TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

SENSORS AND ACTUATORS LABORATORY

by

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November 2020

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

TEACHING INSTRUCTIONAL DESIGN

Course Name	Sensors and Actuators Laboratory	**Credit(s)**	**Prerequisite course(s)**	**Requisite for course(s)**	**Integration Between Other Courses**
Course Code	SCPH603711	1	Electronics 2	-	-
Relation to Curriculum	-				
Semester	7				
Lecturer(s)	Surya Darma, M.Si				
Course Description	After finishing this course, students taking the concentration of Instrumentational Physics in the 7th term is able to precisely explain the concepts of how sensors and actuators work, select and choose sensors and actuators for certain tasks and apply it for monitoring and measuring physical units. (C4). The instructional language used in this course will be the Indonesian language.				

Program Learning Outcome (PLO)	
Sub-PLO 1	To measure electrical and magnetic physical units.

Sub-PLO 2	To process the data made from experiments and produce a final measurement.
Sub-PLO 3	To apply advanced electronics concepts in an embedded system environment.
Sub-PLO 4	Applying concepts in Physics in botch society and livelihood.
Sub-PLO 5	Applying the concepts thought form system and instrumentational physics.
Course Learning Outcome (CLO)	
CLO	Students are able to precisely explain the concepts of how sensors and actuators work, select and choose sensors and actuators for certain tasks and apply it for monitoring and measuring physical units. (C4).
Sub-CLO	
Sub-CLO 1	Able to explain the basic principles of sensors and actuators. (C2)
Sub-CLO 2	Able to determine and select sensors and actuators of certain applications. (C3)
Sub-CLO 3	Able to design and create sensor systems to monitor and measure physical units. (C4)

Study Materials	• Temperature Sensors • Pressure and Wight Sensors • Light Sensors • Flow Sensors • Level Sensors • Magnet Sensors • Proximity Sensors • Chemical Sensors • Electric Actuators • Hydraulic and Pneumatic Actuators
Reading List	• Departemen Fisika FMIPA UI, Buku Panduan Praktikum Sensor dan Aktuator • Beckwith, T. G. , Marangoni, R. D. dan J. H. Lienhard V, Mechanical Measurements (I. Fundamentals of Mechanical Measurement, II. Applied Mechanical Measurements), Addison-Wesley Publishing Company, 6ed , 2006

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	**Introduction**						
2	2	Temperature Sensors a. Operational Principals of RTD b. Characteristics c. Circuit design using an RTD [Reference] 1. The Specific Module 2. Beckwith, T.G., Marangoni, R. D. and J. H. Lienhard V, Mechanical Measurements (I. Fundametals of Mecahnical Measurements II. Aplied Mechanical Measurements). Addison-Wesly Publishing Company. 6ed. 2006	Laboratory work, simulations, creating a report [Estimated time] 200 minutes	Orientation: Introduction to this week's topic (10%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (40%)	Able to report the result of the experiment and simulate it in a report based on the rules that apply	Able to apply what has been learned throughout the module in a final simulation using the specific sensor.	12%

3	2	Pressure and Weight Sensors a. Operational Principals of the Strain Gauge (SG) b. Characteristics c. Circuit design using a Strain Gauge d. Usage of SG sensor for measuring pressure e. Characteristics f. Circuit design for a Pressure Sensor [Reference] 1. The Specific Module 2. Beckwith, T.G., Marangoni, R. D. and J. H. Lienhard V, Mechanical Measurements (I. Fundametals of Mecahnical Measurements II. Aplied Mechanical Measurements). Addison-Wesly Publishing Company. 6ed. 2006	Laboratory work, simulations, creating a report [Estimated time] 200 minutes	Orientation: Introduction to this week's topic (10%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (40%)	Able to report the result of the experiment and simulate it in a report based on the rules that apply	Able to apply what has been learned throughout the module in a final simulation using the specific sensor.	12%
4	2	Light Sensors a. Operational Principals of the Light Sensor b. Characteristics c. Circuit design using a Light Sensor d. Techniques for data processing [Reference] 1. The Specific Module	Laboratory work, simulations, creating a report [Estimated time] 200 minutes	Orientation: Introduction to this week's topic (10%) Exercise: Listen to lecture (50%)	Able to report the result of the experiment and simulate it in a report based on the rules that apply	Able to apply what has been learned throughout the module in a final simulation using the specific sensor.	12%

