SYLLABUS

1. Information about the study programme

1.1 Institution of higher education	West University of Timisoara
1.2 Faculty	Physics and Mathematics
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	**Study of complex devices with ANSYS, ARMP1109**						
2.2 Course coordinator	Dr. Negrilă Radu						
2.3 Seminar coordinator	Dr. Negrilă Radu						
2.4 Year of study	1	**2.5 Semester**	1	**2.6 Type of assessment**	E[1]	**2.7 Type of discipline**	**DS DFA**

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

3.1 Number of hours per week	**4**	**3.2 course**	**2**	**3.3 seminar/laboratory**	**2**
3.4 Total hours in the curriculum	**56**	**3.5 course**	**28**	**3.6 seminar/laboratory**	**28**
Distribution of time:					**hours**
Study based on Instructions, course materials, bibliography and notes					
Additional documentation library, specialized electronic platforms / field					**20**
Training seminars / laboratories, homework, essays, portfolios and essays					**20**
Tutoring					
Examinations[3]					**4**
Other activities					

3.7 Total hours of individual study	**40**
3.8 Total hours per semester[4]	**100**
3.9 Number of credits	**4**

4. Prerequisites (where applicable)

[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.

4.1 of curriculum	
4.2 of skills	

5. Conditions (where applicable)

5.1 for the course	
5.2 for the seminar	

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, such as motors, pumps, actuators, sensors, and power electronics, etc. • Theoretical fundamentals of magnetostatic, alternating-field, magnetotransient, electrostatic, and electrodynamic simulations. • Basic principles of preprocessing, including CAD model preparation, assignment of boundary conditions, electromagnetic excitation sources, and mesh generation methods, as well as control of the numerical solver and postprocessing of simulation results.
Skills	• Analysis of practical industrial problems using widely used finite element simulation software, such as **Ansys Maxwell**. • Ability to select the appropriate simulation type ($2D$vs. $3D$, magnetostatic vs. magnetotransient) for the analysis of the considered subsystem (e.g., solenoid, electrical circuit, motor, etc.). • Preparation of $2D$and $3D$numerical models for finite element simulation through geometry generation or import. • Assignment of electromagnetic excitation sources and boundary conditions for problem definition. • Assignment of material properties. • Generation of a suitable 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), both over time and through visualization of distributions in $2D$or $3D$.

Responsibility and autonomy	• Based on the theoretical introduction and course 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 laboratory sessions, under supervision. • The **"learning by doing"** approach is commonly used in seminars and industrial workshops; accordingly, students will learn to apply the taught content by setting up simulation conditions and interpreting them as they access the relevant software menus.

7. Contents

The platform through which the course materials in electronic format and other learning/bibliographic resources can be accessed: Google Classrom

7.1 Course	**Teaching methods**	**Comments**
1. Maxwell Introduction and Finite Element Method 2. Magnetostatic Solver 3. Eddy Current Solver 4. 4.1 Maxwell Magnetic Transient Solver 5. 4.2 Maxwell Meshing Operations 6. Maxwell Electric Solvers 7. Parametric Simulations 8. Maxwell Postprocessing 9. Rotational Electrical Machines 10. Actuator Simulation Methodology – Static and Transient	Lecture; predominantly theoretical instruction using video projection and the blackboard for demonstrations.	

Bibliography:

- **Brauer, J. R.** *Magnetic Actuators and Sensors*. John Wiley & Sons.
- **Hughes, A., & Drury, B.** *Electric Motors and Drives: Fundamentals, Types and Applications*. 2013.

7.2. Seminar	**Teaching methods**	**Comments**
1. 2D Magnetostatic Analysis (Coil and Slug of Solenoid) 2. Magnetostatic 3D Analysis of Coil and Magnet 3. 3D Eddy Current Analysis with a Spiral Coil above Iron Disk 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 5.1: 3D Electrostatic Analysis	Practical activities; laboratory work consisting of setting up and running simulations, processing the results, and interpreting the data.	

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:

. Workshop Ansys Learning Hub:
- 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

9. Use of tools based on generative artificial intelligence

Generative AI is not permitted (nor needed) for Seminar completion with on hands ANSYS practice. AI can and should be used for debugging simulation setups but this does not produce any written material to be evaluated

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 mastery of the acquired knowledge	Weekly assessment of the theoretical content	20 %

		required for carrying out the laboratory work	
10.5 Seminar	Degree of mastery of the knowledge required to use the specific software	The laboratory activity ends with an assessment in which the student is assigned, by random draw, one of the laboratory works completed during the semester	80 %
10.6 Minimum performance standards			
Passing the laboratory activity requires **mandatory attendance at a minimum of 80 %** of the laboratory sessions.			

Date of submission: 16.9.2026

Titular of the course: Dr. Negrilă Radu
Signatu[redacted]

Date of approval in department:

Seminary titular: Dr. Negrilă Radu
Signatu[redacted]

HEAD OF THE DEPARTMENT: Conf. Dr. Nicoleta Ștefu