

# SYLLABUS

1. **Course Name:** Programmable Logic Controller Lab

2. **Course Code:** PPLC321346

3. **Credits:** 2 (0/2/4)

Duration: 15 weeks (6h main course and 12h self-study)

4. **Instructors:**

1- Nguyen Tan Doi, MEng

2- Nguyen Tran Minh Nguyet, MEng

3- Truong Dinh Nhon, PhD

4- Ta Van Phuong, MEng

5- Nguyen Thi Yen Tuyet, MEng

5. **Course conditions**

Prerequisites: Basic Electronic Lab, Basic Electrical Lab, Digital Lab

Corequisites: Basic Electronic Lab, Digital Lab

6. **Course description**

This course provides students the knowledge of PLC, sensors and actuators. The students have selection and design ability hardware and software for PLC based industrial systems.

7. **Course Goals**

| <i>Goals</i> | <i>Goal description</i>  | <i>ELOs</i>   |
|--------------|--|---------------|
| <b>G1</b>    | An ability to understand and represent sensor and actuator characteristics   | <b>01 (M)</b> |
| <b>G2</b>    | An ability to select suitable PLCs, sensors and actuators. Connecting and checking control diagram for PLC based systems | <b>02 (H)</b> |
| <b>G3</b>    | An ability to program for PLC based industrial applications  | <b>03 (H)</b> |
| <b>G4</b>    | An ability to read and analyse datasheet of sensors and actuators in English.  | <b>05 (M)</b> |
| <b>G5</b>    | An ability to analyse, design and program for PLC based industrial systems.  | <b>11 (H)</b> |

\*Note: High: H; Medium: M; Low: L

8. **Course Learning Outcomes (CLOs)**

| CLOs |      | Description   | ELOs     |
|------|------|---|----------|
| G1   | G1.1 | Represent structure, function and application areas of industrial sensors       | 01       |
|      | G1.2 | Represent structure, function and application areas of actuators                | 01       |
| G2   | G2.1 | Selecting sensors and actuators for industrial applications                     | 02       |
|      | G2.2 | Connecting sensors and actuators  | 02       |
|      | G2.3 | Selecting PLC and DI, DO, AI, AO modules for industrial applications            | 02<br>07 |
|      | G2.4 | Connecting, programming to control PLC based basic industrial applications      | 02<br>07 |
| G3   | G3.1 | Drawing flow chart for control systems  | 03<br>07 |
|      | G3.2 | Understand and apply instruction sets of PLCs                                   | 03       |
|      | G3.3 | Using effectively Simulink and program PLC softwares                            | 03<br>07 |
| G4   | G4.1 | An ability to read, understand structure and function of PLC modules in English | 05       |
| G5   | G5.1 | Represent steps to design PLC and SCADA systems                                 | 11<br>07 |
|      | G5.2 | Defining components of SCADA systems  | 11       |
|      | G5.3 | Designing hardware and software for basic SCADA systems                         | 11       |

## 9. Study materials

- Text book:

[1] Ngo Van Thuyen, *PLC Lab*, UTE, 2016

- Reference:

[2] Hugh Jack, *Automation Manufacturing Systems with PLCs*, April 14 2005

[3] Phan Minh Xuan, Nguyen Doan Phuong, *Automation using SIMATIC S7200, S7300*, Ariculture Ha Noi Puplicher, 1999

[4] LA Bryan, *Programmable Controller*, Industrial Text Company Publication, 1997

## 10. Student Assessments

- Grading points: 10

- Planning for students assessment is followed:

| Type | Content | Linetime | Assessment techniques | CLOs | Rates (%) |
|------|---------|----------|-----------------------|------|-----------|
|------|---------|----------|-----------------------|------|-----------|

