	Universitas Negeri Surabaya Faculty of Engineering, Mechanical Engineering Education Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Instrumentation and Control	8320302039	Study Program Elective Courses	T=2	P=0	ECTS=3.18	6	January 17, 2023

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model	**Project Based Learning**

Program Learning Outcomes (PLO)

PLO study program which is charged to the course

PLO-10	Have an understanding of mathematics and basic mechanical engineering

Program Objectives (PO)

PO - 1	Have good morals, ethics and personality in studying instrumentation and control systems
PO - 2	Have knowledge of the basic principles of instrumentation and control systems on industrial machines to produce a product
PO - 3	Able to collaborate and be responsible in developing instrumentation and control systems according to needs
PO - 4	Have the ability to design instrumentation and control systems for industrial machines to produce a product

PLO-PO Matrix

P.O	PLO-10
PO-1	
PO-2	
PO-3	
PO-4	

PO Matrix at the end of each learning stage (Sub-PO)

P.O	Week															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PO-1																
PO-2																
PO-3																
PO-4																

Short Course Description

In this course students learn about the basic principles of instrumentation and control systems, functions and applications of various types of sensors, basic logic gates, Boolean algebra, relay control and programmable logic controllers (PLC) using various forms of learning in the form of lectures, practicums, designing and using various Learning methods include group discussions, simulations, case studies, and project-based learning.

References

Main :

1. [1] Bolton, W. 2006. Sistem Instrumentasi dan Sistem Kontrol. Penerbit Erlangga: Jakarta
2. [2] Dunn, William C. 2005. Fundamentals of Industrial Istrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.

Supporters:

	1. [3] Groover, Mikell P., 2001. Automation, Production Systems dan Computer Integrated Manufacturing, Second Edition, Prentice-Hall Inc., New Jersey USA. 2. [4] Johnson, C.D. 2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall Inc., New Jersey.
Supporting lecturer	Ir. Wahyu Dwi Kurniawan, S.Pd., M.Pd.

Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [Estimated time]		Learning materials [References]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline (*offline*)	Online (*online*)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Able to explain basic principles and draw block diagrams of instrumentation and control systems	Accuracy explains the basic principles of instrumentation and control systems	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	* Lecture, * Case study, * Discussion, * 2x50	* Lecture, * Case study, * Discussion, * 2x50	**Material:** Basic principles and drawing block diagrams of instrumentation and control systems. **References:** *[1] Bolton, W. 2006. Instrumentation and Control Systems. Erlangga Publisher: Jakarta*	5%
2	Able to explain basic principles and draw block diagrams of instrumentation and control systems	The accuracy of designing the block diagram of a control system	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	* Lecture, * Case study, * Discussion, * Assignment-1: Draw block diagrams of open loop and close loop control systems * 2x50	* Lecture, * Case study, * Discussion, * Assignment-1: Draw block diagrams of open loop and close loop control systems * 2x50	**Material:** Basic principles and drawing block diagrams of instrumentation and control systems. **References:** *[1] Bolton, W. 2006. Instrumentation and Control Systems. Erlangga Publisher: Jakarta*	5%
3	Students are able to identify various types of sensors and their applications	Accuracy of identifying at least 5 types of sensors	**Criteria:** Compliance with the answer key **Form of Assessment** : Participatory Activities	* Lecture, * Discovery learning, * Discussion, * 2x50	* Lecture, * Discovery learning, * Discussion, * 2x50	**Material:** Various types of sensors and their applications **References:** *[2] Dunn, William C. 2005. Fundamentals of Industrial Instrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.*	5%
4	Students are able to identify various types of sensors and their applications	Accuracy of identifying at least 5 types of sensors	**Criteria:** Compliance with the answer key **Form of Assessment** : Participatory Activities	* Lecture, * Discovery learning, * Discussion, * Task-2: Identify at least 5 types of sensors with their applications * 2x50	* Lecture, * Discovery learning, * Discussion, * Task-2: Identify at least 5 types of sensors with their applications * 2x50	**Material:** Various types of sensors and their applications **References:** *[2] Dunn, William C. 2005. Fundamentals of Industrial Instrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.*	5%

