

## SYLLABUS

### 1. Data about the program of study

|                                    |   |
|------------------------------------|---|
| 1.1 Institution                    | The Technical University of Cluj-Napoca     |
| 1.2 Faculty                        | Faculty of Automation and Computer Science  |
| 1.3 Department                     | Computer Science                            |
| 1.4 Field of study                 | Computer Science and Information Technology |
| 1.5 Cycle of study                 | Bachelor of Science                         |
| 1.6 Program of study/Qualification | Computer science/ Engineer                  |
| 1.7 Form of education              | Full time                                   |
| 1.8 Subject code                   | 15.   |

### 2. Data about the subject

|  |  |              |   |   |    |
|--|--|--------------|---|---|----|
| 2.1 Subject name   | <b>Electronic Measurements and Sensors</b>                                   |              |   |   |    |
| 2.2 Course responsible/lecturer                            | Assoc. Professor Rodica Holonec, Phd eng                                     |              |   |   |    |
| 2.3 Teachers in charge of seminars/<br>laboratory/ project | Lecturer Septimiu Crisan, Phd eng  |              |   |   |    |
| 2.4 Year of study  | II   | 2.5 Semester | 1 | 2.6 Type of assessment (E - exam, C - colloquium, V - verification) | E  |
| 2.7 Subject category                                       | DF – fundamentală, DD – în domeniu, DS – de specialitate, DC – complementară |              |   |   | DD |
|  | DI – Impusă, DOp – opțională, DFac – facultativă                             |              |   |   | DI |

### 3. Estimated total time

|  |    |           |        |    |          |  |            |    |         |    |
|--|----|-----------|--------|----|----------|--|------------|----|---------|----|
| 3.1 Number of hours per week   | 4  | of which: | Course | 2  | Seminars |  | Laboratory | 2  | Project |    |
| 3.2 Number of hours per semester   | 56 | of which: | Course | 28 | Seminars |  | Laboratory | 28 | Project |    |
| 3.3 Individual study:  |    |           |        |    |          |  |            |    |         |    |
| (a) Manual, lecture material and notes, bibliography                                 |    |           |        |    |          |  |            |    |         | 15 |
| (b) Supplementary study in the library, online and in the field                      |    |           |        |    |          |  |            |    |         | 8  |
| (c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays |    |           |        |    |          |  |            |    |         | 15 |
| (d) Tutoring   |    |           |        |    |          |  |            |    |         | 3  |
| (e) Exams and tests  |    |           |        |    |          |  |            |    |         | 3  |
| (f) Other activities:  |    |           |        |    |          |  |            |    |         | -  |
| 3.4 Total hours of individual study (suma (3.3(a)...3.3(f)))                         |    |           |        |    |          |  | 44         |    |         |    |
| 3.5 Total hours per semester (3.2+3.4)   |    |           |        |    |          |  | 100        |    |         |    |
| 3.6 Number of credit points  |    |           |        |    |          |  | 4          |    |         |    |

### 4. Pre-requisites (where appropriate)

|                |   |
|----------------|---|
| 4.1 Curriculum |   |
| 4.2 Competence | Basic Electrical circuit theory, Basic Electronics, Analysis methods for electronic circuits; General Physics |

### 5. Requirements (where appropriate)

|                           |  |
|---------------------------|--|
| 5.1. For the course       | Computer, Cloud-based team collaboration software                    |
| 5.2. For the applications | Laboratory room equipped with specific measuring devices and sensors |

### 6. Specific competence

|                              |  |
|------------------------------|--|
| 6.1 Professional competences | <p><b>C1</b> – Operating with basic Mathematical, Engineering and Computer Science concepts (2 credits)</p> <p><b>C1.1</b> – Recognizing and describing concepts that are specific to the fields of calculability, complexity, programming paradigms, and modeling computational and communication systems</p> <p><b>C1.2</b> – Using specific theories and tools (algorithms, schemes, models, protocols, etc.) for explaining the structure and the functioning of hardware,</p> |
|------------------------------|--|