		2. Beckwith, T.G., Marangoni, R. D. and J. H. Lienhard V, Mechanical Measurements (I. Fundametals of Mecahnical Measurements II. Aplied Mechanical Measurements). Addison-Wesly Publishing Company. 6ed. 2006		Feedback: Question and answer with the lecturer (40%)			
5	2	Flow Sensor a. Operational Principals of the Flow Sensor b. Characteristics c. Circuit design using a Flow Sensor d. Techniques for data processing [Reference] 1. The Specific Module 2. Beckwith, T.G., Marangoni, R. D. and J. H. Lienhard V, Mechanical Measurements (I. Fundametals of Mecahnical Measurements II. Aplied Mechanical Measurements). Addison-Wesly Publishing Company. 6ed. 2006	Laboratory work, simulations, creating a report [Estimated time] 200 minutes	Orientation: Introduction to this week's topic (10%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (40%)	Able to report the result of the experiment and simulate it in a report based on the rules that apply	Able to apply what has been learned throughout the module in a final simulation using the specific sensor.	12%
6	2	Level Sensor • Operational Principals of the Level Sensor • Characteristics	Laboratory work, simulations,	Orientation: Introduction to this	Able to report the result of the experiment and simulate it in a report	Able to apply what has been learned throughout the module in a final	12%

		• Types of Level Sensors • Circuit design using a Flow Sensor [Reference] 1. The Specific Module 2. Beckwith, T.G., Marangoni, R. D. and J. H. Lienhard V, Mechanical Measurements (I. Fundametals of Mecahnical Measurements II. Aplied Mechanical Measurements). Addison-Wesly Publishing Company. 6ed. 2006	creating a report [Estimated time] 200 minutes	week's topic (10%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (40%)	based on the rules that apply	simulation using the specific sensor.	
7							
8	2	Magnet Sensor a. Operational Principals of the LVDT and Hall Effect Sensor b. Characteristics c. Specific functions of the Magnet Sensor d. Circuit design using a Magnet Sensor e. Techniques for data processing [Reference] 1. The Specific Module 2. Beckwith, T.G., Marangoni, R. D. and J. H. Lienhard V, Mechanical	Laboratory work, simulations, creating a report [Estimated time] 200 minutes	Orientation: Introduction to this week's topic (10%) Exercise: Listen to lecture (50%) Feedback:	Able to report the result of the experiment and simulate it in a report based on the rules that apply	Able to apply what has been learned throughout the module in a final simulation using the specific sensor.	12%

		Measurements (I. Fundametals of Mecahnical Measurements II. Aplied Mechanical Measurements). Addison-Wesly Publishing Company. 6ed. 2006		Question and answer with the lecturer (40%)			
9	2	Proximity Sensor • Operational Principals of the Proximity Sensor • Characteristics • Circuit design using a Proximity Sensor • Techniques for data processing [Reference] 1. The Specific Module 2. Beckwith, T.G., Marangoni, R. D. and J. H. Lienhard V, Mechanical Measurements (I. Fundametals of Mecahnical Measurements II. Aplied Mechanical Measurements). Addison-Wesly Publishing Company. 6ed. 2006	Laboratory work, simulations, creating a report [Estimated time] 200 minutes	Orientation: Introduction to this week's topic (10%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (40%)	Able to report the result of the experiment and simulate it in a report based on the rules that apply	Able to apply what has been learned throughout the module in a final simulation using the specific sensor.	12%
10	2	Chemical Sensor • Operational Principals of the Chemical Sensor • Characteristics • Circuit design using a Chemical Sensor • Techniques for data processing	Laboratory work, simulations, creating a report	Orientation: Introduction to this week's topic (10%)	Able to report the result of the experiment and simulate it in a report based on the rules that apply	Able to apply what has been learned throughout the module in a final simulation using the specific sensor.	12%