5	Understand actuators and transducers	Accuracy in distinguishing between actuators and transducers	**Criteria:** Compliance with the answer key **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	* Lecture, * Discovery learning, * Discussion, * 2x50	* Lecture, * Discovery learning, * Discussion, * 2x50	**Material:** Actuators and transducers **References:** *[3] Groover, Mikell P., 2001. Automation, Production Systems and Computer Integrated Manufacturing, Second Edition, Prentice-Hall Inc., New Jersey USA.*	5%
6	Distinguish the working principles of basic logic gates	Accuracy distinguishes the working principles of AND, OR, NOT, NAND, NOR logic gates	**Criteria:** Compliance with the answer key **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	* Lecture, * Discovery learning, * Discussion, * 2x50	* Lecture, * Discovery learning, * Discussion, * 2x50	**Material:** Basic logic gates **References:** *[4] Johnson, CD 2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall Inc., New Jersey.*	5%
7	Able to apply Boolean algebra to simplify logical equations	The accuracy of applying Boolean algebra in simplifying logical equations	**Criteria:** Compliance with the answer key	* Lecture, * Discovery learning, * Discussion, * Assignment-4: Simplify logical equations and describe them, * 2x50	* Lecture, * Discovery learning, * Discussion, * Assignment-4: Simplify logical equations and describe them, * 2x50	**Material:** Basic logic gates **References:** *[4] Johnson, CD 2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall Inc., New Jersey.* **Material:** Boolean Algebra **References:** *[2] Dunn, William C. 2005. Fundamentals of Industrial Instrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.*	5%
8	Sub Summative Exam	Sub Summative Exam	**Criteria:** Compliance with the answer key **Form of Assessment** : Participatory Activities	Sub Summative Exam * 2x50	Sub Summative Exam * 2x50	**Material:** Meeting material 1 to 7 **References:** *[1] Bolton, W. 2006. Instrumentation Systems and Control Systems. Erlangga Publisher: Jakarta*	10%
9	Understand the function, main parts, and working principles of relays	Accurately explains the function of the relay, the main parts of the relay, and the working principle of the relay	**Criteria:** Compliance with the answer key **Form of Assessment** : Test	* Lecture, * Discovery Learning, * Discussion in groups, * Assignment-5: Explain the function, main parts, and working principles of relays * 2x5	* Lecture, * Discovery Learning, * Discussion in groups, * Assignment-5: Explain the function, main parts, and working principles of relays * 2x5	**Material:** Relay **References:** *[2] Dunn, William C. 2005. Fundamentals of Industrial Instrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.*	5%

10	Demonstrate a relay system control circuit	Accuracy in demonstrating relay control circuits of relay systems	**Criteria:** Assessment rubric **Form of Assessment** : Practice / Performance	* Laboratory Practice, * Discovery Learning, * Discussion in groups, * Task-5: Explain the function, main parts, and working principles of relays, • Project Based Learning, Discussion in groups • Phase 1: Determining Basic Questions Lecturer asks: How is the quiz control sequence quiz? Students respond to the lecturer‘s questions. • Phase 2: Developing a project plan. The lecturer gives students time to design a series of quiz controls. Students design a series of quiz controls for 3 participants in groups. • Phase 3: Develop a schedule. The lecturer makes an agreement on the deadline for submitting the project. Students develop a timeline for completing the project, a series of quizzes for 3 participants in groups • Phase 4: Monitoring The lecturer monitors the student process of collecting project results. Students submit their work according to the agreed time limit • Phase 5: Testing the Results Students test their	* Laboratory Practice, * Discovery Learning, * Discussion in groups, * Task-5: Explain the function, main parts, and working principles of relays * 2x5	**Material:** Relay systems **References:** *[3] Groover, Mikell P., 2001. Automation, Production Systems and Computer Integrated Manufacturing, Second Edition, Prentice-Hall Inc., New Jersey USA.*	10%

				circuits through computer simulations and relay trainer kits. The circuit testing process is observed by the lecturer to see the quality of the product. • Phase 6: Evaluation of Experience Students revise if the sequence is not correct Lecturer gives students time to reflect and revise the project Lecturer provides suggestions and input on the project * 2x5			
11	Students are able to identify PLC systems	Designing PLC control program flowcharts	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments * 2x50		**Material:** PLC System **References:** *[1] Bolton, W. 2006. Instrumentation Systems and Control Systems. Erlangga Publisher: Jakarta*	5%
12	Students are able to create PLC programs	Designing ladder diagrams using the Cx application. Programmer	**Criteria:** Compliance with the answer key **Form of Assessment** : Assessment of Project Results / Product Assessment, Practices / Performance	Lectures, discussions, questions and answers, exercises and assignments * 2x50		**Material:** PLC Programming **References:** *[2] Dunn, William C. 2005. Fundamentals of Industrial Instrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.*	5%
13	Students are able to create PLC programs	Designing ladder diagrams using the Cx application. Programmer	**Criteria:** Compliance with the answer key **Form of Assessment** : Assessment of Project Results / Product Assessment, Practices / Performance	Lectures, discussions, questions and answers, exercises and assignments * 2x50		**Material:** PLC Programming **References:** *[2] Dunn, William C. 2005. Fundamentals of Industrial Instrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.*	5%
14	Students are able to operate a PLC	Operate the PLC according to SOP	**Criteria:** Assessment rubric **Form of Assessment** : Project Results Assessment / Product Assessment	Laboratory practice, discussions and assignments * 2x50		**Material:** PLC Operation **References:** *[4] Johnson, CD 2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall Inc., New Jersey.*	5%

15	Students are able to operate a PLC	Operate the PLC according to SOP	**Criteria:** Assessment rubric **Form of Assessment** : Project Results Assessment / Product Assessment	Laboratory practice, discussions and assignments * 2x50		**Material:** PLC Operation **References:** *[4] Johnson, CD 2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall Inc., New Jersey.*	5%
16	Summative Exam	Compliance with the answer key	**Criteria:** Assessment rubric **Form of Assessment** : Project Results Assessment / Product Assessment, Test	Summative Exam * 2x50		**Material:** All material **References:** *[1] Bolton, W. 2006. Instrumentation Systems and Control Systems. Erlangga Publisher: Jakarta*	15%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	32.5%
2.	Project Results Assessment / Product Assessment	30%
3.	Practice / Performance	15%
4.	Test	17.5%
		95%

Notes

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.