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# From Automation and Control Training to the Overall Roll-Out of Industry 4.0 Across South-East Asian Nations

# (ASEAN FACTORI 4.0)

**PROJECT No. 609854-EPP-1-2019-1-FR-EPPKA2-CBHE-JP**

**2102435 INDUSTRIAL AUTOMATION COURSE SYLLABUS**

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CHULALONGKORN UNIVERSITY

**COURSE SYLLABUS**

**1. Course Number** 2102435

**2. English Abbreviation of Course Title** IND AUTOMATION

**3. Course Title** Industrial Automation

**4. Credit** 3.0 ( 3.0 – 0.0 – 6.0 )

**5. Responsible Section**

5.1. Faculty/Equivalent:  FACULTY OF ENGINEERING

5.2. Department: DEPARTMENT OF ELECTRICAL ENGINEERING

5.3. Section: Field of Study of Electrical Engineering

**6. Method of Measurement** Letter Grade (A B+ B C+ C D+ D F)

**7. Type of Course** Semester Course

**8. Semester** 2nd semester

**9. Academic Year** 2023

**10. Teaching Management**

|  |  |
| --- | --- |
| Instructor | Evaluation Period |
| Prof. David Banjerdpongchai  Office: 410, Boonrod Binson Bldg. | 30-03-2024 to 30-05-2024 |

**11. Condition** (Prerequisite) : 2102333 Linear Control Systems I and Lab, 2102386 Electronic Circuits

**12. Program that uses this course**

Electrical Engineering

**13. Level** Bachelor Year 3-4

**14. Venue of Class:** Room 305, Engineering 3 Bldg.,

**Schedule:** Tue, Thu 8.00-9.30 am.

**15. Course Description**

Thermal sensors; mechanical sensors; optical sensors; signal conditioning; final control elements; programmable logic control (PLC); analog control; digital control; PLC programming with LD, FBD, SFC languages; communication network modules; human machine interface (HMI); simulation with PLC benchmark.

**16. Course Outline**

**16.1 Learning/Teaching Style:** Onsite/Online

**16.2 Behavioral Objectives**

|  |  |
| --- | --- |
| # | Behavioral Objectives |
| 1 | Explain the principle of instrumentation, sensors, signal conditioners, final control elements in industries.  Learning outcomes : • 02.(a) An ability to apply knowledge of mathematics, science, and engineering  **Teaching/Development Method :** • Lecture • Field trip  **Evaluation Method :** • Written examination • Homework assessment |
| 2 | Explain the principle of programmable logic controller, analog controller, digital controller and applications.  Learning outcomes : • 02.(a) An ability to apply knowledge of mathematics, science, and engineering  **Teaching/Development Method :** • Lecture • Field trip  **Evaluation Method :** • Written examination • Homework assessment |
| 3 | Analyze, design and properly select instrumentations.  Learning outcomes : • 03.(b) An ability to design and conduct experiments, as well as to analyze and interpret data. • 04.(e) An ability to identify, formulate, and solve engineering problems.  **Teaching/Development Method :** • Lecture • Field trip  **Evaluation Method :** • Written examination • Homework assessment • Oral presentation |
| 4 | Practice PLC languages including LD, FBD, SFC, integrate with communication module, human machine interface, and simulation with PLC benchmark.  Learning outcomes : • 04.(e) An ability to identify, formulate, and solve engineering problems.  **Teaching/Development Method :** • Hand-on training  **Evaluation Method :** • Practice assessment • Oral presentation |

