TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

ELECTRONICS 1

by

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

TEACHING INSTRUCTIONAL DESIGN

Course Name	Electronics 1	**Credit(s)**	**Prerequisite course(s)**	**Requisite for course(s)**	**Integration Between Other Courses**
Course Code	SCPH601254	2	Basic Physics 1	Electronics 2, Laboratory Work of Electronics 1, Physics of Measurements	=
Relation to Curriculum	Compulsory Course				
Semester	2nd				
Lecturer(s)	Dr. Djati handoko				
Course Description	*After completing this lecture, students are faced with simple electronic problems, students are able to apply basic electronic concepts to diode, transistor and op-amp circuits from theoretical reviews and troubleshooting. Students are also able to properly design basic electronic designs based on diodes, transistors and op-amps. The language of instruction used in this course is Indonesian*				

Program Learning Outcome (PLO)	
PLO-1	Understand basic principles of experimentation, apply physical measurement methods, and be able to analyze results correctly
PLO-2	Describe the working principle of electronic components
PLO-3	Be able to derive specific formulas for the problem being handled

Course Learning Outcome (CLO)	
CLO-1	After completing this lecture, students are able to understand the principles of discrete electronics: power supplies, diodes, bipolar transistors, field effect transistors and operational amplifiers and are able to apply them in electronic system design. (C3)
Sub-CLO(s)	
Sub-CLO 1	Describe the characteristics of voltage sources, current sources, thevenin's theorem and Norton's theorem and be able to apply them in simple electronic circuits for troubleshooting (C2 and C3)
Sub-CLO 2	Describe the basic concepts of semiconductors and diode pn junctions for implementing troubleshooting (C2 and C3)
Sub-CLO 3	Describe and implement the pn diode and zener diode circuits; including understanding diodes for special needs and troubleshooting (C2 and C3)
Sub-CLO 4	Describe the characteristics of bipolar transistors, and the technique of providing bias voltages for troubleshooting (C2 and C3)
Sub-CLO 5	Describe the AC model of the transistor, and apply it in AC voltage amplifier design and troubleshooting (C2 and C3)
Sub-CLO 6	Describe Common Collector and Common Base amplifiers and apply them in power amplifier design for troubleshooting (C2 and C3)
Sub-CLO 7	Explains the basic concepts of the FET for troubleshooting (C2 and C3)
Sub-CLO 8	Describe the basic operational concepts of amplifiers and their application to linear op-amps for troubleshooting (C2 and C3)
Sub-CLO 9	Explain basic filter concepts and apply them to active filters in troubleshooting (C2 and C3)
Sub-CLO 10	Describe and apply non-linear op-amp circuits in troubleshooting (C2 and C3)
Sub-CLO 11	Describe power supply regulators (linear and switching) for troubleshooting (C2 and C3)
Sub-CLO 12	Designing a simple analog system in the form of Tasks (C3)
Study Materials	• **Diode** : Power Supply, Semiconductors, Diode Theory and Diode Circuits, Diodes for

	special purposes • **Transistor** : Bipolar-Junction Transistor (BJT), Transistor Positioning, Transistor Base Amplifier Circuit, Power Amplifier, Junction Field Effect Transistor (JFET), MOSFET • **Op-amp** : Basic Operational Amplifier (Op-Amp) Structure and its characteristics, Linear Op-Amp Circuits: Inverting and Noninverting Amplifiers, Summing Amplifiers, DC Imperfections, Differential Amplifiers, Instrumentation Amplifiers, Voltage-Controlled Current Sources (VCCS), Single Op-Amp Operation -Supply, Active Filters, Nonlinear Op-Amp Circuits: Comparators, Integrators, Differentiators, Active Diode Circuits, Oscillators and Directional Power Supplies
Reading List	1. A. P. Malvino and D. J. Bates, Electronic Principles, 8th edition, McGraw-Hill Book Co., 2015 2. T.L. Floyd and D.M. Buchla, Analog Fundamentals; A System Approach, Pearson Prentice-Hall, 2013 3. L. M. Faulkenberry, An Introduction to Operational Amplifier, with Linear Applications, 2nd edition, John Wiley & Sons, 1982

