calculus: infinite series, differentiation and partial derivatives of functions of several variables, applications of differentiation, multiple integrals, line integrals, surface integrals, differential equations of first order.

**USV.FIM.IM.DF 01.02**
**Algebra, Analytical and Differential Geometry (Autumn/1)**
4 hours per week; 14 weeks / 1st semester: 28C/28S; ECTS

credits: 5
The course presents the most important concepts, results and mathematical methods in algebra, analytical and differential geometry useful in the perception of physical phenomena and other mathematical courses. An introduction in linear algebra (vector spaces, linear transformations, eigenvalues, quadratic forms, Euclidian spaces), analytical geometry in two or three dimensions, applications of calculus to the study of the geometry of curves and surfaces in Euclidean space.

**USV.FIM.IM.DD 01.03**
**Science and Engineering of Materials (1) (Autumn/1)**
3 hours per week; 14 weeks /1st semester: 28C/14L, ECTS credits: 4
Definition and Classification of Materials. Properties of Materials. Crystal Structure of Metallic Materials. Solidification of Metallic Materials. Physico-chemical Constitution of Metallic Materials. Diffusion. Phase Diagrams of Alloys. Deformation and Fracture of Metallic Materials. Iron-Carbon Equilibrium Diagram. Phase Transformations in Iron Alloys.

**USV.FIM.IM.DF.01.04**
**Applied Informatics (Autumn/1)**
3 hours per week; 14 weeks/1st semester; 28C/14L; ECTS credits: 3
Operating Systems, architecture of the computer, the main aspects of Office package, the main concept of the algorithms and programming.

**USV.FIM.IM.DF.01 05**
**Chemistry (Autumn/1)**
4 hours per week; 14 weeks / 1st semester: 28C/28L; ECTS credits: 5
Introduction to Chemistry: definition, chemistry classifications, atom structure, Chemical bonds, General properties of substances (physical, mechanical, chemical, electrical and magnetic) solutions and disperse systems, industrial water, electrochemistry: electrolysis and laws of electrolysis, the chemical Power Sources, Corrosion and anticorrosive protection of metals and alloys, fuels and lubricants.

**USV.FIM.IM.DF. 01. 06**
**Descriptive geometry (Autumn/1)**
3 hours per week; 14 weeks /1st semester: 14C/28L; ECTS credits: 3
The objectives of this discipline are to provide students a clearer picture of bodies in space through a 2D representation using the projection method and vice versa. Descriptive geometry is a science of the drawing deals with the following main topics: Orthographic drawing; Projection systems; Dihedral and trihedral representation of the point, line and plane; Traces of straight line and plan; Straight line and plane in particular positions; Relative position two straight lines; Intersection between lines and/or planes; Folding line and rotation methods; True length of lines; Measurement of angles; Geometric representation of a prism, pyramid, cone and cylinder; Intersections of polyhedrons with lines and planes; Development drawing. Sections throught a pyramid, cone cylinder and sphere.

**USV.FIM.IM.DC.01.07**
**General economics (Autumn/1)**
2 hours per week; 14 weeks/1th semester: 28C; ECTS credits: 2
The Object and the Method of Economy. Economic Systems. Consumer Theory and Demand Theory. Production and Costs Theory. Supply Theory. Competition. Savings Investment, Unemployment. Currency Banks and the Money Market. The Financial (Capital) Market. Inflation. Macroeconomic Policies. Economic Growth and Development. Economic Integration.

**USV.FIM.IM.DC.01. 08**
**Physical education (1) (Autumn/1)**
1 hour per week; 14 weeks /1st semester: 14S; ECTS credits: 1
Maintaining optimal health status of students and increase their adaptability to environmental factors ; Harmonization of their own physical development and prevention of possible deviations from the installation; Expansion of its own fund basic motor skills , basic applicative and basic sports ones and development of motor skills related; Independent practice of physical exercises , games and various sports; The expression of team spirit and competition , according to a system of rules accepted.

