

## COURSE DESCRIPTION

### 1. Program identification information

|                                      |   |
|--------------------------------------|---|
| 1.1 Higher education institution     | Politehnica University of Bucharest                                       |
| 1.2 Faculty                          | Electronics, Telecommunications and Information Technology                |
| 1.3 Department                       | Department of Applied Electronics and Information Engineering             |
| 1.4 Domain of studies                | Electronic Engineering, Telecommunications and Informational Technologies |
| 1.5 Cycle of studies                 | License (engineering)   |
| 1.6 Program of studies/Qualification | Applied Electronics   |

### 2. Course identification information

|   |    |              |   |  |              |                        |            |
|---|----|--------------|---|--|--------------|------------------------|------------|
| 2.1 Name of the course                  |    |              |   | <b>Automatic Testing of Equipments and Processes</b> |              |                        |            |
| 2.2 Lecturer                            |    |              |   | Ș.l. Dr. Ing. Lucian Andrei PERIȘOARĂ                |              |                        |            |
| 2.3 Instructor for practical activities |    |              |   | Ș.l. Dr. Ing. Lucian Andrei PERIȘOARĂ                |              |                        |            |
| 2.4 Year of studies                     | IV | 2.5 Semester | 8 | 2.6 Evaluation type                                  | Verification | 2.7 Course choice type | Compulsory |

### 3. Total estimated time (hours per semester for academic activities)

|  |    |            |    |                          |       |
|--|----|------------|----|--------------------------|-------|
| 3.1 Number of hours per week, out of which   | 3  | 3.2 course | 2  | 3.3 practical activities | 1     |
| 3.4 Total hours in the curricula, out of which                                       | 42 | 3.5 course | 28 | 3.6 practical activities | 14    |
| Distribution of time   |    |            |    |                          | hours |
| Study according to the manual, course support, bibliography and hand notes           |    |            |    |                          | 20    |
| Supplemental documentation (library, electronic access resources, in the field, etc) |    |            |    |                          | 8     |
| Preparation for practical activities, homeworks, essays, portfolios, etc.            |    |            |    |                          | 6     |
| Tutoring   |    |            |    |                          | 0     |
| Examinations   |    |            |    |                          | 2     |
| Other activities   |    |            |    |                          | 0     |
| 3.7 Total hours of individual study  |    | 36         |    |                          |       |
| 3.9 Total hours per semester   |    | 78         |    |                          |       |
| 3.10 Number of ECTS credit points  |    | 3          |    |                          |       |

### 4. Prerequisites (if applicable)

|                      |  |
|----------------------|--|
| 4.1 curricular       | Measurements in Electronics and Telecommunications, Electronic Measurement Instrumentation, Signals and Measurement Systems - Laboratory, Industrial Electronics and Informatics |
| 4.2 competence-based | General knowledge of measurement techniques, test and measurement equipments, electrical circuits, electrical signals, industrial equipments.                                    |

### 5. Requisites (if applicable)

|                                     |   |
|-------------------------------------|---|
| 5.1 for running the course          | Not applicable.   |
| 5.2 for running of the applications | Compulsory presence at laboratory classes, according to current university regulations. |

## 6. Specific competences

|                          |   |
|--------------------------|---|
| Professional competences | <p>C1. Using fundamental elements related to devices, circuits, systems, instrumentation and electronic technology</p> <p>C1.1. Description of electronic devices and circuits operation and of fundamental methods for measuring basic electrical quantities</p> <p>C1.3. Diagnosis / troubleshooting of circuits, equipments and electronic systems</p> <p>C1.4. Using electronic instruments and specific methods to characterize and evaluate the performances of electronic circuits and systems</p> <p>C6. Technological problem solving in applied electronics</p> <p>C6.1. Defining principles and methods underlying the manufacture, tuning, testing and servicing of appliances and equipments in the fields of applied electronics</p> <p>C6.2. Explanation and interpretation of production processes and maintenance activities for electronic equipments, identifying testing points and measuring electrical quantities.</p> <p>C6.3. Application of management principles for the organization of production, operation and service activities in the fields of applied electronics</p> <p>C6.4. Using criteria and methods for evaluating the quality of production and service activities in the fields of applied electronics</p> |
| Transversal competences  | <p>CT1. Methodical analysis of problems encountered in activity and identification of already established solutions in order to fulfil professional tasks.</p> <p>CT3 Adaptation to new technologies, professional and personal development by long-life learning using printed documentation, specialized software, and electronic resources both in Romanian and in an international language.</p>  |

