



**TEACHING INSTRUCTIONAL DESIGN (BRP)  
COURSE  
SENSORS AND ACTUATORS 2**

**by**

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## **PREFACE**

Teaching Instructional Design (BRP) contains the teaching plans for 1 whole semester. This BRP is arranged to be used as a reference in teaching the course Instrumentation Physics 1 in the Undergraduate Physics Program at FMIPA UI.

The course Sensors and Actuators 1 is designed to be taken in the 5<sup>th</sup> term for physics students while requiring them to have taken the course Electronics 2. In this course, students will learn about Temperature Sensors, Mechanical Sensors, as well as the definition, classification, and characteristics of actuators.

The learning method used in this class is called *Collaborative Learning* (CL) where students will become the focus in the studying process (*Student Centered Learning*). Students will participate in 2 groups called the Focus Group (FG) and the Home Group (HG) while filling in forms that will be handed through out the course. Both these groups will have their own discussions with their own topics. The primary media used for studying this course will be through the eLearning UI platform called SceLE which can be accessed through [scele.ui.ac.id](http://scele.ui.ac.id). Every learning materials, forms, syllabus as well as tasks given to the students can be accessed through SceLE. In the end of the course, students have to present the task given by the teacher based on the topics discussed throughout the course.

This BRP is hoped to be used as a standard for the teaching process for students and teachers as well as the people who want to study this specific course.

Depok, May 2016

**Dr. Santoso**

## General Information

1. Name of Program / Study Level : Physics / Undergraduate
2. Course Name : Sensors and Actuators 2
3. Course Code : SCFI603713
4. Semester : 7
5. Credit : 2 credits
6. Teaching Method(s) : Collaborative Learning (In class/as groups, individually and online)
7. Prerequisite course(s) : Sensors and Actuators 1
8. Requisite for course(s) : Courses in the concentration of Instrumentation Physics
9. Integration Between Other Courses : Laboratory Work of Sensors and Actuators
10. Lecturer(s) : Dr. Santoso
11. Course Description : Explaining the basic principles of Sensors and Actuators which include Optical Sensors (Infrared and Pyroelectric, UV, Visible, and Image Sensors), Magnetic Sensors (Magneto galvanic Sensors, Magneto resistive Sensors, Inductive Sensors and Eddy Currents), Biological Sensors (Biosensor), Pneumatic Sensors, Piezoelectric Actuators, and Thermal Bimorphs.

## I. Course Learning Outcome (CLO) and Sub-CLOs

### A. CLO

Students are able to explain the technology behind sensors and actuators, precisely select and choose sensors and actuators needed for certain conditions, and apply it for monitoring and measuring physical units (C3) (ELO(s) 3, 5, 6, 7)

### B. Sub-CLOs

1	Introduction to the course Sensors and Actuators 1 as well as CL methods (C3)	1
2	Explaining the Definition, Classification and Characteristics of Sensors (C2)	1
3	Explaining the Optical Sensor (Infrared and Pyroelectric) (C2)	1
4	Explaining the Optical Sensor (Ultraviolet and Visible Light Sensors) (C2)	1
5	Explaining the Optical Sensor (Image Sensors) (C2)	1
6	Explaining the Magnetic Sensor (Magneto Galvanic Sensors) (C2)	1
7	Explaining the Magnetic Sensor (Magneto Resistive Sensors) (C2)	1
8	Explaining the Magnetic Sensor (Inductive and Eddy Current Sensors) (C2)	1
9	Explaining Chemical and Biological Sensors (Chemical Sensors) (C2)	1
10	Explaining Chemical and Biological Sensors (Biosensors) (C2)	1
11	Explaining Actuators (Pneumatic Instruments) (C2)	1
12	Explaining Actuators (Piezo Electric) (C2)	1
13	Explaining Actuators (Thermal Bimorphs) (C2)	1

