FACULTY OF TRANSPORT AND MECHANICAL ENGINEERING

Please note! This is a preliminary list of courses for the study year 2016/2017. Changes may occur!

SPRING 2017
BACHELOR COURSES

MMM201 Material Science
2.00 CP (3.0 ECTS)
Structure and properties of materials used in engineering and machine building. Forming and transformation of structure. Diagram of condition. Mechanical and technological properties of materials. Theory and technology of thermo treatment. Construction and instrument materials, non-ferrous metals, polymers and composites. Brand and principles of its choice.

MAT104 Structures and Properties of Engineering Materials
2.00 CP (3.00 ECTS)
The role of engineering materials in technology. Types of materials: metals, polymers, ceramics, glass and composites. Structural levels of materials. Interconnection of structure and properties. Mechanical testing. Engineering properties of materials and methods of processing. Recycling. Principles of material selection.

MTH302 Methodology and Technique of Design
3.00 CP (4.5 ECTS)
General concept of the main stages of design works. Formation and analysis of the consumer requirements as to the design of the object. Methods for designing the optimal machines and mechanisms. Design methods for increasing the strehgth and stiffness of typical machine elements. Unification and standardization in design works. Application of computer facilities in design works.

MTH306 Construction of Machines and Mechanisms
3.00 CP (4.5 ECTS)
Analysis and synthesis of mechanisms. Dynamics, models of dynamic calculation of machines and mechanisms. Principles of projection, planing and desing documentation, technology of assembling. Standartization in machine building. Exploitation reliability, life.

MTM119 Computer Graphics (Advanced course for Mechanical Engineers)
3.00 CP (4.5 ECTS)
Geometric information input, modification and representation. 3D-object representation in the two-dimensional space: perspective, invisible lines and surfaces, shadowing, animation. Mechanism display examples. Interactive graphical systems and standard graphical program using for engineering tasks: 3-dimensionalmachinery and equipment (robots), kinematics and dynamics, finite element analysis for stress analysis, the optimal design of mechanisms. The emphasis on creation of the 3D geometrical models and the documentation formatting and usage.

MTH206 Engineering Measurements and Experiments
2.00 CP (3.00 ECTS)
Experimental investigations in engineering. Methods and technical means for measuring physical and mechanical properties of materials (metals, composites). Measurements of dynamical parameters of mechanisms and structures (vibration, noise, temperature, pressure, flow, matter structure, concentration, force, velocity, acceleration). Types of experiments and plans. Automation of experimental investigations. Identification experiments. Methods for computer analysis and mathematical processing of experimental data.

MMP219 Resistance of Materials (for mechanical engineering) Part 1 and Part 2
5.00 CP (7.5 ECTS)
Basic hypotheses. Mathematik's model. Calculation chart. Forces. Stress.Deformation. Strain.comressions. Strength calculation. Strength theory. Torsion. Bend. The experimental tasks. Flexibility grounds. The general principles and theorems. Displacements. Buckling. Dynamic tasks.

Impact at. Long term strength. Plate and shell. FEM Method: Bending Beam and Buckling. System stability.

MSE305 Hydro- and Gas Dynamics

3.00 CP (4.5 ECTS)

The subject contains consideration of properties of liquids and gases, hydrostatic forces, pressure definition. The Fluid Dynamics course is based on motion equations of liquids and gases. Real flows described in terms of border layer equations and turbulence length. Non dimensional methods used for process modelling. Heat losses and flow types are analysed. Methods of pipe, valve, pump and fan selection. Flow parameters described in nozzles, channels, around the body.

MRA353 Electro, Pneumo and Hydro automatics

3.00 CP (4.5 ECTS)

The energy supply and processing elements of electric, pneumatic and hydro-automatic (EPH) systems, information input elements, signal processing and executive elements, the structure and operating principle. Types of equipment operation algorithm. Operational algorithm realization with pneumatic, hydraulic and hard logic electrical elements.

Programmable controller (PLC) design and management programmes for the system's algorithm. Computer aided selection, calculation, and system performance modelling of the electric, pneumatic and hydro-automatic system components.

MTM205 Engineering Mechanics Problems

3.00 CP (4.5 ECTS)

Use of theoretical laws and engineering methods for investigation of real typical systems. Role of chooses of a precision of calculation of model in a case of incomplete model parameter information. Tasks on static and dynamic loading and mechanical stresses. Problems of optimisation in a pneumatics and electromechanical systems.