**USV.FIM.IM.DC.01.09**
**English 1 (Autumn/1)**
2 hours per week, 28S:14 weeks/ 1th semester, ECTS credits: 2
Multiple general assessment test; An overview of main grammar issues, based on TOEFL and Cambridge tests - vocabulary reminder (at least 14 seperate seminars); Model Test 5, TOEFL Essential English; Structure and written expression; Vocabulary and Reading Comprehension (False friends approach);TOEFL Essentual English 6 – transition to technical terms; TOEFL 7 – Tenses; Science and Technology; The Importance of the Research Theorist; The impact of technology on everyday life

**USV.FIM.IM.DD.02.10**
**Mechanics 1 (Spring/1)**
4 hours per week; 14 weeks / semester: 28C/14S/14L; ECTS credits: 5
Vectors algebra; Forces; Statics of particles; Equivalent systems of forces; Equilibrium of rigid bodies; Moment of a force about a point and about an axis; Reduction of a system of forces to a wrench; Friction; Centers of gravity; Kinematics of particles; Relative motion; Kinematics of rigid bodies; Translation; Rotation about a fixed axis; Plane motion; Motion about a fixed point; General motion.

**USV.FIM.IM.DD. 02 11**
**Science and Engineering of Materials (2) (Spring/1)**
4 hours per week; 14 weeks /2nd semester: 28C/28L; ECTS credits: 5
Ferrous Alloys (Steels and Cast Irons). Nonferrous Metals and Alloys. Sintered Metallic Materials. Polymeric Materials. Ceramic Materials. Composite Materials. Other materials used in technical (Amorphous Metals and Alloys, Materials with Shape Memory, Semiconductors, Biomaterials etc).

**USV.FIM.IM.DF.02.12**
**Physics (Spring/1)**
4 hours per week; 14 weeks / 2nd semester: 28C/14S/14L; ECTS credits: 5
Overview of the main natural phenomena in terms of: mechanics, electromagnetism, optics, atomic physics and, quantum mechanics. Each domain shows the student's theoretical and experimental method to understand the main phenomena for the mechanical engineer.

**USV.FIM.IM.DF.02.13**
**Numerical Methods (Spring/1)**
4 hours per week; 14 weeks /2nd semester: 28C/28L; ECTS

credits: 5
The course elaborates on the following main topics: basic notions in error theory, algorithms and representation of algorithms, numerical methods for solving algebraic and transcendental equations, numerical solution of systems of linear equations, numerical approximation of real functions, Lagrange interpolation, Newton interpolation polynomial, spline interpolation, regression approximation, derivation and numerical integration, numerical solution of differential equations, experimental data processing, implementation of algorithms in Mathcad.

**USV.FIM.IM.DC.02 14**
**Communication (Spring/1)**
2 hours per week; 14 weeks /2nd semester: 28S; ECTS credits: 2
Objectives of effective Communication; Barriers in Communication; Metacommunication - nonverbal communication; Message planning; Intra C, inter C, group C. and mass C; Communication as a transactional process; Negotiation and manipulative techniques; The interview, the CV/resume; Frequent mistakes in today's vernacular as a result of borrowings

**USV.FIM.IM.DF.02.15**
**Technical drawing and infographics 1 (Spring/1)**
4 hours per week; 14 weeks / 2nd semester: 28C/42L; ECTS credits: 5
Drawing elements, Types of drawings, Projection, Sectioning, Dimensioning, Detail drawing, Assembly drawing

**USV.FIM.IM.DC.02. 16**
**Physical education(2) (Spring/1)**
1 hour per week; 14 weeks /2nd semester: 14S; ECTS credits: 1
Maintaining optimal health status of students and increase their adaptability to environmental factors ; Harmonization of their own physical development and prevention of possible deviations from the installation; Expansion of its own fund basic motor skills , basic applicative and basic sports ones and development of motor skills related; Independent practice of physical exercises, games and various sports; The expression of team spirit and competition , according to a system of rules accepted.

**USV.FIM.IM.DC.02.17**
**English 2 (Spring /1)**
2 hours per week;14 weeks /2nd semester: 28S;ECTS credits: 2
Capability to explain and interpret ideas, projects; Build-up of pros and cons in a debate; Identifying the logical sequence among a text parts and the ability to extract the relevant information from that text; Accurate reception of oral or written messages in various communicational stances.
Accurate message output, both written and oral, regarding technical issues; Identifying key elements in a standard speed message; Building interaction in both written and oral communication, building the ability to defend an issue clearly and convincingly in sundry circumstances regarding familiar scientific and technical topics; Transfer and mediation of oral or written messages on diverse topics.

