# SYLLABUS

## 1. Information about the program

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| **1.1** Higher education institution | UNIVERSITY POLITEHNICA OF TIMISOARA |
| **1.2** Faculty[1]/ Department [2] | ELECTRONICS, TELECOMUNICATON AND INFORMATION TECHNOLOGIES/MEO |
| **1.3** Field of study (name/code[3]) | ELECTRONIC ENGINEERING, TELECOMUNICATION AND INFORMATION TECHNOLOGIES |
| **1.4** Study cycle | License |
| **1.5** Study program (name/code/qualification) | TST-ENG/20/20/10/100/10/TST-ENG |

## 2. Information about the discipline

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|---|---|---|---|---|---|---|---|
| **2.1** Name of discipline/ formative category[4] | | | Virtual Instrumentation/DS | | | | |
| **2.2** Coordinator (holder) of course activities | | | Mihaela-Ruxandra LASCU | | | | |
| **2.3** Coordinator (holder) of applied activities[5] | | | Mihaela-Ruxandra LASCU | | | | |
| **2.4** Year of study[6] | 3 | **2.5** Semester | 5 | **2.6** Type of evaluation | E | **2.7** Regime of discipline[7] | DI |

## 3. Total estimated time – hours / semester: direct teaching activities (fully assisted or partly assisted) and individual training activities (unassisted) [8]

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|---|---|---|---|---|---|
| **3.1** Number of fully assisted hours / week | 4 of which: | **3.2** course | 2 | **3.3** seminar / laboratory / project | 0/1/1 |
| **3.1*** Total number of fully assisted hours / semester | 56 of which: | **3.2*** course | 28 | **3.3*** seminar / laboratory / project | 0/14/14 |
| **3.4** Number of hours partially assisted / week | of which: | **3.5** training | | **3.6** hours for diploma project elaboration | |
| **3.4*** Total number of hours partially assisted / semester | of which: | **3.5*** training | | **3.6*** hours for diploma project elaboration | |
| **3.7** Number of hours of unassisted activities / week | 1.36 of which: | additional documentary hours in the library, on the specialized electronic platforms and on the field | | | 0.5 |
| | | hours of individual study after manual, course support, bibliography and notes | | | 0.5 |
| | | training seminars / laboratories, homework and papers, portfolios and essays | | | 0.36 |
| **3.7*** Number of hours of unassisted activities / semester | 19 of which: | additional documentary hours in the library, on the specialized electronic platforms and on the field | | | 7 |
| | | hours of individual study after manual, course support, bibliography and notes | | | 7 |
| | | training seminars / laboratories, homework and papers, portfolios and essays | | | 5 |
| **3.8 Total hours / week** [9] | 5.36 | | | | |
| **3.8* Total hours /semester** | 75 | | | | |
| **3.9 Number of credits** | 3 | | | | |

## 4. **Prerequisites** (where applicable)

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[1] The name of the faculty which manages the educational curriculum to which the discipline belongs
[2] The name of the department entrusted with the discipline, and to which the course coordinator/holder belongs.
[3] The code provided in HG - on the approval of the Nomenclature of fields and specializations / study programs, annually updated.
[4] Discipline falls under the educational curriculum in one of the following formative disciplines: Basic Discipline (DF), Domain Discipline (DD), Specialist Discipline (DS) or Complementary Discipline (DC).
[5] Application activities refer to: seminar (S) / laboratory (L) / project (P) / practice/training (Pr).
[6] Year of studies in which the discipline is provided in the curriculum.
[7] Discipline may have one of the following regimes: imposed discipline (DI) or compulsory discipline (DOb)-for the other fundamental fields of studies offered by UPT, optional discipline (DO) or optional discipline (Df).
[8] The number of hours in the headings 3.1 *, 3.2 *, ..., 3.8 * is obtained by multiplying by 14 (weeks) the number of hours in headings 3.1, 3.2, ..., 3.8. The information in sections 3.1, 3.4 and 3.7 is the verification keys used by ARACIS as: (3.1) + (3.4) ≥ 28 hours / wk. and (3.8) ≤ 40 hours / wk.
[9] The total number of hours / week is obtained by summing up the number of hours in points 3.1, 3.4 and 3.7.