MTH301 Machine Dynamics and Strength

3.00 CP (4.5 ECTS)

Mechanism, machine, classification. Dynamics of machines and mechanisms. Free, forced and parametric oscillations of machine elements. Vibration protection of machines. Friction in machines. Motion irregularity of machine elements. Analysis and calculations of machine elements on reliability, stability, fatigue strength, impact load. Creep and stress relaxation in machine elements. Practical application of vibration effects in engineering (technological vibromachines, vibrodiagnostics of defects, etc).

MMI101 Fluid Mechanics

2.00 CP (3.0 ECTS)

Subject gives an overview of the basic questions about liquid and gas flows and the most sufficient calculation model choice. Different kinds of flow are viewed and various processes in nature and machine industry fluid circuits are explained.

Subject explains how real fluid circuits work. Mostly pneumatic and hydraulic circuits for movement and force generating are overviewed. Components of these circuits are analysed and properties of those components are viewed. Parameters and calculation principles of hydraulic circuits are shown. Hydraulic circuits for movement generation are analysed.

MRA320 Methods and Technology of Process Control

3.00 CP (4.5 ECTS)

The essence and types of automation, models of control systems and their classification. Description of process control in different physical systems – mechanical, electrical, thermal, biological etc. Process control and analysis in continuous time and frequency domains. Computer control. Characteristics of discrete time control. Laplace and z-transforms. Process modeling by computers. Electronic control system equipment.

MSE201 Heat Study

2.00 CP (3.0 ECTS)

The course includes topics related to the thermal phenomena in various systems, processes and power plants: Thermodynamic systems and parameters. Basic laws of thermodynamics. Specific heat, internal energy, entropy. Processes and cycles. Water and steam tables and charts. Humid air. Cycles of thermal machines. Steam power equipment. Heat transfer with conduction, convection,

radiation. Complex heat transfer. Design methods of heat exchangers. Fuel and combustion theory. Water and steam boilers. Heat utilizing equipment.

MSE304 Technical Thermodynamics and Heat Exchange

3.00 CP (4.5 ECTS)

The subject deals with the problems of thermal processes in nature and technical equipment. Basic topics: thermodynamic systems - characteristics and parameters. Ideal and real gases. Basic laws of thermodynamics. Specific heat, internal energy, enthalpy, entropy, exergy. Thermodynamic processes and cycles. Water and water steam. Humid air. Gas and steam flows. Steam and gas cycles of thermal machines. Refrigerators and heat pumps. Mechanisms and heat transfer. Steady and unsteady heat conduction. Theory of similarity. Convective heat transfer. Thermal and velocity boundary layers. Complex heat transfer. Heat utilizing equipment. Design of heat exchangers.

MASTER COURSES

MMP510 Experimental Mechanics and Technical Diagnostics *(graduate)*

4.00 CP (6.0 ECTS)

Reliability. Quality. Definition of testing. Functioning and monitoring diagnostics. Mathematical simulation of objects. Methods of measurement of parameters of testing object. Flaw detection and introscopy. Methods and means of diagnostics. Examples of diagnostic procedures: automobile transport, aircrafts, sea and river transport, railway transport, building engineering structures, technological machines.

MMP535 Fracture Theory (*graduate)*

3.00 CP (4.5 ECTS)

Griffith ideas on cracks stability conditions. Irvin method. Stress concentration. Stress intensity factor. Fracture toughtness. Energy methods: J-integral, strain energy release rate parameter, R-curve. Damagemechanics. Cracks and debonding in composites. Cyclic loading and de-bonding in composites. Cyclic loading and cracks propagation conditi-ons.

MTH503 Computer-Aided Analysis of Mechanical Systems of Machines (*graduate)*

4.00 CP (6.0 ECTS)

Matrix methods in mechanism kinematics and dynamics. The method of constraints for planar kinematic analysis. Revolute, prismatic, gear and cam pairs are considered together with other 2 degrees-of-freedom types of constraints. Formal description of kinematic diagrams. The automatic assembly of the systems of equations for position, velocity and acceleration analysis. Geometry of masses. Forward and inverse tasks of geometric, statistic, kinematic and dynamic analysis. Dynamics of planar systems. Computation of planar generalized forces for external forces and for actuator-spring-damper element. Relations between transfer velocity, angular velocity of rigid body and generalized velocities: analogue matrices. Simple applications of inverse and forward dynamic analysis. Numerical integration of first-order initial-value problems. Accuracy and stability of integration methods. Kinematics of rigid bodies in space. Reference frames for the location of a body in space. Euler angles and Euler parameters. Velocity, acceleration and angular velocity. Relationship between the angular velocity vector and the time derivatives of Euler parameters. Kinematic analysis of spatial systems. Basic kinematic constraints. Joint definition frames. Denavit-Hartenberg notation. The constraints required for the description in space of common kinematic pairs (revolute, prismatic, cylindrical, spherical). Equations of motion of constrained spatial systems. Computation of spatial generalized forces for external forces and for actuator-springdamper element. Computation of reaction forces from Lagrange's multipliers.