## Mechanical Engineering 2 rd year

**USV.FIM.IM.DF.03.01**
**Special Mathematics (Autumn/2)**
3 hours per week; 14 weeks / 3rd semester: 28C/14S; ECTS credits: 4
Basics about: systems of ordinary differential equations, linear partial differential equations, fields theory, derivative of a complex function of a complex variable, integration of complex functions and Cauchy theorems, series of analytical functions, Taylor series, Laurent series, residues theory, Laplace transform and its applications, trigonometric series, Fourier series.

**USV.FIM.IM.DD.03.02**
**Mechanics 2 (Autumn/2)**
4 hours per week; 14 weeks / semester: 28C/14S/14L; ECTS credits: 4
Moments of inertia; Radius of gyration; Parallel-axis theorem; Principal axes and principal moments of inertia; Dynamics of particles: Equations of motion, Linear momentum, Angular momentum, Work and kinetic energy; Dynamics of systems of particles; Dynamics of rigid bodies: Angular momentum; Linear momentum theorem; Angular momentum theorem; Kinetic energy ad work theorem; motion of a rigid body in three dimensions; Euler's equations of motion; Motion of a gyroscope; Principle of virtual work; D'Alembert's principle

**USV.FIM.IM.DD.03.03**
**Strength of materials (1) (Autumn/2)**
4 hours per week; 14 weeks / 3rd semester: 28C/28S; ECTS credits: 4
The object and problems of the strength of materials. The bodies schematization. The loads schematizition. Material mechanical properties. Fundamental criteria for computation. Inertia moments of plane areas. Diagrams for sectional efforts (Axial forces diagrams; diagrams of shear forces; Diagrams of bending moments). Elements of elasticity theory. Spatial stress state. Spatial strain state. Plane stress state. Plane strain state. Tension - compression of straight beams. Torsion of straight beams.

**USV.FIM.IM.DD.03.04**
**Mechanisms (1) (Autumn/2**
4 hours per week; 14 weeks / 3rd semester: 28C/14S/14L; ECTS credits: 5
Mobility; degree of freedom, classification of mechanisms; planar, spherical, and spatial mechanisms; positional, velocity, and acceleration analysis; lower joint mechanisms vectorial loop method for planar kinematics; Hartenberg-Denavit convention; kinematics of spatial linkages; cam mechanisms; displacements diagram, characteristic geometrical parameters; cam profile tracing; pressure angle; minimum radius-of-curvature; spur gears, fundamental law of toothed gearing; the manufacture of gear teeth; interference and undercutting; contact ratio; helical gears, contact of helical gear teeth; herringbone gears; crossed-axis helical gear; bevel gears; crown and face gears; hypoid gears; basics of worm and worm gears; mechanisms train.

**USV.FIM.IM.DD.03.05**
**Tolerances and dimensional control (Autumn/2)**
3 hours per week; 14 weeks /3rd semester: 28C/14L; ECTS credits: 4
This course familiarizes the students with the prescription and control of the dimensional and geometrical precision of the machine elements. It presents the dimensional and geometrical precision, dimensions' chains, basic notions concerning the dimensional and geometrical measurements and control, statistical control methods.

**USV.FIM.IM.DD.03.06**
**Materials Technology (Autumn/2)**
3 hour per week; 14 weeks / 3rd semester: 28C/14L; ECTS credits: 4

Technological process; Alloy casting. Materials plastic deformation; Metallic materials welding; Cutting metal materials by thermal processes. Ceramic material processing technologies; Plastics processing technologies; Composite materials manufacturing technology; Nonconventional technologies.

**USV.FIM.IM.DF.03.07**
**Technical drawing and infographics 2 (Autumn/2)**
4 hours per week; 14 weeks / 3rd semester: 28C/28L; ECTS credits: 4
Introduction to AutoCAD, Drawing convention, Interfacing with AutoCAD, Drawing objects, Creating a new drawing, Drawing, editing, hatching, dimensioning commands, 2D applications

**USV.FIM.IM.DC.03.08**
**Physical education (3) (Autumn/2)**
1 hour per week;14 weeks / 3rd semester: 14S; ECTS credits: 1
In practical work find content specific learning units gymnastics, athletics, team sports. From basic gymnastics using operational means to organize your lesson to influence selective locomotor training and the athletic exercises of the body for exercise.

