MECHATRONICS ENGINEERING

No.	Neptun Code	Subjects	Semesters																													Prerequisites		
			1.					2.					3.					4.					5.					6.					7.					
			lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr			
Basics of Natural Science																																							
1	BGRMA1HNEC	Mathematics I.	3	2		ex	6																															
2	BGRMA2HNEC	Mathematics II.						3	2		ce	6																									1		
3	BGRFM11NEC	Engineering Physics	2			ex	4																															
4	BGRMFM4NEC	Engineering Physics Measurements																	1	pm	2																1		
5	BGRME11NEC	Introduction to the Mechatronics	3			pm	3																															
6	BGBMN11NEC	Mechanics I.	2	1		ex	4																															
7	BGBMN22NEC	Mechanics II.						3	1		pm	4																									6		
8	BGBMN33NEC	Mechanics III.											2	2		ce	6																				7		
9	BGRET12NEC	Electrical Engineering I.						2		2	ex	4																									3	sign	
10	BAGMN11NEC	Engineering Materials	3		2	pm	6																															
Economical and Human Knowledge																																						
11	GGTKG1M5EC	Economics I.																				2			ex	2												
12	GGTKG2M6EC	Economics II.																									1	1		ex	2					11		
13	BGRIKO14NEC	Environmental Technology																2			pm	2																
14	BGRLG15NEC	Logistic																				2			pm	3										11	p	
15	BAGMB15NEC	Quality Technology																				1	1		pm	2										2		
16	BGBJO17NEC	Legal Knowledge																															2			ex	2	5 Sem.		
Basics of Profession																																						
20	BGRIA1HNEC	Informatics I	2			ex	3																															
21	BGRIA2HNEC	Informatics II						2			ex	3																									20		
22	BGRIALHNEC	Informatics Laboratory								2	pm	2																									20	p	
23	BGBGG11NEC	Machine Design I	2		1	ex	4																															
24	BGBGG22NEC	Machine Design II						2		1	pm	4																									23		
25	BGBGG33NEC	Machine Design III											2		2	ex	5																				24		
26	BGBRST3NEC	Computer Systems for Product Engineering											1		3	pm	4																				25	p	
27	BAGAC12NEC	Materials Technology I						2		1	pm	4																											
Optional subjects																																						
50	BGRPV16NEC	Programable Circuits and Controls																																			31		
51	BGRPN16NEC	C ++ Programming																																			21		
52	BAGGM26NEC	Mechatronics of Manufacturing Systems																																			35		

No.	Neptun Code	Subjects	Semesters																													Prerequisites		
			1.					2.					3.					4.					5.					6.					7.						
			lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr	lc	pr	lb	re	cr			
28	BAGAC23NEC	Materials Technology II											2			ex	3																					27		
29	BGRIR14NEC	Control Engineering																2		2	ex	4																2		
30	BGRAD14NEC	Analogue and Digital Circuits I																1		2	pm	4																9		
31	BGRAD25NEC	Analogue and Digital Circuits II																					2		1	ex	4											30		
32	BGRPH14NEC	Pneumatics and Hydraulics																2		2	ex	5																5		
33	BGRRHG5NEC	Thermo- and Fluid-dynamical Engines																					2	1	1	ex	4											3		
34	BAGGT12NEC	Manufacturing Engineering I						1		1	pm	3																										10		
35	BAGGT23NEC	Manufacturing Engineering II											2		2	pm	5																					34		
36	KMEEA13TEC	Elctronics											2	1	1	ex	4																					9	p	
37	KMEFM15TEC	Precision Mechanics																					1		1	pm	3											36		
38	KMEIF16TEC	Interfaces																										1		1	pm	3						31		
39	BGBBER7NEC	Safety Engineering, Ergonomics																															2			pm	3	8	sign	
Supplementary subjects																																								
80	GTSTESTNEV	Physical Education I							2		as																													
81	GTSTESTNEV	Physical Education II												2		as																								
82	BAGGM12NEC	Mechanical Eng. practice I							2		as																													
83	BAGGM23NEC	Mechanical Eng. practice II												2		as																						82		
Optional subjects																																								
18	BGBETK7NEC	Engineering Ethic																																						
19	GSVEU17NEC	EU Knowledge																																						
64	BGRMAFVNEC	Topics in Mathematics																											1		pm	2								
65	BGBAV10NEC	Aviatica I.																3			pm	3																		
69	BGBBSA2NEC	Basics of Organising Safety																2			pm	3																		
70	BGRGP1VNEC	GPGPU Programming													2	pm	3																							
Complex systems specialization																																								
44	BGRNT14NEC	Micro and Nanotechnologies I																3		2	ex	6																36		
45	BGRNT25NEC	Micro and Nanotechnologies II																					2	2		ex	6											44		
46	KMEOA16TEC	Low Dimensional Self-Organising Systems																										3	2		ex	6						45		
47	BGRRR14NEC	Industrial Robot Systems I.																2	1		pm	5																8	sign	
48	BGRRR25NEC	Industrial Robot Systems II.																					3	1	2	ex	7											47		

ex – examination, pm – practice mark, ce – course examination, as - assignement
p - both the subject and the prerequisite can be choosen in the same semester