## II. Teaching Plan

Week	Sub-CLO	Study Materials	Teaching Method	Time Required	Learning Experiences (*O-E-F)	Sub-CLO Weight on Course (%)	Sub-CLO Achievement Indicator	References
1	1	Introduction	Lecturing Class	100 minutes	70% O, 0% E, 30% F	4	Explaining the basic teaching methods used in class	
2	2,3,4,5,6,7	1 <sup>st</sup> Phase of Focus Group Discussion no. 1	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Each Focus Group will explore and discuss the individual tasks that will be distributed to everyone based on their specific topic	1
3	2,3,4,5,6,7	2 <sup>nd</sup> Phase of Focus Group Discussion no. 1	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	The Focus Group members will present their individual task to the other members of the group	1
4	2,3,4,5,6,7	1 <sup>st</sup> Phase of Home Group Discussion no. 1	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Presenting the result of the Focus Group Discussion to the Home Group	1
5	2,3,4,5,6,7	2 <sup>nd</sup> Phase of Home Group Discussion no. 1	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Preparing the materials needed for the presentation	1

6	2,3,4,5,6,7	1 <sup>st</sup> Presentation	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Able to explain the basic concepts of: a) Definition, Classification, and Characteristics of Sensors b) Temperature Sensors	1
7	2,3,4,5,6,7	2 <sup>nd</sup> Presentation	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Able to explain the basic concepts of: a) Definition, Classification, and Characteristics of Sensors b) Temperature Sensors	1
8	<b>Mid Term Exam</b>							
9	8,9,10,11,12,13	1 <sup>st</sup> Phase of Focus Group Discussion no. 2	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Each Focus Group will explore and discuss the individual tasks that will be distributed to everyone based on their specific topic	1
10	8,9,10,11,12,13	2 <sup>nd</sup> Phase of Focus Group Discussion no. 2	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	The Focus Group members will present their individual task to the other	1

							members of the group	
11	8,9,10, 11,12, 13	1 <sup>st</sup> Phase of Home Group Discussion no. 2	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Presenting the result of the Focus Group Discussion to the Home Group	1
12	8,9,10, 11,12, 13	2 <sup>nd</sup> Phase of Home Group Discussion no. 2	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Preparing the materials needed for the presentation	1
13	8,9,10, 11,12, 13	1 <sup>st</sup> Presentation	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Able to explain the basic concepts of: a) Mechanical Sensors b) Actuators	1
14	8,9,10, 11,12, 13	2 <sup>nd</sup> Presentation	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Able to explain the basic concepts of: a) Mechanical Sensors b) Actuators	1
15	8,9,10, 11,12, 13	Reviewing Final Exam Materials	Lecturing Class	100 minutes				
16	<b>Final Exam</b>							

\*) O : Orientation  
E : Discussion  
F : Feedback

References:

1. <https://scele.ui.ac.id/course/view.php?id=8661> enrollment key:
2. Sensors, Volume 6, Optical Sensor, W. Goppel, J. Hesse, JN. Zemel, VCH, 1992.

3. Fraden, J. , GAIP Handbook of Modern Sensors, Physics, Designs and Applications, J American Institute of Physics, 2004.
4. Sensors, Volume 5, Magnetic Sensor, W. Gospel, J. Hesse, JN. Zemel, VCH, 1989.
5. Instrumentation Reference Book, Walt Boyes, Butterwort - Heinemann, 2003
6. Webster, John G., The Measurement, Instrumentation and Sensors Handbook, CRC Press, 1999. Instrumentation Reference Book, Walt Boyes, Butterwort - Heinemann, 2003
7. William C. Dunn, Introduction to Instrumentation, Sensors, and Process Control, Artech House, 2006.



