SYLLABUS

1. Information about the study programme

1.1 Institution of higher education	West University of Timisoara
1.2 Faculty	Facultatea de Fizica si Matematica
1.3 Department of	Physics
1.4 Field of study	Physics
1.5 Study cycle	Master
1.6 Study programme	Advanced Research Methods in Physics

2. Information about the subject/discipline

2.1 Name	**Practical course, ARMP2404**						
2.2 Course coordinator	Dr. Negrilă Radu						
2.3 Seminar coordinator	Dr. Negrilă Radu						
2.4 Year of study	II	**2.5 Semester**	II	**2.6 Type of assessment**	E[1]	**2.7 Type of discipline**	**DS DOP**

3. Total estimated time (hours of teaching per semester)[2]

3.1 Number of hours per week	**3**	**3.2 course**	**0**	**3.3 seminar/laboratory**	**3**
3.4 Total hours in the curriculum	**36**	**3.5 course**	**0**	**3.6 seminar/laboratory**	**36**

Distribution of time:	**hours**
Study based on Instructions, course materials, bibliography and notes	**24**
Additional documentation library, specialized electronic platforms / field	**6**
Training seminars / laboratories, homework, essays, portfolios and essays	**60**
Tutoring	**21**
Examinations[3]	**3**
Other activities	

3.7 Total hours of individual study	**111**
3.8 Total hours per semester[4]	**150**
3.9 Number of credits	**6**

[1] According to article 37, paragraph (1) of the Higher Education Law no. 199/2023, with subsequent amendments and additions, "the academic success of a student during a study program is determined by verifying the acquisition of the expected learning outcomes through exam-type evaluations and evaluation throughout the semester".

[2] The total number of contact hours and individual study hours will be aligned with the number of credits allocated to the course. One credit corresponds to a total between 25 and 30 hours of teaching activities and individual study. At the level of academic departments may establish, by discipline categories, the exact equivalence between one credit and the number of hours.

[3] The hours corresponding to examinations are added only to the point 3.8 – The total hours per semester, not to be added to the point 3.7 – Total hours of individual study.

[4] Total hours per semester = total hours in the curriculum + total hours of individual study + hours allocated to examinations.

4. Prerequisites (where applicable)

4.1 of curriculum	Electricity and Magnetism Computational Physics
4.2 of skills	General Competencies: the ability to accumulate basic general knowledge; the correct use of terminology from computer science.

5. Conditions (where applicable)

5.1 for the course	Laptop + projector
5.2 for the seminar	Computers with Ansys license

6. Discipline objectives - expected learning outcomes which contribute to the completion and passing the discipline

Knowledge	• Understanding the role of finite element simulation in the development of industrial products (engines, pumps, actuators, sensors, power electronics, etc.) • Elements of the theory of magnetostatic simulations, in alternating fields, magnetotransients, electrostatics, and electrodynamics • Basic elements in preprocessing (preparing CAD models, assigning boundary conditions, electromagnetic excitation sources, methods for generating computational meshes), controlling the numerical solver, and postprocessing simulation results
Skills	• Analysis of practical industrial problems using widely used finite element numerical simulation software (such as Ansys Maxwell) • Ability to choose the correct type of simulation (2D vs 3D, magnetostatic or magnetotransient) for analyzing the considered subassembly (solenoid, electric circuit, motor, etc.) • Preparation of 2D and 3D numerical models for finite element simulation by generating or importing the computational geometry • Assignment of electromagnetic excitation sources and boundary conditions to define the problem • Assignment of material properties • Generation of an appropriate computational mesh • Basic understanding of numerical settings relevant to solution convergence • Analysis of results through postprocessing of global quantities (torque, forces, induced voltage, applied or induced currents) as well as local quantities (electromagnetic fields, induced currents, demagnetization level, ohmic losses, hysteresis losses) over time or by visualizing 2D or 3D distributions