BASICS OF NATURAL SCIENCE

1 Mathematics I. BGRMA1HNEC
Dr. Ágnes Bércesné Novák associate professor

The course gives an overall review of elementary functions. The major materials to study include inverse trigonometric functions, hyperbolic functions and their inverses, functional limits and rate of change. The course also covers derivatives, derivatives of elementary functions, rules of differentiation, chain rule, implicit differentiation and Mean Value Theorems. The students will acquire the knowledge of extrema: necessary and satisfactory conditions for finding local minima and maxima, equation of a tangent line, necessary and satisfactory conditions for finding points of inflexion, curve sketching, antiderivative and standard antiderivatives.
The subject also contains functions of a linear function, integration by part, integration by substitution, definite integral, Newton-Leibniz theorem, partial fractions, integrating trigonometrical functions, area, volumes, surfaces of solids of revolution. Other main guidelines are the following: centre of gravity, improper integrals, complex numbers: addition, multiplication, nth root in different forms: algebraic, trigonometrical and exponential forms, solving quadratic equations and Gaussian plane.

2 Mathematics II. BGRMA2HNEC
Dr. Ágnes Bércesné Novák associate professor

Goals: Having completed this course, students must have developed a clear understanding of the fundamental concepts of single and multivariable calculus, complex numbers and probability theory. Students will have a range of skills allowing them to work effectively with the concepts. The basic concepts are the following: numbers: integers, rational, real, imaginary, complex, improper integrals, partial and total derivatives, global and local extrema, classical notion of probability, random variables and their distributions, basic statistics notion of differential equations, solving methods, solving linear system of equations, notion and application of matrices.

3 Engineering Physics BGRFM11NEC
Dr. Endre Ruszinkó associate professor

The students will get a deep insight into fluids at rest: pressure, pressure gauges, surface tension, Archimedean principle, fluid sin motion: Bernoulli's equation and its applications, laminar flow and turbulent flow and viscosity. The course also covers the working fluid, heat, work and the system, state equations, The First Law, Reversible and irreversible processes. Other major materials to study include Carnot's cycle, the heat engine and the heat pump, the Second Law and entropy.

4 Engineering Physics Measurements BGRMFM4NEC
Dr. Endre Ruszinkó associate professor

The aim of the measurements is to provide the students with basic measuring skills as well as to illustrate the lectures on physics. Labs involve the following projects: Thermal Expansion, Efficiency of Heat Engines, Microwave Optics, Optical Spectroscopy, Radioactivity, Gamma-Spectroscopy, Fundamental constants.

5 Introduction to the Mechatronics BGRME11NEC
Dr. István Nagy associate professor

The students will acquire the knowledge of the subject and concept of mechatronics. The main guidelines are the following: characteristics and the components of mechatronics systems, mechanical parts of the systems: transmission of the power, energy and moving mechanisms, electrical parts of the system: sensors, transducers, electric circuits, metrology: measuring systems, principle of measuring, electronic and non-electronic measuring.
The course also covers signal processing, distribution of the signals, information technology: the phases of the information processing, typically used in mechatronics, and even control strategies: software-based control strategies.

6 Mechanics I. BGBMN11NEC
Dr. Árpád Czifra associate professor

The aim of this subject is to introduce the principles of statics and their practical application. To reach this goal, the subject is divided into themes as follows: fundamentals of vector and matrix algebra, principles and fundamental laws

of statics, description of forces, ideal supports, systems of forces in 2-D and 3-D, distributed forces, equilibrium of rigid structures, internal forces (axial force, shear force, bending moment), cantilever beams and two-supported beams. Statically determinate multi-supported beams, pin-jointed trusses and frames, friction related problems, gravitational load, centre of gravity, second moment of area, Mohr's circle of second moment of area and parallel axis theorem are studied as well.

7 Mechanics II. BGBMN22NEC
Dr. Árpád Czifra associate professor

The aim of this subject is to introduce the principles of strength of materials and their practical application. To reach this goal, the subject deals with the themes as follows: fundamentals of strength of materials, introduction to the theory of elasticity, general state of stress, stress tensor, principal stresses and principal directions and representation of stress states by Mohr's circles of stresses. The subject also contains normal and shear strains, strain tensor, principal strains and principal axes, stress-strain relation of linear elastic materials (Hooke's law), strain energy, tension and compression, shearing and bending, deformation of a bended beam and its stress state and strain energy.
Other major materials to study are torsion, elastic and plastic buckling, combined static load, dimensioning on strength, distortion energy theory, maximum shear stress theory and energy theorems of structural mechanics.