**16.3 Teaching Plan**

|  |  |
| --- | --- |
| Week | Topic |
| 1 | Introduction of Process Control |
| 2 | Analog signal conditioning |
| 3 | Digital signal conditioning |
| 4 | Thermal sensors |
| 5 | Mechanical sensors |
| 6 | Optical sensors |
| 7 | Final Control |
| 8 | Discrete state process control  Controller disciples |
| 9 | Analog controllers |
| 10 | Digital controllers |
| 11\* | Introduction of Programmable Logic Controllers |
| 12\* | Applications of Programmable Logic Controllers |
| 13\* | PLC Programming Languages: Ladder Diagram, Function Block Diagram, Sequential Function Chart |
| 14\* | Lab 1 CODESYS, Visualization |
| 15\* | Lab 2 PLC Benchmark, HMI GALILEO |

**Remark:** \* means modified topics.The modified curriculum has been meticulously crafted in collaboration with the Factori 4.0 Erasmus+ project 609854-EPP-1-2019-1-FR-EPPKA2-CBHE-JP.

* Introduction to Programmable Logic Controllers (PLC): Prof. Paisan Kittisupakorn
* Applications of Programmable Logic Controllers: Prof. David Banjerdpongchai
* Ladder Diagram, Function Block Diagram, Sequential Function Chart Using CODESYS, Visualization: Sirikanya Singcuna and team
* PLC Benchmark, HMI GALILEO: Sirikanya Singcuna and team

**16.4 Teaching Media:** Electronic Media and Website

**16.5 Communication with students through social network**

16.5.1 Form and Usage: Facebook and MS Team

16.5.2 Learning Management System: CourseVille

**16.6 Student Consultation:** 2 hours per week

**16.7 Assessment**

|  |  |  |
| --- | --- | --- |
| No. | Activity | Percent |
| 1 | Homework (6 assignments\*3 + CAS Evaluation 2) | 20 |
| 2 | Presentation (3 times\*4 + Q/A 4) | 16 |
| 3 | Midterm | 25 |
| 4 | Final | 25 |
| 5 | Study visit | 8 |
| 6 | Seminars (3 times\*2) | 6 |

**16.8 Assessment Criteria**

1) Homework grade:

A = Excellent, B = Good, C = Fair,

D = Need to improve, F = Suspect of plagiarism

Student with F are invited for investigation.

Grade A, B receives 3 points C receives 2 points, D receives 1 point, and F receives 0.  
2). Presentation will be evaluated based on 4 aspects:

rationale & clear objectives 20%, sequence and completion 40%, self-study and citation 20%, discussion, conclusions, and references 20%.

**17. Reading List**

**17.1 Required Text**

Curtis D. Johnson, Process Control Instrumentation Technology, ISBN: 1292026014, Pearson Prentice Hall, 8th Edition. 2014.

Programmable Logic Controller: Fundamentals and Practices, Center of Excellence in Intelligent Control Automation of Process Systems, Faculty of Engineering, Chulalongkorn University, 2023.

**17.2 Supplementary Texts**

W. H. Kwon, S. H. Han, S. Han, Receding Horizon Control: Model Predictive Control for State Models, ISBN: 978-1-84628-024-5, Springer, 2005.

K. J. Åström and T. Hägglund, Automatic Tuning of PID Controllers, IEEE/CRC Press, Chapter 52, The Control Handbook, W. S. Levine ed., 1995.

**17.3 Related electronic media and websites**

Emna Moones, Thomas Vosgien, Lyes Kermad, El Dafaoui, Abderrahman El Mhamedi, et al., PLM Standards Modelling for Enterprise Interoperability: A Manufacturing Case Study for ERP and MES, Systems Integration Based on ISA-95, in Proc. of 6th International IFIP Working Conference on Enterprise Interoperability (IWEI), May 2015, Nîmes, France. pp.157-170, https://hal.inria.fr/hal-01438399

Fieldbus Foundation www.fieldbus.org

Profibus www.profibus.com   
IEC TC65 www.iec.ch/tc65

**18. Teaching Evaluation**

**18.1 Evaluation** CU CAS [www.cas.chula.ac.th](http://www.cas.chula.ac.th)

**18.2 Changes made in accordance with previous year**

Add the PLC trainings as part of the teaching.