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

31000 Faculty of Civil and Mechanical Engineering

General data

Code	MTM119
Course title	Computer Graphics (Advanced course for Mechanical Engineers)
Course status in the programme	Compulsory/Courses of Limited Choice
Responsible instructor	Aleksandrs Januševskis
Academic staff	Jānis Januševskis Anatolijs Meļņikovs Alvis Kambuts Mārtiņš Irbe Dmitrijs Ļitvinovs
Volume of the course: parts and credits points	1 part, 4.5 credits
Language of instruction	LV, EN
Annotation	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	Obligātā/Obligatory 1. Saxena An., Sahay B. Computer Aided Engineering Design. 2010. – 416 p. 2. Paul Schilling, Randy Shih. Parametric Modeling with SOLIDWORKS. SDC Publications. 2015. -557p. 3. T. Hsu, D.K. Sinha. Computer- Aided Design; An Integrated Approach. New York, Los Angeles, San Francisco,West Publishing Company,1992.-487. Papildus/Additional 1. Matt Lombard. SolidWorks Bible. Wiley. –1179 p. 2. SolidWorks Office - Essentials: Parts and Assemblies (Volume 1, 2), Concord, MA, 2004. -546. 3. SolidWorks Office - Essentials: Drawings, Concord, MA, 2004. -436. 4. D.C.Planchard, M.P.Planchard. Engineering Design with SolidWorks. CSWP. SDC Publications. 2010.
Course prerequisites	Computer skills, mathematics, engineering graphics

Course contents

Content	Full- and part-time intramural studies		Part time extramural studies	
	Contact Hours	Indep. work	Contact Hours	Indep. work
The role of the computer graphics for the development of the projects and its significance. Graphic packages and standards. Graphic primitives & formats	3	3	1	5
Mathematical fundamentals of graphics. Straight line, circle, ellipse, curve, Bézier curves. Ferguson Segments.	3	3	1	5
Curve-fitting technique: polynomial, polynomial regression with least squares adjustment, interpolation by splines.	3	3	1	5
Piece-wise polynomial functions, polynomial B-splines, NURBS.	3	3	1	5
Raster scans graphics algorithms. Display types. SolidWorks Costing.	6	6	2	10
Planar object transformations. Concatenation of transformations. Manipulation of images.	3	3	1	5
The basics of three-dimensional graphics. Spatial transformation in the simplistic cases.Rotation of rigid body about arbitr	3	3	1	5
Geometric modelling of the engineering objects. Surface modelling. Rigid body modeling. ACIS and PARASOLID kernels.	3	3	1	5
Projection techniques of the objects and the types of projections. Mathematical relationships of projections.	3	3	1	5
Algorithms for elimination of invisible lines and surfaces of objects.	3	3	1	5
Geometrical features of graphical models (length of curves, surface area, body volume).	3	3	1	5
Computer simulation and animation. Windows, viewport, transformation of the projection points. Clips. Creation of animat	3	3	1	5

Practical design techniques. Sketch blocks. SolidWorks tools: Toolbox, FeatureWorks, Design Checker, DimXpert.	6	6	2	10
SolidWorks Utilities. Design of wire bundles. Hard and flexible piping design. Dies modelling with MoldFlowXpress.	3	3	1	5
Possibilities of SolidWorks Visualize and PhotoView360. SolidWorks Sustainability.	6	6	2	10
Engineering design using computer networks. E-drawings. MBD technology. The site 3DContentCentral.	6	6	2	10
Total:	60	60	20	100

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

Evaluation criteria of study results

Criterion	%
Revision tests	10
Performance of practical works	20
Course Work	30
Exam	40
Total:	100

Study subject structure

Part	CP	Hours			Tests		
		Lectures	Practical	Lab.	Test	Exam	Work
1.	4.5	1.0	1.0	1.0		*	