I. 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	**Sub-CLO 1** Describe the characteristics of voltage sources, current sources, thevenin's theorem	- **Introduction** - **Thevenin and Norton Theorm** - **Powersupply**	- **Face-to-face lecture** (60 minutes) - **Structured individual learning**	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts:		8 %

	and Norton's theorem and be able to apply them in simple electronic circuits for troubleshooting (C2 and C3)		1. Reading study material at EMAS (40 minutes) 2. Doing problem sets (30 minutes)	material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS F (30%) **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the problem set	a. Powersupply and current b. Thevenin and Norton Theorm also apply for troubleshooting		
2	**Sub-CLO 2** Describe the basic concepts of semiconductors and diode pn junctions for implementing troubleshooting (C2 and C3)	- **Semiconductor** - **Diode theorm** - **Basic diode circuit**	- **Structured individual learning** 1. Reading study material at EMAS (40 minutes) 2. Doing problem sets (30 minutes)	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: a. Semiconductor introduction b. PN junction diode, unbiased and biased also apply for troubleshooting		8 %

				F (30%) **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the problem set			
3	**Sub-CLO 3** Describe and implement the pn diode and zener diode circuits; including understanding diodes for special needs and troubleshooting (C2 and C3)	- **Diode for special purpose**	- **Structured individual learning** 1. Reading study material at EMAS (40 minutes) 2. Reading the other reference for answer problem set (40 minutes) 3. Doing problem set (50 minutes)	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS Reading the other reference for answer problem set F (30%) **Synchronous:** Question and answer session during the lecture	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: a. Model and characteristic of Diode b. Rectifier c. Capacitor with filter d. Diode Zener utilization e. Clipper, Clamper, and Voltage Multiplier Circuits also apply fot troubleshooting		8 %

				Asynchronous Answer the problem set			
4	**Sub-CLO 4** Describe the characteristics of bipolar transistors, and the technique of providing bias voltages for troubleshooting (C2 and C3)	- **Bipolar Junction Transistor (BJT)** - **Pre-voltage transistor**	- **Face-to-face lecture** (60 minutes) - **Structured individual learning** 1. Reading study material at EMAS (40 minutes, 2. Doing problem sets (30 minutes)	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS Reading the other reference for answer problem set F (30%) **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the problem set	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: a. Characterisctic and Modeling Transistor b. Refraction of transistor		8 %
5	**Sub-CLO 5** Describe the AC	- **Amplifier Circuit**	- **Face-to-face lecture** (60	**O (40%)** **Synchronous**:	After attending lectures (synchronous), and		8 %

	model of the transistor, and apply it in AC voltage amplifier design and troubleshooting (C2 and C3)	- **Basic transistor, AC transistor**	minutes) - **Structured individual learning** 1. Reading study material at EMAS (40 minutes. 2. Doing problem sets (30 minutes)	Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS Reading the other reference for answer problem set F (30%) **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the problem set	reading material in EMAS (asynchronous), students can explain the basic concepts: a. Beta AC Parameter b. AC resistance of Emitter c. Amplifier analysist		
6	**Sub-CLO 6** Describe Common Collector and Common Base amplifiers and apply them in power amplifier	- **Power Amplifiers**	- **Structured individual learning** 1. Reading study material at EMAS (40 minutes)	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: a. Amplifier CC, CB		8 %

	design for troubleshooting (C2 and C3)		2. Reading the other reference for answer problem set (40 minutes) 3. Doing problem set (50 minutes)	**E (30%)** **Asynchronous:** Doing problem sets at EMAS Reading the other reference for answer problem set F (30%) **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the problem set	b. CE and CC cascades c. Darlington d. Power amplifier, class A, B, and C e. Push-Pull Brace		
7	**Sub-CLO 7** Explains the basic concepts of the FET for troubleshooting (C2 and C3)	- **Junction Field Effec Transistor (JFET), MOSFET**	- **Structured individual learning** 1. Reading study material at EMAS (40 minutes) 2. Reading the other reference for answer problem set (	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: a. FET architecture b. JFET and refraction c. MOSFET and refraction d. Amplifier JFET		8 %