8 Mechanics III. BGBMN33NEC
Dr. Árpád Czifra associate professor

The aim of this subject is to introduce the principles of both kinematics and dynamics and their practical application. To reach this goal, the subject deals with the themes as follows: fundamental conceptions of kinematics and kinetics, velocity and acceleration, throwing, circular motion, harmonic vibration and kinematics of rigid bodies. Other main guidelines are the following: state of velocity, state of acceleration, plane kinematics of rigid bodies, relative motion, kinematics of simple plane mechanisms, kinetics of a particle, Newton's laws, momentum principles and kinetic energy. The students will also acquire the knowledge of work and power theorems, constrained motion of a particle, undamped and damped vibration, plane kinetics of rigid bodies, mass moment of inertia, parallel axis theorem and fundamental conception of dynamics.

9 Electrical Engineering I. BGRET12NEC
Dr. István Nagy associate professor

In the framework of this subject the students are introduced to the basic elements of the electrical circuits. The course also contains structure and characteristics of the active and passive circuit elements, the basic laws, relations of electrical engineering, and the basic principles of electrical machines operations as well as DC machines, AC machines, transformers and 3ph machines.

10 Engineering Materials BAGMN11NEC
Dr. Pál Rácz associate professor

The students will get a deep insight into the fundamentals of materials testing, mechanical, physical metallurgical and non-destructive testing methods, atomic and higher structures of metals, polymers, ceramics and composites, solidification and crystalline structure of metals.
The subject also covers interpretation of the equilibrium diagram and its information content, the process of cold forming and recrystallisation and the consequences in practice and the role of heat treatments in modification of properties of metals.

ECONOMICAL AND HUMAN KNOWLEDGE

11 Economics I. GGTKG1M5EC
Dr. András Medve associate professor

Main guidelines of the subject are the following: an introduction to economics, scarcity and efficiency, the three main concepts of economics organization, consumer behaviour, the optimal choice of the consumers and price elasticity of demand. In the framework of this subject the students are also presented consumer surplus, manufacturers' behaviour, company and enterprise, production function, production costs, short and long-term cost functions.
The course covers the profit, market structures, offer of companies in perfect competition, long-term supply. Profit

maximization of monopoly and oligopolies. The students will examine market of input factors, labour market, capital market, stock market, property market and externalities.

12 Economics II. GGTKG2M6EC
Dr. András Medve associate professor

In the focal points of the subject there are topics such as macroeconomics and its interrelations, actors, output and income, measurement of the macroeconomics performance, macroeconomics cycle, consumption and saving function, demand on the capital market and multiplier effect. The students will also have the chance to study equilibrium income, macro demand, labour market and employment, macro supply, economic equilibrium, the modern money and banking system. Other major materials contain economic growth, conjuncture, inflation and unemployment, the role of the state in economy, fiscal and monetary policy and international trade policy.

13 Environmental Technology BGRIKO14NEC
Dr. Annamária Várkonyi-Kóczy professor

The outline of the subject is the following: ecology, classification of industrial vast, environmental management, renewable energy sources, noise protection technology, water purification technology, air cleaning technology, soil protection technology, and health protection technology. Students are supposed to develop understanding of the main fields of environmental technology and its methods.

14 Logistic BGRLG15NEC
Dr. Gabriella Orbán senior lecturer

The purpose of this course is to inspire logistical thinking of students. The basic logistical principles will be presented, including the main logistical activities within companies (purchasing, production, distribution, and waste management), between companies (supply chain management), and problem solving in logistical tasks. We will deal with storage, material handling, packaging, warehousing, loading, and transportation of freight as well as using the latest logistical examples, both in theory and in practice.

15 Quality Technology BAGMB15NEC
Dr. Ágota Drégelyi-Kiss associate professor

The themes of the subject are basics of metrology, calibration of measuring instruments, statistics of measurement results, determination of uncertainty, requirements of accredited calibration and test laboratories. Other major materials to study include standards and demands of quality systems, main segments of quality systems, working of quality systems and case studies. Students are supposed to be familiar with questions and processes of quality assurance, and understand its meaning.

16 Legal Knowledge BGBJO17NEC
Dr. Ádám Guttengéber associate professor

The students will get a deep insight into the history, development and social role of the law, state and law, the concept of law, the legal system and the types of law, hierarchy of sources of law, the concept, validity and effect of the legislation, the legal capacity and certain groups of entities. In the focal point of the subject there are topics like the place and role of the Constitution in the Hungarian legal system, the social relationships governed by the Constitution, the fundamental citizens' rights and obligations, groupings of public bodies and their main task and authority, the national and local bodies of legislation and enforcement.
The subject also deals with the task and authority of the Parliament, the government and the local governments, the judicial authorities, the courts and the prosecutors.

BASICS OF PROFESSION

20 Informatics I. BGRIA1HNEC
Dr. Annamária Várkonyi-Kóczy professor

The topics of the subject are the following: history of information technology, fields of information technology,

hardware architecture, software classification, entropy and information theory, coding theory, security, operating systems, internet, intranet, WiFi, cloud computing , malware, firewall. Students are required to be familiar with the main issues of information technology, they have to understand and handle its tools and phenomenon.

