SYLLABUS

1. Data about the program of study

1.1 Institution	Technical University of Cluj-Napoca
1.2 Faculty	Faculty of Electronics, Telecommunications and information Technology
1.3 Department	Applied Electronics
1.4 Field of study	Electronic Engineering, Telecommunications and Information Technologies
1.5 Cycle of study	Bachelor of Science
1.6 Program of study / Qualification	Applied Electronics / Engineer
1.7 Form of education	Full time
1.8 Subject code	18.00

2. Data about the subject

2.1 Subject name	Materials for Electronics						
2.2 Subject area	Theoretical area Methodological area Analytic area						
2.3 Course responsible	Lect. Prof. Alexandra Fodor, PhD Eng. Alexandra.Fodor@ael.utcluj.ro						
2.4 Teacher in charge with seminar / laboratory / project	Lect. Prof. Ionuţ Ciocan, PhD Eng. Ionut.Ciocan@ael.utcluj.ro						
2.5 Year of study	II	2.6 Semester	1	2.7 Assessment	E	2.8 Subject category	DID/DI

3. Estimated total time

3.1 Number of hours per week	3	of which: 3.2 course	2	3.3 seminar / laboratory	1
3.4 To Total hours in the curriculum	100	of which: 3.5 course	28	3.6 seminar / laboratory	14

Distribution of time	hours
Manual, lecture material and notes, bibliography	24
Supplementary study in the library, online specialized platforms and in the field	12
Preparation for seminars / laboratories, homework, reports, portfolios and essays	14
Tutoring	5
Exams and tests	3
Other activities:	

3.7 Total hours of individual study	58
3.8 Total hours per semester	100
3.9 Number of credit points	4

4. Pre-requisites (where appropriate)

4.1 curriculum	-
4.2 competence	Relations and theorems for electric circuits; physics; chemistry;

5. Requirements (where appropriate)

5.1. for the course	Amphitheatre, Cluj-Napoca

5.2. for the seminars / laboratories / projects	Laboratory, Cluj-Napoca

6. Specific competences

Professional competences	C1 - To use the fundamental elements regarding electronic devices, circuits, systems, instrumentation and technology • C1.4 Use of electronic tools and specific methods to characterize and evaluate the performance of electronic circuits and systems • C1.5 Providing a theoretical background for the characteristics of the designed systems C4 - To design and use low complexity hardware and software applications, specific to applied electronics • C4.3 Identification and optimization of hardware and software solutions of problems related to: industrial electronics, medical electronics, automotive electronics, automation, robotics, production of consumer goods • C4.4 Use of appropriate performance criteria for the evaluation, including by simulation, of hardware and software of dedicated systems or service activities in which microcontrollers or computing systems of reduced or medium complexity are used C5 - To apply knowledge, concepts and basic methods from power electronics, automated systems, electric energy management, electromagnetic compatibility • C5.2 Qualitative and quantitative interpretation of the functioning of circuits in the fields of: power electronics, automatic systems, electricity management, medical electronics, auto electronics, consumer goods; analysis of the functioning from the point of view of electromagnetic compatibility • C5.4 Evaluation, based on the criteria of technical quality and environmental impact of the equipment in the fields of applied electronics: power electronics, automatic systems, electricity management, medical electronics, automotive electronics, consumer goods C6 - To solve technological problems, specific to applied electronics C6.1 Defining the principles and methods underlying the manufacture, adjustment, testing and troubleshooting of the appliances and equipment in the fields of applied electronics
Cross competences	N/A

7. Discipline objectives (as results from the key competences gained)

7.1 General objective	Development of competences in the field of materials used in electronics.
7.2 Specific objectives	1. Assimilation of theoretical knowledge regarding the materials used in electronics. 2. Acquiring skills for the use of laboratory equipment.

8. Contents

8.1 Lecture (syllabus)	Teaching methods	Notes
1. Course description. An overview of electronic materials.	Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation	Use of .ppt presentation, projector, blackboard
2. Matter structure and bonding		
3. Electronic band theory of solids		
4. Classification of materials - conductors, insulators, semiconductors		
5. Dielectric materials – definitions, classifications and general aspects		
6. Fundamental properties of dielectrics		
7. Applications of dielectrics		
8. Breakdown of dielectrics. Dielectric materials used in electronics.		
9. Semiconductor materials – definitions, classifications and general aspects		
10. Intrinsic semiconductors		
11. Extrinsic semiconductors		
12. PN junction. Some semiconductors used in electronics.		
13. Conductors		
14. Magnetic materials. Preparation for the final exam.		