			40 minutes) 3. Doing problem set (50 minutes)	Reading the other reference for answer problem set F (30%) **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the problem set	and MOSFET		
8	**Mid-Term Exam**						
9	**Sub-CLO 8** Describe the basic operational concepts of amplifiers and their application to linear op-amps for troubleshooting (C2 and C3)	- **Basic structure and structure of Operational Amplifier (Op-Amp) and**	- **Face-to-face lecture** (60 minutes) - **Structured individual learning** 1. Reading study material at EMAS (40 minutes) 2. Doing problem sets (30 minutes)	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS **F (30%)** **Synchronous:** Question and	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: a. Op-amp and Non-ideal Characteristic b. Op-amp configuration with feedback c. Linier Op-amp circuits d. Op-amp operation with single supply		8 %

				answer session during the lecture **Asynchronous** Answer the problem set			
		- **Linier Op-amp Circuits : Inverting and Non-inverting Amplifier, Summing Amplifier**	- **Structured individual learning** 1. Reading study material at EMAS (40 minutes) 2. Reading the other reference for answer problem set (40 minutes) 3. Doing problem set (50 minutes)	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS Reading the other reference for answer problem set F (30%) **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the problem set	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: e. Op-amp and Non-ideal Characteristic f. Op-amp configuration with feedback g. Linier Op-amp circuits h. Op-amp operation with single supply		

		- **DC Imperfections, Differential Amplifiers, Instrumentation Amplifiers** - **VCCS, single supply Op-amp**	- **Face-to-face lecture** (60 minutes) - **Structured individual learning** 1. Reading study material at EMAS (40 minutes) 2. Doing problem sets (30 minutes)	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS **F (30%)** **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the problem set	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: i. Op-amp and Non-ideal Characteristic j. Op-amp configuration with feedback k. Linier Op-amp circuits l. Op-amp operation with single supply		
10	**Sub-CLO 9** Explain basic filter concepts and apply them to active filters in troubleshooting (C2 and C3)	- **Active Filters**	- **Face-to-face lecture** (60 minutes) - **Structured individual learning** 1. Reading study material	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: a. Definition of Filter		8 %

			at EMAS (40 minutes) 2. Doing problem sets (30 minutes)	**E (30%)** **Asynchronous:** Doing problem sets at EMAS Reading the other reference for answer problem set F (30%) **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the problem set	b. Passive RC Filter c. Salten & Key configuration d. Bikuadratik Filter and State Variable		
11	**Sub-CLO 10** Describe and apply non-linear op-amp circuits in troubleshooting (C2 and C3)	- **Non-Linear Op-Amp Circuits : Comparators, Integrators, Differentiatiors, Diode Active Circuit, Oscillators**	- **Structured individual learning** 1. Reading study material at EMAS (40 minutes) 2. Reading the other reference for answer problem set (40 minutes)	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS Reading the other	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: a. General comparator b. Comparator with Hysteris Window c. Integrator Differensiator d. Precision Rectifier		8 %

			3. Doing problem set (50 minutes)	reference for answer problem set F (30%) **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the problem set			
12	**Sub-CLO 11** Describe power supply regulators (linear and switching) for troubleshooting (C2 and C3)	- **Regulated Power Supply**	- **Structured individual learning** 1. Reading study material at EMAS (40 minutes) 2. Reading the other reference for answer problem set (40 minutes) 3. Doing problem set (50 minutes)	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS Reading the other reference for answer problem set F (30%) **Synchronous:**	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts: a. Power Supply Characteristic b. Shunt Regulator c. Regulator with IC d. Current Booster e. DC to DC convertor f. Power supply Switching		8 %

				Question and answer session during the lecture **Asynchronous** Answer the problem set			
13	**Sub-CLO 12** Designing a simple analog system in the form of Tasks (C3)	- **Final project**	- **Structured individual learning** 1. Reading study material at EMAS (40 minutes) 2. Reading the other reference for answer problem set (40 minutes) 3. Doing problem set (50 minutes)	**O (40%)** **Synchronous**: Face-to-face lecture via MS Teams **Asynchronous:** Reading study material at EMAS **E (30%)** **Asynchronous:** Doing problem sets at EMAS Reading the other reference for answer problem set F (30%) **Synchronous:** Question and answer session during the lecture **Asynchronous** Answer the	After attending lectures (synchronous), and reading material in EMAS (asynchronous), students can explain the basic concepts of designing tools and explaining how it's work.		8 %

				problem set			
14	Final Exam						

****) Synchronous: learning interactions between lecturers and students are carried out at the same time, using video or chat tapplication**

Asynchronous: learning interactions are carried out flexibly and don't have to be at the same time, for example using discussion forums or independent study / student assignments.