21 Informatics II. BGRIA2HNEC
Dr. Annamária Várkonyi-Kóczy professor

Students are required to learn a high level programming language: Delphi. The topics of the subject are the following: history of Delphi language, syntactical elements, variables, operators, instructions, functions, structures, arrays, unions, standard I/O, modules, low and high level file handling, I/O handling, Object Oriented Programming and structured Query Language.

22 Informatics Laboratory BGRIALHNEC
Dr. Annamária Várkonyi-Kóczy professor

Students are expected to acquire experience in the field of information technology and programming. This subject supports the theoretical subject of Information Technology II. Topics of the subject: basic practice of Delphi language, standard I/O practice, file practice, I/O handling, usage of programming languages in industrial environment.

23 Machine Design I. BGBGG11NEC
Dr. Erzsébet Ancza associate professor

The aim of this course is to provide an introduction to drawing fundamentals and to develop drawing skills of the students. The first part of the course covers such topics as: layout of Technical Drawing, line styles, lettering, scale, geometric construction, transformation, projection (orthographic projection, central or perspective projection, oblique projection), axonometric view (isometric, diametric, Kavalier etc.).
The second part of the course focuses on topics as follows sketching, dimensioning, sectioning, fits and tolerances, surface roughness, symbolical representation, detail and assembly drawing.

24 Machine Design II. BGBGG22NEC
Dr. Endre Korondi associate professor

The aim of this course is to provide an overview of repeatedly used simple machine components, their tasks and models applied at dimensioning. This course covers the topics as follows: types of load, friction and rolling resistance, material models, methods of dimensioning on simple and combined static loads and on repeated loads (harmonically varying loads, random varying loads), and threaded connection.
Other main guidelines are the following riveted joint, welded joints (butt seam, fillet seam), soldering, brazing, glued connections, press fitted joints, key joint, pins, shaped joints, dimensioning of shafts, sliding bearings (hydrostatic and hydrodynamic sliding bearings), rolling bearings, couplings (rigid couplings, elastic couplings) and clutches.

25 Machine Design III. BGBGG33NEC
Dr. Endre Korondi associate professor

The aim of this course is to provide an overview of drives by friction force and drives by shape. Their tasks, models applied at dimensioning and operation will also be presented. This course covers the topics as follows: friction drives, belt drives (flat belt drives, Vee-belt drives, multiple Vee-belt drives), chain drive, worm gear drive, gear drives, dimensioning of gears on strength, types of teething (spur teething, helical teething, spiral teething, hypoid teething etc.), teething with profile displacement, undercutting, tooth sharpening and failure mechanisms of gears.

26 Computer Systems for Product Engineering BGBRST3NEC
György Gyurecz senior lecturer

The course covers concept and basics of integrated modeling in product lifecycle management, shape centered models for mechanical units and their construction, primary shape adding and reverse engineering. Simulations for loads on parts, part placing, kinematics, shape adding, and appearance. Interoperability of modeling systems in inhomogeneous environments is studied as well.

27 Materials Technology I. BAGAC12NEC
Dr. Pál Rácz associate professor

The course gives an overview of basic materials processing methods, like casting, rolling, forging, bulk and sheet metal forming, polymer processing, powder metallurgy, etc.
The students will get a deep insight into material properties and their effect on castability and formability, joining of metals, soldering, brazing, welding, surface coating, materials and forming technology. Other main guidelines include engineering materials and forming processes, functions, loads, materials and shapes of parts, metals and their alloys, heat treatments and tests.

28 Materials Technology II. BAGAC23NEC
Dr. Pál Rácz associate professor

The students will acquire the knowledge of fundamentals of heat treating technologies, equilibrium and non-equilibrium, structures, properties, process parameters and technologies of quenching, tempering, annealing and normalising. Other major materials to study include thermochemical and thermomechanical heat treatment processes and their basic parameters, case hardening, nitriding of steels, surface heat treatment technologies, evaluation and optimising of technologies. Heat treating furnaces, cooling media, atmospheres, and testing of heat treated parts are studied as well.

29 Control Engineering BGRIR14NEC
Dr. Róbert Szabolcsi professor

The course covers the basics of automatic control theory, modern control theory, mathematical models of dynamical systems, Laplace-transformation used in control theory and state-space representation of dynamical systems. The students will get a deep insight into block diagrams, signal flow charts, basic terms and their analysis, time domain responses, frequency domain responses, open loop system analysis and closed loop system analysis.
Other main guidelines include reference signal tracking problems, disturbance rejection and sensor noise attenuation problems, and their solution in control engineering, stability problems of the closed loop control systems, main elements of the control engineering, and their dynamical description.
Other major materials to study include dynamic performances used in control engineering, control system preliminary design: pole placement, LQ-based design methods, solution to control problems of control engineering using MATLAB, analogue and digital devices used in control engineering. Basics of PLC-technology and PLC compact controllers used in control engineering.