		[Reference] 1. The Specific Module 2. Beckwith, T.G., Marangoni, R. D. and J. H. Lienhard V, Mechanical Measurements (I. Fundametals of Mecahnical Measurements II. Aplied Mechanical Measurements). Addison-Wesly Publishing Company. 6ed. 2006	[Estimated time] 200 minutes	Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (40%)			
11	2	Electric Actuators a. Operational Principals of the Electric Actuator b. Characteristics c. Circuit design using an Electric Actuator d. Techniques for controlling voltage / current [Reference] 1. The Specific Module 2. Beckwith, T.G., Marangoni, R. D. and J. H. Lienhard V, Mechanical Measurements (I. Fundametals of Mecahnical Measurements II. Aplied Mechanical Measurements). Addison-Wesly Publishing Company. 6ed. 2006	Laboratory work, simulations, creating a report [Estimated time] 200 minutes	Orientation: Introduction to this week's topic (10%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (40%)	Able to report the result of the experiment and simulate it in a report based on the rules that apply	Able to apply what has been learned throughout the module in a final simulation using the specific sensor.	12%

12	2	Hydraulic and Pneumatic Actuators • Operational Principals of the Hydraulic and Pneumatic Actuators • Characteristics • Circuit design using Hydraulic and Pneumatic Actuator • Techniques for controlling voltage / current • [Reference] 1. The Specific Module 2. Beckwith, T.G., Marangoni, R. D. and J. H. Lienhard V, Mechanical Measurements (I. Fundametals of Mecahnical Measurements II. Aplied Mechanical Measurements). Addison-Wesly Publishing Company. 6ed. 2006	Laboratory work, simulations, creating a report [Estimated time] 200 minutes	Orientation: Introduction to this week's topic (10%) Exercise: Listen to lecture (50%) Feedback: Question and answer with the lecturer (40%)	Able to report the result of the experiment and simulate it in a report based on the rules that apply	Able to apply what has been learned throughout the module in a final simulation using the specific sensor.	12%
13	Final Exam						

Assignment Design

Week	Assignment Name	Sub-CLOs	Assignment	Scope	Working Procedure	Deadline	Outcome
1	Evaluation of sub-CLO 1	1	Doing assignments in EMAS	• Analog Filters • Signal Conditioning • Digital Filters • Readout • Mechanical Actuators • Electrical Actuators • Hydraulic and Pneumatic Actuators	Individual Tasks on EMAS	40 minutes	Assignment Sheet on EMAS
2	Home Group Discussion	2	Discussion in Ms. Teams	Temperatures Sensors • Operational Principals of the RTD Sensor • Characteristics • Circuit Design using RTD Sensors	Group Discussion, Synchronus on MsTeams	60 minutes (outside of class)	Video recording or discussion results
2	Simulation	2	Doing a simulation on the sensor on one of the allowed simulators	Work on a simulation for an RTD sensor on one of the allowed simulators	Making a video on the simulation	120 minutes	Uploading the video on EMAS / Youtube and report the link
3	Home Group Discussion	2	Discussion in Ms. Teams	Pressure Sensors and Load Sensors • Operational Principals of the Strain Gauge (SG) • Characteristics	Group Discussion, Synchronus on MsTeams	60 minutes (outside of class)	Video recording or discussion results

				• Circuit design using a Strain Gauge • Usage of SG sensor for measuring pressure • Characteristics • Circuit design for a Pressure Sensor			
3	Simulation	2	D Doing a simulation on the sensor on one of the allowed simulators	Characteristics of the Pressure and Load Sensors as well as its Circuits.	Making a video on the simulation	120 minutes	Uploading the video on EMAS / Youtube and report the link
4	Home Group Discussion	2	Discussion in Ms. Teams	Light Sensors • Operational Principals of the Light Sensor • Characteristics • Circuit design using a Light Sensor • Techniques for data processing	Group Discussion, Synchronus on MsTeams	60 minutes (outside of class)	Video recording or discussion results
4	Simulation	2	Doing a simulation on the sensor on one of the allowed simulators	Characteristics of the Light Sensor as well as its Circuits.	Making a video on the simulation	120 minutes	Uploading the video on EMAS / Youtube and report the link
4	Presentation and Focus Group Discussion	2	Presentation and Discussion on MsTeams	Light Sensor	Group Presentation, Synchronus on MsTeams	60 minutes	Rubric Scoresheet
5	Home Group Discussion	2	Discussion in Ms. Teams	Flow Sensor	Group Discussion,	60 minutes (outside of class)	Video recording or discussion results