## 7. Course objectives (as implied by the grid of specific competences)

|                                     |  |
|-------------------------------------|--|
| 7.1 General objective of the course | The course provides the theoretical and practical knowledge (concepts, principles, equipments and standards) regarding the testing of equipment and processes.   |
| 4.2 Specific objectives             | <p>Create the following skills and abilities:</p> <ul style="list-style-type: none"> <li>- understanding and solving a wide range of testing problems using techniques, equipment and software testing according to actual standards;</li> <li>- using classical measurement and control instruments and advanced automated test equipments;</li> <li>- understanding and applying of testing procedures in predictive maintenance;</li> <li>- testing of electrical installations and power quality analysis in accordance with actual standards;</li> <li>- understanding boundary scan testing implemented in integrated circuits and circuit boards;</li> <li>- understanding of built in self testing procedures;</li> <li>- knowing of communication standards used for programmable instruments and programming of these instruments to perform measurements;</li> <li>- application of manual and automated calibration procedures and evaluation of measurement uncertainty.</li> </ul> |

## 8. Content

| 8.1 Lectures   | Teaching techniques  | Remarks |
|--|--|---------|
| 1. Introduction in testing processes. Changes to quality standards and measurement standards. Evolution of testing systems and applications.   | Teaching is carried out through the presentation and questioning methods. Modern teaching methods (video projector) are used for presentation of the course notes, applications notes and demonstrative software applications. The lectures notes and presentations are available to students in pdf format. | 2 hours |
| 2. Predictive testing and maintenance. Principles, advantages, disadvantages. Applications.  |  | 2 hours |
| 3. Infrared non-invasive testing techniques. Thermography equipments. Applications of thermal inspections in predictive maintenance.   |  | 2 hours |
| 4. Testing of electrical installations according to EN61557 electrical safety standard. Electric systems. Security categories and rules. EN61557 testing requirements and methods. Applications in predictive maintenance.   |  | 2 hours |
| 5. Power quality analysis according to EN50160 and EN61000-4-30 standards. Testing requirements and methods. Applications in predictive maintenance.   |  | 2 hours |
| 6. Testing of data buses. Operating parameters specified by the communication standards RS-232, RS-485, CAN, USB, Ethernet, etc. Applications in predictive maintenance.   |  | 2 hours |
| 7. Testing of electronic components and printed circuit boards. Testing methods. Automated Test Equipments (ATE). Advantages / disadvantages.  |  | 4 hours |
| 8. Boundary Scan Testing (BST) of integrated circuits according to IEEE1149.1 standard. Testing system architecture for integrated circuits. Boundary Scan Testing for circuit boards. Applications.   |  | 2 hours |
| 9. Built-in Self Testing (BIST). Testing system architecture. Test vectors generation.   |  | 2 hours |
| 10. Testing systems with programmable instruments. Standard Commands for Programmable Instruments (SCPI). The structure of programmable instruments. Syntax of SCPI messages. The GPIB bus (IEEE488.1).  |  | 4 hours |
| 11. LXI standard (LAN extension for instruments). The testing system architecture. Applications. Advantages, disadvantages.  |  | 2 hours |
| 12. Testing systems based on wireless technologies: Bluetooth and WiFi (WLAN).   |  | 2 hours |
| Bibliography <ul style="list-style-type: none"> <li>• R. Stoian, R. Popovici, A. Hălăngau, R. Dumitrescu, „<i>Testarea echipamentelor, instalațiilor și proceselor. Lucrări practice</i>”, Editura Politehnica Press, București, ISBN 978-606-527-125-3, 2010.</li> <li>• Rodica Stoian, <i>Sisteme de Testare</i>. Note de curs, format electronic, 2012.</li> <li>• Rodica Stoian, <i>Proceduri de evaluare si exprimare a incertitudinii de masurare</i>, Editura Foton International, 2001.</li> <li>• Rodica Stoian, <i>Standarde de comunicatie pentru instrumentatie programabila</i>, Ed. Printech, 1999.</li> <li>• Rodica Stoian, <i>Campuri finite. Circuite de calcul</i>. Ed. Printech, Bucuresti, 1999.</li> </ul> |  |         |