30 Analogue and Digital Circuits I. BGRAD14NEC
Dr. István Nagy associate professor

The students will acquire the knowledge of main electronic parts of semiconductors: diodes, transistors, FETs and their basic circuits, amplifiers, operational amplifiers and their basic circuits, application samples, integrated stabilizer, multiplier, and other non-linear circuits. The course also shows application examples.
Students are supposed to be familiar with the basics of analogue and digital technology, they have to analyse, establish and repair analogue circuits.

31 Analogue and Digital Circuits II. BGRAD25NEC
Dr. István Nagy associate professor

The students will get a deep insight into logical circuit creation from analogue one, logical circuit families (RTL, DTL,DCTL, TTL), basics of logical functions and their descriptions, usage and handling, sequential circuits, flip-flops counters, shift registers, memories, working and technology of digital circuits classes, SSI, MSI, LSI circuits, VLSI circuits.
Other major materials to study include microprocessors and their auxiliary circuits, buses, micro-controllers and their usage and FPGAs.
Students are expected to be familiar with the basics of digital technology, they have to analyse, establish and repair digital circuits.

32 Pneumatics and Hydraulics BGRPH14NEC
Dr. Endre Ruszinkó associate professor

The principles, functions, terminology and uses of fluid power components are studied in this course. Control techniques are examined by interpreting hydraulic and pneumatic drawings and symbols. The course provides a survey of actuation

and fluid power transmission devices, as well as the properties of fluids. System-technical introduction of the control and auxiliary components of the energy converter of hydraulic and pneumatic power transmitters. Construction and planning methods of hydraulic and pneumatic systems

33 Thermo- and Fluid-dynamical Engines BGRRHG5NEC
Dr. Endre Ruszinkó associate professor

The course covers axiomatic presentation and the fundamental mathematical methods of Classical Thermostatics: the 0th, 1st, and 2nd Main Postulates: statistical and mechanical formulation of the approximate independence of sub-systems; Boltzmann's Entropy and the fundamental entropy function. Other main guidelines are the following: optimum under constraints, Lagrange Multipliers, the Energy Minimum Principle, Legendre transformation, reservoirs and Thermodynamic Potentials; the necessary condition for the stability of the thermal equilibrium, phase transitions and the 3rd Postulate. The students will deal with applications: quasi-stationary process, refrigerators systems, heat pumps, and gas and steam power plants, industrial cooling towers. They will also study about the basics in Fluid Dynamics: tensor fields, densities and current densities, Continuity Equation, Euler Equation, viscosity, applications: Dimensional Analysis, scaling rules, friction factor, flow of fluid in pipes, surface heat transfer coefficient, forced convection, rotodynamic pumps and motors, specific speed, cavitations, Bernoulli's Theorem, NPSH. Numerical laboratory consists of the use of MS EXCEL & Visual Basic for function fitting to evade the use of tabulated data.

34 Manufacturing Engineering I. BAGGT12NEC
Dr. Viktor Gonda associate professor

The course focuses on definition of technology, scope and relationships, manufacturing of specific materials for mechatronic applications, types of materials, metals. The students will be able to examine inorganic non-metal materials, attributes and manufacturing of semiconductors, production technologies, material impairment and protection (break, ageing, corrosion, biological impairment, Tribology), surface treatment methods and their technologies, joining technologies (mechanical, chemical, electronical) and even PC board technologies and mounting.

35 Manufacturing Engineering II. BAGGT23NEC
Dr. Balázs Mikó associate professor

The course covers principles of cutting, energetic process of cutting, tool wear and tool life, basic figures of planning of economic cutting, cutting methods, types of tools, tool angles, exercises and types of machine tools. The students will study general structure of machine tools, main components, structure of NC, CNC machine tools, locating features, tooling process and manufacturing methods of characteristic surfaces (inner cylindrical surface, hole, and plane).

36 Elctronics KMEEA13TEC
Dr. Péter Turmezei associate professor

This subject provides an insight into physical working of semiconductor devices and their features. The topics of the subject are divided into semiconductor materials, alloying semiconductors, PN boundary, diodes and their characteristics, bipolar transistors and their characteristics. The students will also get an insight into J FETs and MOS FETs, basic circuits of discrete elements, operational amplifier, features and inside structures of OP A, and their basic circuits.

37 Precision Mechanics KMEFM15TEC
Dr. Marianna Lendvay associate professor

Main features of precision mechanics are examined. The subject contains concepts, parts and devices, typical precision mechanics solutions, measurement instruments of precision mechanics, mechanical, optical and electrical devices. Other main materials are special field of precision mechanics usage, i. e. Winchester and effect of precision mechanics on present technology. Students are required to be familiar with the main field of precision mechanics, such as parts, tools and measurements technology.