				• Operational Principals of the Flow Sensor • Characteristics • Circuit design using a Flow Sensor • Techniques for data processing	Synchronus on MsTeams		
5	Simulation	2	Doing a simulation on the sensor on one of the allowed simulators	Characteristics of the Flow Sensor as well as its Circuits.	Making a video on the simulation	120 minutes	Uploading the video on EMAS / Youtube and report the link
5	Presentation and Focus Group Discussion	2	Presentation and Discussion on MsTeams	Flow Sensors	Group Presentation, Synchronus on MsTeams	60 minutes	Rubric Scoresheet
6	Home Group Discussion	2	Discussion in Ms. Teams	Level Sensor • Operational Principals of the Level Sensor • Characteristics • Types of Level Sensors • Circuit design using a Flow Sensor	Group Discussion, Synchronus on MsTeams	60 minutes (outside of class)	Video recording or discussion results
6	Simulation	2	Doing a simulation on the sensor on one of the allowed simulators	Characteristics of the Level Sensor as well as its Circuits.	Making a video on the simulation	120 minutes	Uploading the video on EMAS / Youtube and report the link
6	Presentation and Focus Group Discussion	2	Presentation and Discussion on MsTeams	Level Sensor	Group Presentation, Synchronus on MsTeams	60 minutes	Rubric Scoresheet

7	Mid Term Exam	1,2,3	Presenting the progress that has been made on the final project	Includes all models designed based on the transfer function and early simulations			
8	Home Group Discussion	2	Discussion in Ms. Teams	Magnet Sensor • Operational Principals of the LVDT and Hall Effect Sensor • Characteristics • Specific functions of the Magnet Sensor • Circuit design using a Magnet Sensor • Techniques for data processing	Group Discussion, Synchronus on MsTeams	60 minutes (outside of class)	Video recording or discussion results
8	Simulation	2	Doing a simulation on the sensor on one of the allowed simulators	Characteristics of the Magnet Sensor as well as its Circuits.	Making a video on the simulation	120 minutes	Uploading the video on EMAS / Youtube and report the link
8	Presentation and Focus Group Discussion	2	Presentation and Discussion on MsTeams	Magnet Sensor	Group Presentation, Synchronus on MsTeams	60 minutes	Rubric Scoresheet
9	Home Group Discussion	2	Discussion in Ms. Teams	Proximity Sensor • Operational Principals of the Proximity Sensor • Characteristics • Circuit design using a Proximity Sensor • Techniques for data processing	Group Discussion, Synchronus on MsTeams	60 minutes (outside of class)	Video recording or discussion results

9	Simulation	2	Doing a simulation on the sensor on one of the allowed simulators	Characteristics of the Proximity Sensor as well as its Circuits.	Making a video on the simulation	120 minutes	Uploading the video on EMAS / Youtube and report the link
9	Presentation and Focus Group Discussion	2	Presentation and Discussion on MsTeams	Proximity Sensor	Group Presentation, Synchronus on MsTeams	60 minutes	Rubric Scoresheet
10	Home Group Discussion	2	Discussion in Ms. Teams	Chemical Sensor • Operational Principals of the Chemical Sensor • Characteristics • Circuit design using a Chemical Sensor • Techniques for data processing	Group Discussion, Synchronus on MsTeams	60 minutes (outside of class)	Video recording or discussion results
10	Simulation	2	Doing a simulation on the sensor on one of the allowed simulators	Characteristics of the Chemical Sensor as well as its Circuits.	Making a video on the simulation	120 minutes	Uploading the video on EMAS / Youtube and report the link
10	Presentation and Focus Group Discussion	2	Presentation and Discussion on MsTeams	Chemical Sensor	Group Presentation, Synchronus on MsTeams	60 minutes	Rubric Scoresheet
11	Home Group Discussion	2	Discussion in Ms. Teams	Electric Actuators • Operational Principals of the Electric Actuator • Characteristics • Circuit design using an Electric Actuator	Group Discussion, Synchronus on MsTeams	60 minutes (outside of class)	Video recording or discussion results

