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| **Measurement and Automatics II.** |

**Code: MFMET32R04-EN**

**ECTS Credit Points: 4**

**Evaluation: mid-semester grade**

Year, Semester: 3rd year/1st semester

Number of teaching hours/week:

Lecture: **2**

Practice: **2**

**Prerequisites: Electrotechnics and Electronics II. MFELT32G02-EN,**

**Measurement and Automatics I. MFMET31R03-EN**

**Topics**:

Different theoretical foundation of control engineering. Technical and application control functions. Programmable logic controllers. Members of the control loop. The members of the control loop steady state analysis. Linear transition state regulations. Linear members describing state transition. Control loop analysis. Stability and quality characteristics. Selection and setting of regulators. Digital controllers.

**Literature:**

1. Robert H. Bishop: Labview 2009 student edition, 2009, Prentice Hall, ISBN-13:978-0132141291
2. Travis, Jeffrey LabVIEW for everyone: graphical programming made easy and fun / Jeffrey Travis, Jim Kring 2007. p:1032

**Schedule**

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| **1st week:**  **Lecture:** The theoretical bases of control technology. Basic concepts, symbols and allocation. Comparison of control and feedback control. Subdivision of control and feedback control.  **Practice:** General description about laboratory regulations. Accident prevention and safety education. | **2nd week:**  **Lecture:** Feedback control. Signs and characteristics of a control loop. Loop tags (a sensor, a signal generator, subtraction, signal processing, an amplifier, an actuator). Automatic feedback control subdivision.  **Practice:** Realization of logic functions “And, Or, Not” with relays. |
| **3rd week:**  **Lecture: C**ontrol systems. Boolean algebra, basic operations (And, Or, Not). Basic identity of Boolean algebra.  **Practice: “**Nand” and “Nor” logic functions realization with relays. | **4th week:**  **Lecture:** De Morgan's theorems. Two-variable logic functions (Nor, Inhibition, Antivalency, Equivalency, Implication).  **Practice:** Compilation of logical relations on practicing board with “Nand” gates. |
| **5th week:**  **Lecture:** Functions to simplify algebraic and graphical way. Operation and programming of freely programmable logic controllers (PLCs).  **Practice:** Compilation of logical relations on practicing board with Nor gates. | **6th week:**  **Lecture:** Linear Control Systems. Test methods (time domain, frequency domain, and transfer functions method).  **Practice:** PLC programming. Measuring internal timers and counters. |
| **7th week:**  **Lecture:** Linear control steady-state operation. Linear terms (P, I, D) and transmission coefficient. Linear coupling of tags (serial, parallel, feedback).  **Practice:** Analysis and determination of one variable proportional transfer function. | **8th week:**  **Mid-term test** |
| **9th week:**  **Lecture:** A proportional tag, negative feedback through a proportional tag. Examination of feedback.  **Practice:** Determination of a variable proportional transfer function and its analysis. | **10th week:**  **Lecture:** Analysis of proportional (type 0) control. Examination of integral (type 1) control. Gaining and measuring a concept loop.  **Practice:** Analysis transfer function of two variable proportional tag. |
| **11th week:**  **Lecture:** Linear feedback control transition state. Typical testing functions. Linear tags differential equations. Transfer function preparation about transmission function.  **Practice:** Conditions and analysis of a variable storage differentiator tag and its transfer function. | **12th week:**  **Lecture:** Transition, transfer function and differential equations of a proportional and integral tag. Transition, transfer function and differential equations of a derivate and dead time tag.  **Practice:** Analyze proportional-integral (PI) tag transition function. |
| **13th week:**  **Lecture:** Control loops investigation in a transition state. Control loops stability criterion with Routh-Hurwitz and high-quality specifics.  **Practice:** Analyzing the proportional-derivative (PD) tag and its transition function. | **14th week:**  **Lecture:** Continuous (P, I, D, PI, PD, PID) controllers. Non-electrical quantities electrical measuring. Temperature and pressure measurement. Flowing liquids and gases in fluid volume measurement.  **Practice:** The Proportional-Integral-Derivative (PID) tag recording its transition function and function analyzing. |
| **15th week:**  **End-term test** |  |

**Requirements**

**A, for a signature:**

Attendance at **lectures** is recommended, but not compulsory.

Participation at **practice classes** is compulsory. A student must attend the practice classes and may not miss more than three times during the semester. In case a student does so, the subject will not be signed and the student must repeat the course. A student can’t make up a practice class with another group. Attendance at practice classes will be recorded by the practice leader. Being late is equivalent with an absence. Missed practice classes must be made up for at a later date, being discussed with the tutor. Active participation is evaluated by the teacher in every class. If student’s behavior or conduct doesn’t meet the requirements of active participation, the teacher may evaluate his/her participation as absence because of the lack of active participation in class.

Students have to **submit all the twelve reports** as scheduled minimum on a sufficient level.

During the semester there are two tests: the mid-term test in the 8th week and the end-term test in the 15th week. Students have to sit for these tests.

**B, for a grade:**

The course ends in a **mid-semester grade** based on the average of the grades of the drawings and the average of the test results. The mid-semester grade is calculated as an average of them:

* the average grade of the twelve reports
* the average grade of the two tests

The minimum requirement for the mid-term and end-term tests is 60%. Basing on the score of the tests separately, the grade for the tests is given according to the following table:

Score Grade

0-59 fail (1)

60-69 pass (2)

70-79 satisfactory (3)

80-89 good (4)

90-100 excellent (5)