- Fluke Corporation, “*Motor and Drive Troubleshooting: Basic Testing to Advanced Diagnostics*”, American Technical Publishers, Inc., Illinois, USA, 2011.
- Fluke Corporation, The Snell Group, “*Introduction to Thermography Principles*”, American Technical Publishers, Inc., Illinois, USA, 2009.
- B. Nadeau-Dostie, ed., *Design for At-Speed Test, Diagnosis and Measurement*, Boston: Kluwer Academic Publishers, 2000.
- S. Mourad, Y. Zorian, *Principles of Testing Electronic Systems*, John Wiley & Sons Inc., 2000.
- K. P. Parker, *The Boundary-Scan Handbook*. Boston: Kluwer Academic Publishers, 1998.
- R. A. Witte, *Electronic Test Instruments: Theory and Applications*. Englewood Cliffs, New Jersey: PTR Prentice Hall, 1993.

| 8.2 Practical applications   | Teaching techniques   | Remarks |
|--|---|---------|
| 1. Equipments and installations testing using thermal imaging techniques.  | Teaching is based on the experimentation method, using dedicated testing equipments (which includes both hardware and software components) and dedicated educational software applications. Students perform experimental measurements, analyzing and interpreting the measured data. | 2 hours |
| 2. Testing of electrical installations according with EN61557 electrical safety standard.  |   | 2 hours |
| 3. Power quality analysis according with EN50160 standard.   |   | 2 hours |
| 4. Data buses testing.   |   | 2 hours |
| 5. Remote control of programmable instruments.   |   | 2 hours |
| 6. Wireless transmission of data acquired by measurement instruments.  |   | 2 hours |
| 7. Manual calibration of a multimeter.   |   | 2 hours |
| Bibliography   |   |         |
| <ul style="list-style-type: none"> <li>• R. Stoian, R. Popovici, A. Hălăngau, R. Dumitrescu, „<i>Testarea echipamentelor, instalațiilor și proceselor. Lucrări practice</i>”, Editura Politehnica Press, București, ISBN 978-606-527-125-3, 2010.</li> </ul> |   |         |

### **9. Bridging the course content with the expectations of the epistemic community representatives, professional associations and employers representatives for the domain of the program**

The course syllabus respond to the needs and requirements of evolution and development of testing systems, offering to graduate students of Applied Electronics (ELA) program the chance to engage in extremely different domains: automation and industrial equipments, production of electrical and electronic appliances and equipments, transportation, telecommunications, production and distribution of electricity, renewable energy systems, etc.

The ELA program provides to graduate students appropriate skills and training for the actual needs and scientific and technological qualifications, of high quality and competitively, allowing them rapid employment after graduation. This fact is consistent with the University Politehnica of Bucharest policies, both in terms of content and structure, but also in terms of skills and international openness offered to students.

### **10. Evaluation**

| Type of activity | 10.1 Evaluation criteria  | 10.2 Evaluation methods  | 10.3 Weight in the final mark |
|------------------|---|--|-------------------------------|
| 10.4 Lectures    | - knowledge and understanding of fundamental theoretical notions; | Mid-term examination (1 hour). The subjects cover Chapters 1-6 and contain 4 | 30%                           |

|   |   |   |     |
|---|---|---|-----|
|   | - comparative analysis of testing techniques and methods;<br>- capacity to apply the theoretical notions to solve practical problems.                                       | questions.<br>Final examination (1 hour), at the end of the semester. The subjects cover Chapters 7-12 and contain 4 questions.   | 30% |
| 10.5 Practical applications   | - acquiring and understanding of taught knowledges;<br>- practical application of testing methods using laboratory equipments;<br>- ability to analyze the testing results. | At the end of each lab session, students answer a quiz with questions from platforms. The total score is obtained by cumulating the all scores obtained in each laboratory. | 40% |
| 10.6 Minimal performance standard   |   |   |     |
| Supporting a test for determining and describing the technological operations necessary to achieve and / or testing of an electronic device or equipment.<br>Accumulating at laboratory, mid-term and final exams for at least 50 points out of 100 points. |   |   |     |

Date  
01.11.2015

Lecturer  
Ș.l.dr.ing. Lucian Andrei PERIȘOARĂ

Instructor for practical activities  
Ș.l.dr.ing. Lucian Andrei PERIȘOARĂ

Date of department approval  
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Director of Department,  
Prof.dr.ing. Sever PAȘCA