SYLLABUS

1. Information about the program

1.1 Higher education institution	Universitatea Politehnica Timișoara
1.2 Faculty[1] / Department[2]	OF ELECTRONICS, TELECOMMUNICATIONS AND INFORMATION TECHNOLOGIES / Applied Electronics Department
1.3 Field of study (name/code[3])	Electronics, Telecommunications and Information Technologies Engineering /20/20/10
1.4 Study cycle	Master
1.5 Study program (name/code/qualification)	AUTOMOTIVE ELECTRONIC SYSTEMS/ 20/20/10 / 2152

2. Information about discipline

2.1a Name of discipline/The educational classe[4]	Thermal Design and Techniques to Minimize Disruptive Effects / DS Proiectare termică și tehnici pentru minimizarea efectelor perturbative						
2.1b Name of discipline in Romanian							
2.2 Coordinator (holder) of course activities	Lect. Septimiu Lica, B.Sc. (Phys.) Ph.D. (Eng.)						
2.3 Coordinator (holder) of applied activities[5]	Lect. Septimiu Lica, B.Sc. (Phys.) Ph.D. (Eng.)						
2.4 Year of study[6]	1	**2.5** Semester	2	**2.6** Type of evaluation	E	**2.7** Regime of discipline[7]	DOB

3. Total estimated time (direct activities (fully assisted), partially assisted activities and unassisted activities[8])

3.1 Number of hours fully assisted/week	4 ,of which:	course	2	seminar/laboratory/project			3
3.1* Total number of hours fully assisted/sem.	70 ,of which:	course	28	seminar/laboratory/project			42
3.2 Number of on-line hours fully assisted/sem	24 ,of which:	course	16	seminar/laboratory/project			10
3.3 Number of hours partially assisted/week	- ,of which:	project, research	-	training	-	hours designing M.A. dissertation	-
3.3* Number of hours partially assisted/ semester	- ,of which:	project of research	-	training	-	hours designing M.A. dissertation	-
3.4 Number of hours of unassisted activities/ week	5.71 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field					2
		Study using a manual, course materials, bibliography and lecture notes					1.71
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays					2
3.4* Total number of hours of unasssited asctivities/ semester	80 ,of which:	Additional documentation in the library, on specialized electronic platforms, and on the field					28
		Study using a manual, course materials, bibliography and lecture notes					24
		Preparation of seminars/ laboratories, homework, assignments, portfolios, and essays					28
3.5 Total hrs./week[9]	9.71						
3.5* Total hrs./semester	150						
3.6 No. of credits	6						

4. Prerequisites (where applicable)

4.1 Curriculum	• Physics • Electromagnetics Engineering • Electronic Design Automation • Microwaves • Microcontrollers • Electronic Packaging
4.2 Learning outcomes	• Digital competencies (working on a PC)

	• Good command of CAD software • Programming basic knowledge • Superior mathematics usage abilities • Understating the modeling of physical phenomena (electromagnetics and thermal

5. **Conditions** (where applicable)

5.1 of the course	• Classroom with a minimum of 30 places with video projector. • The students will participate in classes (courses and practical applications) with mobile phones on silence profile / mode. Also, phone calls will not be tolerated during classes, leaving the classroom for personal phone calls is also prohibited. Conversations through messages are forbidden, and other activities that that lead to distraction will also be prohibited. • Delay of students in the course and laboratory will not be tolerated as it proves to be disruptive to the educational process
5.2 to conduct practical activities	• Laboratory room with PCs running a set of Spice and FEM simulation software, video projector, Internet connection and whiteboard. • During the practical application there will be a project, and because of this each student will have a freeware installed on his / her own PC. • The project will be carried out according to a schedule established by mutual agreement with the students, based on a Gantt chart and exact milestones. There will be penalties for delays and bonuses for overtaking. • If the final deadline is not met, as a penalty, the maximum mark of project will be 8. • Postponement requests will not be accepted, except for well-founded ones.