|                       |  |
|-----------------------|--|
|                       | <p>software and communication systems</p> <p><b>C1.3</b> – Building models for various components of computing systems</p> <p><b>C1.4</b> – Formal evaluation of the functional and non-functional characteristics of computing systems</p> <p><b>C1.5</b> – Providing a theoretical background for the characteristics of the designed systems</p> <p><b>C2</b> – Designing hardware, software and communication components (2 credits)</p> <p><b>C2.1</b> – Describing the structure and functioning of computational, communication and software components and systems</p> <p><b>C2.2</b> – Explaining the role, interaction and operation of hardware, software and communication components</p> <p><b>C2.3</b> – Construction of hardware and software components of computing systems using design methods, languages, algorithms, data structures, protocols and technologies</p> <p><b>C2.4</b> – Evaluating the functional and non-functional characteristics of the computing systems using specific metrics</p> <p><b>C2.5</b> – Implementation of hardware, software and communication components</p> |
| 6.2 Cross competences | N/A  |

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

|                         |  |
|-------------------------|--|
| 7.1 General objective   | To provide a foundation in important topics of engineering system instrumentation such as: metrology, measurement techniques, electronic measurement devices, sensors principles and applications , virtual instrumentation  |
| 7.2 Specific objectives | <p>To provide principle knowledge, practical training and measurement best practice regarding the instrumentation systems</p> <p>To provide knowledge about sensors in order to perform the documentation, implementation, and development of complex equipment and measurement devices.</p> |

### 8. Contents

| 8.1 Lectures  | Hours | Teaching methods   | Notes                          |
|---|-------|--|--------------------------------|
| Measurement fundamentals. Terms and definitions. The structure of a complex instrumentation system. Sensors   | 2     | Presentation, heuristic conversation, exemplification, problem presentation, teaching exercise, case study, formative evaluation | The lectures are taught online |
| Fundamentals of Metrology. Measurement Units. Measurements Standards. Traceability. Measurement terminology. Errors and Uncertainties. The Measuring Instrument Specifications. | 2     |  |                                |
| Random Errors Analysis. Basic Concepts in Probability. Normal Distribution. Central Limit Theorem. The Evaluation of Uncertainties in Measurements                              | 2     |  |                                |
| Meters. Analog Meters-Classifications and Symbols. Types of Analog Instruments. Voltmeters. Ammeters. Wattmeters, Ohmmeters   | 2     |  |                                |
| Measurements with Bridges and Potentiometers. Wheatstone Bridge. Principle. Strain gauge measurement bridges. Types of AC bridges. Potentiometers.                              | 2     |  |                                |
| Amplification in Instrumentation. Operational Amplifiers. Basic circuits. Instrumentation Amplifiers. Current to Voltage, Resistance to Voltage Converters. Bridge Amplifiers.  | 2     |  |                                |
| Electronic Voltmeters. DC Electronic Voltmeters. Types of AC Electronic Voltmeters. Lock-in Amplifiers. Principles and Applications   | 2     |  |                                |
| Electronic Counters. Digital measurement of frequency and time  | 2     |  |                                |
| Digital Multi-meters (DMM). Computing Measuring Systems. Data Acquisition Boards. Sample and Hold Circuits. Nyquist theorem.  | 2     |  |                                |

