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

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				**Other classes**
Lectures: 2	Practice: 2	Other forms of classes	Independent work: 0	

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