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| **4.1** Curriculum | • C, C++ Programming, Analog Micro Electronics, Analog Integrated Circuits, Basic Electronics |
| **4.2** Competencies | • Using specialized software and electronic resources written in English |

**5. Conditions** (where applicable)

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| **5.1** of the course | • Classroom as required |
| **5.2** to conduct practical activities | • Classroom as required |

**6. Specific competencies** acquired through this discipline

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| Specific competencies | • Programming languages and techniques use.<br>• Signal and image acquisition and processing applications<br>• Identification and appropriate use of key programming concepts and techniques.<br>• Software implementation of algorithms.<br>• Solving problems using advanced programming techniques, implementing Cloud, IoT methods.<br>• Learning programming skills in graphic programming.<br>• Development of a complete application in graphic programming, starting from specifications, phasing, debugging, preparing the project for distribution and drawing up documentation<br>• . |
| Professional competencies ascribed to the specific competencies | • Application of knowledge, concepts and basic methods related to computer system architecture, microprocessors, microcontrolers, programming languages and techniques.<br>• Application of basic methods for signal acquisition and processing. |
| Transversal competencies ascribed to the specific competencies | • Methodical analysis of field-related problems aimed at identifying acknowledged solutions, thus ensuring the accomplishment of professional tasks.<br>• Adaptation to new technologies, professional and personal development through continuous training, using printed documentation sources, specialized software and electronic resources in Romanian and at least one foreign language |

**7. Objectives of the discipline** (based on the grid of specific competencies acquired - pct.6)

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|---|---|
| **7.1** The general objective of the discipline | • LabVIEW represents graphical programming for data acquisition, instrument I/O, measurement analysis and visualization. LabVIEW can be used to: acquire analog waveforms using a DAQ board, store the waveforms in a file and retrieve them, collect, and log temperature data, control an instrument connected to a serial port, acquire waveforms from a serial instrument, control GPIB instrument, acquire waveforms from a GPIB instrument, plot acquired data on strip charts and graphs. Save data in files that you can retrieve with a spreadsheet. Finally, we can create virtual instruments using LabVIEW software for various fields of applications like Control system, Signal Processing, and Image processing etc. and effective virtual instruments that shall use minimum memory space and work effectively with any processor. It is possible to interface the computer with DAQ to monitor process and control real world applications and analyze the throughput using the tools in LabVIEW software.<br>• |
| **7.2** Specific objectives | • Apply structured programming concepts in developing VI programs and employ various debugging techniques.<br>• Apply the knowledge of LabVIEW programming for simulating and analyzing the data.<br>• Create applications that uses plug-in DAQ boards and built-in analysis functions to process the data.<br>• Build applications that use General Purpose Interface Bus and Serial Communication Interface.<br>• Design and analyze various applications using Advanced Signal Processing toolkit. |

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| | • Design and analyze various applications using Control and Simulation toolkit;<br>• Generate the report using built in LabVIEW functions.<br>• Acquire, analyze and present an ECG signal using Virtual Instrumentation and also implementing an algorithm to calculate its heart rate. |

**8. Content** [10]

| **8.1** Course | Number of hours | Teaching methods [11] |
|---|---|---|
| 1. GRAPHICAL PROGRAMMING ENVIRONMENT<br>Introduction<br>History of Virtual Instrumentation<br>LabView and Virtual Instrument<br>Conventional and Graphical Programming<br>Future Perspective<br>Owned and Free Labels<br>Tools and Other Palettes<br>Arranging Objects<br>Pop-up menus<br>Color Coding, Code Debugging, Context Sensitive Help<br>Virtual Instrument Types, Creating Sub-virtual instruments | 4 | Lecture and heuristic dialogue |
| 2. FUNDAMENTALS OF VIRTUAL INSTRUMENTATION PROGRAMMING<br>Modular programming<br>Controlling Program execution with structures<br>Composite data arrays and clusters<br>Visual display types - graphs and charts-analog and digital<br>Shift registers and feedback nodes<br>Local, global and shared variables<br>Exploring string and File input and output operations | 6 | |
| 3. DATA ACQUISITION WITH LABVIEW<br>Concept of Virtual Instrumentation<br>PC based data acquisition<br>Typical on board DAQ card<br>Resolution and sampling frequency<br>Multiplexing of analog inputs<br>Single-ended and differential inputs<br>Different strategies for sampling of multi-channel analog inputs<br>Concept of universal DAQ card<br>Use of timer-counter<br>Analog outputs on the universal DAQ card-NI-DAQmx Tasks | 6 | |
| 4. CLUSTER OF INSTRUMENTS IN SYSTEM<br>Interfacing of external instruments to a PC RS232C, RS-422, RS485<br>USB standards-IEEE488<br>Standard-ISO-OSI model for series bus<br>Introduction to bus protocols of MODbus and CANbus. | 6 | |
| 5. ANALYSIS TOOLS AND SIMPLE APPLICATION IN VI<br>Signal Processing and manipulation<br>Anti-aliasing Filter<br>Frequency-Domain Signal analysis (DFT and FFT)<br>Power Spectrum<br>Windowing<br>Practical Hints for Frequency Domain Analysis<br>Signal Processing Functions<br>Time Domain Analysis, Frequency Domain Analysis<br>Filters<br>Control design and simulation<br>Simulation of a simple second order system<br>Report generation<br>Generation of HTML page. | 6 | |
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[10] It details all the didactic activities foreseen in the curriculum (lectures and seminar themes, the list of laboratory works, the content of the stages of project preparation, the theme of each practice stage). The titles of the laboratory work carried out on the stands shall be accompanied by the notation "(*)".
[11] Presentation of the teaching methods will include the use of new technologies (e-mail, personalized web page, electronic resources etc.).

