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

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Instrumentation and Control	2120102028	MK Strengthening Study Programs	T=2	P=0	ECTS=3.18	6	January 23, 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 that is charged to the course	
PLO-5	Work independently and in groups
PLO-14	Science and engineering knowledge

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-5	PLO-14
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. Dunn, William C. 2005. Fundamentals of Industrial Istrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.

Supporters:

	1. Bolton, W. 2006. Sistem Instrumentasi dan Sistem Kontrol. Penerbit Erlangga: Jakarta 2. Groover, Mikell P., 2001. Automation, Production Systems dan Computer Integrated Manufacturing, Second Edition, Prentice-Hall Inc., New Jersey USA. 3. Johnson, C.D. 2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall Inc., New Jersey.
Supporting lecturer	Agung Prijo Budijono, S.T., M.T. 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	* Lectures, * Case studies, discussions in groups * 2x50		**Material:** Basic principles and drawing block diagrams of instrumentation and control systems. **Reference:** *Dunn, William C. 2005. Fundamentals of Industrial Instrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.*	2%
2	Able to explain basic principles and draw block diagrams of instrumentation and control systems	Designing a block diagram of a control system	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	* Lectures, * Case studies, discussions in groups * 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. **Reference:** *Dunn, William C. 2005. Fundamentals of Industrial Instrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.*	2%
3	Students are able to identify various types of sensors and their applications	Accuracy of identifying at least 5 types of sensors	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities	* Lectures, * Discovery learning, discussions in groups * 2x50		**Material:** Various types of sensors and their applications **References:** *Dunn, William C. 2005. Fundamentals of Industrial Instrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.*	2%
4	Able to identify various types of sensors and their applications	Accuracy explains the application of at least 5 types of sensors	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	* Lecture, * Discovery learning, * Discussion in groups, * Task-2: Identify at least 5 types of sensors with their applications * 2x50		**Material:** Various types of sensors and their applications **References:** *Dunn, William C. 2005. Fundamentals of Industrial Instrumentation and Process Control. USA: Mc Graw-Hill Companies, Inc.*	2%

5	Distinguish the working principles of basic logic gates	Accuracy distinguishes the working principles of AND, OR, NOT, NAND, NOR logic gates	**Criteria:** Assessment rubric **Forms of Assessment** : Participatory Activities, Portfolio Assessment, Tests	* Lecture, * Discussion in groups, * Assignment-3: Explain the different working principles of AND, OR, NOT, NAND, NOR logic gates * 2x50		**Material:** Basic logic gates **Reference:** *Bolton, W. 2006. Instrumentation Systems and Control Systems. Erlangga Publisher: Jakarta*	5%
6	Able to apply Boolean algebra to simplify logical equations	The accuracy of applying Boolean algebra in simplifying logical equations	**Criteria:** Compliance with the assessment rubric **Form of Assessment** : Participatory Activities	* Lectures, * Discovery learning, discussions in groups * 2x50		**Material:** Boolean Algebra **Reference:** *Bolton, W. 2006. Instrumentation Systems and Control Systems. Erlangga Publisher: Jakarta*	5%
7	Able to apply Boolean algebra to simplify logical equations	The accuracy of applying Boolean algebra in simplifying logical equations	**Form of Assessment** : Participatory Activities, Tests	* Lecture, * Discovery learning, discussion in groups, * Task-4: Simplify logical equations and describe them, * 2x50		**Material:** Boolean Algebra **Reference:** *Bolton, W. 2006. Instrumentation Systems and Control Systems. Erlangga Publisher: Jakarta*	5%
8	UTS	Compliance with the answer key gets a score of 100	**Criteria:** Compliance with the answer key gets a score of 100	UTS * 2x50			20%
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:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	* Lecture, * Discovery Learning, Discussion in groups, * Assignment-5: Explain the function, main parts, and working principles of relays * 2x50		**Material:** Relay **Bibliography:** *Groover, Mikell P., 2001. Automation, Production Systems and Computer Integrated Manufacturing, Second Edition, Prentice-Hall Inc., New Jersey USA.*	10%
10	Understand basic logic gates	Explain the working principles of basic logic gates. Differentiate basic logic gates. Draw basic logic circuits	**Criteria:** Assessment rubric **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Tests	• Laboratory Practice • Project Based Learning, Discussion in groups • Phase 1: Determining Basic Questions The lecturer asks: What is the control sequence for the quiz 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		**Material:** Design of relay control systems **References:** *Groover, Mikell P., 2001. Automation, Production Systems and Computer Integrated Manufacturing, Second Edition, Prentice-Hall Inc., New Jersey USA.*	20%

