TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

INSTRUMENTATION PHYSICS 1

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 Instrumentation Physics 1 is designed to be taken in the 5^{th} term for physics students while requiring them to have taken the course Electronics 2. In this course, students will learn about the standard instruments that is used in instrumentational systems as well as its reliability and safety procedures. In the end of the course, students will present a task given by the teaching that is appropriate with the topics in class.

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. Adhi Harmoko S

I. General Information

1.	Name of Program / Study Level	:	Physics / Undergraduate
2.	Course Name	:	Instrumentation Physics
3.	Course Code	:	SCFI603712
4.	Semester	:	5
5.	Credit	:	2 credits
6.	Teaching Method(s)	:	Collaborative Learning (In class/as groups, individually and online)
7.	Prerequisite course(s)	:	Electronics 2
8.	Requisite for course(s)	:	Electronics 2
9.	Integration Between Other Courses	:	Courses in the concentration of Instrumentation Physics
10.	Lecturer(s)	:	Dr Adhi Harmoko S
11.	Course Description	:	Explaining the basic principles of instrumentational systems which will discuss about types of instrumentation, models instrumentational systems, instrument characters, calibration principals, noise measurement and signal processing, indicators, and instruments for testing electrical signals, methods on converting electrical units, protocols in transmitting digital signals, digital computation and smart devices, and also the reliabilities and safety protocols of instrumentational systems.

II. Course Learning Outcome (CLO) and Sub-CLOs

A. CLO

Students are able to explain basic concepts on instrumentation based on scientific and physical properties. (ELO(s) 3, 5, 6, 8)

B. Sub-CLOs

1	Applying Teaching Methods (C3)	1
2	Explaining types of instrumentations (C2)	1
3	Explaining the models of instrumentational systems (C2)	1
4	Explaining the static and dynamic characters of instrumentation systems (C2)	1
5	Explaining the systematic and random mistakes that can happen in the measuring process (C2)	1
6	Explaining the concepts of calibration (C2)	1
7	Explaining noise measurement and signal processing (C2)	1
8	Explaining the instruments and indicators for assessing electrical signals (C2)	1
9	Explaining the methods of converting electrical signal units, including the delta-sigma method (C2)	1
10	Explaining the transmission of electrical, pneumatic, fiber optic and radio signals (C2)	1
11	Explaining the protocols of transmitting digital signals (C2)	1
12	Explaining digital computation and smart devices (C2)	1
13	Explaining how to display, record and present the results of data measurement (C2)	1
14	Explaining the reliability and safety protocols of instrumentational systems (C2)	1

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III. 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	Collaborative Learning	100 minutes	70% O, 0% E, 30% F	4	Explaining the basic teaching methods used in class	
2	2	Types of instrumentations	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	7	Able to explain the basic concepts of: a) Active and Passive Instruments b) Analogue and Digital Instruments c) Smart and Nonsmart Instruments	Chapter 2 Page 12-16
3	3	Instrumentation System Modelling	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	7	Able to explain the basic concepts of: a) Models of Instrumentational Systems	
4	4	Characteristics of Static and Dynamic Instruments	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	7	Able to explain the basic concepts of: a) Measurement Uncertainty	Chapter 2 Page 16-25

							b) Precision/Repeatability/ Reproducibility c) Zero-Order Instrument d) First-Order Instrument	
5	5	Systematic and Random mistakes done in the measurement process	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	7	Able to explain the basic concepts of: a) Sources of Systematic Error b) Reduction of Systematic Errors c) Quantification of Systematic Errors	Chapter 3 Page 33-42
6	6	Calibration Principals	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	7	Able to explain the basic concepts of: a) Principles of Calibration b) Control of Calibration Environment c) Calibration Chain and Traceability	Chapter 4 Page 64-67
7	7	Noise measurement and	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Able to explain the basic concepts of:	Chapter 5 Page 78-101

		signal processing					a) Analogue Filters b) Digital Filters	
8	8	Indicators and instruments in assessing electrical signals	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Able to explain the basic concepts of: a) Digital Meters b) Analogue Meters c) Oscilloscopes	Chapter 6 Page 102-118
9	**Mid Term Exam**							
10	9	Methods in converting electrical signal units, including the delta-sigma method	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	7	Able to explain the basic concepts of: a) Bridge Circuits b) Resistance Measuremen c) Frequency Measurement	Chapter 7 Page 119-144
11	10	Electrical, pneumatic, fiber optic and radio signal transmission	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	7	Able to explain the basic concepts of: a) Electrical Transmission b) Pneumatic Transmission c) Fiber-Optic Transmission d) Optical Wireless Telemetry	Chapter 8 Page 151-162