Bibliography

1. Fărcaş Cristian – Materiale pentru electronică, Ed. Risoprint, Cluj-Napoca, 2009
2. Angus Rockett - The Materials Science of Semiconductors, 2008.
3. William D Callister, Jr David G Rethwish - Materials Science and Engineering An Introduction, 2018.
4. Jaeger, Richard C Travis N Blalock, Microelectronic circuit design 4 th ed., 2010.
5. Ashcroft, N W and Mermin N D Solid State Physics, Saunders, 1976

8.2 Seminar / laboratory / project	Teaching methods	Notes
1. Introduction. Labour protection	Didactic and experimental proof, didactic exercise, team work	Use of laboratory instrumentation, experimental boards, white/ magnetic
2. Electrical conductor materials		
3. Ferromagnetic materials		
4. Solid dielectric materials		
5. P-N junction barrier capacitance		
6. Temperature dependence of resistivity (conductors and semiconductors)		
7. Lab recovery and finalization of laboratory activity		

Bibliography

1. Fărcaş Cristian – Materiale pentru electronică, Ed. Risoprint, Cluj-Napoca, 2009
2. Creţ Rodica – Materiale pentru electronică, U.T. Press, Cluj-Napoca, 2004
3. Pitică Dan, Radu Mihaela - Componente electronice pasive, Litografia UTC-N, 1994
4. Schroder D. – Semiconductor Material and Device Characterization, John Wiley & Sons, 2006
5. Yu P., Cardona M. – Fundamentals of Semiconductors. Physics and Materials Properties, Springer, 2010.
6. Pop V., Chicinaş, Jumate N. – Fizica materialelor. Metode experimentale, Presa Universitară Clujeană, 2001
7. Drăgulinescu M., Manea, A., Materiale pentru electronică, Ed. Matrix Rom, Bucureşti, 2002.
8. Noţingher, P., Materiale pentru electrotehnică, Ed. Politehnica Press, Bucureşti, 2005.
9. Popovic, R.S., Hall Effect Devices - 2nd ed., Bristol; Philadelphia: Institute of Physics, 2004.
10. Zeghbroeck, B., Principles of Semiconductor Devices and Heterojunctions, Paperback - Nov 25, 2008.

9. Bridging course contents with the expectations of the representatives of the community, professional associations and employers in the field

The discipline content and the acquired skills are in agreement with the expectations of the professional organizations and the employers in the field, where the students carry out the internship stages and/or occupy a job (in the field of *electronics and telecommunications engineering*), and the expectations of the national organization for quality assurance (ARACIS).

10. Evaluation

Activity type	10.1 Assessment criteria	10.2 Assessment methods	10.3 Weight in the final grade
10.4 Course	The level of acquired theoretical knowledge and practical skills	Summative evaluation written exam (theory and problems)	80%
10.5 Seminar/ Laboratory	The level of acquired knowledge and abilities	- Continuous formative evaluation - practical lab test	20%
10.6 Minimum standard of performance			

Quality level:

Minimal knowledge:

- ✓ *Knowledge of the main properties of conductive, semiconductor, insulating and magnetic materials.*
- ✓ *Knowledge of the main materials used in electronics.*

Minimal competences:

- ✓ *To be able to list the main properties of materials used in electronics.*
- ✓ *To be able to specify the main advantages and disadvantages of the materials used in electronics.*

Quantitative level:

- ✓ *To perform all laboratory works*
- ✓ *The exam and laboratory marks must be at least 5*
- ✓ *The final mark for the subject is calculated with the relation: 0.8 * Exam mark + 0.2 * Lab mark*

Date of filling in:	Responsible	Title Surname NAME	Signature
20.06.2023	Course	Lect. Prof. Alexandra Fodor, PhD Eng.	
	Applications	Lect. Prof. Ionuţ Ciocan, PhD Eng.	

Date of approval in the Department of …….. 30.06.2023	Head of Department Prof. Dorin PETREUȘ, PhD eng
Date of approval in the Council of Faculty of Electronics, Telecommunications and Information Technology 12.07.2023	Dean Prof.Ovidiu Aurel POP, PhD eng