**USV.FIM.IM.DD.04.10**
**Mechanisms (1a) (Spring/2)**
2 hour per week; 14 weeks /4th semester: 28P; ECTS credits:2
Applying of geometrical method for kinematical analysis of a planar mechanism; velocity and acceleration polygon methods, vectors loop method for planar kinematics; design of cam in a mechanism with imposed motion law of the follower.

**USV.FIM.IM.DD.04.11**
**Strength of materials (2) (Spring/2)**
5 hours per week; 14 weeks / 4th semester: 28C/28S/14L; ECTS credits: 4
Bending. Pure bending of straight beams. Naviers's formula. Tangential stresses in sections subject to simple bending. Juravski's formula. Deflections of straight beams subjected to bending. Energy methods in determining displacements. Castigliano's theorem. The theorem of Mohr and Maxwell. Veresceaghin's method. Statically indeterminate beams. Buckling beams. Dynamic action of forces. Fatigue of materials. Applications of elasticity theory.

**USV.FIM.IM.DD.04.12**
**Thermotechnics (Spring/2)**
4 hours per week; 14 weeks / 4th semester: 28C/28S/28L; ECTS credits: 6
Basic Concepts and Definitions: Thermodynamic Systems and Surroundings, Types of Thermodynamic Systems, Thermodynamic Equilibrium, First Law of Thermodynamics: Energy, Potential Energy, Kinetic Energy, Specific Internal Energy, Specific Enthalpy, Work, Heat, Entropy, Ideal Gas, Thermodynamic systems and processes: Isochoric Process, Isobaric process, Isentropic Process, Polytropic Process, Throttling Process, Second Law of Thermodynamics, Methods of Thermodynamics, Third Law of Thermodynamics, Property diagrams and steam tables: Property Diagrams, Pressure-Temperature (P-T) Diagram, Pressure-Specific Volume (P-v), Diagram Pressure-Enthalpy (P-h) Diagram Enthalpy-Temperature (h-T), Diagram, Temperature-Entropy (T-s) Diagram, Enthalpy-Entropy (h-s) or Mollier Diagram, Steam Tables, The Wet Air, Gas Dynamics, Heat transfer terminology: Heat and Temperature, Heat and Work, Modes of Transferring Heat, Heat Flux, Thermal Conductivity, Log Mean Temperature Difference, Convective Heat Transfer Coefficient, Overall Heat Transfer Coefficient, Bulk Temperature, Conduction heat transfer, Convection heat transfer, Radiant heat transfer, Thermal machines.

**USV.FIM.IM.DD.04.13**
**Fluids mechanic (Spring/2)**
4 hours per week; 14 weeks / 4th semester: 28C/14L/14S; ECTS credits: 4
Introduction and fundamental concepts, Fluid statics, Fundamental concepts used in fluid flow analysis, The energy equation, Inviscid incompressible fluid flow, Inviscid compressible flow, The momentum equation, Dimensional analysis and similitude, Incompressible viscous flow, Definition and classification of hydro-pneumatic machines, Efficiency of hydro-pneumatic machines, The basic equation of turbo-machinery, Pumps and hydraulic turbines, Theoretical and experimental determination of the energy characteristic curves.

**USV.FIM.IM.DD.04.14**
**Electrotechnics and electric machines and drives (Spring/2)**
3 hours per week; 14 weeks / 4th semester: 28C/14L; ECTS credits: 4
Periodic electrical signals, Electrical circuits, Laws, theorems and methods of analysis of electrical circuits, Magnetic circuits, Electrical circuit analysis, Electrical transformer, Asynchronous electric machine, DC electric machine, Synchronous electric machine.

