SYLLABUS

1. Data about the program of study

1.1	Institution	Technical University of Cluj-Napoca
1.2	Faculty	Faculty of Electrical Engineering
1.3	Department	Electrotechnics and Measurements
1.4	Field of study	Electrical Engineering
1.5	Cycle of study	Bachelor of Science
1.6	Program of study/ Qualification	Electrical System Cluj-Napoca in English language
1.7	Form of education	Full time
1.8	Subject code	49.00

2. Data about the subject

2.1	Subject name				CAD Tools	
2.2	Course responsible/ lecturer				*Prof. Dr. Ing. Ioan Marius Purcar, marius.purcar@ethm.utcluj.ro*	
2.3	Teachers in charge of Seminars/ Laboratory/ Project				*Prof. Dr. Ing. Ioan Marius Purcar, marius.purcar@ethm.utcluj.ro*	
2.4 Year of study		3	2.5 Semester	2	2.6 Type of assessment *(E – exam, C – colloquium, V – verification)*	E
2.7 Subject category		*DF – fundamental, DD – in the field, DS – specialty, DC – complementary*				DS
		DI – compulsory, DO – elective, Dfac – optional				DI

3. Estimated total time

3.1 Number of hours per week:	4	of which	3.2 Course	2	3.3 Seminar		3.3 Laboratory	2	3.3 Project	
3.2 Total hours per semester	56	of which	3.5 Course	28	3.6 Seminar		3.6 Laboratory	28	3.6 Project	

3.7 Individual study:	
(a) Manual, lecture material and notes, bibliography	20
(b) Supplementary study in the library, online and in the field	12
(c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays	15
(d) Tutoring	8
(e) Exams and tests	14
(f) Other activities	0

3.8 Total hours of individual study *[sum (3.7(a) to 3.7(f))]*	69
3.9 Total hours per semester *[sum of 3.4 and 3.8]*	125
3.10 Number of credit points	5

4. Prerequisites (where applicable)

4.1	Curriculum	No
4.2	Competences	• General knowledge of computer use • General knowledge of technical drawing • Knowledge of electrical circuit and wiring design

5. Requirements (where appropriate)

5.1	For the course	Cluj-Napoca

5.2	For the applications	Cluj-Napoca

6. Specific competences

Professional competences	6.1.1. Implementation and use of hardware and software applications in specific electrical engineering problems. 6.1.2. Use of dedicated CAD/CAE/CAM tools in design, numerical modeling and manufacturing in electrical engineering. 6.1.3. Knowledge of the principles of computer-aided modeling: • Wireframe models; • Solid models: BREP representation, Sweeping, CSG; • Parametric and feature-based modeling; • Parametric representation of curves and surfaces; 6.1.4. Use and application of different CAD and CAE tools in the design of electromechanical devices and electrical circuits; • Use of SolidWorks® and SolidWorks Electrical systems in the design of electrical and electronic equipment • Use of SolidWorks Electrical and specific component libraries in the design of electrical control circuits • Use of the CircuitWorks module in SolidWork for the design of printed circuit boards fully populated with specific circuit components, exporting or reading them in the industrial standard IDF 2.0, IDF 3.0 or PADS • Use of CAE modules in SolidWorks® (Simulations and FlowWorks) for numerical analysis of designed models 6.1.1. Use and application of CAM tools in the production of assemblies or subassemblies of finished products
Cross competences	6.2.1. Identifying the objectives to be achieved, the available resources, the conditions for their completion, the work stages, the working times, the deadlines and the related risks. 6.2.2. Identifying roles and responsibilities in a multidisciplinary team and applying techniques for effective communication and work within the team. 6.2.3. Efficient use of computer-aided design tools and virtual resources (Internet portals, specialized software applications, databases, online courses, etc.) both in Romanian and in an international language. 6.2.4. Skills in using and applying several CAD/CAE/CAM systems through direct experience and solving practical problems. 6.2.5. Awareness of the importance of CAD-CAE computer-aided technologies in the optimal design of electromechanical devices.