6. **Learning outcomes** acquired through this discipline

Knowledge	• C1. The student/graduate demonstrates advanced knowledge of the categories of electronics, the principles of electricity and engineering, and the physics and mathematics required for the design and analysis of complex electronic systems. • C7. The student/graduate explains mathematical and physical methods used in the modeling and analysis of industrial processes. • C10. The student/graduate explains design methods and manufacturing techniques employed in the development of electronic, mechanical, and optical microsystems. • C14. The student/graduate explains methods and techniques for modeling power electronic systems, including the analysis of components and their interactions. • C16. The student/graduate demonstrates advanced knowledge of the operating principles, typologies, and applications of sensors. • C17. The student/graduate explains methods and techniques for designing sensors and integrated sensor systems within complex products.
Skills	• A2. The student/graduate conducts scientific research in electronics, developing innovative methods and solutions for circuits, semiconductors, and advanced technological applications. • A3. The student/graduate designs electronic systems, including circuits, equipment, and applications in fields such as automotive and instrumentation. • A5. The student/graduate drafts technical reports and project documentation in compliance with engineering standards. • A16. The student/graduate synthesizes scientific and technical information from interdisciplinary fields relevant to microsystems. • A18. The student/graduate designs and develops microsystems using dedicated simulation and modeling tools. • A22. The student/graduate models power electronic systems, using simulation tools and mathematical methods for optimization. • A23. The student/graduate designs sensors, selecting appropriate materials and technologies for specific applications.

Responsibility and autonomy	• RA4. The student/graduate promotes innovation and lifelong learning, integrating scientific and technological progress into research and development activities. • RA5. The student/graduate assumes responsibility for preparing and communicating technical reports to stakeholders. • RA6. The student/graduate engages in lifelong learning, continuously updating competences in line with scientific and technological progress. • RA7. The student/graduate assumes responsibility for the quality of design and the functionality of industrial monitoring equipment. • RA8. The student/graduate demonstrates autonomy in the use of analysis software and in decision-making regarding the design and testing of equipment.

7. **Objectives of the discipline** (based on the grid of learning outcomes acquired)

- To become familiar with the main electromagnetic and thermal phenomena and their main effects that can lead to poor performance of electronic equipment.
- Development of the ability to estimate electromagnetic interference through simulations and to choose appropriate solutions to reduce perturbations.
- Learning the main design methods to avoid perturbations.
- Creating analytical skills to discriminate between several solutions that lead to the final product optimization
- Several skills development in the field of thermal phenomena and awareness of their implications in electronic equipment.
- Phenomena simulation in transient regime and in steady state.
- Cooling solutions design.
- Creating a virtual prototype and performing tests on it.

8. **Content**

8.1 Course	Number of hours	Of which online	Teaching methods
Introduction to the issue of disturbances (electromagnetic field, EMI) and thermal phenomena	2	2	Lecture supported by slides, explanation, conversation, exercise solving, case study, problematization, comparative analysis, cognitive conflict induction, Phillips 6-6, debates, Jigsaw method, Venn-Euler diagram, Virtual Campus, email, and various electronic materials.
Mathematical Methods. Numerical Methods for Differentiation and Integration	2	2	
Electromagnetic emissions, fundamentals of signal integrity	2	2	
Transmission Lines. Impedance Matching. High-Speed Circuit Design. Signal Integrity. IBIS Models. PCB-Implemented Circuit Elements	2	2	
Crosstalk. Noise Filtering. Functional Block-Based Schematic Partitioning and Identification of Electromagnetic Redesign Issues. Schematic Modifications and Adaptations	2	2	
Circuit and Cable Shielding. Methods for Reducing Rise Time to Minimize Emissions. PCB Design Rules. Component Placement. Aggressor and Victim Signals. Current Loops	2	0	
Power Distribution Network Design. Power and Ground Planes, PCB Stack-Up. Grounding Concepts (Star, Common Point, Comb, etc.). Decoupling Capacitors. Case Study: PCBs for Switching Power Supplies	2	0	
Introduction and Fundamentals of Thermodynamics. FEM	2	2	
Advanced Simulation of Electromagnetic and Thermal Phenomena in Equipment	2	2	
Power Dissipation in Electronic Components. Thermal Resistance and Impedance Calculation. Practical Heat Dissipation Mechanisms	2	2	
Cooling Methods. Heatsink and PCB Cooling Surface Calculations. Thermal Pastes and Heat Pipes. Optimal Heatsink Placement and Integration into the Enclosure	2	0	
Case Studies. Interpretation of Simulations	2	0	

Methods for Measuring and Testing Thermal Quantities in Electronic Equipment and Components. Interpretation of Results	2	0	
Electrical and Thermal Co-Simulation. Multi-Physics Co-Simulations	2	0	

