DESCRIPTION OF THE COURSES

- Course code: ELR3108
- Course title: Numerical methods in analysis of electromagnetic fields in electrical machines and apparatus
- Language of the lecturer: polish

Course form	***Lecture***	***Classes***	***Laboratory***	***Project***	***Seminar***
*Number of hours/week**	*1*		*2*		
*Number of hours/semester**	*15*		*30*		
Form of the course completion	*pass*		*pass*		
ECTS credits					
Total Student's Workload					

- Level of the course (basic/advanced): advanced
- Prerequisites: Principals of electrotechnology, electrical machines
- Name, first name and degree of the lecturer/supervisor: Antal Ludwik dr hab.
- Names, first names and degrees of the team's members: Zieliński Piotr dr
- Year:.....2..... Semester:.....3.....
- Type of the course (obligatory/optional): optional
- Aims of the course (effects of the course): skills in modern, numerical designing of electromechanical devices
- Form of the teaching (traditional/e-learning): traditional
- Course description: Classification and description of electromagnetic fields in electrical machines and apparatus and methods of ascertaining their space distribution. Boundary conditions of field equations. Practical application of QuickField and Flux2D/3D programs to model construction and problem solution by the finite element method (FEM). Calculation of: inductance, electromagnetic force and torque and eddy current power losses, based on fixed electromagnetic field distribution.
- Lecture:

Particular lectures contents	*Number of hours*
1. Basic electromagnetic laws. Maxwell Equations. Poynting theorem.	*2*
2. Energetic relations. Scalar and vector potential.	*2*
3. Electromagnetic properties of materials used in electrical machines and apparatus	*2*
4. Basics of finite differences and finite elements method.	*2*
5. Construction of calculating model, mesh generation (programs QuickField and Flux2D/3D). Field-circuit models.	*2*
6. Induction parameter calculations using power and magnetic coupling methods. Self and mutual inductance of single- and multi-phase windings.	*2*
7. Electrodynamic forces and electromagnetic torque. Movement modelling.	*2*
8. Power losses in windings, magnetic cores and in construction elements	*1*

of machines and apparatus.	

- Classes – the contents:
- Seminars – the contents:
- Laboratory – the contents:

Exemplary calculation of magnetic field distribution, inductance, force and torque by finite element method using QuickField program.

Development of project electromagnetic calculations for electrical machines, electromagnetic coupling and valves, actuators and electromagnets for various electrical apparatus.

- Project – the contents:
- Basic literature:

J. Turowski, Obliczenia elektromagnetyczne elementów maszyn i urządzeń elektrycznych, WNT, Warszawa 1982

J. Turowski, Elektrodynamika techniczna, WNT, Warszawa 1993

A. Demenko, Symulacja dynamicznych stanów pracy maszyn elektrycznych w ujęciu polowym, Wydawnictwo Politechniki Poznańskiej, 1997

- Additional literature:

M. N. O. Sadiku, Numerical Techniques in Electromagnetics, CRC PRESS LLC, 2001

M. Dąbrowski, Pola i obwody magnetyczne maszyn elektrycznych, WNT, Warszawa 1971

- Conditions of the course acceptance/credition:

Adequately developed electromagnetic project for electrical machine or apparatus

***** - depending on a system of studies