7. Discipline objectives (based on specific competencies acquired)

7.1	General objective	• Knowledge of the principles of computer-aided design (CAD-CAE) and CAM production techniques and tools specific to electrical and electromechanical engineering and their application in the context of the product life cycle.
7.2	Specific objectives	• Knowledge of the principles and techniques of computer-aided modeling:

		- Development of skills in using design software: SolidWorks (Mechanical product design, Electrical 2D/3D, Wire Routing, Harness Design and CircuitWorks) for project development - Development of skills in using CAE simulation programs integrated in SolidWorks: Simulations and FlowWorks, for numerical analysis of designed models - Generation of technical documentation

8. Contents

8.1. Course (Lectures)		Number of hours	Teaching methods	Additional remarks
1	• The usage of CAD/CAM/CAE computer-aided technologies in the development of components and equipment	2	PowerPoint presentations, interactive tutorials, debates, problem-based learning presentations, online and onsite.	Each course content unit has a duration of 2 hours.
2	• Graphic visualization systems • Principles of 2D and 3D design and modeling in integrated CAD/CAM/CAE systems • Graphic coordinate systems: MCS, WCS, SCS, VCS • A synthesis of geometric transformations and projections	2		
3	Comparative presentation of the main CAD software: AutoCAD, SolidEdge, Inventor, SolidWorks, Catia, PTC Creo, Unigraphics NX, and Solid Edge.	2		
4	• Computer modeling techniques: - Wireframe modeling, - Solid body-based modeling, - Parametric and feature-based modeling • Representation and visualization of curves and surfaces: - Parametric representation - B-spline, Bezier, NURBS • Practical examples	2		
5	• Elements of design used in engineering: - Elements of technical drawing in mechanical, electrical and electronic engineering - Tolerances in mechanical, electrical and electronic engineering • Specific materials and their interaction • Elements of product engineering	2		
6	• Introduction to AutoCAD and SolidWorks modeling systems: - Fundamentals of feature-based solid body modeling - Functions and modules in AutoCAD and SolidWorks	2		

	- Part-based model design • Practical examples			
7	• Advanced modeling with SolidWorks: - Creating configurations - Designing with macros - Part assemblies - Generating documentation and technical drawings • Practical examples	2		
8	• Advanced CAD systems and their industrial applications: - SolidWorks Electrical 2D/3D and Electrical Routing in the design of electrical control diagrams and electrical circuits - Using the CircuitWorks module in SolidWorks for the design of printed circuit boards, exporting or reading them in the industrial standards IDF, PADS and MCM. - Electrical Wire Routing and Harness Design • Practical examples	2		
9	• AutoCAD Electrical and SolidWorks Electrical: - Principles - Standards and component libraries - Standards for the representation of electrical control diagrams - Generating technical drawings and documentation • Practical examples	2		
10	• CircuitWorks: - Principles - Industrial standards IDF 2.0, IDF 3.0 or PADS - Analysis of design constraints - Visualization and prototyping - Generating technical drawings and documentation - Numerical Analysis • Practical examples	2		
11	• Virtual testing technologies CAD-CAE with applications in: - Electromagnetism - Mechanical stress - Thermotechnics - Fluid dynamics • Model conversion and conversion standards between CAD-CAD, CAD-CAE and CAE-CAE systems	2		

	• Defining calculation models • Simplifying calculation models • Practical examples			
12	• Methods for numerical simulation of electro-thermo-mechanical processes integrated in CAE systems • Principles of numerical simulation methods: finite difference method (FDM), finite element method (FEM), boundary element method (BEM) • Comparative presentation of FDM, FEM and BEM methods • Generation of discretization grids • Association of boundary conditions and material properties • Practical examples	2		
13	• CAD/CAM systems and their industrial applications - CAD/CAM integration and CNC numerical code generation - Virtual prototyping in the development of finished products • Practical examples	2		
14	• CAD data organization - Data structure and databases - Product data management (PDM) • Principles of Product Lifecycle Management (PLM) • Use of CAD-CAE/CAM tools in PLM • Practical examples	2		

Bibliography

1. Purcar, M., Bojiță, A., Avram A., Instrumente CAD, ISBN 978-606-737-408-7, 136 p., Editura UTPress, Cluj-Napoca 2019.
2. Purcar M., Modeling the Electrode Shape Changes for Electroforming and Electrochemical Machining Processes, ISBN 978-973-713-272-7, 181 pp, Editura Mediamira, Cluj-Napoca 2010.
3. Kunwoo, L., - Principles of CAD/CAM/CAE Systems, Addison – ISBN 0-13-178454-4, Wesley Longmam, Inc. 1999.

