RTU Course "Computer Graphics (Advanced course for Mechanical Engineers)"

15325 Teorēt.mehānikas un materiālu pretestības katedra

General data

Code	MTM119
Course title	Computer Graphics (Advanced course for Mechanical Engineers)
Course status in the programme	Compulsory/Courses of Limited Choice
Course level	Undergraduate Studies
Course type	Academic
Field of study	Mechanics, Mechanical Engineering, Machine Building
Responsible instructor	Januševskis Aleksandrs
Academic staff	Januševskis Jānis Meļņikovs Anatolijs
Volume of the course: parts and credits points	1 part, 3.0 Credit Points, 4.5 ECTS credits
Language of instruction	LV, EN, RU
Possibility of distance learning	Not planned
Maximum auditorium capacity	24
Maximum number of students per semester	150
Abstract	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.
Goals and objectives of the course in terms of competences and skills	The systematic learning of the computer graphics major problems and the mathematical basis. The understanding of the computer aided design (CAD) concepts and acquisition of the practical skills of CAD software application for the design of a wide range of engineering objects
Structure and tasks of independent studies	Each student independently carries out practical exercises and develops the coursework. The basic task of the coursework is to provide the basis required to create the 3D model of the mechanical equipment of the moderate complexity and to create the drawings of parts and assemblies.
Recommended literature	1. Saxena An., Sahay B. Computer Aided Engineering Design. 2005. – 393 p. 2.T. Hsu, D.K. Sinha. Computer- Aided Design; An Integrated Approach. New York, Los Angeles, San Francisco,West Publishing Company,1992.-487. 3. SolidWorks Office - Essentials: Parts and Assemblies (Volume 1, 2), Concord, MA, 2004. -546. 4. SolidWorks Office - Essentials: Drawings, Concord, MA, 2004. -436. 5. ANSYS/ED Workbook. Swanson Analysis Systems, Inc., Houston, PA,USa,1993.
Course prerequisites	Computer skills, mathematics, engineering graphics

Course outline

Theme	Hours
The role of the computer graphics for the development of the projects and its significance. Graphic packages and standards. Graphic primitives & formats	3
Mathematical fundamentals of graphics. Straight line, circle, ellipse, curve, Bézier curves.	3
Curve-fitting technique: polynomial, polynomial regression with least squares adjustment, interpolation by splines.	3
Piece-wise polynomial functions, polynomial B-splines, NURBS.	3
Raster scans graphics algorithms. Display types.	3
Planar object transformations. Concatenation of transformations. Manipulation of images.	3
The basics of three-dimensional graphics. Spatial transformation in the simplistic cases.Rotation of rigid body about arbitr	3
Geometric modelling of the engineering objects. Surface modelling. Rigid body modeling. ACIS and PARASOLID kernels.	3
Projection techniques of the objects and the types of projections. Mathematical relationships of projections.	3
Algorithms for elimination of invisible lines and surfaces of objects.	3
Geometrical features of graphical models (length of curves, surface area, body volume).	3
Computer simulation and animation. Windows, viewport, transformation of the projection points. Clips. Creation of animat	3
Practical design techniques. Sketch blocks. SolidWorks tools: Toolbox, FeatureWorks, Design Checker, DimXpert.	3
SolidWorks Utilities. Design of wire bundles. Hard and flexible piping design. Dies modelling with MoldFlowXpress.	3
Possibilities of PhotoWorks and PhotoView360.	3
Engineering design using computer networks. E-drawings. The site 3DContentCentral.	3

Learning outcomes and assessment

Learning outcomes	Assessment methods
The student must know how to create the virtual 3D geometric models and computerized design documentation applying the SolidWorks software.	Corresponding models and documentation obtained in practical and laboratory works.

The student must be familiar with computer graphics problems to be solved, the mathematical foundations for solving the algorithms, the basic concepts of CAD and should possess practical skills to design mechanical engineering objects applying the CAD software.	Corresponding question at the examination. Development quality and observance of the submission deadline of the coursework, student attendance rate, as well as participation in students scientific conferences and the Olympiads on computer graphics are considered additionally

Study subject structure

Part	CP	ECTS	Hours per Week			Tests		
			Lectures	Practical	Lab.	Test	Exam	Work
1.	3.0	4.5	1.0	1.0	1.0		*	