RIGA TECHNICAL UNIVERSITY

FACULTY OF TRANSPORT AND MECHANICAL ENGINEERING

Please note! This is a preliminary list of courses for the study year 2018/2019. Changes may occur!

AUTUMN 2018

BACHELOR COURSES

MTH303 Automatization of Calculation of Construction Durability (Basic Course)
3.00 CP (4.5 ECTS)
Calculations of design strength as the integral part of computer aided design and analysis (CAD/CAE). An overview of numerical techniques for CAE: matrices, eigenvalue problems, differentiation, integration, linear algebraic equations. Finite element method (FEM). Applying FEM for solution of the elasticity theory problems. Geometric modelling. Discretization of the real structures. Review of general purpose FEM programs. Capabilities of the strength analysis programs. FE libraries, solution methods and commands. Pre-processing, post-processing and other special capabilities.

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.

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.

MSE201 Heat Study
2.00 CP (3.0 ECTS)
The course ``Basics of Thermal Engineering`` 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.

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.

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).

MMP343 Mechanics of Composite and Elastic Materials
2.00 CP (3.0 ECTS)
Classification of elastomers. Creep and relaxation. Mechanical models. Walter principle. Hysteresis. Creep phenomenon for metal structures. composite material properties. Reinforcement structures. Composites manufacturing technology. Stress approaches. Strength criteria. Material structure optimization.

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.

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.

MTM341 Numerical Analysis in Engineering Mechanics
2.00 CP (3.0 ECTS)
Analysis of functions and functionals. Extreme values. Optimisation tasks. Numerical analysis of simple analytical expression and experimental data. Analysis and operation of physical and engineering systems by using mathematical techniques. Dynamic analysis of mechanical, hydraulical and thermal systems. Response of these systems to initial conditions, and to transient, steady and random inputs. Stability. Analysis of simple feedback systems.

MMP219 Resistance of Materials (for mechanical engineering) Part 1
2.00 CP (3.0 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.

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.

MTM201 Theoretical Mechanics (for mechanical engineers) Part 1
2.00 CP (3.0 ECTS)
Axiomes. Constraints. Simplification and equilibrium of forces systems. Friction of sliding, rotation and turning. Centre of mass. Tensors of inertia. Kinematics and dynamics of particle. Types of motion of a body. Kinematics and dynamics of particle in different frames of reference. General theorems of dynamics. Dynamics of a rigid body. Method of kinetic-static. Balancing. Gyroscope. D'Alembert's principle. Balancing.

MASTER COURSES

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).

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

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.

MTH504 Numerical Analysis for Research of Dynamics of Machines (for Master Students)
4.00 CP (6.0 ECTS)
This is the basic course on the use of numerical methods for the analysis and optimization of machine and mechanism dynamics. In the present field the researchers have to deal with complex problems of numerical mathematics, which demand the proficiency level above the average and is not limited to knowledge of the basic math course.
The main topics of the study subject are:
Ideology of engineering calculation. Preciseness/Exactress, stability, complexity, automation. Analysis of linear systems of freguency and time diapason. Methods of analysis of nonlinear systems. Stability of numerical methods. Hard and badly defined systems. Covered methods. Meshanisms with geometrical sites: differential - algebrical systems. Analysis of machine regulation systems. Simplifying the dynamical models. Programms: MathCad, WorkingModel, MSC ADAMS.

MTH502 Dynamics and Control of Machines (for Master Degree students) *(graduate)*
4.00 CP (6.0 ECTS)
The main groups and structure of controlled machines with dynamic load. Control as dynamic process with a definite goal. Typical mathematical models of the actuating mechanisms and drive systems of machines. Linearization and reduction of equations. Essentially nonlinear elements. Principles, algorithms, implementation methods of the automatic control, their classification. System stability and functioning quality, basic methods of analysis and synthesis. Conceps of extremal, adaptive, hierarhical control systems.

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.

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.

MRA253 Basics of Technical Design *(graduate)*
2.00 CP (3.0 ECTS)
Marketing demands, fashion and style. The human potential and willingness to use a particular object (ergonomics). Technical aesthetics. Fundamental concepts of design: composition, form, colour. Laws of the design form development in the historic perspective.

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.

MTH505 Rotary Machines (*graduate)*

3.00 CP (4.5 ECTS)

Rotating parts of structures, shafts of energy and transportation machinery parts. A key initiative of the dynamic load factor, rotor disbalance. The dynamic calculation methods are analysed. The rotor balancing methods are considered. Within the framework of the present study subject the students should perform independent work on the following themes: 1st Supercritical speed, calculation; 2nd Differential equations of rotor oscillation with two degrees of freedom; 3rd Dynamic load for the rotor supports.