

Study program: Mechanical engineering			
Type and level of studies: Master studies			
Course unit: Design of hydraulic and pneumatic control systems			
Teacher in charge: Prof. dr Novak Nedić			
Language of instruction: English			
ECTS: 6			
Prerequisites: None			
Semester: Autumn			
Course unit objective: Introducing students to methodology of analysis, synthesis and design of hydraulic and pneumatic control systems.			
Learning outcomes of the course unit By overcoming this program, the student is trained to design of hydraulic and pneumatic control systems for different objects and processes.			
Course unit contents <i>Theoretical classes</i> An introduction to the design/construction of hydraulic and pneumatic control systems (HPCS). The transfer of fluid energy, motion and control. Control of motion (position, velocity, acceleration, force) and processes (pressure, temperature, etc.). The criteria for design of HPCS. HPCS with uniform (constant) and variable motion and load. Influential design parameters (compressibility, friction, losses, contamination and control parameters) and design requirements. Types and structure of HPCS. Static and dynamic characteristics of HPCS. Design of controllers. <i>Practical classes</i> Mathematical modeling of HPCS. Design of a pump controlled hydraulic control system. Design of a valve controlled hydraulic control system. Design of pneumatic control systems. Hydraulic systems for synchronized motion of more cylinders. HS with locking of hydraulic cylinder. Complex hydraulic systems. Design of compensators and regulators of HPCS. Design of sequential controlled hydraulic and pneumatic actuators. Proportional and servo techniques. Simulation and testing of HPCS.			
Literature 1) N. Manring, Hydraulic Control Systems, John Wiley & Sons, Inc., 2005. 2) J. Watton, Fluid Power Systems: Modeling, Simulation, Analog and Microcomputer Control, Prentice-Hall, 1989. 3) M. Jelali, A. Kroll, Hydraulic Servo-systems: Modelling, Identification and Control, Springer-Verlag, Berlin, 2002. 4) C.R. Burrows, K.A. Edge, Power Transmission and Motion Control, University of Bath, 1998. 5) W. Kriesel, W. Töpfer, Funktionseinheiten der Automatisierungstechnik. Elektrisch, Pneumatisch, Hydraulisch, Verlag Technik Berlin, 1988.			
Number of active teaching hours			Other classes
Lectures: 2	Practice: 1	Other forms of classes: 2	
Teaching methods Lectures, auditory and laboratory exercises, consultations, colloquiums and a final exam.			
Examination methods (maximum 100 points)			
Exam prerequisites	No. of points:	Final exam	No. of points:
Student's activity during lectures	5	oral examination	
Practical classes/tests	5	written examination	
Seminars/homework		Project	70
Colloquium	20		
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	