Responsibility and autonomy	• Based on the theoretical introduction with course materials (slides), students will be guided to perform the simulation on the laboratory computer • They will follow step-by-step instructions to complete the simulation during the lab session, being guided throughout the process • The philosophy of "learning by doing" is primarily used in industrial seminars and workshops, and according to this approach, participants will learn to apply the taught content by setting up the simulation conditions and explaining them as they are accessed in the specific menus

7. Contents

The platform through which the course materials in electronic format and other learning/bibliographic resources can be accessed: e-learning.uvt.ro

7.1 Course	**Teaching methods**	**Comments**
1. Maxwell Introduction and Finite Element Method	Lecture, primarily theoretical information delivery using video projection and a board for demonstrations.	
2. Magnetostatic Solver		
3. Eddy Current Solver		
4. Maxwell Magnetic Transient Solver.		
5. Maxwell Electric Solvers		
6. Parametric simulations		
7. Maxwell Postprocessing		
8. Rotational Electrical Machines		
9. Actuator simulation methodology – static and transient		
Bibliography: ➢ John R Brauer-Magnetic actuators and sensors-John Wiley and Sons (2006) ➢ Hendertshot, J. R., Miller, T. J. E.-Design of Brushless Permanent Magnet Motors-Magna Physics Publications (1994) ➢ Austin Hughes and Bill Drury (Auth.)-Electric Motors and Drives. Fundamentals, Types and Applications (2013)		
7.2. Seminar	**Teaching methods**	**Comments**
1. 2D Magnetostatic Analysis (Coil and Slug of Solenoid)	Practical activities, laboratory work consisting of setting up and running simulations, processing, and interpreting data.	
2. Magnetostatic 3D Analysis of Coil and Magnet		
3. 3D Eddy Current Analysis with a Spiral Coil above Iron Disk		
4. 4. 2D Magnetic Transient Analysis (stepper like actuator) 4.2 3D Magnetic Transient Analysis (Solenoid) 4.3 Maxwell A-Phi Transient Solver on a PCB like circuit		
5. 5.1: 3D Electrostatic Analysis 5.2: 2D Electrostatic Analysis - Planar Capacitor 5.3: 2D Electrostatic Analysis Cylindrical Capacitor		

5.4: 3D DC and AC Conduction Analysis on Connector Cable		
6. Parametric Analysis (3D Coil and Slug of Solenoid)		
7. Post Processing - 2D Eddy Current		
8. Radial, Tangential, Trapezoidal and Caretzian Magnetization		
9. Halbach Array Mageys		
10. Demagnetization due to fault and temperature		
11. PMSM Example Motor Simulation (Cogging Torque, Motor Power Balance, Torque Rpm Map)		
12. Solenoidal Actuator plunger design		

Bibliography:

- Ansys Maxwell Getting Started
- Introduction to Electric Machines
- Ansys Maxwell Magnets
- Ansys Maxwell Advanced Motor Traning
- Maxwell Actuator Training
- Electronic Transformer Training

8. Corroboration of the course contents with the epistemic expectations of the community representative, professional associations and representative employers of the programme itself

The course content is directly linked to the practical use in a contemporary industrial setting, for the training of engineers to use simulation software for electromechanical design and evaluation of electrical devices.

9. Use of tools based on generative artificial intelligence

The use of generative AII tools is not permitted

10. Evaluation

Type of activity	**10.1 Evaluation criteria**	**10.2 Evaluation methods**	**10.3 Percentage of the final mark**
10.4 Course	Degree of knowledge acquisition	Weekly assessment of the understanding of theoretical elements necessary for conducting laboratory work	20 %
10.5 Seminar	Degree of knowledge acquisition for using specific software programs	The laboratory activity concludes with an evaluation where the student randomly selects a laboratory work, among	80 %

		those performed during the semester, to complete	
10.6 Minimum performance standards			
Passing the laboratory activity requires mandatory attendance of at least 80% of the laboratory sessions.			

Date of submission:
30.1.2026

Titular of the course:
Dr. Negrilă Radu
Signature:

Date of approval in department:

Seminary titular:
Dr. Negrilă Radu
Signature:

HEAD OF THE DEPARTMENT:
Conf. Dr. Nicoleta Ștefu