38 Interfaces KMEIF16TEC
Márk Horváth assistant lecturer

The course involves basics in the field of interface circuits, students are supposed to be able to design various interface circuits for various goals. The topics of the subject are the following: interface problems, level interfaces, simple binary

input interfaces, simple binary output interfaces, converters, circuit families, special interface circuits in industrial circumstances. Interface buses, special interface devices are also studied.

39 Safety Engineering, Ergonomics BGBBER7NEC
Dr. Csaba Kósa associate professor

Introduction to the structural, personal and real conditions of healthy and safe working conditions. Students have to master the principles of safe operation of different working systems, principles of safety of work, ergonomics of working systems.
Other major materials include real working circumstances (air conditioning, acoustic and vibration protection, lighting, radiations), safety engineering of electricity and safety engineering of labour instruments' operation and evaluation.

SUPPLEMENTARY SUBJECTS

80 Physical Education I. GTSTESTNEV
Györgyné Fehér trainer

The aim of the subject is to provide the conditions of regular sports activities for the students, to advertize the healthy way of living and to draw attention to the preventive values of physical training. Students can choose freely from the branches and courses offered by the Physical Education and Sports Institute.

81 Physical Education II. GTSTESTNEV
Györgyné Fehér trainer

The aim of the subject is to provide the conditions of regular sports activities for the students, to advertize the healthy way of living and to draw attention to the preventive values of physical training. Students can choose freely from the branches and courses offered by the Physical Education and Sports Institute.

82 Mechanical Eng. Practice I. BAGGM12NEC
Tamás Nikitscher training engineer

The course includes orientation (information about the subject, team arrangement, and exemption), preface of cutting, basics of cutting, specificity of turning, safety education, main measurement equipment of a workshop. The students will acquire the knowledge of build-up-, operation and parts of lathe, workpiece chucks and positioning equipment, preparation of workpiece (sawing), basic operations on lathe.
Other major issues include intermission, machining of special geometries, machining practice (lathe) I – „First tool path", movement of slides, machining practice (lathe) II – Type of operation: longitudinal, facing, drilling, machining practice (lathe) III – Internal operation, machining practice (lathe) IV – Thread turning and machining practice (lathe) V – Thread turning.

83 Mechanical Eng. Practice II. BAGGM23NEC
István Burai training engineer

Safety education is examined. The subject contains basics of milling: initial considerations, the component, basics of milling: the machine, basics of milling: tools, tool holders. Topics are divided into workpiece fixtures and positioning equipment, basic operations on machine tool: face milling, shoulder milling, slot milling, machining of special geometries. Other main materials to study include machining practice I –milling, machining practice II –milling, basics of drilling, initial considerations: machine tool, tools, tool holders, machining practice III –drilling basic of grinding, initial considerations: machine tool, machining practice IV – grinding And machining practice V – grinding.

OPTIONAL SUBJECTS

18 Engineering Ethic BGBETK7NEC
Dr. Sándor Horváth associate professor

The future of mankind is not a technological question, but an ethical one. The technology to destroy the whole

humanity is already in our hand, that is why the technical intelligentsia assume specially high responsibility. Engineering knowledge is power to live with responsibly that is the reason why engineers need their own moral laws and engineering ethics. This subject focuses on the questions of general ethics, more important ethic tendencies from the ancient times to the twentieth century as well as the ethical norms of the big world religions. It analyses the specific questions of engineering ethics in detail, environment protection, use of energy, the borders of engineering risks and the ethic questions of undertaking and taking responsibility.

19 EU Knowledge GSVEU17NEC
Dr. Valéria Szekeres associate professor

The students will get a deep insight into the introduction to integration theory, types and levels of economic cooperation in theory and practice, preconditions of successful cooperations, historical, economic and political reasons for the European integration and the Idea of Europe. Other main guidelines include history of the European integration, the Three Communities (ECSC, EEC, and EAEC).
The course also deals with integrating countries with different economic and social development, reforms in the European Union, Constitution or Treaty?, renewal of the cooperation and EU's role in the World Economy. The main topics related to this subject contain contribution to global GDP, main export and import relations, distribution of goods and services exported and imported by the EU member states, free trade agreements between the EU and other countries/integrations. The core material also examines internationalisation of European companies, Hungary's economic connections with the EU member states, Hungary as an EU member state: process of the integration into the economic and monetary union.

64 Topics in Mathematics BGRMAFVNEC
Dr. László Hanka senior lecturer

The main guidelines of the subject are the following: theory of ordinary differential equations, first order and second order differential equations, systems of linear differential equations, theory of oscillations and theory of series. The students will also deal with numerical series, tests for convergence, function series, power series, Cauchy-Hadamard's theorem, Taylor-series and applications of Taylor-series.
The course also covers real and complex Fourier-series and its applications, Parseval's theorem, discrete and continuous Fourier-transform, Laplace transform and its applications. Linear algebra and theory of matrices, vector spaces, subspaces, theory of linear equation systems, linear transformations, eigenvalues, eigenvectors, orthogonality, theory of graphs, and its applications are studied as well.

