Study program: Electrical and Computing Engineering – Module: Industrial Power Engineering

Type and level of studies: Master studies (second level of studies)

Course unit: Control of Electrical Drives

Teacher in charge: Marko M. Rosić and Sanja V. Antić

Language of instruction: English

ECTS: **6**

Prerequisites: Passed exams: Electrical Drives and Electrical Machines

Semester: Winter

Course unit objective

Course objective is to provide necessary level of knowledge for understanding and solving problems in the area of electric drives control. Course goal is to acquaint students with electric drive mathematical models, estimation algorithms as well as a variety of control principles of DC and AC drives such as scalar control, direct torque control, field oriented control, etc.

Learning outcomes of Course unit

After completing the course, each student is expected to be able to:

- carry out identification of types and components of most common electric drive systems,
- develop a dynamic model of DC and AC machine and analyse its dynamics, and understand its transient behaviour
- understand the components of modern drive systems including power electronics, sensors and real-time controllers
- understand and present the principle of various control methods in different types of electric drives
- analyse systems of open and closed loop control

Course unit contents

Theoretical classes

Students are introduced to the following topics:

- Mathematical model of DC machine and analysis of its dynamics with permanent excitation,
- Speed and torque control methods of DC drives (synthesis of current and speed control loop, control in field weakening),
- Complex mathematical model of AC machine (Clarke and Park mathematical transformation),
- Control methods of AC drive: scalar and vector control (V/Hz control, Field Oriented Control, Direct Torque Control, etc.), flux estimation techniques and operation in flux weakening regime etc.
- Power inverter configurations and PWM technics for power supply generation

Practical classes

Computer sessions: Modelling DC and AC machines in MATLAB/Simulink, analysis and comparison of DTC methods with discrete and continuous voltage vectors.

Laboratory exercises in EMPR laboratory: Modelling and control of DC machine, implementation of scalar, vector and direct torque control algorithms on AC drive based on real time DSP systems.

Literature

[1] S. Vukokosavic, *„Control of Electrical Drives“,* Springer US, 2007
[2] P. C. Krause, O. Wasynczuk, and S. D. Sudhoff, “*Analysis of Electric Machinery and Drive Systems*”, IEEE, 2002.
[3] B. Bose, “*Modern Power Electronics and Ac Drives*”, Prentice-Hall, Inc., 2002.
[4] P. Vas, “*Sensorless Vector and Direct Torque Control*”, Oxford University Press, 1998.
[5] H. Abu Rub, A. Iqbal, J. Guzinski, “*High Performance Control of AC Drives with Matlab/Simulink Models*”, WILEY, 2012
[6] Boldea, I. Nasar, S. A., “*Electric drives*”, Taylor&Francis Group, 2006.

Number of active teaching hours				**Other classes**
Lectures: 2	*Practice: 2*	*Other forms of classes:* 1	*Independent work:* Case study	

Teaching methods: consultations, independent individual work

Examination methods (maximum 100 points)

Exam prerequisites	**No. of points:**	**Final exam**	**No. of points:**
Student’s activity during lectures	**10**	oral examination	**25**
Practical classes	**10**	written examination	**25**
Seminars/homework	**20**	.....	
Project	**10**		

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