|        |   |         |  |  |    |
|--------|---|---------|--|--|----|
| Exam01 | <ul style="list-style-type: none"> <li>- Selecting suitable sensors and actuators</li> <li>- Connecting sensors and actuators</li> <li>- Connecting sensors, actuators and PLC modules for basic applications</li> <li>- Configuring and programming for PLC</li> </ul> | Week 5  | <ul style="list-style-type: none"> <li>-Working in Group</li> <li>-Discussion</li> </ul> | G1.1<br>G1.2<br>G2.1<br>G2.2<br>G2.3<br>G2.4<br>G4.1 | 30 |
| Exam02 | <ul style="list-style-type: none"> <li>- Drawing flow chart and programming for industrial applications</li> </ul>  | Week 9  | <ul style="list-style-type: none"> <li>-Working in Group</li> <li>-Discussion</li> </ul> | G3.1<br>G3.2   | 30 |
| Exam03 | <ul style="list-style-type: none"> <li>- Drawing flow chart and programming for industrial applications with analog sensors</li> <li>- Using simulink and program software for different PLC</li> </ul>   | Week 12 | <ul style="list-style-type: none"> <li>-Working in Group</li> <li>-Discussion</li> </ul> | G3.2<br>G3.3   | 20 |
| Exam04 | <ul style="list-style-type: none"> <li>- Steps to design PLC and SCADA systems</li> <li>- Designing basic SCADA systems</li> </ul>  | Week 15 | <ul style="list-style-type: none"> <li>-Working in Group</li> <li>-Discussion</li> </ul> | G5.1<br>G5.2<br>G5.3                                 | 20 |

### 11. Course details:

| Week    | Contents  | CLOs   |
|---------|---|--|
| 1,<br>2 | <b>Lesson 1: &lt;SENSOR, ACTUATOR AND APPLICATIONS&gt; ( 0 / 12 / 24 )</b>  |  |
|         | <b>A/ Contents and teaching methods: (12 )</b><br><b>Contents:</b> <ul style="list-style-type: none"> <li>1.1 Investigating, defining, checking parameters of buttons, switches, sensors.</li> <li>1.2 Investigating, defining, checking parameters of Valve, Cylinders, Relays, Contactors, Motors and Inverters.</li> </ul> <b>Teaching methods:</b> <ul style="list-style-type: none"> <li>+ Presentation.</li> <li>+ Simulink</li> <li>+ Group discussion.</li> </ul> | <b>G1.1</b><br><b>G1.2</b><br><b>G2.1</b><br><b>G2.2</b> |
|         | <b>B/ Self-Study contents: (24 )</b> <ul style="list-style-type: none"> <li>+ Download datasheets of sensors and actuators</li> <li>+ Read and analyse parameters of sensors and actuators.</li> <li>+ Defining application areas of sensors and actuators.</li> </ul>  | <b>G1.1</b><br><b>G1.2</b><br><b>G4.1</b>                |
| 3,      | <b>Lesson 2: &lt;HARDWARE STRUCTURE OF PLC&gt; (0 / 18 / 36 )</b>   |  |

|                     |   |                              |
|---------------------|---|------------------------------|
| 4,<br>5             | <b>A/ Contents and teaching methods: ( 18 )</b><br><b>Contents:</b> <ul style="list-style-type: none"> <li>2.1 Investigating, defining, checking parameters of PLC: Power, CPU, DI, DO, AI, AO Modules and Communication Process Modules.</li> <li>2.2 Connecting sensors, actuators and PLC modules.</li> <li>2.3 Programming for PLC basic applications.</li> </ul> <b>Teaching methods:</b> <ul style="list-style-type: none"> <li>+ Presentation.</li> <li>+ Simulink</li> <li>+ Group discussion.</li> </ul>   | G2.3<br>G2.4<br>G4.1         |
|                     | <b>B/ Self-Study contents: (36 )</b> <ul style="list-style-type: none"> <li>+ Download datasheet of PLC modules.</li> <li>+ Read and analyse structure and parameters of PLC modules.</li> <li>+ Install simulink and programming software</li> </ul>   | G2.1<br>G2.2<br>G2.3<br>G4.1 |
| 6,<br>7,<br>8,<br>9 | <b>Lesson 3: &lt;PLC PROGRAMMING&gt; ( 0 / 24 / 48 )</b><br><b>A/ Contents and teaching methods: ( 24 )</b><br><b>Contents:</b> <ul style="list-style-type: none"> <li>3.1 Investigating instruction sets: bit, mov, convert, compare, math, Timer, Counter, sub-routine and interrupt routine</li> <li>3.2 Drawing flow chart for basic applications: Start_Stop Motor, Forward and Reverse Motor Control, Sequential Motor Control, Star and Triangle Motor Control, Automatic Door Control.</li> <li>3.3 Flowchart based Programming.</li> <li>3.4 Programming and simulink for different PLC</li> </ul> <b>Teaching methods:</b> <ul style="list-style-type: none"> <li>+ Presentation.</li> <li>+ Simulink</li> <li>+ Group discussion.</li> </ul> | G3.1<br>G3.2<br>G3.3         |
| 10,                 | <b>B/ Self-Study contents: (48 )</b> <ul style="list-style-type: none"> <li>+ Download manual of instruction PLC set.</li> <li>+ Read and analyse instruction set.</li> <li>+ Investigate symbols which are used in flowchart</li> </ul>  | G3.1<br>G3.2<br>G4.1         |
|                     | <b>Lesson 4: &lt;ANALOG PROCESSING IN PLC&gt; ( 0 / 18 / 36 )</b>   |                              |

