TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

SYSTEM INSTRUMENTATION

by

Dr. Adhi Harmoko S

Undergraduate Program in Physics
Faculty of Mathematics and Natural Sciences
Universitas Indonesia
Depok
November 2020

UNIVERSITAS INDONESIA
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
PHYSICS UNDERGRADUATE STUDY PROGRAM

TEACHING INSTRUCTIONAL DESIGN

Course Name	System Instrumentation	**Credit(s)**	**Prerequisite course(s)**	**Requisite for course(s)**	**Integration Between Other Courses**
Course Code	SCPH604710	5	Electronics 2	-	-
Relation to Curriculum	-				
Semester	5				
Lecturer(s)	Dr. Adhi Harmoko S				
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.				

Program Learning Outcome (PLO)	
Sub-PLO 1	Describing the fenomenon, findings and both contemporary and current topics in Physics.

Sub-PLO 2	Building a strong perception towards the development of the current development of science and technology related to physics.
Sub-PLO 3	Applying concepts in Physics towards the process of production.
Sub-PLO 4	Applying concepts in Physics in both society and livelihood.
Sub-PLO 5	Applying the concepts thought form system and instrumentational physics.
Course Learning Outcome (CLO)	
CLO	Students are able to apply (C3) various basic instrumentation techniques for data acquisition using computers through the software of LabVIEW or other programming languages. (ELO(s) 3, 5, 6, 8)
Sub-CLO	
Sub-CLO 1	Applying Teaching Methods (C3)
Sub-CLO 2	Explaining types of instrumentations (C2)
Sub-CLO 3	Explaining the models of instrumentational systems (C2)
Sub-CLO 4	Explaining the static and dynamic characters of instrumentation systems (C2)
Sub-CLO 5	Explaining the systematic and random mistakes that can happen in the measuring process (C2)
Sub-CLO 6	Explaining the concepts of calibration (C2)
Sub-CLO 7	Explaining noise measurement and signal processing (C2)

Sub-CLO 8	Explaining the instruments and indicators for assessing electrical signals (C2)
Sub-CLO 9	Explaining the methods of converting electrical signal units, including the delta-sigma method (C2)
Sub-CLO 10	Explaining the transmission of electrical, pneumatic, fiber optic and radio signals (C2)
Sub-CLO 11	Explaining the protocols of transmitting digital signals (C2)
Sub-CLO 12	Explaining digital computation and smart devices (C2)
Sub-CLO 13	Explaining how to display, record and present the results of data measurement (C2)
Sub-CLO 14	Explaining the reliability and safety protocols of instrumentational systems (C2)
Study Materials	• Types of Instrument models, systems and characters • Calibration Principals • Noise measurement and Signal Processing • Instrument Indicators • Instruments for testing electrical signals • Converting Electrical units • Protocols in transmitting digital signals • Digital Computation and smart devices • Reliabiliteis and Safety protocols
Reading List	• Moris, Alan S, *Measurement and Instrumentation Principles, 3rd Ed*, Butterworth – Heinemann, 2001 • Boyes, Walt, *Instrumentation Reference Book, 3rd Ed*, Butterworth – Heinemann, 2003. • Webster, John G., *Measurement Instrumentation and Sensor Handbook*, CRC Press, 1999.

Teaching Plan

Week	Sub-CLO	Study Materials [with reference]	Teaching Method [with est. time]	Learning Experiences (*O-E-F)	Sub-CLO Achievement Indicator		Sub-CLO Weight on Course (%)
					General	Specific	
1	1	• Introduction	Collaborative Learning [Estimated time] 100 minutes	Orientation: Introduction to this week's topic (70%) Feedback: Question and answer with the lecturer (30%)	Explaining the basic teaching methods used in class	Applying the basic teaching methods used in class	4%
2	2	• Types of instrumentations [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100 minutes	Orientation: Introduction to this week's topic (70%) Feedback: Question and answer	Able to explain the basic concepts of: a) Active and Passive Instruments b) Analogue and Digital Instruments	Able to apply the basic concepts of: a) Active and Passive Instruments b) Analogue and Digital Instruments	7%

				with the lecturer (30%)	c) Smart and Nonsmart Instruments	c) Smart and Nonsmart Instruments	
3	2	• Data acquisition systems based on computers [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100 minutes	Orientation: Introduction to this week's topica (20%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (30%)	Able to explain the basic concepts of Models of Instrumentational Systems	Able to apply the basic concepts of Models of Instrumentational Systems	7%
4	4	• Introduction to LabVIEW [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed,	Collaborative Learning [Estimated time] 100 minutes	Orientation: Introduction to this week's topica (20%)	Able to explain the basic concepts of: a) Measurement Uncertainty	Able to apply the basic concepts of: a) Measurement Uncertainty	7%

		Butterworth – Heinemann, 2001		Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (30%)	b) Precision/Repeatability/ Reproducibility c) Zero-Order Instrument First-Order Instrument	b) Precision/Repeatability/ Reproducibility c) Zero-Order Instrument First-Order Instrument	
5	5	• Systematic and Random mistakes done in the measurement process [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100x2 minutes	Orientation: Introduction to this week's topica (20%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer	Able to explain the basic concepts of: a) Sources of Systematic Error b) Reduction of Systematic Errors c) Quantification of Systematic Errors	Able to apply the basic concepts of: a) Sources of Systematic Error b) Reduction of Systematic Errors c) Quantification of Systematic Errors	7%