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Bibliography [12] 1. Lascu Mihaela, Ionel Raul, Programare grafica, Editura Politehnica Timisoara, ISBN**:** 978-606-554-908-1, 236 pag., 2015.
2. Lascu Mihaela, Tehnici avansate de programare în LabVIEW, Editura Politehnica Timişoara, ISBN 978-973625-532-8, 310 pag., 2007.
3. Bitter, R., Mohiuddin, T., Nawrocki, M., LabVIEW: Advanced Programming Techniques, CRC Press, ISBN 0-8493-2049-6, 440 pag., 2007.
4. Cottet, F., Ciobanu, O., Bazele programării în LabVIEW, Ed. Matrix Rom, Bucureşti1998.
5.***G Programming Reference Manual. National Instruments, January 1998.
6. ***LabVIEW Function and VI Reference Manual. National Instruments, January 1998
7. Essick,J., Advanced LabVIEW Labs, Prentice Hall, 1999
8. Travis, J.,Kring, J., LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition) (National Instruments Virtual Instrumentation Series) (Hardcover), August 2006 ISBN-10: 0131856723
9. Stamps, D, . Learn Labview 2012 Fast, SDC Publications, 2013, ISBN1585038504, 9781585038503.
10. Jennings Richard, De La Cueva Fabiola, LabVIEW Graphical Programming, Fith Edition, McGraw-Hill, 2020, ISBN 978-260-13526-8

| **8.2** Applied activities [13] | Number of hours | Teaching methods |
|---|---|---|
| 1.Laboratory Development of basic algorithms in LabVIEW. | 2 | Topics presentation, discussions, questions, solving problems |
| 2.Laboratory Development of sub-virtual instruments. | 2 | |
| 3.Laboratory Working with files. Generation of Fibonacci series using formula node and shift registers and store data in files. | 2 | |
| 4.Laboratory Managing data. Building a virtual instrument to find whether a given number is prime number or not using flat sequence structure/stacked sequence structure. | 2 | |
| 5.Laboratory Development of algorithms using arrays and clusters functions. Simplifying code. | 2 | Topics presentation, discussions, questions, solving problems |
| 6.Laboratory Working with common architectures. Amplitude modulated wave generation and demodulated on. | 2 | Topics presentation, discussions, questions, solving problems |
| 7.Laboratory Understanding Data Acquisition. Data Acquisition from various sensors using DAQ Cards for Finite and Continuous Buffered Acquisition Mode. | 2 | Topics presentation, discussions, questions, solving problems |
| 8.Project Building a virtual instrument to simulate and study the performance of first order and second order systems.<br>9.Project Acquire, analyze, and present an ECG signal using Virtual Instrumentation and implement an algorithm to calculate its heart rate and ECG processing.<br>10.Project Digital signal processing system-design using LabVIEW. | 6 | Implementing different programming architectures, project implementation |
| 11.Project Digital image processing using LabVIEW.<br>12.Project Image processing with LabVIEW and IMAQ Vision.<br>13.Project Programming Arduino with LabVIEW. Build interactive and fun learning projects with Arduino using LabVIEW.<br>14.Project Biological signal processing and analysis for healthcare monitoring. | 8 | Implementing different programming architectures, project implementation |

Bibliography [14] 1. Lascu Mihaela, Ionel Raul, Programare grafica, Editura Politehnica Timisoara, ISBN**:** 978-606-554-908-1, 236 pag., 2015.
2. Lascu Mihaela, Tehnici avansate de programare în LabVIEW, Editura Politehnica Timişoara, ISBN 978-973625-532-8, 310 pag., 2007.
3. Bitter, R., Mohiuddin, T., Nawrocki, M., LabVIEW: Advanced Programming Techniques, CRC Press, ISBN 0-8493-2049-6, 440 pag., 2007.
4. Cottet, F., Ciobanu, O., Bazele programării în LabVIEW, Ed. Matrix Rom, Bucureşti1998.
5.***G Programming Reference Manual. National Instruments, January 1998.

