

Course Title: Electric Machines and Drives	
Institute/Division:	Department of Electrical Engineering Faculty of Electrical and Computer Engineering
Course code:	E-EMD
Erasmus subject code:	0713 Electricity and energy
Number of contact hours:	45
Course duration:	1 semester (Fall/Winter)
ECTS credits:	6
Course description:	<p>The aim of the course is to familiarize students with the design features, principles of electromechanical energy conversion in electric machines and with the basics of electric drive systems. The course includes the following topics:</p> <ul style="list-style-type: none">• Magnetic circuits, structure and properties of windings of transformers and rotating electric machines. Rotating and pulsating magnetic fields. Induction and electromagnetic moment. Electromotive force of rotation and transformation. Circuit models: dynamic and steady-state equations for symmetry of structure and supply, assuming linearity of the magnetic circuit.• Transformers: construction and principle of operation, circuits and connection groups of three-phase transformers, equivalent circuit and determination of its parameters, voltage variation, power losses and efficiency, parallel operation of transformers.• Induction machines: construction and principle of operation, equivalent circuit and determination of its parameters, electromagnetic torque and range of stable operation, power balance and efficiency, starting and speed control of slip-ring and squirrel-cage motors.• Cylindrical and salient pole synchronous machines: construction and principle of operation, description of steady state at synchronous speed, equivalent circuits in d-q axes, determination of equivalent circuit parameters, stand-alone operation and cooperation with the synchronous generator network, phasor diagrams for motor, generator and compensator operation, asynchronous motor start-up, generator synchronization with the network, V curves.• DC commutator machines: construction and principle of operation, commutation and the phenomenon of armature interaction, steady-state equations for a machine with parallel and series excitation, methods of starting and speed control• Electromechanical drive systems: electric drives, mechanics of rotary and linear motion, dynamics of the drive, reduction of the mechanical system to the motor shaft, approximate solution of the mechanical equation, selection of the motor for the drive.• Drives with DC motors: control of drives with separately excited DC motors, electric braking, automatic speed control.• Drives with brushless DC motors and permanent magnet-excited synchronous motors and their regulation.

- Drives with induction motors: induction motor power supply systems, mathematical description of induction motors, steady-state equations, regulation properties of induction motors, speed control by changing frequency.

After completing the course student should be able to know the structure, operating principle and operating properties of transformers and rotating electric machines and drives, to perform calculations and analysis of the selected state of steady-state operation of an electric machine and methods of starting and speed control, to explain measurement methods for testing electric machines, to select the methods and scope of measurements of an electric machine, to select of the motor for the drive and explain regulation properties of motors and speed control methods.

Course type: Lectures (15h), Laboratory (15h), Exercises (15h)

Literature: S.K. Sandhev — Electric machines, Cambridge University Press, 2018.
H.M.Allasouli — Electric machines: Lecture notes, Kindle Edition, 2020.
P.C.Sen — Electric machines end power electronics third edition, John Wiley & Sons Inc, 2013.

Assessment method: Laboratory exercises and practical calculations

Prerequisites: Analysis of electrical circuits, Electromechanical energy conversion, Solving electromagnetic field problems

Contact Person: Anna Shymanska, PhD Eng., anna.shymanska@pk.edu.pl