8.2. Applications - Seminar /Laboratory/Project		Number of hours	Teaching methods	Additional remarks
1	**SolidWorks:** • General presentation • System configuration • Reading and saving data • Interface customization • 2D and 3D sketches • Blocks • Basic modeling functions	2	Exercises and applications solved as examples, discussions on solution methods, completion	Each laboratory session has a duration of 4 hours and takes place every two weeks. Thus, 2 works are
2	**SolidWorks**	2		

	• Model parameterization • Assembly construction • Generating, viewing reports and technical documentation of the project		of proposed problems.	combined in one laboratory session.
3	**Elements of advanced design in SolidWorks:** • Design configurations • Macro language	2		
4	**Project 1 (from the practical works 1, 2, and 3)**	2		
5	**SolidWorks Electrical 2D:** • Overview • System configuration • Defining installations and their locations • Drawing single and three-phase routes • Inserting functions and symbols for components including their numbering • Setting and numbering terminals • Using the terminal plan	2		
6	**SolidWorks Electrical 2D:** • Creating and assigning data to project-specific components • Creating and testing new symbols • Customizing component names • Generating, viewing reports and project documentation with SolidWorks Electrical 2D	2		
7	**SolidWorks Electrical 3D:** • Electrical Wire Routing and Harness Design • Generating, viewing reports and project documentation with SolidWorks Electrical			
8	**Project 3 (from the practical works 5, 6, and 7)**	2		
9	**Designing PCBs in SolidWorks CircuitWorks:** • Overview • System configuration • Reading and saving data • IDF and PADS format • Using advanced tools • Specific annotations • Automatic generation of assemblies	2		
10	**Designing PCBs in SolidWorks CircuitWorks:** • Importing data • Exporting data • ECAD format	2		
11	**CAM systems and their industrial applications** • 3-axis milling machine • Generating CNC numerical code) • Generating numerical code for making PCBs	2		

	• Virtual prototyping in the development of finished products (3D printer)			
123	**Project 4 (from the practical works 9, 10, and 1)**	2		
13	**Simulations and FlowWorks** • Presentation • Basic functions • Performing a configuration for numerical analysis • Boundary conditions • Viewing the results using the simulation for optimal design	2		
14	**Project 5 (from the practical works 9, 10, and 1)**	2		
Bibliography Purcar, M., Bojiță, A., Avram A., Instrumente CAD, ISBN 978-606-737-408-7, 136 p., Editura UTPress, Cluj-Napoca 2019.				

9. Alignment of course content with expectations of the epistemic community, professional associations, and representative employers in the field

The content of the discipline is consistent with what is taught in other electrical engineering faculties both within the Technical University and in other universities in the country and abroad.
For a better corelation of the discipline's content to the labour market requirements, it has been adapted according to the current requirements of the business environment at the level of Cluj-Napoca municipality.

10. Assessment

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade (%)
10.4 Course	Theoretical test	Written test presented orally or written text presented electronically. The evaluation will take place, as the case may be: online or onsite.	50 %
10.5 Laboratory/ project	Activity in class and project implementation	Activity in class and project implementation	50 %
10.6 Minimum standard of performance: Standard: Complete the test and construct, according to design standards, an electromechanical model and an electrical diagram. Minimum level: Correctly answer half of the test questions and construct half of an electromechanical model and an electrical diagram. The final grade must be at least 5, and the grades for the written test and the laboratory test must also be at least 5.			

Date of completion	Lecturers	Title/ Surname/ Name:	Signature
September 2024	Course	Ioan Marius Purcar	
	Applications Seminar/ Laboratory/ Project	Ioan Marius Purcar	

Date of approval in the ETHM Department Council September 2024	**Head of Department:** Prof. Eng. MICU Dan Doru, PhD
Date of approval in the Faculty of Electrical Engineering Council September 2024	**Dean:** Assoc. Prof. Eng. CZIKER Andrei, PhD