# SYLLABUS

## 1. Data about the program of study

| | | |
|---|---|---|
| 1.1 | Institution | The Technical University of Cluj-Napoca |
| 1.2 | Faculty | Electronics, Telecommunications and Information Technology |
| 1.3 | Department | Applied Electronics |
| 1.4 | Field of study | Electronics and Telecommunications Engineering |
| 1.5 | Cycle of study | Bachelor of Science |
| 1.6 | Program of study/Qualification | Telecommunications Technologies and Systems/ Engineer, Applied Electronics/ Engineer |
| 1.7 | Form of education | Full time |
| 1.8 | Subject code | TST-E18.00, EA-E18.00 |

## 2. Data about the subject

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 2.1 | Subject name | Materials for Electronics | | | | | | | | | |
| 2.2 | Subject area | Electronics and Telecommunications Engineering | | | | | | | | | |
| 2.3 | Course responsible/lecturer | Assoc. Prof. Cristian Farcas, PhD | | | | | | | | | |
| 2.4 | Teachers in charge of applications | Assist. Prof. Ionut Ciocan, PhD | | | | | | | | | |
| 2.5 | Year of study | II | 2.6 | Semester | 1 | 2.7 | Assessment | V | 2.8 | Subject category | DD/DI |

## 3. Estimated total time

| Year/ Sem. | Subject name | No. of weeks | Course [hours/week] | Applications [hours/week] S | Applications [hours/week] L | Applications [hours/week] P | Course [hours/sem.] | Applications [hours/sem.] S | Applications [hours/sem.] L | Applications [hours/sem.] P | Indiv. study | TOTAL | Credits |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| II / 1 | Materials for Electronics | 14 | 2 | | 1 | | 28 | | 14 | | 58 | 100 | 4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3.1 | Number of hours per week | 3 | 3.2 | of which, course | 2 | 2 | applications | 1 |
| 3.4 | Total hours in the curriculum | 42 | 3.5 | of which, course | 28 | 3.6 | applications | 14 |

| Individual study | Hours |
|---|---|
| Manual, lecture material and notes, bibliography | 24 |
| Supplementary study in the library, online and in the field | - |
| Preparation for seminars/laboratory works, homework, reports, portfolios, essays | 28 |
| Tutoring | 3 |
| Exams and tests | 3 |
| Other activities | 0 |

| | | |
|---|---|---|
| 3.7 | Total hours of individual study | 58 |
| 3.8 | Total hours per semester | 104 |
| 3.9 | Number of credit points | 4 |

## 4. Pre-requisites (where appropriate)

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|---|---|---|
| 4.1 | Curriculum | N / A |
| 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 applications | Laboratory, Cluj-Napoca |

## 6. Specific competences

| | | |
|---|---|---|
| Professional competences | Theoretical knowledge (what the student must know): | The student must know:<br>✓ Matter structure and lattice defects;<br>✓ classification of materials - conductors, insulators, semiconductors;<br>✓ properties of dielectrics and their applications;<br>✓ breakdown in dielectrics;<br>✓ classification of semiconductors;<br>✓ intrinsic and extrinsic conduction;<br>✓ properties and applications of semiconductors;<br>✓ electrical conductions in metals;<br>✓ properties of magnetic materials and their applications; |
| | Acquired skills (what the student is able to do): | After completing the discipline, the students will be able to:<br>✓ recognize different types of materials;<br>✓ determine different parameters of capacitors;<br>✓ distinguish different types of magnetic materials;<br>✓ determine different parameters of a conductive materials;<br>✓ use pn junction as temperature sensor; |
| | Acquired abilities: (what type of equipment the student is able to handle) | After completing the discipline, the students will be able to:<br>✓ use the lab instrumentation (power supply, oscilloscope, function generator, multimeter) for the experimental studies;<br>✓ determine relative dielectric constant;<br>✓ display on an oscilloscope the hysteresis curve of a magnetic core;<br>✓ display the voltage vs current characteristic of electronic devices; |
| | In accordance with Grila1 and Grila2 RNCIS | C1 - To use the fundamental elements regarding electronic devices, circuits, systems, instrumentation and technology<br>C4 - To design and use low complexity hardware and software applications, specific to applied electronics<br>C5 - To apply knowledge, concepts and basic methods from power electronics, automated systems, electric energy management, electromagnetic compatibility<br>C6 - To solve technological problems, specific to applied electronics |
| Cross competences (Grila1 and Grila2 RNCIS) | | N.A. |

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

| | | |
|---|---|---|
| 7.1 | General objectives | Developing the competences regarding the use and analysis of electronic materials. |
| 7.2 | Specific objectives | 1. Developing skills and abilities necessary for the use of the electronic materials.<br>2. Developing skills and abilities for the use of the 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. | | |
| 8.2. Applications (lab) | | Teaching methods | Notes |
| 1 | Introduction. Labour protection | Didactic and experimental proof, didactic exercise, team work | Use of laboratory instrumentation, experimental boards, white/ magnetic board |
| 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

Competences acquired will be used in the following COR occupations (Electronics Engineer; Telecommunications Engineer; Electronics Design Engineer; System and Computer Design Engineer; Communications Design Engineer) or in the new occupations proposed to be included in COR (Sale Support Engineer; Multimedia Applications Developer; Network Engineer; Communications Systems Test Engineer; Project Manager; Traffic Engineer; Communications Systems Consultant).

10. Evaluations

| Activity type | 10.1 | Assessment criteria | 10.2 | Assessment methods | 10.3 | Weight in the final grade |
|---|---|---|---|---|---|---|
| Course | | The level of acquired theoretical knowledge and practical skills | | - Summative evaluation written exam (theory and problems) | | - E, max 10 pts. 80% |
| Applications | | The level of acquired abilities | | - Continuous formative evaluation<br>- practical lab test | | - L, max. 10 pts. 20% |
| 10.4 Minimum standard of performance | | | | | | |
| $L \geq 5$ and $E \geq 4.5$ and $0,8E+0,2L \geq 4.5$ | | | | | | |

Date of filling in
1.10.2018

Course responsible
Assoc. Prof. Cristian Fărcaş, PhD

Teachers in charge of applications
Assist. Prof. Ionuţ Ciocan, PhD