MTH507 Lifting and Transporting Machines (*graduate)*

4.00 CP (6.0 ECTS)

Ways of transferring/shifting hard objects, liquids, loose and other materials, the physical and mechanical issues of their transfer. Design and exploitation of the machines used in the agriculture, processing industries (mainly food, wood processing, construction materials) and service industries (mainly cargo transit, transport, seaport).

MMP532 Mechanics of Composite Materials (*graduate)*

3.00 CP (4.5 ECTS)

Composite materials. Fibres. Matrix materials. Types of composite materials. Calculation of the stresses and strains in composite materials. The methods and models of micromechanics of

composites. The model of the unidirectional composite. The model of the composite, armed with short fibres. FEM application in the micromechanics of composite materials. Macro mechanics of composites. Strength and fracture in composites.

MTM408 Optimization Methods *(graduate)*
4.00 CP (6.0 ECTS)
Extremes of analytic function. Extreme types. Minimum and maximum conditions of analytical function. General optimization problem formulation. Criteria and constraint types. Linear and nonlinear programming, the numerical methods. Gradient method. Local and global optimum. Universal and specialized optimization software. Functionals, the classical methods of functional minimization. Optimal control task standard form. Introduction to optimal control - Pontryagin maximum principle and dynamic programming. Introduction to multiobjective and robust optimization. In this course, students are not creating own optimization software codes, but will use specialized commercial software. Theoretical training target is to create the ability to formulate different optimization problems and use of commercial computer software for problem solution.

MSE535 Non-Standard Sources of Energy *(graduate)*
3.00 CP (4.5 ECTS)
The subject gives basic knowledge in matters of non-standard and alternative energy sources, sustainable development theory, legislative acts and strategies on different levels that support and promote use of such energy sources and the modernization of utilization technologies. Huge attention is given to energy sources that have been used already for several centuries – solar, wind, running water (oceans, sees, rivers, tidal and ebb energy), biomass. The potential and the level of the utilization technology of every source is carefully evaluated according to technical, economic, environmental aspects. Emphasis is put on efficiency of energy conversion and total profitability. From the same aspects household and industrial waste, sludge from water treatment plants is considered. Interest is also built towards nuclear energy and hydrogen technologies. All sources are evaluated on the level of EU and the Republic of Latvia development plans.

MTM516 Analysis and Optimization of Machines, Structures and Technological Processes *(graduate)*
3.00 CP (4.5 ECTS)
Strategy of experiment organization. Basic statistical concepts. Classical experimental designs (Factorial design, Box-Behnken, D-optimal). Space filling designs. V.Eglajs experimental design. Latin Hypercube Design. Regression analysis. Parametric and non-parametric approximation methods. Radial basis functions. Response surface methodology. Experimental Designs for fitting of Response surfaces. Filtration of Outliers. Classification of optimization problems. Handling of nonlinear constraints. Deterministic and stochastic global optimization methods (Taboo search, simulated annealing, genetic algorithms, multistart methods). Virtual prototyping of mechanical systems. Metamodelling and optimization by using EDAOpt, ANSYS and ADAMS programs.

MSE541 Theory of Boundary Layer *(graduate)*
4.00 CP (6.0 ECTS)
Study course is planned for extended studies of heat and mass transfer, fluid mechanics and aerodynamic theory and practical applications. The main emphasis is on the convective heat exchange and the related phenomena of flow mechanics. Basic topics: Hydrodynamic and thermal boundary layers. Laminar, transient and turbulent flows. Viscosity, compressible and incompressible flows. Differential equations of flow dynamics and heat mass transfer. Boundary layer evaluation and empirical relationships. Analytical and numerical methods for solving equations. Modelling and simulation methods. Empirical methods of heat exchange and flow mechanics.

MTM409 Technical System Vibration and Stability *(graduate)*
4.00 CP (6.0 ECTS)
Composition of motion differential equations for technical systems. Stability of equilibrium. Vibration of linear discreet systems. Parametric vibrations. Stability. Free and forced vibration of rods, shafts, beams. Non-linear cases. Simple vibrations of discs plate and shells. Vibration of rotors. Stability.

MSE432 Thermodynamics and Gas Dynamics *(graduate)*
3.00 CP (4.5 ECTS)
The subject “Thermodynamics and Gas Dynamics” covers different thermodynamic systems and their characteristics. Energy transition types. Simple and complicated thermodynamic systems.