

Study program: Mechatronics			
Type and level of studies: Master studies (second level of studies)			
Course unit: Modeling and Simulation of Mechanical Processes			
Teacher in charge: Ivan Milićević , teaching assistant Vojislav Vujičić			
Language of instruction: English			
ECTS: 6			
Prerequisites: Passed all technical mechanics and mechanics of machines			
Semester: Winter			
Course unit objective			
Introduction to modeling and calculations in technical work using modern methods of analytical mechanics; mechanics of controlled motion systems; the use of computers in mechanics.			
Learning outcomes of Course unit			
The use of acquired knowledge of technical mechanics for solving complex mechanical systems: mechanisms, mechanics robot; the use of computer in mechanical calculations, MATLAB, RoboticsToolbox.			
Course unit contents			
Theoretical classes			
Solving kinematics of complex system of bodies using the transformation matrices: Direct and indirect task of kinematics. Rotary transformation matrices and their properties. Homogeneous coordinates and transformation matrices. Introducing of vector in homogeneous coordinates. Homogeneous transformation matrices. Basic homogeneous rotation matrix. Basic homogeneous translation matrix. D-H parameters. Algorithm for determining homogeneous transformation matrices. Examples of determining D-H parameters and forming transformational matrices. Solving dynamics of complex system of bodies using the transformation matrices: Direct and indirect task of kinematics. Euler-Lagrange equation of motion. Manipulator joint speed. Kinetic energy. Potential energy. Equations of motion. Examples. Newton-Euler's formulation. Rotated coordinate system. Moving coordinate system. Kinematics of segments. Recursive motion equations. Recursive motion equations of segments around their coordinate systems. Computer algorithm. Examples. General D'Alambert motion equations. Examples. The use of computers applications for calculation of kinematics and dynamics, and simulation of motion: Computer simulation methods of behavior and analysis of mechanical systems. Design and analysis of models of robots using the MATLAB software package. Transformational matrices. Trajectories. Direct kinematics. Simulation. Inverse kinematics. Inverse dynamics.			
Practical classes			
Students solve practical examples from all sections presented in theoretical classes; students are given instructions on how to do a seminar in field of 'the use of computers for solving kinematics and dynamics of industrial robots' as well as to perform the simulation of movement using MATLAB software package.			
Literature			
1. Corke, P. I., A Robotics Toolbox for MATLAB, Release 9, 2013, http://www.petercorke.com/RTB/robot.pdf			
2. Corke, P.: Robotics, Vision and Control: Fundamental Algorithms in MATLAB, Springer-Verlag Berlin Heidelberg, 2011.			
Number of active teaching hours			
Lectures: 2	Practice: 2	Other forms of classes	Independent work: 0
			Other classes
Teaching methods: Theoretical and practical classes, seminar. In theoretical classes, students are learning theoretical basics that are needed to understand and solve practical examples.			
Examination methods (maximum 100 points)			
Exam prerequisites	No. of points:	Final exam	No. of points:
Student's activity during lectures	10	oral examination	30
Practical classes/tests	10	written examination	0
Seminars/homework	50	
Project	0		
Other			
Grading system			
Grade	No. of points	Description	
10	91-100	Excellent	
9	81-90	Exceptionally good	
8	71-80	Very good	
7	61-70	Good	
6	51-60	Passing	
5	less than 50	Failing	