|   |       |                              |   |
|---|-------|------------------------------|---|
| Data Acquisition Boards Components. Digital to Analog Converters. Analog to Digital Converters. Virtual Instruments   | 2     |                              |   |
| The Analog and Digital Oscilloscopes  | 2     |                              |   |
| Transducers, Sensors and Actuators. Terminology. Principles and Classifications. Analog and Digital Sensors.  | 2     |                              |   |
| Analog Sensors. Potentiometers. Variable-Inductance and Capacitance Sensors. Temperature sensors.   | 2     |                              |   |
| Digital sensors. Encoders. Optical Sensors: Fiber-Optic Sensors, Light sensors  | 2     |                              |   |
| Bibliography  |       |                              |   |
| 1. Rodica Holonec, Electrical Measurements and Instrumentation, Editura Mediamira, Cluj-Napoca, 2003, 259 p, ISBN 973-9357-42-3   |       |                              |   |
| 2. Todoran, Gh., Copandean, R.; Masurari Electrice si Electronice. Editura Mediamira; Cluj Napoca. 2003. 282p. ISBN 973-9357-61-X.  |       |                              |   |
| 3. Dragomir, N.D., TÂRNOVAN, I.G., Crişan, T.E. – Electrical Measurement of Non Electric Quantities. Vol. I. Editura MEDIAMIRA, Cluj-Napoca, România, 2002. ISBN 973-9358-75-6. |       |                              |   |
| 4. TÂRNOVAN, I. G. – Metrologie electrică și instrumentație. Editura MEDIAMIRA, Cluj-Napoca, România, 2003. ISBN 973-9357-39-3.   |       |                              |   |
| 5. Munteanu, R., TÂRNOVAN, I.G., Dragomir, N.D., Popovici, O. – Electrotehnică și convertoare energetice. Editura MEDIAMIRA, Cluj-Napoca, România, 1997.                        |       |                              |   |
| 6. <a href="http://users.utcluj.ro/~tarnovan/Electronic%20Measurements%20and%20Sensors.htm">http://users.utcluj.ro/~tarnovan/Electronic%20Measurements%20and%20Sensors.htm</a>  |       |                              |   |
| 8.2 Applications – Seminars/Laboratory/Project  | Hours | Teaching methods             | Notes   |
| Analog and Digital Measurement Devices  | 2     | Onsite & online applications | Experimental circuits, Computer LabView software, NI hardware |
| Domain Extension of Analog Measurement Instruments  | 2     |                              |   |
| Single-phased A.C. Circuits Measurements  | 2     |                              |   |
| The Wheatstone Bridge   | 2     |                              |   |
| The Oscilloscope. Basics and Measuring Principles   | 2     |                              |   |
| Virtual Instrumentation: LabView - Basic Operations   | 2     |                              |   |
| Virtual Instrumentation applications  | 2     |                              |   |
| Data Acquisition Systems: Single Sample Acquisition Mode  | 2     |                              |   |
| Data Acquisition Systems. Signal Processing Applications  | 2     |                              |   |
| Temperature Measurement   | 2     |                              |   |
| Level and Flow Measurement  | 2     |                              |   |
| Displacement Measurement  | 2     |                              |   |
| Angular Speed Measurement   | 2     |                              |   |
| Final Assessment of Laboratory Reports  | 2     |                              |   |
| Bibliography  |       |                              |   |
| 1. Rodica Holonec, B. Tebrean, I.G. Tarnovan, Gh. Todoran, Electronic Measurements: Laboratory Manual Editura U.T. PRESS, Cluj-Napoca 2010, ISBN.978-973-662-600                |       |                              |   |
| 2. Munteanu, R., Dragomir, N.D., TÂRNOVAN, I.G., Holonec, Rodica, Bortoş, P. – Tehnici de măsurare. Îndrumător de laborator. Atelierul de multiplicare al U.T.C.-N., 1995.      |       |                              |   |

\*Se vor preciza, după caz: tematica seminariilor, lucrările de laborator, tematica și etapele proiectului.

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

The acquired skills will be required of employees who work in designing or testing of sensors and instrumentation systems.

### 10. Evaluation

| Activity type | Assessment criteria  | Assessment methods | Weight in the final grade |
|---------------|--|--------------------|---------------------------|
| Course        | Final exam (E)-Theoretical questions and exercises (3 hours) | Online examination | 80%                       |

|   |                       |                           |     |
|---|-----------------------|---------------------------|-----|
| Seminar   |                       |                           |     |
| Laboratory  | Practical circuit (P) | Checking of functionality | 10% |
|   | Homework (HW)         | Verification of results   | 10% |
| Project   |                       |                           |     |
| Minimum standard of performance: $G=(E+P+HW)/100$ ; Condition to take the credits: $G \geq 5$ ; |                       |                           |     |

| <b>Date of filling in:</b> | <b>Titulari</b> | <b>Titlu Prenume NUME</b>           | <b>Semnătura</b> |
|----------------------------|-----------------|-------------------------------------|------------------|
|                            | Course          | Assoc.Prof. Rodica Holonec, PhD eng |                  |
|                            | Applications    | Lecturer Septimiu Crisan, PhD eng   |                  |

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| <b>Date of approval in the department</b>      | Head of department<br>Prof.dr.ing. Rodica Potolea |
| <b>Date of approval in the Faculty Council</b> | Dean<br>Prof.dr.ing. Liviu Miclea                 |