**USV.FIM.IM.DD.04.15**
**Applied electronics (Spring/2)**
3 hours per week; 14 weeks / 4th semester: 28C/14L; ECTS credits: 3
Introduction in Electronics; Concepts of semiconductor physics; Pn junction; Semiconductor diodes; Types of diodes; Bipolar transistor; Field Effect Transistors; MOS transistor; Other devices with junctions; Optoelectronic semiconductor devices; Regime of switching semiconductor devices; Diode Circuits; Amplifiers; Reaction in amplifiers; Harmonic oscillators

**USV.FIM.IM.DC.04.16**
**Physical education (4) Spring/2**
1 hour per week; 14 weeks / 4th semester:14S; ECTS credits: 1
In practical work find content specific learning units gymnastics, athletics, team sports. From basic gymnastics using operational means to organize your lesson to influence selective locomotor training and the athletic exercises of the body for exercise.

## Mechanical Engineering 3 rd year

**USV.FIM.IM.DD.05.01**
**Machine Elements 1 (Autumn/3)**
4 hours per week; 14 weeks / 5th semester: 28C/14L/14S; ECTS credits: 4
This is the first part of machine elements course, concerning modelling, design, integration and best practices for use of machine elements such as shafts, hydrodynamic, hydrostatic and rolling bearings, keys, pins, cotters assembly methods and springs. For each type of elements a brief description, stresses, failure, recommended materials and calculus criteria is

presented. These are reinforced by a substantial design project wherein students design a manual screw presses for bearing extraction.

**USV.FIM.IM.DD.05.02**
**Machine Elements 1a - Project (Autumn/3)**
2 hours per week; 14 weeks /5th semester:28P; ECTS credits: 2
The project thematic proposes students to design a manual screw press for bearing extraction from shafts. Starting from a given bearing, several design stages are covered. The presses screw is first designed, followed by an axial bearing meant to reduce friction between the screw tip and the shaft end, the nut, the presses cross beam and the extractor arms. Several other driving, coupling and safety elements are also designed, such as the crank, bolts and safety bracket. At the end, based on the dimensioning and verification calculus, technical drawings are made for each of the studied machine elements as well as for the presses assembly.

**USV.FIM.IM.DD 05 05**
**Thermal treatments (Autumn/3)**
3 hours per week; 14 weeks / 5th semester: 28C/14L; ECTS credits: 4
What is heat Treating? Importance and Classifications. Fundamentals of Heat Treating of steel. Hardness and Hardenability. Furnace and Related Equipement for Heat Treating. Instrumentation and Control of Heat Treating Processes. Heat Treating of Carbon Steels. Heat Treating of Alloy Steels. Case Hardening of Steel. Flame and Induction Hardening. Heat Treating of Stailnless Steels. Heat Treating of Tool Steels. Heat Treating of Cast Irons. Heat Treating of Nonferrous Alloys. Assuring the Quality of Heat Treated Product.

**USV.FIM.IM.DD.05.06**
**The basics of computer assisted design (Spring/3)**
3 hours per week; 14 weeks / 6th semester: 28C/14L/14P; ECTS credits: 4
Introduction to AutoCAD, Drawing convention, Interfacing with AutoCAD, Drawing objects, Creating a new drawing, Drawing, editing, hatching, dimensioning commands, 2D applications

**USV.FIM.IM.DD.06.08**
**Machine Elements 2 (Spring /3)**
3 hours per week; 14 weeks / 6th semester: 28C/14L; ECTS credits: 3
This is the second part of machine elements course, concerning basics on classical design of mechanical parts, such as statics and dynamics of mechanical elements, failure criteria, tribology elements, reliability, mechanical choice criteria and so on. Also elements of mechanical transmissions construction and design (gears, belts transmissions, chain and belts variators, friction variators, chain transmission) are also presented.

**USV.FIM.IM.DD.06.09**

**Machine Elements 2a - Project (Spring /3)**
2 hours per week; 14 weeks /6th semester:28P; ECTS credits: 2
Students must design a two stage (belts and gears) mechanical transmission system. Starting from a given material, several steps are followed so that the gear outputs an imposed torque and speed. The designed speed reducer must use single stage spur gears reducer and an external V belt transmission. The belt transmission, gears geometry and shafts dimensions are calculated. The shafts resistance to fatigue, vibration and strain are verified. All the gear's transmission elements must be calculated. The reducer gear housing must be designed and the thermal regime is verified. The projects must contain technical drawings for V belt pulleys, spur gears, shafts, gear housing, as well as for the speed reducer assembly.