|                  |   |                      |
|------------------|---|----------------------|
| 11,<br>12        | <b>A/ Contents and teaching methods: ( 18 )</b><br><b>Contents:</b> <ul style="list-style-type: none"> <li>4.1 Investigating and defining parameters of analog sensors: Temperature, pressure, ultrasonic sensors.</li> <li>4.2 Connecting, drawing flowchart and programming for industrial applications: Temperature control, Pressure control and Level control..</li> </ul> <b>Teaching methods:</b> <ul style="list-style-type: none"> <li>+ Presentation.</li> <li>+ Simulink</li> <li>+ Group discussion.</li> </ul>   | G3.2<br>G3.3         |
|                  | <b>B/ Self-Study contents: (36 )</b> <ul style="list-style-type: none"> <li>+ Download manual of analog sensors.</li> <li>+ Read and analyse parameters and functions of sensors</li> <li>+ Draw flowchart for basic control systems.</li> </ul>  | G3.2<br>G3.3<br>G4.1 |
| 13,<br>14,<br>15 | <b>Lesson 5: &lt;SCADA SYSTEM&gt; ( 0 / 18 / 36 )</b>   |                      |
|                  | <b>A/ Contents and teaching methods: (18 )</b><br><b>Contents:</b> <ul style="list-style-type: none"> <li>5.1 Studing SCADA software:: Wincc, Intouch, Labview, Factory Talk.</li> <li>5.2 Investigating hardware devices of SCADA systems: Sensors, actuators, PLC, HMI, Networks, PC.</li> <li>5.3 Communicating between software and hardware in SCADA systems.</li> <li>5.4 Designing basic SCADA systems.</li> </ul> <b>Teaching methods:</b> <ul style="list-style-type: none"> <li>+ Presentation.</li> <li>+ Simulink</li> <li>+ Group discussion.</li> </ul> | G5.1<br>G5.2<br>G5.3 |
|                  | <b>B/ Self-Study contents: ( 36 )</b> <ul style="list-style-type: none"> <li>+ Installing SCADA software.</li> <li>+ Downloading manual of SCADA software.</li> <li>+ Designing application graphics for Temperature, pressure and level systems.</li> </ul>  | G5.1<br>G5.2<br>G4.1 |

## 12. Learning ethics:

- Home assignments and projects must be done by the students themselves. Plagiarism found in the assessments will get zero point for midterm and final scores

## 13. First approved date: August 01 2012

## 14. Approval level:

**Dean**

**Department**

**Instructor**

**Nguyen Minh Tam, PhD**

**Nguyen Thanh Hai, PhD**

**Tan Doi Nguyen, MEng**

**15. Syllabus updated process**

|   |                    |
|---|--------------------|
| <b>1<sup>st</sup> time:</b> Updated content dated | Instructors        |
| <b>2<sup>st</sup> time:</b> Updated content dated | Head of department |