Bibliography[10] 1. Joao Pedro A. Bastos, Nelson Sadowski, Electromagnetic Modeling by Finite Element Methods, Marcel Dekker, Inc., 2003.
2. Nathan Ida, Joao P.A. Bastos, Electromagnetics and Calculation of Fields - 2nd ed., Springer-Verlag New York, Inc., 1997.
3. Roland W. Lewis, Perumal Nithiarasu, Kankanhalli N. Seetharamu, Fundamentals of the Finite Element Method for Heat and Fluid Flow, John Wiley & Sons Ltd., 2004.
4. All Jamnia, Practical Guide to the Packaging of Electronics - Thermal and Mechanical Design and Analysis, Marcel Dekker, Inc., 2003.
5. John H. Lienhard IV, John H. Lienhard V, A Heat Transfer Textbook - 3rd ed., Phlogiston Press, 2003.
6. Andrei Vladimirescu, The Spice Book, John Wiley & Sons, Inc., 1994.
7. *** http://www.sae-itc.org/industry.htm
8. Daryl L. Logan, A First Course in the Finite Element Method - 5th ed., Cengage Learning, 2012.
9. IPC-D-317A -Design Guidelines for Electronic Packaging Utilizing High-Speed Techniques
10. IPC-2141 - Controlled Impedance Circuit Boards and High Speed Logic Design
11. IPC-2221 - Generic Standard on Printed Board Design
12. IPC-2152 - Standard for Determining Current-Carrying Capacity In Printed Board Design
13. Douglas Brooks, Signal Integrity Issues and Printed Circuit Board Design, Prentice Hall, 2003.
14. Stephen C. Thierauf, High-Speed Circuit Board Signal Integrity, Artech House, Inc., 2004.
15. Clyde F. Coombs, Jr., Printed Circuits Handbook, McGraw-Hill Companies, Inc., 2008.

8.2 Applied activities[11]	Number of hours	Of which online	Teaching methods
Implementation of Numerical Calculation Methods	2	2	Comparative Analysis, Problematization, Demonstration, Simulation, Case Study, Exercise Solving
Microstrip and Stripline Transmission Lines PCB-Implemented Elements	2 2	2 0	
2D Geometry Creation. Mesh Optimization. Electromagnetic Simulation	2	0	
Simulation of 3D Problems	2	2	
Simulations for Signal Integrity Power Distribution Network Integrity	2 2	2 0	, Debates, Role-Playing
2D and 3D Thermal Problems. Simulation of Conduction. Convection, and Radiation	2 2 2	0 0 0	Virtual Campus, Email
Electro-Thermal Co-Simulations	2	0	Electronic Materials
Project Topic Allocation Planning and Preliminary Discussions	2 2	2 0	Projects
Project Progress Meetings. Project Presentations. Final Evaluation	2	0	

Bibliography[12] 1. Frederic Hecht, FreeFem++, Third Edition, Version 3.51 http://www.freefem.org/ff++/ftp/freefem++doc.pdf
2. B. Lucquin, O. Pironneau, Introduction to Scientific Computing, Wiley 1998.
3. All Jamnia, Practical Guide to the Packaging of Electronics - Thermal and Mechanical Design and Analysis, Marcel Dekker, Inc., 2003.
4. Roland W. Lewis, Perumal Nithiarasu, Kankanhalli N. Seetharamu, Fundamentals of the finite element method for heat and fluid flow, John Wiley & Sons Ltd., 2004.

9. Evaluation

Type of activity	**9.1** Evaluation criteria[13]	**9.2** Evaluation methods	**9.3** Share of the final grade

9.4 Course	Knowledge of specific terminology. Ability to use notions in practical cases. Knowledge of regulations in the fields. Ability to operate with the models and methods presented. Ability to propose solutions and methods to solve application problems. System level design skills	Exam on the Theoretical Concepts Taught	50 %
9.5 Applied activities	**S:**		
	L: Ability to use the software packages, methods and models correctly.	Homework and tests	10 %
	P: Presenting a case study, identifying the main vulnerabilities, the optimization methods applied, the correct implementation in the simulation and highlighting the obtained results. Performance analysis of the proposed solution and ideas for improvement	Personal project presentation	40%
	Pr:		
	Tc-R[14]:		
9.6 Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified[15]			
• Identify the possible presence of electromagnetic perturbations in a practical case of electronic equipment. • Basic topics knowledge in the field of electromagnetic interference and signal integrity. • Basic notions knowledge in the field of thermal phenomena in electronic equipment. • Identifying overheating and proposing a cooling method in a simple practical case.			

Date of completion	Course coordinator (signature)	Coordinator of applied activities (signature)
24/09/2025	Lect. Septimiu Lica PhD	Lect. Septimiu Lica PhD
Head of Department (signature)	**Date of approval in the Faculty Council [16]**	**Dean (signature)**
Assoc. Prof. Mircea Băbăiță PhD	7.10.2025	Prof. Cătălin Căleanu PhD