Process Automation					AR-205
Rota annually SS	**Duration** 1 Semester	**Semester** 2nd (Semester)	**SWS** 8 SWS	**Credit Points** 10	**Workload** 250 h

1 Modul structure

Course (Abbreviation)	Type/ SWS	Presence	Self study	Credits
a) Logic Control (LC)	Lecture / 2 SWS	30 h	60 h	3
b) Logic Control (LC)	Tutorial / 2 SWS	30 h	60 h	3
c) Process Control Lab	Lab / 4 SWS	50 h	20 h	4

2 **Language:** English

3 Content

(a, b) Logic controllers are widely used to supervise the safe operation of equipment, and to enforce desired operating sequences. In many applications, such controllers are realized by Programmable Logic Controllers (PLCs) or Distributed Control Systems (DCSs). The course covers the underlying mathematical models and notions, teaches basic design concepts for logic control, and introduces into the programming of PLCs. In the tutorials, the students design, implement, and test logic controllers for simple examples. The students have to perform a logic controller programming task as a home assignment.

1. Introduction: motivation and application examples for logic control
2. Mathematical foundations: Boolean algebra and functions
3. Hardware realization of logic controllers
4. Fundamentals of PLC programming: PLC operating systems and standard functions
5. Programming languages according to the international standard IEC 61131-3 (including function block diagrams, ladder diagrams, instruction list and structured text programs, and the specification of sequential controls by sequential function charts)

(c) A Process Control Lab consisting of six practical lab experiments (DYN 2, DYN 3, DYN 5, DYN 6, DYN 10, DYN 11) and three computer experiments (DYN 22 a, b, DYN 26) (see appendix A).

Literature:

- R.W.Lewis: Programming Industrial Control Systems using IEC6113-3. IEE Control Engineering Series, No, 5, IEE, London, 1995
- Karl-Heinz John, M. Tiegelkamp: IEC 61131-3: programming industrial automation systems. Springer, ISBN: 3-540-67752-6, Berlin, 2001
- C. G. Cassandras, S. Lafortune: Introduction to Discrete Event Systems. Kluwer Academic Publishers, 1999
- J. E. Hopcroft, J. D. Ullman: Introductions to Automata Theory, Languages, and Computation. Addison Wesley, 2000

4 Goals

In this course, the students learn the importance of logic control and the state of the art of the technology used to implement such controllers. They can analyze and formalize the tasks of a logic controller and can formally specify its behavior. They are able to implement simple logic controllers and to apply modern techniques to their analysis. They can evaluate the complexity of a logic control task. The Process Control Laboratory allows the students to apply control theory from this and other courses to realistic example problems.

5 Examination Requirements

The final exam will be an oral (30 minutes) or written (2 hour) exam, depending on the number of participants (form will be announced in the second week of the course). In addition, there will be a graded home assignment. The requirements for the laboratory are described in appendix A.

6	**Formality of Examination** ☒ Module Finals ☐ Accumulated Grade
7	**Module Requirements (Prerequisites)** The lab course builds upon the course Control Theory and Applications which is compulsory in the first semester.
8	**Allocation to Curriculum:** Program: Automation & Robotics, Field of study: Process Automation As major field of study in Process Automation, this course is mandatory.
9	**Responsibility/ Lecturer** *Prof. Dr. S. Engell/* Prof. Dr. S. Engell