

# **Improvements for the Education of Functional Safety at the University of Miskolc**

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# INTRODUCTION

The Faculty of Mechanical Engineering and Informatics at the University of Miskolc offers training courses in mechanical, mechatronic, logistic, energetic, electrical and information engineering. Since different knowledge is necessary for each specialization, the structure of the topics varies and the field of industrial safety is educated with different priority in these courses. Earlier, the education of functional safety was based on risk graph defined in DIN standard and focused mainly on applications for preventive methods using relay.

# 1996

Due to the rapid development of microprocessor and PLC technologies, new methods had to be worked out. As regards our first project, in 1996, our team was charged with the development of a power plant related to using safety PLC for gas burner automatics. At that time, the available knowledge proved to be incomplete. That is the reason why we decided to focus on the industrial safety and started to collect professional papers and publications from this area.

# 2001 - 2004

- The results of our research work were presented in domestic conferences and in 2001, we were charged with the training of industrial safety for electrical engineers of a chemical plant.
- In 2004, we participated in an event organized by Mr. Baradits in Budapest, where the program officer of the European Union delivered a lecture in which he pointed out that Hungary was falling behind in this field. In this year, the IEC 61508 standard entered into force in Hungary as well.

# 2005

In 2005, the Faculty of Mechanical Engineering and Informatics at the University of Miskolc earned a project called 'Knowledge Centre of Mechatronic and Logistic Systems'. Within this project, we did research and development work in connection with functional safety as well as we carried out a large-scale infrastructure development for our laboratory. The topics of the research and development work were related to power plant, cement plant and logistics. The results were presented in the famous DCS conference.

# 2006

In 2006, a new subject called Safety Control Systems was firstly introduced for the newly started full-time and correspondence BSc Electrical Engineering courses in the specialization of Industrial Automation and Communication. Currently, 10-12 students graduate in this specialization each year and the research field of 2 or 3 students' research work is concerned with safety.

# The subjects for the specialization of Industrial Automation and Communication are as follows:

Subject code	Semester	Subject name	Lecture	Practice	Requirements	Credit	Pre-conditions
GEVAU110B	5	Micro-controllers	2	2	Exam	5	GEVAU103B
GEVAU331B	5	WEB-Services and Technologies	2	2	Exam	5	-
GEVAU174B	5	Industrial Data Communication and SCADA Systems-I	2	2	Exam	5	GEVAU103B
GEVAU175B	6	Industrial Data Communication and SCADA Systems-II	2	2	Practice	5	GEVAU103B
GEVAU176B	6	Field Instrumentation	2	2	Exam	5	GEVAU107B
GEVAU116B	6	Control Engineering Software	2	2	Exam	5	GEVAU105B
GEVAU143B	6	Project Work	0	4	Practice	4	GEVAU174B
GEVAU177B	7	Safety Control Systems	2	2	Exam	5	-
GEVAU101B	7	Industrial Technologies	2	2	Practice	5	-
GEVAU144B	7	BSc-Degree-Project	0	14	Practice	15	GEVAU143B

In 2006, after consultations of industrial experts, I came to a decision of working out an overall knowledge on PLC technique, industrial communication systems and safety control systems. For achieving this goal, I decided to carry out an eight-volume book with CD in cooperation with co-authors and sponsors.

# 2006 - 2010

Within this work the following books have been published so far:

- **Ajtonyi: PLC and SCADA-HMI systems II. & Industrial Communication Systems II.**

Sub-title: *PLC programming according to the IEC 61131-3 standard.*

AUT-INFO Ltd., Miskolc, October 2007., pages 290, ISBN: 978-963-06-3165-5.

- **Ajtonyi: PLC and SCADA-HMI systems II. & Industrial Communication Systems II.**

AUT-INFO Ltd., Miskolc, May 2008., pages 408, ISBN: 978-963-661-833-9., ISSN: 1789-5456.

- **Ajtonyi: PLC and SCADA-HMI systems III.**

AUT-INFO Ltd., Miskolc, October 2008., pages 304, ISBN: 978-963-06-5774-7., ISSN: 1789-5456.

- Ajtonyi: **Industrial Communication Systems I.**  
AUT-INFO Ltd., Miskolc, December 2008., pages 431, ISBN: 978-963-06-5813-3., ISSN: 1789-5456.
- Ajtonyi: **Industrial Communication Systems III.**  
AUT-INFO Ltd., Miskolc, April 2008., pages 340, ISBN: 978-963-06-8988-5., ISSN: 1789-5456.

The next volume called Industrial Communication Systems IV is going to be released in July the topic of which focuses on the wireless industrial systems.

- At this time, my colleagues and me are working on a new volume called Safety Control Systems. I am counting on several domestic experts as authors in composing this book. According to my plan this book – nearly half of which has already been created in electric format – will have been released by the end of this year or at the beginning of the next year.
- For information, I am attaching the sections completed and planned for this book.

# István Ajtonyi: Safety Control Systems

1. Introduction, Elements
2. Probability Calculus and Models related to the Safety
3. Models and Methods for Systematic Hazard and Fault Analysis
  - 3.1. Events Tree
  - 3.2. LOPA Analysis
  - 3.3. Fault Tree Analysis
  - 3.4. Reliability Block Diagram
  - 3.5. Markov Models and Matrices
  - 3.6. FMEA Method

## 4. Safety System Architectures and related Calculations.

4.1. E/E/PE marking System based on Redundancy

4.2. 1001: One-channel System

4.3. 1002: Two-channel System

4.4. 2002: Two-channel System

4.5. 1001D: One-channel System with Diagnostic

4.6. 1002D: Two-channel System with Diagnostic

4.7. 1002D Architecture

4.8. 2003D Architecture

4.9. Further Architectures

5. HAZOP Analysis
6. MSz-IEC 61508 Standard
7. MSz-IEC 61511 Standard
8. Safety Control Systems
9. Safety Control Systems in Practice
10. IEC 13849-1 standard
11. IEC 62061 standard
12. Domestic Industrial Case Studies



- In this year, we earned a high value project for infrastructure development and the University of Miskolc was granted the title of OUTSTANDING UNIVERSITY. The project number has been shown in the first slide.
- I would like to ask you, dear participants to assist us in publishing the book as authors or sponsors. Unfortunately I cannot show pictures about our laboratory due to our institute is under reconstruction. I hope that I will be able to show some pictures next year.

Thank you for your attention!