				• Techniques for controlling voltage / current			
11	Simulation	2	Doing a simulation on the actuator on one of the allowed simulators	Characteristics of the Electric Actuators as well as its Circuits.	Making a video on the simulation	120 minutes	Uploading the video on EMAS / Youtube and report the link
11	Presentation and Focus Group Discussion	2	Presentation and Discussion on MsTeams	Electric Actuators	Group Presentation, Synchronus on MsTeams	60 minutes	Rubric Scoresheet
12	Home Group Discussion	2	Discussion in Ms. Teams	Hydraulic and Pneumatic Actuators • Operational Principals of the Hydraulic and Pneumatic Actuators • Characteristics • Circuit design using Hydraulic and Pneumatic Actuator • Techniques for controlling voltage / current	Group Discussion, Synchronus on MsTeams	60 minutes (outside of class)	Video recording or discussion results
12	Simulation	2	Doing a simulation on the actuator on one of the allowed simulators	Characteristics of the Hydraulic and Pneumatic Actuators as well as its Circuits.	Making a video on the simulation	120 minutes	Uploading the video on EMAS / Youtube and report the link
12	Presentation and Focus	2	Presentation and Discussion on MsTeams	Hydraulic and Pneumatic Actuators	Group Presentation,	60 minutes	Rubric Scoresheet

	Group Discussion				Synchronus on MsTeams		
12	Evaluation of sub-CLO 2	2	Answering Questions in EMAS	• State Variables • Time Response Towards various Standard Signals • Controlling Techniques of a Response System towards Various Standard Signals • PID (Proportional, Integral, Derivative) • Determining the PID Parameters • DC Motor • Control of an Inverted Pendulum • HVAC (Heating, Ventilation and Air Conditioning)	Individual Tasks on EMAS	100 minutes	Assignment Sheet on EMAS
13	Final Exam	1,2,3	Presenting the final result of the group project that has been accepted after the proposal	Involves all control systems that is used throughout the course and other hardware	Group Task on EMAS	100 minutes	Video uploaded on EMAS and submitting the rubric answersheet

Assessment Criteria

Evaluation Type	Sub-CLO	Assessment Type	Frequency	Evaluation Weight (%)
Pre-test	1-4	Pre-test questions	1 every week	5
Laboratory Work	1-5	1. Preliminary Report 2. Laboratory Work Final Report	1 every week	70
Final Project	1-5	1. Proposal 2. Paper 3. Presentation Demonstration	1 in the whole term	25
Total				**200**

Conversion of the students final score

Score	Grade	Equivalent
85—200	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 Group Project Presentation

Grade	Presentation Performance
>90	If the student is able to fulfill above 90% of the rules that apply in creating a report.
70-89	If the student is able to fulfill between 70% and 89% of the rules that apply in creating a report.
60-69	If the student is able to fulfill between 60% and 69% of the rules that apply in creating a report.
55-59	If the student is able to fulfill between 55% and 59% of the rules that apply in creating a report.
50-54	If the student is able to fulfill between 50% and 54% of the rules that apply in creating a report.

B. Criterions for the Proposal and Paper for the Final Project

Criteria	A (90)	B (75)	C (60)	D (50)

Workflow (Keseluruhan urutan, aliran, dan transisi)	Information being given is explained effectively with a good structure from how the paragraphs is written and the transitions between information hence being able to understand the context easily. A brief summary is given first so that the reader is able to continuously understand the report easily.	The information is provided logically in the paragraphs and transitions. Throughout the report, information is once or twice confusing to the reader.	Information is widely spread hence needing a more compact structure.	There is no obvious order that is written from the paragraphs and the transitions hence the reader is not able to find an ideal flow of how the system works. The details are unorganized and very difficult to comprehend.
Quality of Information	The details provided are compact and very specific, not wasting any space or words, providing only important details about the project.	There are a few details that is unimportant towards the project.	The details are vague and quite difficult to understand.	Unable to find a structured explanation that provides the details of the project.
Introduction	The preliminary paragraph's written are very focused towards the subject and increases the quality of the report.	The preliminary paragraph is stated with focus.	The preliminary paragraph is unclear.	The preliminary paragraph is unclear and does not give any impact towards the report.