II. Assignment Design

Week	Assignment Name	Sub-CLOs	Assignment	Scope	Working Procedure	Deadline	Outcome
1	Assignment 1	1	Problem Set	**Introduction :** • Power Supply • Current Source • Thevenin Theory • Norton Theory • Troubleshooting	Online at MsTeam	15 minutes	*Score online*
2	Assignment 2	2	Problem Set	**Semiconductor and Diode Theory** • Conductor, isolator, and semiconductor • Intristik and Semiconductor Doping • Unbiased forward and Reverse Bias Diode • Ideal Diode • 2^{nd} an 3^{rd} approximation • Thermodynamic equilibrium	Online at MsTeam	15 minutes	*Score online*
3	Assignment 3	3	Problem Set	**Diode Circuits** • Diode as a rectifier • Diode as signal formers • Diode Zener • LED	Online at MsTeam	15 minutes	*Score online*
	Homework 1	1 - 3	Problem Set	**Introduction** **Semiconductor and Diode Theory** **Diode Circuits**	Individual Homework		Answer Sheet

4	Assignment 4	4	Problem Set	**Basic of Transistor** • Unbiased dan biased transistor • CE Connection • Basis and Collector Curve • Transistor Bias	Online at MsTeam	15 minutes	*Score online*
	Homework 2	4	Problem Set	**Basic of Transistor**	Individual Homework		Answer Sheet
5	Assignment 5	5	Problem Set	**AC Transistor Model** • Base and emitter refractive amplifier • Small Signal • AC Beta • Voltage gain • Swamped amplifier	Online at MsTeam	15 minutes	*Score online*
6	Assignment 6	6	Problem Set	**Power Amplifier** • Two load line • Amplifier class A • Amplifier class B • Push-pull	Online at MsTeam	15 minutes	*Score online*
	Homework 3	5 - 6	Problem Set	**AC Transistor Model** **Power Amplifier**	Individual Homework		Answer Sheet
7	Assignment 7	7	Problem Set	**MOSFET** • Depletion MOSFET model • D-MOSFET Curve • MOSFET Amplifier • Digital Switch • CMOS • FET Power	Online at MsTeam	15 minutes	*Score online*

8	Assignment 8	8	Problem Set	**Operational Amplifier (Op-amp)** • Introduction Op-amp • Amplifier Inverting and Non-Inverting • Some linear circuits	Online at MsTeam	15 minutes	*Score online*
9	Assignment 9	9	Problem Set	**Filter** • Basic concept of Filter • Active and passive Filter • High Filter • Low pass, high pass, and hand pass filter	Online at MsTeam	15 minutes	*Score online*
	Homework 4	9	Problem Set	**Filter**	Individual Homework		Answer Sheet
10	Assignment 10	10	Problem Set	**Non linear Op-amp** • Comparator • Integrator • Waveform generation • Active diode circuits • Differentiator	Online at MsTeam	15 minutes	*Score online*
11	Assignment 11	11	Problem Set	**Regulared Power Supply** • Characteristic • Shunt regulator • Series regulator • DC to DC converter • Switching regulator	Online at EMAS	15 minutes	*Score online*
12	Homework 5	10 - 11	Problem Set	**Non linear Op-amp** **Regulared Power Supply**	Individual Homework		Answer Sheet

III. Assessment Criteria (Learning Outcome Evaluation)

Sub-CLO	Evaluation Type	Assessment Type	Frequency	Evaluation Weight (%)
1 – 6	Mid – Term Exam	Exam Question via EMAS	1	20
7 – 11	Final Exam	Exam Question via EMAS	1	30
1 – 11	Problem Set	Answer Sheet	1	20
1 – 11	Individual Project	Presentation Final Project	1	30
Total				100

IV. Rubric(s)

This rubric is used as a guideline for assessing or giving levels of student performance results. a rubric usually consists of assessment criteria that include the dimensions / aspects that are assessed based on indicators of learning achievement. This assessment rubric is useful for clarifying the basics and aspects of the assessment so that students and lecturers can be guided by the same thing regarding the expected performance demands. Lecturers can choose the type of rubric according to the assessment given.

A. Conversion of the student's 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 - < 50	D	1.00
< 40	E	0.00

B. Essay Question Score Criteria (Invidual Assignment, Mid-Term Exam and Final Exam)

Score	Quality Answer
100	The answer is very precise, all the definitions and main components are complete
76 – 99	The answer is quite precise, the meaning and the main components are almost complete
51 – 75	Inaccurate answers, incomplete understanding and main components
26 – 50	The answer is very inaccurate, the meaning and the main components are very incomplete
<25	Wrong answer