**USV.FIM. IM. DD.06.11**
**Mechanical vibrations (Spring/3)**
3 hours per week, 14 weeks/6-th semester: 28C/14L, ECTS credits: 3
Vector calculus elements. Matrix expressions for operations of vector algebra. Inertial characteristics of mechanical systems. Dynamical characteristics of mechanical systems. Basic theorems of dynamics for rigid bodies systems. Newton-Euler equations. Oscillating systems with one degree of freedom without and with damping. Forces oscillations, graphical representations, transmissibility, seismic systems' theory. Oscillating systems with 2 DOF, with finite number of DOF and continuous systems. Modelling of actual nonlinear oscillatory systems. Modelling of oscillatory systems occurring during metal cutting operations. Use of dedicated educational software for modelling and study of dynamical systems behaviour.

**USV.FIM. IM.DD.06.14**
**Hydraulic and pneumatic actuation systems (Spring/3)**
3 hours per week; 14 weeks / 6th semester: 28C/14L; ECTS credits: 3
This course introduces basic concepts of hydraulic and pneumatic drives, and the main aspects taken into account in the choice of drive systems based on areas of use, and applications. The hydraulic section covers introductory elements on fluid power, hydraulic systems and components, as well as basic fluid-related measurements. Hydraulic circuit designs including electro-hydraulics circuits are also covered. In the pneumatics section, students will be able to approach basic pneumatic problems using gas laws, as well as to identify and explain the role of various pneumatic components. For the pneumatic circuit design section, students will be able to design and analyse basic and multiple pneumatic circuits as well as electro-pneumatic circuits.
**USV.FIM.IM.DID.06.16**
**Practical training (Spring/3)**
90 hours 3 weeks / 6th semester; ECTS credits: 4
Practical activities enable the student to put into practice the theory and/or skills they are studying, often in a practical environment: field work, work placements, presentations, working in laboratories and workshops. Practical sessions allow learners to: demonstrate and extend their skills; collect specimens; carry out experiments; demonstrate their subject knowledge; apply theory in practice; demonstrate their awareness in applying health and safety regulations / *Practical activities on specific aspects on industrial engineering in different institutions/companies. Solving specific problems related with industrial engineering.*

**USV.FIM.IM.S.06.19**
**Biomechanics (Spring/3)**

4 hours per week; 14 weeks / semester: 28C/14L/14P; ECTS credits: 4
Laws of motion; Skeletal tree; Bone, cartilage and ligaments; Joints of the human body; Contact Forces in Static Equilibrium; Leavers; Muscle Force in Motion; Moment Arm and Joint Angle; Center of gravity; General dynamics theorems; Conservation of linear momentum; Center of mass and its motion; bodies in planar motion; Angular velocity, angulat acceleration; Angular momentum; Conservation of angular momentum; Instantaneous center of rotation; Aplications to human body dynamics.

## Mechanical Engineering 4 th year

**USV.FIM.IM.IV DS.08.10.**
**Experimental methods in mechanical engineering. (Spring/4)) 4 hours per week; 14 weeks /8th semester: 28C/28L; ECTS credits: 3.**
The course is intended to give an advanced view on the general aspects of research in engineering. The students will be introduced to the existing research methods, experimental design and planning, to advance data analysis and statistical interpretation as well as regarding the dissemination of the results. The course is not a laboratory one, though, in order to facilitate the understanding, numerous practical examples and experimental data related to engineering questions are used throughout the course.

**USV.FIM.IM.IV DS.08.18.**
**Automatic control. (Spring/4)) 3 hours per week; 14 weeks /8th semester: 28C/14L; ECTS credits: 3.** Automatic control is a must on most of the engineering systems, assuring not only the functionality but also the safety in exploitation. Examples can be found everywhere from medical to industrial applications. Moreover, an increased interest has been observed in the automation of mobile robots (eg. autonomous cars and drones) and of the industrial production lines and processes. This course introduces the principles of automatic control from the simple systems to complex dynamical systems. Upon completion the student will understand the principle of the automation control and how to use some of the industry standards such as PID (Proportional, Integral, and Derivative) controllers as well as the modern automation controllers based on fuzzy logic and machine learning.