

# Syllabus

## 1. Data about the program of study

|                                    |                                              |
|------------------------------------|----------------------------------------------|
| 1.1 Institution                    | Technical University of Cluj-Napoca          |
| 1.2 Faculty                        | Automation and Computer Science              |
| 1.3 Department                     | Automation                                   |
| 1.4 Field of study                 | Systems Engineering                          |
| 1.5 Cycle of study                 | Bachelor of Science                          |
| 1.6 Program of study/Qualification | Automation and Applied Informatics (English) |
| 1.7 Form of education              | Full time                                    |

## 2. Data about the subject

|                                        |                                                            |              |   |                        |              |
|----------------------------------------|------------------------------------------------------------|--------------|---|------------------------|--------------|
| 2.1 Subject name                       | <b>Hydro-Pneumatic Equipment</b>                           |              |   | Discipline code        | <b>42.00</b> |
| 2.2 Course responsible/lecturer        | prof. dr. ing. Levente Tamas (Levente.Tamas@aut.utcluj.ro) |              |   |                        |              |
| 2.3 Teachers in charge of applications | Drd. ing. Robert Konievic                                  |              |   |                        |              |
| 2.4 Year of study                      | 3                                                          | 2.5 Semester | 2 | 2.6 Assessment (E/C/V) | E            |
| 2.7 Type of subject                    | DF – fundamental, DS – specialty, DC – complementary       |              |   |                        | DS           |
|                                        | DOB – compulsory, DOP – elective, DFA – optional           |              |   |                        | DOB          |

## 3. Estimated total time

|                                                                                      |    |           |            |    |             |   |                |    |             |   |
|--------------------------------------------------------------------------------------|----|-----------|------------|----|-------------|---|----------------|----|-------------|---|
| 3.1 Number of hours per week                                                         | 4  | of which: | 3.2 Course | 2  | 3.3 Seminar | 0 | 3.3 Laboratory | 2  | 3.3 Project | 0 |
| 3.4 Number of hours per semester                                                     | 56 | of which: | 3.5 Course | 28 | 3.6 Seminar | 0 | 3.6 Laboratory | 28 | 3.6 Project | 0 |
| 3.7 Individual study                                                                 |    |           |            |    |             |   |                |    |             |   |
| (a) Manual, lecture material and notes, bibliography                                 |    |           |            |    |             |   |                |    |             | 3 |
| (b) Supplementary study in the library, online and in the field                      |    |           |            |    |             |   |                |    |             | 6 |
| (c) Preparation for seminars/laboratory works, homework, reports, portfolios, essays |    |           |            |    |             |   |                |    |             | 5 |
| (d) Tutoring                                                                         |    |           |            |    |             |   |                |    |             | 5 |
| (e) Exams and tests                                                                  |    |           |            |    |             |   |                |    |             | 0 |
| (f) Other activities:                                                                |    |           |            |    |             |   |                |    |             | 0 |
| 3.8 Total hours of individual study (sum of (3.3(a))...(3.3(f)))                     |    |           |            | 19 |             |   |                |    |             |   |
| 3.9 Total hours per semester (3.2+3.4)                                               |    |           |            | 75 |             |   |                |    |             |   |
| 3.10 Number of credit points                                                         |    |           |            | 3  |             |   |                |    |             |   |

## 4. Pre-requisites (where appropriate)

|                |                                                                                                                    |
|----------------|--------------------------------------------------------------------------------------------------------------------|
| 4.1 Curriculum | Control engineering, system theory, process modelling                                                              |
| 4.2 Competence | Design and implementation of basic control loops including also electrical and telecommunication equipment English |

## 5. Requirements (where appropriate)

|                           |                                                                           |
|---------------------------|---------------------------------------------------------------------------|
| 5.1. For the course       | N/A                                                                       |
| 5.2. For the applications | Attendance is compulsory. Reading and understanding of the lecture notes. |

## 6. Specific competences

|                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Professional competences | <p>C4. To have knowledge about the functional principles of the fluid equipment's and to have an in-depth knowledge about the analysis and synthesis of the control loops containing hydro-pneumatic equipment's.</p> <p>C4.1 To understand the interfaces for this equipment and to choose the right equipment for a fluid control loop in industry.</p> <p>C4.2 To be able to design and build fluid control loops and use the implementation methods studied for exploiting these equipment's</p> <p>C4.3 To have knowledge about specific controllers, sensors, interfaces for hydro-pneumatic systems and using these devices in the industrial setups</p> |
|--------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

|                   |                                                                                                                                                                                                                                                                           |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Cross competences | <p>To have competences for making analysis/design of hydro-pneumatic systems</p> <p>To have communication competences specific to engineers from the hydro-pneumatic domain</p> <p>To have the ability to adopt emerging technological parts specific to this domain.</p> |
|-------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 7. Expected learning outcomes

|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|-------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Knowledge                     | The student can describe the construction and operating principles of various hydraulic and pneumatic systems. The student can describe different mathematical modeling approaches for hydraulic and pneumatic processes. The student can identify and describe fundamental concepts from systems theory for the analysis of hydraulic and pneumatic systems. The student can identify and describe fundamental concepts from control theory for the design of hydraulic and pneumatic automatic control systems. The student can describe different implementation solutions for hydraulic and pneumatic automation in simulations and experimental setups, and can interpret and evaluate the performance of the obtained results. |
| Skills                        | The student can apply various construction and operating principles of hydraulic and pneumatic systems. The students can apply different mathematical modeling approaches for hydraulic and pneumatic processes. The students can analyze hydraulic and pneumatic systems. The student can design hydraulic and pneumatic automatic control systems and implement and test different solutions through simulations and experimental setups.                                                                                                                                                                                                                                                                                          |
| Responsibilities and autonomy | The student is capable of undertaking hydraulic and pneumatic automation projects: identifying and justifying the most appropriate automation solution, implementing and testing the solution, preparing the technical documentation and providing user training, and proposing potential long-term improvements.                                                                                                                                                                                                                                                                                                                                                                                                                    |