							e) Radiotelemetry	
12	11	Protocols in digital signal transmision	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	7	Able to explain the basic concepts of: a) Digital Transmission Protocols	Chapter 8 Page 163
13	12	Digital computations and smart devices	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Able to explain the basic concepts of: a) Principles of Digital Computation b) Intelligent Devices	Chapter 9 Page 165-185
14	13	Displaying, recording and presenting the results of data measurement	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Able to explain the basic concepts of: a) Display of Measurement Signals b) Recording of Measurement Data c) Presentation of Data	Chapter 11 Page 200-213
15	14	The reliabilities and safety protocols of instrumentational systems	Collaborative Learning	100 minutes	20% O, 50% E, 30% F	8	Able to explain the basic concepts of: a) Reliability b) Safety Systems	Chapter 12 Page 224-241

16	**Final Exam**

*) O : Orientation
E : Discussion
F : Feedback

References:

1. Moris, Alan S, *Measurement and Instrumentation Principles, 3rd Ed*, Butterworth – Heinemann, 2001
2. Boyes, Walt, *Instrumentation Reference Book, 3rd Ed*, Butterworth – Heinemann, 2003.
3. Webster, John G., *Measurement Instrumentation and Sensor Handbook*, CRC Press, 1999.

IV. 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	a) Active and Passive Instruments b) Analogue and Digital Instruments c) Smart and Nonsmart Instruments	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
3	Individual and Group Tasks	3	Questions	Models of Instrumentational Systems	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
4	Individual and Group Tasks	4	Questions	a) Measurement Uncertainty b) Precision/Repeatability/ Reproducibility c) Zero-Order Instrument d) First-Order Instrument	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
5	Individual and Group Tasks	5	Questions	a) Sources of Systematic Error b) Reduction of Systematic Errors c) Quantification of Systematic Errors	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
6	Individual and Group Tasks	6	Questions	a) Principles of Calibration b) Control of Calibration Environment c) Calibration Chain and Traceability	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone

							assignment sheet
7	Individual and Group Tasks	7	Questions	a) Analogue Filters b) Digital Filters	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
8	Individual and Group Tasks	8	Questions	a) Digital Meters b) Analogue Meters c) Oscilloscopes	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
10	Individual and Group Tasks	10	Questions	a) Bridge Circuits b) Resistance Measurement c) Frequency Measurement	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
11	Individual and Group Tasks	11	Questions	a) Electrical Transmission b) Pneumatic Transmission c) Fiber-Optic Transmission d) Optical Wireless Telemetry e) Radiotelemetry	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
12	Individual and Group Tasks	11	Questions	Digital Transmission Protocols	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
13	Individual and Group Tasks	12	Questions	a) Principals of Digital Computation b) Intelligent Devices	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
14	Individual and Group Tasks	13	Questions	a) Display of Measurement Signals b) Recording of Measurement Data	As a group, individually and online	100 minutes	Student power point, result of presentation,

				c) Presentation of Data			standalone assignment sheet
15	Individual and Group Tasks	14	Questions	a) Reliability b) Safety Systems	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet

V. Assessment Criteria (Learning Outcome Evaluation)

Evaluation Type	Sub-CLO	Assessment Type	Frequency	Evaluation Weight (%)
Online Activity	2-14	Activity in Scele	2x3	10
Final Presentation / paper: a) Home Group Discussion b) Focus Group Discussion c) Home Group Discussion (Verification)	2-8 and 10-15	Assessment Sheet	2x3	10
Home Group Presentation	2-8 or 10-15	PowerPoint	1	20
Individual Assignments	2-14	Standalone Assignment Sheet	3	10
Group Assignments	2-14	PowerPoint	3	10
Mid-Term Exam	2-8	Essay Questions	1	20
Final Exam	10-15	Essay Questions	1	20
Total				**100**

VI. Rubric(s)

A. Criterions 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. Criterions 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

Attachment 1. Example Questions

Mid-Term Exam

1. Explain the difference between analog and digital instruments as well as the advantages digital instruments have over analog instruments.
2. A resistant tungsten thermometer with a work area between -270 to 1100 °C has a miss accuracy of 1.5% from its full scale. What is the miss accuracy if the temperature reads 950 °C?