### III. Assignment Design

Week	Assignment Name	Sub-CLO	Assignments	Scopes	Working Procedure	Deadline	Outcome
1	Individual and Group Tasks	1	Questions	Teaching Methods	As a group, individually and online	100 minutes	-
2	Individual and Group Tasks	2	Questions	Summarize the main topic Doing tasks Filling out the form	As a group (FG), individually and online	1 week	Form, Student Assignment Sheet
3	Individual and Group Tasks	3	Questions	Summarize the main topic Doing tasks Filling out the form	As a group (FG), individually and online	1 week	Form, Student Assignment Sheet
4	Individual and Group Tasks	4	Questions	Summarize the main topic Doing tasks Filling out the form	As a group (HG), individually and online	1 week	Form, Group Assignment Sheet
5	Individual and Group Tasks	5	Questions	Summarize the main topic Doing tasks Filling out the form	As a group (HG), individually and online	1 week	Student Power Point, Result of Presentation, Form
6	Presentation	6	Questions	Explaining the concepts of: a) Optical Sensors b) Magnetic Sensors	As a group, individually and online	100 minutes	Student Power Point, Result of Presentation, Form

7	Presentation	7	Questions	Explaining the concepts of: a) Optical Sensors b) Magnetic Sensors	As a group, individually and online	100 minutes	Student Power Point, Result of Presentation, Form
9	Individual and Group Tasks	8	Questions	Summarize the main topic Doing tasks Filling out the form	As a group (FG), individually and online	1 week	Form, Student Assignment Sheet
10	Individual and Group Tasks	10	Questions	Summarize the main topic Doing tasks Filling out the form	As a group (FG), individually and online	1 week	Form, Student Assignment Sheet
11	Individual and Group Tasks	11	Questions	Summarize the main topic Doing tasks Filling out the form	As a group (HG), individually and online	1 week	Form, Group Assignment Sheet
12	Individual and Group Tasks	11	Questions	Summarize the main topic Doing tasks Filling out the form	As a group (HG), individually and online	1 week	Student Power Point, Result of Presentation, Form
13	Presentation	12	Questions	Explaining the concepts of: a) Chemical and Biological Sensors b) Actuators (Pneumatic Instruments, Piezoelectric, and Thermal Bimorphs)	As a group, individually and online	100 minutes	Student Power Point, Result of Presentation, Form
14	Presentation	13	Questions	Explaining the concepts of: a) Chemical and Biological Sensors b) Actuators (Pneumatic Instruments, Piezoelectric, and Thermal Bimorphs)	As a group, individually and online	100 minutes	Student Power Point, Result of Presentation, Form
15	Reviewing Final Exam Materials	14	Questions	Explaining the concepts of: a) Chemical and Biological Sensors b) Actuators (Pneumatic Instruments, Piezoelectric, and Thermal Bimorphs)	As a group, individually and online	100 minutes	

#### IV. Assessment Criteria (Learning Outcome Evaluation)

Evaluation Type	Sub-CLO	Assessment Type	Frequency	Evaluation Weight (%)
Forms	2-13	Activity in Scele		20
Student Assignment Sheet	2;3;4;5;6;7; and 8;9;10;11;12;13	Evaluation Form (LTM)	2	20
Papers and Presentation (HG1 and HG2)	2-7 and 8-13	PowerPoint	2	10
Presentation	2-7 and 8-13	LTM	2	10
Mid-Term Exam	2-7	Essay Questions	1	20
Final Exam	8-13	Essay Questions	1	20
<b>Total</b>				<b>100</b>

#### V. Rubric(s)

##### A. Criteria for Presentation

Grade	Quality of Answer
85-90	If the group is able to present their materials logically, fluently and is able to finish their presentation on time while also being able to answer questions being given by other students or the teacher.
75-84	If the group is able to present their materials logically and fluently while also being able to answer questions being given by other students or the teacher but is not able to manage their time properly
65-74	If the group is able to present their materials logically but is not able to logically explain the process of their material
55-64	The group is not able to present their materials fluently nor logically and is not able to manage their time properly
<55	

##### B. Criteria for the Mid-Term Exam and Final Exam

Grade	Quality of Answer
100	The answers are precise, every definition and main components are included
76-99	The answers precise enough, all definitions and main components that are needed to answer the question are almost precise
51-75	The answers are less precise, the definitions and main components that are needed to answer the question are less precise
26-50	The answers are very unprecise, the definitions and main components that are needed to answer the questions are missing a lot of details

<25	Wrong answer
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