[12] At least one title must belong to the discipline team and at least one title should refer to a reference work for discipline, national and international circulation, existing in the UPT library.
[13] Types of application activities are those specified in footnote 5. If the discipline contains several types of applicative activities then they are sequentially in the lines of the table below. The type of activity will be in a distinct line as: "Seminar:", "Laboratory:", "Project:" and / or "Practice/training".
[14] At least one title must belong to the discipline team.

6. ***LabVIEW Function and VI Reference Manual. National Instruments, January 1998
7. Essick,J., Advanced LabVIEW Labs, Prentice Hall, 1999
8. Travis, J.,Kring, J., LabVIEW for Everyone: Graphical Programming Made Easy and Fun (3rd Edition) (National Instruments Virtual Instrumentation Series) (Hardcover), August 2006 ISBN-10: 0131856723
9. Stamps, D, . Learn Labview 2012 Fast, SDC Publications, 2013, ISBN1585038504, 9781585038503.
10. Singh R., Gehlot A., Bhupendra Singh, Sushabhan Choudhury, Arduino-Based Embedded Systems, Interfacing, Simulation, and LabVIEW GUI, 2018, CRC Press, Taylor and Francis Group
11. Jennings Richard, De La Cueva Fabiola, LabVIEW Graphical Programming, Fith Edition, McGraw-Hill, 2020, ISBN 978-260-13526-8

**9. Corroboration of the content of the discipline with the expectations of the main representatives of the epistemic community, professional associations and employers in the field afferent to the program**

- One of the most important function that Virtual Instrumentation discipline has is to attract third-year students from the Faculty of Electronics and Telecommunication in the graphical programming area. This condition is established as the examples used during the teaching discipline Virtual Instrumentation are sufficiently diverse, relevant for current students to create an accurate picture and useful virtual instruments on the relationship that Virtual Instrumentation has with other computational disciplines.
- The cross-discipline contents for Virtual Instrumentation follows the expectations and needs of the professional community and is tracked carefully in short cycles - one year, and long cycles - three years: on the one hand, it supervises the number of students that are engaged after one year of completing the course, and on the other hand the number of students selected within 3 years from completion of the course, those who prove skills in research or outstanding academic results.
- The feedback from the students who manage investments in companies and have representative positions have an important role in updating from year to year the labor and course teaching, according to market needs.
- Virtual instrumentation (graphical programming) is also studied in universities as University of Texas, USA, New York University, USA, Dalhousie University, Canada

**10. Evaluation**

| Type of activity | **10.1** Evaluation criteria [15] | **10.2** Evaluation methods | **10.3** Share of the final grade |
|---|---|---|---|
| **10.4** Course | Knowledge of discussed concepts. Minimum passing grade 5. | Written exam, each subjects gets a score. | 75% |
| **10.5** Applied activities | **S:** | | |
| | **L:** Problem solving. . Minimum passing grade 5 | Reports for every lab work, written tests, homework | 12,5% |
| | **P**[16]**:** Project implementation. Nota minimă de promovare 5 | Project evaluation concerning the quality of the taught project and the quality of the activity during the project activity | 12,5% |
| | **Pr:** | | |
| **10.6** Minimum performance standard (minimum amount of knowledge necessary to pass the discipline and the way in which this knowledge is verified [17]) | | | |
| • Concepts understanding which the course focuses on. Knowledge is verified by written exam, written tests and project work: Exam-Knowledge, understanding and correct use of the discipline-specific programming language. Laboratory-Explaining and interpreting the knowledge taught and applying it in solving practical problems; Critical and constructive reflection on the knowledge taught Project-Creativity, innovation, autonomy, responsibility, socio-professional interaction, personal and professional development.<br>• The minimum passing grade of 5 is obtained from the grade for the applied activities of at least 5 and the grade for the exam of at least 5. The final grade is calculated by adding one third of the grade from the applied activities to two thirds of the grade from the exam. | | | |

| **Date of completion** | **Course coordinator (signature)** | **Coordinator of applied activities (signature)** |
|---|---|---|
| 22.06.2023 | | |
| **Head of Department (signature)** | **Date of approval in the Faculty Council** [18] | **Dean (signature)** |

[15] Syllabus must contain the procedure for assessing the discipline, specifying the criteria, methods and forms of assessment, as well as specifying the weightings assigned to them in the final grade. The evaluation criteria shall be formulated separately for each activity foreseen in the curriculum (course, seminar, laboratory, project). They will also refer to the forms of verification (homework, papers, etc.)
[16] In the case where the project is not a distinct discipline, this section also specifies how the outcome of the project evaluation makes the admission of the student conditional on the final assessment within the discipline.
[17] It will not explain how the promotion mark is awarded.
[18] The endorsement is preceded by the discussion of the board's view of the study program on the discipline record.

14.09.2023