				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 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 * 2 X 50			
11	Understand the functions, main parts, advantages and disadvantages and programming procedures of PLC	Accuracy in explaining PL functions, the main parts of a PLC, identifying the advantages and disadvantages of a PLC, and understanding PLC programming procedures	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Tests	* Lecture, * Discussion in groups, * Task-6: explain the function, main parts, advantages and disadvantages of PLC, * 2 X 50		**Material:** PLC **Reference:** *Johnson, CD 2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall Inc., New Jersey.*	5%
12	Designing PLC programs	Assessment rubric	**Criteria:** The accuracy of designing ladder diagrams using the Cx application. Programmer in completing the project **Form of Assessment** : Participatory	• Laboratory Practice • Project Based Learning, Discussion in groups • Phase 1: Determining Basic Questions		**Material:** PLC Programming **Reference:** *Johnson, CD 2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall*	10%

			Activities, Project Results Assessment / Product Assessment	The lecturer asks: How to make a traffic light control circuit using a PLC? Students respond to the lecturer's questions. • Phase 2: Develop a project plan. The lecturer gives students time to design the program and operate the PLC. Students design a ladder diagram using cx.programmer 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 PLC programming and operating project • 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 circuits using computer simulations and PLC 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 * 2 X 50		*Inc., New Jersey.*	
13	Designing PLC programs	The accuracy of designing ladder diagrams using the Cx	**Criteria:** Assessment rubric **Form of**	• Laboratory Practice • Project Based		**Material:** PLC Programming **Reference:** *Johnson, CD*	10%

			application. Programmer in completing the project	**Assessment** : Participatory Activities	Learning, Discussion in groups • Phase 1: Determining Basic Questions The lecturer asks: How to make a traffic light control circuit using a PLC? Students respond to the lecturer's questions. • Phase 2: Develop a project plan. The lecturer gives students time to design the program and operate the PLC. Students design a ladder diagram using cx.programmer 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 PLC programming and operating project • 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 circuits using computer simulations and PLC 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		*2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall Inc., New Jersey.*	

				and input on the project			
14	Operate the PLC	Skilled in operating PLC according to procedures	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	* 2 X 50 • Laboratory Practice • Project Based Learning, Discussion in groups • Phase 1: Determining Basic Questions The lecturer asks: How to make a traffic light control circuit using a PLC? Students respond to the lecturer's questions. • Phase 2: Develop a project plan. The lecturer gives students time to design the program and operate the PLC. Students design a ladder diagram using cx.programmer 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 PLC programming and operating project • 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 circuits using computer simulations and PLC 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		**Material:** PLC Operation **Reference:** *Johnson, CD 2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall Inc., New Jersey.*	10%

				to reflect and revise the project Lecturer provides suggestions and input on the project * 2 X 50			
15		Skilled in operating PLC according to procedures	**Criteria:** Assessment rubric **Form of Assessment** : Participatory Activities	• Laboratory Practice • Project Based Learning, Discussion in groups • Phase 1: Determining Basic Questions The lecturer asks: How to make a traffic light control circuit using a PLC? Students respond to the lecturer's questions. • Phase 2: Develop a project plan. The lecturer gives students time to design the program and operate the PLC. Students design a ladder diagram using cx.programmer 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 PLC programming and operating project • 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 circuits using computer simulations and PLC trainer kits. The circuit testing process is observed by the lecturer to see the quality of the product. • Phase 6:		**Material:** PLC Operation **Reference:** *Johnson, CD 2003. Process Control Instrumentation Technology, Seventh Edition. USA: Prentice Hall Inc., New Jersey.*	10%

				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 * 2 X 50			
16	UAS	Compliance with the answer key gets a score of 100	**Criteria:** Compliance with the answer key gets a score of 100	UAS * 2x50			30%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	58.34%
2.	Project Results Assessment / Product Assessment	16.67%
3.	Portfolio Assessment	1.67%
4.	Test	21.34%
		98.02%

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.