				(30%)			
6	6	• Calibration Principals [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100x2 minutes	Orientation: Introduction to this week's topica (20%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (30%)	Able to explain the basic concepts of: a) Principles of Calibration b) Control of Calibration Environment Calibration Chain and Traceability	Able to apply the basic concepts of: a) Principles of Calibration b) Control of Calibration Environment c) Calibration Chain and Traceability	7%
7	7	• Noise measurement and signal processing [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100 minutes	Orientation: Introduction to this week's topica (20%) Exercise:	Able to explain the basic concepts of: a) Analogue Filters b) Digital Filters	Able to apply the basic concepts of: a) Analogue Filters b) Digital Filters	8%

				Listen to lecture (50%) Feedback: Question and answer with the lecturer (30%)			
8	8	• Indicators and instruments in assessing electrical signals [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100 minutes	Orientation: Introduction to this week's topica (20%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (30%)	Able to explain the basic concepts of: a) Digital Meters b) Analogue Meters c) Oscilloscopes	Able to apply the basic concepts of: a) Digital Meters b) Analogue Meters c) Oscilloscopes	8%

9	**Mid Term Exam**						
10	9	• Methods in converting electrical signal units, including the delta-sigma method [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100 minutes	Orientation: Introduction to this week's topica (20%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (30%)	Able to explain the basic concepts of: a) Bridge Circuits b) Resistance Measurement c) Frequency Measurement	Able to apply the basic concepts of: a) Bridge Circuits b) Resistance Measurement c) Frequency Measurement	7%
11	10	• Electrical, pneumatic, fiber optic and radio signal transmission [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed,	Collaborative Learning [Estimated time] 100x2 minutes	Orientation: Introduction to this week's topica (20%) Exercise:	Able to explain the basic concepts of: a) Electrical Transmission b) Pneumatic Transmission c) Fiber-Optic Transmission	Able to apply the basic concepts of: a) Electrical Transmission b) Pneumatic Transmission c) Fiber-Optic Transmission	7%

		Butterworth – Heinemann, 2001		Listen to lecture (50%) Feedback: Question and answer with the lecturer (30%)	d) Optical Wireless Telemetry e) Radiotelemetry	d) Optical Wireless Telemetry e) Radiotelemetry	
12	11	• Protocols in digital signal transmission [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100x2 minutes	Orientation: Introduction to this week's topica (20%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (30%)	Able to explain the basic concepts of Digital Transmission Protocols	Able to apply the basic concepts of Digital Transmission Protocols	7%

13	12	• Digital computations and smart devices [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100 minutes	Orientation: Introduction to this week's topica (20%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (30%)	Able to explain the basic concepts of: a) Principles of Digital Computation b) Intelligent Devices	Able to apply the basic concepts of: a) Principles of Digital Computation b) Intelligent Devices	8%
14	13	• Displaying, recording and presenting the results of data measurement [Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100 minutes	Orientation: Introduction to this week's topica (20%) Exercise: Listen to lecture	Able to explain the basic concepts of: a) Display of Measurement Signals b) Recording of Measurement Data c) Presentation of Data	Able to apply the basic concepts of: a) Display of Measurement Signals b) Recording of Measurement Data c) Presentation of Data	8%

				(50%) Feedback: Question and answer with the lecturer (30%)			
15	14	• The reliabilities and safety protocols of instrumentational systems Reference] Moris, Alan S, Measurement and Instrumentation Principles, 3rd Ed, Butterworth – Heinemann, 2001	Collaborative Learning [Estimated time] 100 minutes	Orientation: Introduction to this week's topica (20%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (30%)	Able to explain the basic concepts of: a) Reliability b) Safety Systems	Able to apply the basic concepts of: a) Reliability b) Safety Systems	8%
16	Final Exam						

Assignment Design

Week	Assignment Name	Sub-CLOs	Assignment	Scope	Working Procedure	Deadline	Outcome
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 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 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	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet

				Quantification of Systematic Errors			
6	Individual and Group Tasks	6	Questions	a) Principles of Calibration b) Control of Calibration Environment 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 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 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 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 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	As a group, individually and online	100 minutes	Student power point, result of presentation,

				• Intelligent Devices			standalone assignment sheet
14	Individual and Group Tasks	13	Questions	a) Display of Measurement Signals b) Recording of Measurement Data • Presentation of Data	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet
15	Individual and Group Tasks	14	Questions	a) Reliability c) Safety Systems	As a group, individually and online	100 minutes	Student power point, result of presentation, standalone assignment sheet

Assessment Criteria

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 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
Total				**100**

Conversion of the students final score

Score	Grade	Equivalent
85—100	A	4,00
80—<85	A-	3,70
75—<80	B+	3,30
70—<75	B	3,00
65—<70	B-	2,70
60—<65	C+	2,30
55—<60	C	2,00
40—<55	D	1,00
<40	E	0,00

Rubric(s)

A. Criterions for the 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. Mid term exam and Final term 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