

## SYLLABUS

### 1. Program information

|                                   |                                                                                   |
|-----------------------------------|-----------------------------------------------------------------------------------|
| 1.1 Higher education institution  | Technical University of Cluj-Napoca                                               |
| 1.2 Faculty                       | Faculty of Electronics, Telecommunications and Information Technology             |
| 1.3 Department                    | Bases of Electronics                                                              |
| 1.4 Field of study                | Electronic engineering, telecommunications and information technologies           |
| 1.5 Cycle of study                | Bachelor of Science                                                               |
| 1.6 Study program / Qualification | Electronic engineering, telecommunications and information technologies/ Engineer |
| 1.7 Form of education             | IF – full-time education                                                          |

### 2. Course information

|                                                                  |                                                                                                               |              |   |                        |       |
|------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|--------------|---|------------------------|-------|
| 2.1 Course title                                                 | Analysis and Synthesis of Circuits                                                                            |              |   | Course code            | 25.00 |
| 2.2 Course coordinator                                           | Lecturer Ioana Sărăcuț, PhD eng. <a href="mailto:ioana.Saracut@bel.utcluj.ro">ioana.Saracut@bel.utcluj.ro</a> |              |   |                        |       |
| 2.3 Seminar/ laboratory/ project/ practical activity coordinator | Lecturer Ioana Sărăcuț, PhD eng. <a href="mailto:ioana.Saracut@bel.utcluj.ro">ioana.Saracut@bel.utcluj.ro</a> |              |   |                        |       |
| 2.4 Year of study                                                | II                                                                                                            | 2.5 Semester | 2 | 2.6 Type of assessment | E     |
| 2.7 Course status                                                | Formative category                                                                                            |              |   |                        | DD    |
|                                                                  | Optionality                                                                                                   |              |   |                        | DOB   |

### 3. Estimated total time

|                                                                                                    |    |           |             |    |             |    |                |    |             |  |                        |  |
|----------------------------------------------------------------------------------------------------|----|-----------|-------------|----|-------------|----|----------------|----|-------------|--|------------------------|--|
| 3.1 Hours per week                                                                                 | 4  | of which: | 3.2 Lecture | 2  | 3.3 Seminar | 1  | 3.3 Laboratory | 1  | 3.3 Project |  | 3.3 Practical training |  |
| 3.4 Hours per semester                                                                             | 56 | of which: | 3.5 Lecture | 28 | 3.6 Seminar | 14 | 3.6 Laboratory | 14 | 3.6 Project |  | 3.3 Practical training |  |
| 3.7 Time distribution (hours per semester) for individual study and assessment:                    |    |           |             |    |             |    |                |    |             |  |                        |  |
| (a) Assessment                                                                                     |    |           |             |    |             |    |                |    |             |  | 14                     |  |
| (b) Study using textbook, course materials, bibliography, and notes                                |    |           |             |    |             |    |                |    |             |  | 28                     |  |
| (c) Additional documentation in the library, on specialized electronic platforms, and in the field |    |           |             |    |             |    |                |    |             |  | 8                      |  |
| (d) Preparation for seminars/laboratories, assignments, reports, portfolios and essays             |    |           |             |    |             |    |                |    |             |  | 12                     |  |
| (e) Tutoring                                                                                       |    |           |             |    |             |    |                |    |             |  | 3                      |  |
| (f) Other activities                                                                               |    |           |             |    |             |    |                |    |             |  | 4                      |  |
| 3.8 Total hours of individual study and assessment (sum of (3.7(a))...(3.7(f)))                    |    |           |             |    |             |    |                |    | 69          |  |                        |  |
| 3.9 Total hours per semester (3.4+3.8)                                                             |    |           |             |    |             |    |                |    | 125         |  |                        |  |
| 3.10 Number of credits                                                                             |    |           |             |    |             |    |                |    | 5.0         |  |                        |  |

#### 4. Prerequisites (where applicable)

|                  |                                                   |
|------------------|---------------------------------------------------|
| 4.1 curriculum   | Knowledge acquired in Signals and Systems course. |
| 4.2 competencies | Relations and theorems for electric circuits.     |

#### 5. Requirements (where applicable)

|                                                              |                          |
|--------------------------------------------------------------|--------------------------|
| 5.1. for the development of the lecture                      | Microsoft Teams platform |
| 5.2. for the development of the seminar/ laboratory/ project | Microsoft Teams platform |