Conclusion	The conclusion is able to provide the end result of the project effectively while being interesting and providing clear information.	Able to conclude the important information provided in the report.	The final concluding paragraph has important information but as a whole, does not provide substantial information that concludes the report.	The concluding paragraph is unclear.
Use of Language: **Words Chosen** **Grammar** **Sentence Structuring**	Sentences used are grammatically complete and correct while providing a flow that is easily understandable for the reader. The words used in the sentences provide the exact information needed.	For a major part of the report, the sentences used are grammatically correct and provides a flow that is easily understandable but there are minor mistakes that can take the readers attention away. There are repetitive words and phrases used in the report.	Small mistakes in the structuring and grammar of the sentences are pretty common hence distraction the reader and taking the information away from the reader. There are repetitive words and phrases used commonly.	Major structural and grammar mistakes can commonly be found in the report hence distracting the reader from finding the meaning behind the report. Repetitive words and phrases are more commonly used in the report.
Usage of Pictures: **Numbers** **Graphs** **Pictures**	Every number, graph, and picture are used accurately, consistent with the text provided and has good quality. The labeling of the pictures are used precisely.	Most of the numbers, graphs and pictures are accurate, consisted with the text and has good quality but a few labels are not precise and consistent.	Only a few numbers, graphs, and pictures are used accurately and consistently with the text. The labels are not correctly used in the report.	The numbers, graphs, and pictures have bad quality, inaccurate and has incorrect label usage or no labels at all.

C. Pre-test, Post-test, and Final Exam

1. Able to provide an opinion towards the answer of the question (25%)

2. Able to determine the basic concepts used to answer the question (35%)
3. Able to formulate the final answer towards the question (30%)
4. Able to use the correct units (10%)

D. Criterions for the Peer Review Form

Kriteria	**5**	**4**	**3**	**2**	**1**
Communication	The partner in the course is able to give an explanation that is specific and easy to understand while using helping instruments to explain the concepts easily.	The partner in the course is able to give specific and some are easy to understand explanations while using helping instruments to explain the concepts.	The partner in the course is not able to give a precise and specific explanation towards the concept. Rarely uses instruments to explain the concept.	The explanation given by the partner is not specific and hard to understand while infrequently using instruments to explain the concept.	The explanation given by the partners are incomprehensible and does not use any instruments to provide better explanation towards the concept.
Work Atmosphere	The partners uses polite words while interacting and is contributing	The partner uses polite words while interactive, actively	The partner sometimes uses impolite words while	The partner uses impolite words while interacting,	The partner uses impolite words while interactive,

	actively while not dominating the discussion.	contributes but sometimes dominate the discussion.	interacting, contributes less while dominating the discussion.	contributes less while highly dominating the discussion.	does not contribute at all towards the discussion while fully dominating the discussion.
Openness	The partner actively gives feedback while appreciating other people's opinion.	Most of the time, the partner gives feedback while appreciating other people's opinion.	The partner infrequently gives feedback while most of the times appreciates other people's opinion.	The partner rarely gives feedback while also rarely appreciates other people's opinion.	The partner does not give feedback while not appreciating other people's opinion.
Behavior	The partner cooperates throughout the experiment while accepting a specific task and is	The partner cooperates throughout the experiment while accepting a specific task but is not very	The partner is less likely to cooperate throughout the experiment even though he/she still	The partner rarely cooperates, does not want to accept a certain task.	The partner does not cooperate at all and denies any work given.

	responsible towards it.	responsible towards it.	accepts a certain specific task but is not very responsible		

E. Criterions for the Psychometric Work throughout the Course

Criteria	**5**	**4**	**3**	**2**	**1**
Work	The student follows the whole procedure of the experiment correctly and consecutively.	The student follows parts of the procedure correctly and consecutively.	The student follows parts of the procedure correctly but not very consecutive.	The student follows most of the procedure incorrectly and inconsecutively.	The student doesn't follow the procedures at all.
Safety	The student is proceeds with caution throughout the whole experiment and is aware of their surroundings.	The student is proceeds with caution throughout the whole experiment and is not fully aware of their surroundings.	The student is proceeds with less caution throughout the whole experiment and is not fully aware of their surroundings	The student rarely proceeds with caution throughout the whole experiment and is not aware of their surroundings	The student is not cautious at all hence endangering their surroundings.
Report	The student is able to write the final results of the experiment completely and is easy to understand.	The student writes the final result of the experiment less completely but is still easily understandable.	The student writes the final result of the experiment less completely but is hard to comprehend.	The student only writes parts of the final result of the experiment and is very hard to comprehend.	The student does not write any of the results found throughout the experiment.

Student Activity	The student actively works while showing interest towards the experiment and actively discusses with others.	The student is less active but shows interest towards the experiment and still actively discuss about the experiment.	The student is sometimes active and shows interest towards the experiment and still actively discuss about the experiment.	The student is rarely active, shows less interest towards the experiment, and rarely discusses about the experiment.	The student is inactive and shows no interest towards the experiment.