65 Aviatica I. BGBAV10NEC
Dr. András Jancsó associate professor

The theoretical material gives introduction into the theoretical physics questions of flying, studies the general conceptual viewpoints of forming an aeroplane, the connections between the functions and structural construction of the separate structural elements and at the same time it deals with questions of mechanics, sizing, materials, and confronts with practical applications and their morals of these theoretical considerations.
As for the airport project, the students have to put what they theoretically acquired about flying during the course into practice with flying their own models.

69 Basics of Organising Safety BGBBSA2NEC
Dr. Sándor Horváth associate professor

The students will get a deep insight into the concept of safety organising, its content, aim, safety measures, methods in history and the development of the safety activity. The subject examines risks, events, extraordinary events, risk-analysis, view points of property protection, data protection, disaster recovery, fire protection, and labour protection as opposed to the economic risks.
The course also covers the basic principles of object protection, opportunities of forming defensive circles, devices and procedures applied there. The core materials also examines the specialities of person protection activity – guard – and the differences from the solutions applied to date, safety of private, corporate, social, religious and cultural events.

70 GPGPU Programming BGRGP1VNEC
Ákos Tóth senior lecturer

The students will get a deep insight into the history of GPU programming, data parallelism, CUDA program structure,

introduction to CUDA C. Device memories and data transfer, Kernel functions and threading and thread cooperation. Other major materials to study include atomics, streams, performance considerations, floating point considerations, application case studies, parallel programming and computational thinking and brief introduction to OpenCL.
Complex systems specialization

44 Micro and Nanotechnologies I. BGRNT14NEC
Dr. Péter Pál Bakucz associate professor

Students are required to be familiar with the main fields of micro and nanotechnologies and their usage. The main topics of the subject are the following: development of micro- and nanotechnology, historical perspective, characteristics and results, review of micro- and nanotechnologies, physical and chemical fundamentals, the place and role of micro- and nanotechnologies among the advanced technologies, specific properties of micro- and nanodimensional structures, mechanical, electrical, optical, etc., characteristics and effects.

45 Micro and Nanotechnologies II. BGRNT25NEC
Dr. Péter Pál Bakucz associate professor

Topics of the subject are the following: nanoelectronics and nano-optoelectronics, operational principles and devices, reduced dimensional (two- and one-dimensional) electron system semiconductor devices, nanodimensional devices, mechanical, electromechanical, electronic, optical, optoelectronic and magnetic devices. The students will acquire the knowledge of quantum effect of semiconductor devices, characterization and measurement techniques and apparatuses of micro- and nanometric technologies, nanometric resolution in depth and on the surface, atomic resolution electron microscopy, atomic force microscopy (AFM) and scanning tunneling microscopy (STM).

46 Low Dimensional Self-Organising Systems KMEOA16TEC
Dr. Ákos Nemcsics professor

The course covers the concept of the low-dimensional system, quantum confinement, electronic band structure, density of states; examples for low-dimensional systems (quantum film, quantum wire, quantum dot, super lattice), concept of the self-assembled system; cases for self-assembled system (from living nature, from lifeless nature, from material science), driving forces, pattern formation, fractals, adaptive dynamics, transformation via non equilibrium way, role of fluctuation, entropy and cases in material science (instabilities in laser effect, Gunn-instability). The topics are divided into the crystal growth (Frank van der Merve, Stanski-Krastanov, Vollmer-Weber), linear and non linear theory; in-situ investigation of the growth (by optical methods, by electron beam, by X-ray etc.); ex-situ investigation (by scanning tunneling microscopy, by electron microscopy etc.) growth technology of the low-dimensional crystal structures (Molecular Beam Epitaxy and other epitaxial technologies, laser ablation etc.) The growth process, the surface coverage, the lattice mismatch and the critical layer thickness are also studied.

47 Industrial Robot Systems I. BGRRR14NEC
Dr. János Somló professor emeritus

The main guidelines are the following: manufacturing automation, robotics, and mechatronics: history, systems and subsystems, tasks and definitions, robot kinematics, motion planning, robot types: cylindrical, humanoid, SCARA, etc., direct and inverse kinematics for those and time optimal motion planning.

48 Industrial Robot Systems II. BGRRR25NEC
Dr. János Somló professor emeritus

The major materials to study include general methods of robotics, the homogeneous transformations and generalized vectors, the Denavith- Hartenberg generalization, the parametric method of motion planning, general method of time optimal motion determination, robot dynamics, robot control, realization of robot motions and the model of drive systems.