## 8. Course objectives

|                     |                                                                                                                                                                                                                                                                                                                                          |
|---------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| General objective   | Analysis, Design, and Testing of Fluid Power Automation Systems.                                                                                                                                                                                                                                                                         |
| Specific objectives | <p>Knowledge of the construction and operating principles of hydraulic and pneumatic equipment</p> <p>Modeling and analysis of hydraulic and pneumatic processes</p> <p>Design of hydraulic and pneumatic automatic control systems</p> <p>Testing of hydraulic and pneumatic automation systems through simulations and experiments</p> |

## 9. Contents

| 9.1 Lectures                                                                                                 |          |                                                    |                                                                       |
|--------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------|-----------------------------------------------------------------------|
| 9.1 Lecture                                                                                                  | No.hours | Teaching methods                                   | Notes                                                                 |
| Introduction to the hydraulic-pneumatic systems                                                              | 2        | Presentation using beamer/online shareing possible | The presentations include real life examples as well as case studies. |
| Theoretical aspects of the fluids                                                                            | 2        |                                                    |                                                                       |
| Passive circuit elements                                                                                     | 2        |                                                    |                                                                       |
| Active circuit elements                                                                                      | 2        |                                                    |                                                                       |
| Applications to active-passive circuit elements                                                              | 2        |                                                    |                                                                       |
| Pneumatic actuators with membranes                                                                           | 2        |                                                    |                                                                       |
| Pneumatic transducers                                                                                        | 2        |                                                    |                                                                       |
| Pneumatic cylinder control equipment's                                                                       | 2        |                                                    |                                                                       |
| Discrete pneumatic circuits                                                                                  | 2        |                                                    |                                                                       |
| Hydraulic sources and motors                                                                                 | 2        |                                                    |                                                                       |
| Hydraulic control systems                                                                                    | 4        |                                                    |                                                                       |
| Case study of a control loop                                                                                 | 4        |                                                    |                                                                       |
| Bibliography                                                                                                 |          |                                                    |                                                                       |
| 1. Gh.Lazea, R.Robotin, S.Herle, C.Marcu – Echipamente de automatizare pneumatic si hidraulice UTPress 2006. |          |                                                    |                                                                       |
| 2. A.Hanieh – Fluid Power Control: Hydraulics and Pneumatics- Cambridge Publishing. 2012.                    |          |                                                    |                                                                       |
| 3. James Daines - Fluid Power: Hydraulics and Pneumatics, Goodheart Willcox Publ., 2009                      |          |                                                    |                                                                       |
| 9.2 Aplifications (seminar/laboratory/project/practical work)                                                | No.hours | Teaching methods                                   | Notes                                                                 |
| Flow measurement with restrictor                                                                             | 4        | Practical work including computation and           | Encouraging team work 2-                                              |
| Pneumatic amplifiers.                                                                                        | 4        |                                                    |                                                                       |
| Electro-pneumatic converter                                                                                  | 4        |                                                    |                                                                       |

|                                                                                                 |   |                                          |                          |
|-------------------------------------------------------------------------------------------------|---|------------------------------------------|--------------------------|
| Pneumatic actuators and pressure transducers                                                    | 4 | discussion/or online<br>variant on Teams | 3 students in<br>a group |
| Sorting application with pneumatic cilinders                                                    | 4 |                                          |                          |
| Simulation of the pneumatic circuits                                                            | 4 |                                          |                          |
| Simulation of hydraulic circuits in SymHydraulics                                               | 4 |                                          |                          |
| Bibliography                                                                                    |   |                                          |                          |
| 1. L. Tamas et. al.: Hydraulci and Pneumatic Control Equipments –laboratory book, UTPress, 2015 |   |                                          |                          |

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

Both the equipments and the course content are including parts which were consulted with companies from this field, including Emerson, Baumann Automation, Bosch and Siemens representatives from Cluj-Napoca, Romania.

**11. Evaluation**

| Activity type                                           | 11.1 Assessment criteria                                                        | 11.2 Assessment methods                         | 11.3 Weight in the final grade |
|---------------------------------------------------------|---------------------------------------------------------------------------------|-------------------------------------------------|--------------------------------|
| 11.4 Course                                             | Theoretical concepts<br>Analytic and synthetic work                             | Written exam/or online<br>exam on Teams         | 8 from 10                      |
| 11.5 seminar/<br>laboratory/ project/<br>practical work | Understanding the laboratory<br>work as well as performing<br>the hands-on part | Laboratory colloquium / or<br>online evaluation | 2 from 10                      |
| 11.6 Minimum performance standard: 5 from 10            |                                                                                 |                                                 |                                |

| Date of filling in:                      |              | Title Firstname NAME                              | Signature |
|------------------------------------------|--------------|---------------------------------------------------|-----------|
| 10.07.2026                               | Course       | Prof. dr. ing. Levente Tamas                      |           |
|                                          | Applications | Drd. ing. Robert Konievic                         |           |
|                                          |              |                                                   |           |
|                                          |              |                                                   |           |
|                                          |              |                                                   |           |
|                                          |              |                                                   |           |
|                                          |              |                                                   |           |
| Date of approval by the Department Board |              | Head of Department<br>Prof.dr.ing. Honoriu VĂLEAN |           |
| Date of approval by the Faculty Council  |              | Dean<br>Prof.dr.ing. Vlad MUREȘAN                 |           |