#### 6. Specific competencies acquired

|                           |                                                                                                                                                                                                                                                                                                                                                                     |
|---------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Professional competencies | C1 Use of fundamental elements related to electronic devices, circuits, systems, instrumentation and technology                                                                                                                                                                                                                                                     |
|                           | C1.1 Description of the operation of electronic devices and circuits and of the fundamental methods for measuring electrical quantities                                                                                                                                                                                                                             |
|                           | C1.2 Analysis of low-/medium-complexity electronic circuits and systems for their design and measurement                                                                                                                                                                                                                                                            |
|                           | C1.4 Use of electronic instruments and specific methods to characterize and evaluate the performance of electronic circuits and systems                                                                                                                                                                                                                             |
|                           | C1.5 Design and implementation of low-/medium-complexity electronic circuits using CAD-CAM technologies and standards in the field                                                                                                                                                                                                                                  |
|                           | C2 Application of basic methods for signal acquisition and processing                                                                                                                                                                                                                                                                                               |
|                           | C2.1 Time-domain, spectral and statistical characterization of signals                                                                                                                                                                                                                                                                                              |
|                           | C2.2 Explanation and interpretation of signal acquisition and processing methods                                                                                                                                                                                                                                                                                    |
|                           | C2.3 Use of simulation environments for signal analysis and processing                                                                                                                                                                                                                                                                                              |
|                           | C2.4 Use of specific methods and instruments for signal analysis                                                                                                                                                                                                                                                                                                    |
|                           | C4 Design and use of low-complexity hardware and software applications specific to applied electronics                                                                                                                                                                                                                                                              |
|                           | C4.1 Definition of the concepts, principles and methods used in: computer programming, high-level and specific languages, CAD techniques for creating electronic modules, microcontrollers, computer-system architecture, programmable electronic systems, graphics and reconfigurable hardware architectures                                                       |
|                           | C4.2 Explanation and interpretation of the requirements specific to hardware and software structures in the fields of: computer programming, high-level and specific languages, CAD techniques for creating electronic modules, microcontrollers, computer-system architecture, programmable electronic systems, graphics and reconfigurable hardware architectures |
|                           | C4.4 Use of appropriate performance criteria to evaluate, including by simulation, the hardware and software of dedicated systems or service activities using microcontrollers or low-/medium-complexity computer systems                                                                                                                                           |
|                           | C4.5 Design of dedicated equipment in the fields of applied electronics, using microcontrollers, programmable circuits or computer systems with a simple architecture, including the related programs                                                                                                                                                               |
|                           |                                                                                                                                                                                                                                                                                                                                                                     |

|                           |  |
|---------------------------|--|
| Transversal<br>competence |  |
|---------------------------|--|

## 7. Expected learning outcomes

|                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Knowledge                   | <ul style="list-style-type: none"> <li>- The student/graduate explains and interprets theoretical and experimental results in mathematics, physics, chemistry, economics, technical drawing and computer science.</li> <li>- The student/graduate describes, identifies and summarizes elementary concepts and methods related to electronic devices, circuits and instrumentation, as well as their application in concrete problems</li> </ul>                                                                                                                                                                                                                                                                                                                                               |
| Skills                      | <ul style="list-style-type: none"> <li>- The student/graduate prepares execution and assembly technical drawings in written/printed format or by means of computer-aided design.</li> <li>- The student/graduate applies modern project management techniques, economic techniques and decision-making techniques, including in a multidisciplinary framework.</li> <li>- The student/graduate uses fundamental methods for measuring electrical quantities and assesses electronic devices and circuits, as well as linear and digital integrated circuits of low/medium complexity.</li> <li>- The student/graduate designs, measures, evaluates performance, diagnoses and troubleshoots functional blocks composed of low/medium-complexity electronic devices and/or circuits.</li> </ul> |
| Responsibility and autonomy | <ul style="list-style-type: none"> <li>- The student/graduate describes, identifies and summarizes elementary concepts and methods related to electronic devices, circuits and instrumentation, as well as their application in concrete problems</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

## 8. Course objectives (based on the grid of specific competencies acquired)

|                                     |                                                                                                                                                                                                                                                       |
|-------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8.1 General objective of the course | The development of the skills regarding the analysis and synthesis of passive and active systems.                                                                                                                                                     |
| 8.2 Specific objectives             | <ol style="list-style-type: none"> <li>1. Knowledge and understanding of basic approaches regarding analysis and synthesis of systems.</li> <li>2. Development of skills and abilities for the analysis and synthesis of passive circuits.</li> </ol> |