OPTIONAL SUBJECTS

50 Programable Circuits And Controls BGRPV16NEC
Dr. István Nagy associate professor

This subject is intended to use the basic relations in programmable logical devices (PLDs) and PLC programming. The students are introduced to the programming of: PLA, PAL, GAL, FPGA circuits and its inner structure. In the second part of the semester the students will be introduced to the PLC technology, more specifically the structure of the bit/byte controlled PLCs and PLC programming, FPGA technology, FPGA options, advantages (and disadvantages) of creating high-integrity embedded systems using FPGAs. FPGA vs. ASIC And FPGAs as a prototyping platform. Other main materials include working with "soft" processor cores, basics of HDL and digital logic, concurrent statements (AND, OR gates etc), sequential statements (flip-flops). The students will get an insight into the introduction to HDL tools (synthesis, fit & route). Why use VHDL? Other major guidelines cover packages, components and architecture, top level modules, libraries (IEEE), port map, signals / variables, process & sensitivity lists, modelism & test benches.

51 C ++ Programming BGRPN16NEC
Ákos Tóth senior lecturer

The subject contains introduction to C++, structure of a program, variables, operators, control flow, if statements, for statements, while statements, do while statements, break and continue, arrays, strings, pointers and references. The course also deals with functions, OOP, classes and class members, constructors, destructors, operator overloading, inheritance, input and output (I/O), templates, STL and exceptions.

52 Mechatronics of Manufacturing Systems BAGGM26NEC
Dr. Balázs Mikó associate professor

The course examines the principles of CNC machine tools and CNC programming, basics of manufacturing process planning, methods and techniques, and application of CAD/CAM systems as well.

53 Mechatronics of vehicles BGRJM14NEC
Sándor Kerekes senior lecturer

The course focuses on the vehicle as a complex mechatronics system, vehicle dynamics - dynamics of linear and lateral motion, elements of automotive drivetrain, internal combustion engine management (spark-ignition engines, diesel engines) and starting systems. The students will get an overview of automotive sensors, electrical systems and power supply of vehicles, alternators, electric and hybrid drive line, integrated starter alternator (ISG) and the basics of electromagnetic compability (EMC). Other main guidelines include bus systems of vehicles, diagnoses of Automotive Engines, vehicle modelling, braking systems, ABS antilock braking systems for vehicles, adaptive cruise control and vehicle chassis systems: suspension system, wheels, tires, power assisted steering. The students will also acquire the knowledge of safety systems: air bag, tire-pressure monitoring system, comfort and convenience systems and lighting.

54 CAD KMESG17TEC
Dr. Zsolt Horváth professor

The subject teaches about computer aided design and manufacturing (CAD, CAM) in creating printed circuit boards. The topics are the following: connection between CAD/CAM systems – how different professions use them, the history of PCB manufacturing and procedure of design: schematics, positioning the footprints, wiring. The students will also get a deep insight into creating the schematics and nets, use of buses, types of footprints, checking of design, creating netlist, handling footprints, the function of layers, problems of wiring, automated wiring, setting parameters, creating, over viewing and checking CAM data. In the laboratory session, students must complete an exercise using computer. They receive a precise designing objective which must be completed within the given time limit.

55 Networks of Informatics BGRIH16NEC
Dr. Péter Pál Bakucz associate professor

Introduction to Neural Networks. The students will get an answer to: What is a neural network? Topics are divided into Neuron Model, Network Architectures and Learning neuron model, activation functions, network architectures, learning algorithms, learning paradigms, learning tasks, knowledge representation, and neural networks vs. statistical methods.

The course also covers Perceptrons and Linear Filters perceptron neuron, perceptron learning rule, adaline, LMS learning rule, adaptive filtering, XOR problem backpropagation multilayer feedforward networks, backpropagation algorithm and working with backpropagation. Other major materials to study include advanced algorithms, performance of multilayer perceptrons, dynamic networks, historical dynamic networks, focused time-delay neural network, distributed time-delay neural network, NARX network, layer recurrent network and computational power of dynamic networks. The subject focuses on learning algorithms, system identification, model reference adaptive control, Radial Basis Function Networks RBFN structure, exact interpolation, radial basis functions, radial basis function networks, RBFN training, RBFN for pattern recognition, comparison with multilayer perceptron, probabilistic networks and generalized regression networks, as well. Other main guidelines contain Self-Organizing Maps self-organization, self-organizing maps, SOM algorithm, and properties of the feature map and learning vector quantization.

56 Diploma Work BGRSD1MNEC
Ingrid Langer senior lecturer

The aim of the diploma work is that at the end of the course the student individually solves a complex task according to the requirements of the professional knowledge, demonstrating that he or she acquired competent knowledge and is familiar with the technical literature. The general rules of the subject "Diploma Work" is contained in § 32 of TVSZ. The requirement of the subject "Diploma Work" is a signature. The diploma work must be defended at the Final Examination. To fulfill the requirements of the subject the student has to attend consultations at least four times and the "Consultation Diary" has to be signed by the assigned supervisor.

57 Integrated Practice (specialised) BGRGY17NEC
Dr. István Nagy associate professor

Inside this subject the students are sent to firms for a 14 weeks' practice. The firms are evaluating the students' work, and at the end of the course, are giving verification to the professors about their performance. The selected firms have contracts with the institute.