Cracow University of Technology

Subject: **Electrical machines & drives**

Course code:

Erasmus subject code 0713 Electricity and energy

Type of course, the number of hours in the plan of study

Lectures	Laboratories	Computer laboratories	Projects
20	10	10	5

Prerequisites and additional requirements: Fundamentals of mechanics on a level of lecture in physics in terms of dynamics and statics. Methods of description and analysis of electrical circuits. Methods for measuring DC and AC electrical quantities. Sensors. The basic method of measuring the velocity and position. The principle and the mathematical description of electrical machines operation. Basic power electronic systems of processing AC voltage to DC voltage (AC / DC), DC voltage to DC voltage (DC/DC) and DC voltage to AC voltage (DC/AC).

Description of learning outcomes for module:

Social He/she can contact with colleagues and accept the rules of work in a team, take responsibility for collaborative tasks.

Skills He/she is able to plan and carry out the simulation and measurements of the operating characteristics, as well as the extraction of basic parameters characterizing the electrical and power electronic devices, is able to present the results in the numerical and graphical form and to interpret them and draw the right conclusions.

Knowledge He/she has basic knowledge in principles of electrical machines operation, and understands typical structures and properties of electromechanical systems

Assessment method: Lectures, laboratory exercises and project.

Lecturers: Janusz Petryna, Ph.D., Arkadiusz Duda, M.Sc.

Contact person: Janusz Petryna, jpetryna@pk.edu.pl

Lectures (verte)		
L1	DC machines and drives . Separately excited motor and series motor – mathematical description. Starting and braking process. Steady states load and operational characteristics. Converter controlled DC drives.	5 hrs
L2	AC induction machines and drives. Mathematical description and load and operational characteristics. Basics of frequency control of AC induction motors. Slip ring motor speed control by rotor resistance modulation. Constant power AC-DC asynchronous electromechanical cascade. Constant torque electric cascade. Starting and braking process with use power electronic units.	5 hrs
L3	AC synchronous machines and drives. Mathematical description. Motors fed from supply network vs. power electronic units. Speed and power control. BLDC motors in drive systems. Load and operational characteristics.	5 hrs
L4	Introduction to drive systems. Drive transmission systems, total moment of inertia, load torque characteristics. Types of duty of electric motors. Selection of the motor for the specific drive type and train. Synthesis of the drive based on supply voltage course.	5 hrs

Laboratory and computer excercises		
Lab1	Leonard drive system. Static load characteristics. Dynamic states observation and analysis. Automatic speed control system for separately excited motor.	2.5 +2.5 hrs
Lab2	AC induction squirrel cage motor in frequency controlled drive. Operational and load characteristics forming. Dynamic states observation and control.	2.5 +2.5 hr
Lab3	Constant power AC-DC asynchronous cascade/ Constant torque AC cascade.. Speed control. Load characteristics.	2.5 +2.5 hrs
Lab4	DC brushless motor. Static characteristics and dynamic states analysis.	2.5 +2.5 hrs

Project		
P1	All students receive job design arranged according to one scheme: given is a mechanical transmission system, the duty of working machine and drive waveform changes in speed, or temporary duty cycle. The motor should be selected for this purpose and its control in the form of voltage supply course should be defined. The motors are selected based on manufacturers data sheets available on the internet. Students may need adjust the motor gear or a switchable gearbox. One should choose the power system and its control method (eg. power electronic system, power transformer, etc.) The test of the correct operation of the drive is to make a computer simulation of the power supply voltage: smooth or inverter provided depending on the complexity of the mathematical model. Implementation of the same task can be performed using DC or AC motors. At the end, students must prepare a presentation of the topic and its implementation and the results obtained.	5 hrs