## 9. Contents

| 9.1 Lecture                                                 | No. of hours | Teaching methods | Remarks |
|-------------------------------------------------------------|--------------|------------------|---------|
| Circuit analysis with signal flowgraphs.                    | 2            |                  |         |
| Stability analysis with linear invariant systems.           | 2            |                  |         |
| Graphical stability analysis criteria (Michailov, Nyquist). | 2            |                  |         |
| State space. Definitions of state variables.                | 2            |                  |         |
| Formulation of state equations for a passive circuit.       | 2            |                  |         |

| 9.1 Lecture                                                                                                        | No. of hours | Teaching methods | Remarks |
|--------------------------------------------------------------------------------------------------------------------|--------------|------------------|---------|
| Passive two-ports analysis. Symmetric and nonsymmetrical two-ports.                                                | 2            |                  |         |
| Applications of two-ports.                                                                                         | 2            |                  |         |
| Matching of circuits.                                                                                              | 2            |                  |         |
| T, PI and $\Gamma$ -shaped impedance matching circuits. Rejection of frequencies with impedance matching circuits. | 2            |                  |         |
| Passive filters. Constant-k filters.                                                                               | 2            |                  |         |
| Derived filters. Characteristic impedance correction.                                                              | 2            |                  |         |
| Applications of filters.                                                                                           | 2            |                  |         |
| System function approximation. Active filters: biquads                                                             | 2            |                  |         |
| Review. Examination preparation.                                                                                   | 2            |                  |         |
|                                                                                                                    |              |                  |         |
| Bibliography                                                                                                       |              |                  |         |

| 9.2 Seminar /laboratory /project /practical training | No. of hours | Teaching methods                                                                                                             | Remarks                                                                      |
|------------------------------------------------------|--------------|------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| Seminary classes                                     |              | Solving of problems and review of some theoretical aspects.<br>Didactic and experimental proof, didactic exercise, team work | Seminary – Use of the blackboard.<br>Laboratory – Use of the Matlab program. |
| Signal flowgraph.                                    | 2            |                                                                                                                              |                                                                              |
| Stability criteria.                                  | 2            |                                                                                                                              |                                                                              |
| State space.                                         | 2            |                                                                                                                              |                                                                              |
| Passive two-ports.                                   | 2            |                                                                                                                              |                                                                              |
| Impedance matching circuits.                         | 2            |                                                                                                                              |                                                                              |
| Constant-k and derived filters.                      | 2            |                                                                                                                              |                                                                              |
| Filters                                              | 2            |                                                                                                                              |                                                                              |
| Laboratory classes                                   |              |                                                                                                                              |                                                                              |
| Signals and Systems (recap).                         | 2            |                                                                                                                              |                                                                              |
| Linear Time-Invariant Systems.                       | 2            |                                                                                                                              |                                                                              |
| Stability of Systems                                 | 2            |                                                                                                                              |                                                                              |
| 1st order and 2nd order Systems.                     | 2            |                                                                                                                              |                                                                              |
| Filtering.                                           | 2            |                                                                                                                              |                                                                              |
| State Variables.                                     | 2            |                                                                                                                              |                                                                              |
| Lab classes recovery.                                | 2            |                                                                                                                              |                                                                              |
| Bibliography                                         |              |                                                                                                                              |                                                                              |

**10. Alignment of the course contents with the expectations of the epistemic community, professional associations, and representative employers in the field related to the program**

The course content and the teaching-learning-assessment methods are aligned with the current requirements of the Electronics, Telecommunications, and Information Technology Engineering field, considering the expectations of the academic and professional community, representative employers, as well as the national quality assurance standards in higher education. The course helps prepare students in line with employer expectations and the quality requirements set for engineering study programs.

## 11. Assessment

| Activity type                                                | 11.1 Assessment criteria                                             | 11.2 Assessment methods<br>(and type of assessment:<br>continuous/ summative) | 11.3 Weight<br>in final grade |
|--------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------|-------------------------------|
| 11.4 Lecture                                                 | The level of acquired theoretical knowledge                          | 2 written tests (30p) – TC                                                    | Max 30%                       |
| 11.5 Seminar/<br>Laboratory/ Project<br>/Practical activity  | The level of acquired skills and abilities                           | Evaluation during the semester (10p) – TL                                     | Max 10%                       |
| Exam                                                         | The level of acquired theoretical knowledge, of skills and abilities | Written examination (60p) – E                                                 | Max 60%                       |
| Final mark = (TC+TL+E) / 10                                  |                                                                      |                                                                               |                               |
| 11.6 Minimum performance standard<br>TC+TL > 20p and E > 25p |                                                                      |                                                                               |                               |

| Completion date: | Course coordinators | teaching rank, title First name<br>LAST NAME | Signature |
|------------------|---------------------|----------------------------------------------|-----------|
| 23.06.2026       | Lecture             | Lecturer Ioana Sărăcuț, PhD eng.             |           |
|                  | Applications        | Lecturer Ioana Sărăcuț, PhD eng.             |           |
|                  |                     |                                              |           |

Approval of the Head of the Department coordinating the course, only if this differs from the department organizing the study program

Head of the

Date of approval by the Council of the Department of Bases of Electronics

Head of the Bases of Electronics  
Department  
Prof. Sorin HINTEA, Ph.D.

26.06.2026

Date of approval by the Council of the Faculty of Electronics, Telecommunications and Information Technology

Dean,  
Prof. Ovidiu-Aurel POP, Ph.D.

30.06.2026