	Universitas Negeri Surabaya Faculty of Mathematics and Natural Sciences Physics Education Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Physics Measurement Systems	8420302188	Compulsory Study Program Subjects	T=2	P=0	ECTS=3.18	1	August 16, 2023

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model	**Project Based Learning**

Program Learning Outcomes (PLO)

PLO study program which is charged to the course

Program Objectives (PO)

PO - 1	Have the ability to utilize ICT-based learning resources and learning media in studying physics measurement systems.
PO - 2	Have knowledge and skills in planning physics measurement systems
PO - 3	Have knowledge and skills in implementing physics measurement systems
PO - 4	Have a responsible attitude which is reflected in fulfilling work safety and maintaining measuring instruments in measuring physical quantities.

PLO-PO Matrix

P.O
PO-1
PO-2
PO-3
PO-4

PO Matrix at the end of each learning stage (Sub-PO)

P.O	Week															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PO-1																
PO-2																
PO-3																
PO-4																

Short Course Description	This course explains the concept of physical measurement systems, measurement techniques, analysis of errors in measurements, application of measurement instruments in the laboratory including: ruler, caliper, screw micrometer, measuring cup, Ohaus balance, stopwatch, thermometer, voltmeter, ammeter, ohmmeter and oscilloscope in everyday life. Lectures are carried out using the case method, questions and answers, presentations and assignments.

References

Main :

1. Bell, D. A. 2004. Electronics Instrumentation and Measurement. USA: Springer.
2. Fornasini, P. 2008. The Uncertainty In Physical Measurements An Introduction to Data Analysis In The Physics Laboratory. New York: Springer.
3. Gupta, S.V. 2012. Measurement Uncertainties Physical Parameters and Calibrations of Instruments. New York: Springer.
4. Keithley. 2004. Low Level Measurement Handbook Precision DC Current, Voltage, and Resistance Measurements. USA: Keithley Instruments Inc.
5. Moris, A. S. 2001. Measurement and Instrumentation Principles, Third Edition. Butterworth Heinemann

Supporters:

Supporting lecturer	Dr. Dwikoranto, M.Pd. Setyo Admoko, S.Pd., M.Pd. Abd. Kholiq, S.Pd., M.T. Abu Zainuddin, S.Pd., M.Pd. Mita Anggaryani, M.Pd., Ph.D. Mukhayyarotin Niswati Rodliyatul Jauhariyah, S.Pd., M.Pd. Dr. Muhammad Satriawan, M.Pd. Muhammad Habibbulloh, M.Pd. Dr. Oka Saputra, M.Pd

Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [Estimated time]		Learning materials [References]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline (*offline*)	Online (*online*)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	1.Have the ability to describe the concept of measuring physical quantities 2.Have the ability to describe the concept of characteristics of physical measuring instruments	1.Have the ability to describe the concept of measuring physical quantities 2.Have the ability to describe the concept of characteristics of physical measuring instruments	**Criteria:** 1.Activity level 2.accuracy in answering **Form of Assessment** : Participatory Activities	Question and Answer Discussion Presentation 2 X 50		**Material:** Basics of Measurement **Literature:** *Moris, AS 2001. Measurement and Instrumentation Principles, Third Edition. Butterworth Heinemann*	2%
2	Have the ability to explain the concept of significant numbers	Have the ability to explain the concept of significant numbers	**Criteria:** 1.Activity level 2.Accuracy in answering **Form of Assessment** : Participatory Activities	Question and Answer Discussion Presentation 2 X 50		**Material:** Basics of Measurement **Literature:** *Moris, AS 2001. Measurement and Instrumentation Principles, Third Edition. Butterworth Heinemann*	1%
3	1.Have the ability to describe the concept of single measurement techniques and repeated measurements 2.Have the ability to describe the concept of uncertainty in measurement and the propagation of measurement error 3.Have the ability to describe work safety concepts using physical quantity measuring instruments	1.Have the ability to describe the concept of single measurement techniques and repeated measurements 2.Have the ability to describe the concept of uncertainty in measurement and the propagation of measurement error 3.Have the ability to describe work safety concepts using physical quantity measuring instruments	**Criteria:** 1.Activeness in answering 2.accuracy of answers **Form of Assessment** : Participatory Activities	Discussion Presentation Questions and Answers Assignment 2 X 50		**Material:** Characteristics of Measuring Instruments **Literature:** *Moris, AS 2001. Measurement and Instrumentation Principles, Third Edition. Butterworth Heinemann*	1%
4	1.Have the ability to identify data resulting from measurements of physical quantities 2.Have the ability to present data from measurements of physical quantities	1.Have the ability to identify data resulting from measurements of physical quantities 2.Have the ability to present data from measurements of physical quantities	**Criteria:** 1.Activeness in answering 2.accuracy of answers **Form of Assessment** : Participatory Activities, Portfolio Assessment	□ Learning Form: Offline lecture □ Learning Method: Case Method Case: 1 Present several measurement results using several different measuring instruments, then: how to present the data so that it is easy to analyze 2 X 50		**Material:** Characteristics of Measuring Instruments **Literature:** *Moris, AS 2001. Measurement and Instrumentation Principles, Third Edition. Butterworth Heinemann*	5%

5	1. Have the ability to analyze the results of measurements of physical quantities using the concept of standard deviation (SD) analysis 2. Have the ability to analyze the results of measurements of physical quantities using the concept of standard error (SE) analysis	1. Have the ability to analyze the results of measurements of physical quantities using the concept of standard deviation (SD) analysis 2. Have the ability to analyze the results of measurements of physical quantities using the concept of standard error (SE) analysis	**Criteria:** 1. activeness in answering 2. accuracy in answering **Form of Assessment** : Participatory Activities	□ Learning Form: Offline Lecture □ Learning Method: Case Method Case 2: Given a table of measurement data using certain measuring instruments with a total of 10 data and 25 data. How to find SD and SE from the measurement results 2 X 50			5%
6	1. Have the ability to analyze the results of measurements of physical quantities using the concept of weighted average analysis 2. Have the ability to analyze the results of measurements of physical quantities using graphic analysis concepts	1. Have the ability to analyze the results of measurements of physical quantities using the concept of weighted average analysis 2. Have the ability to analyze the results of measurements of physical quantities using graphic analysis concepts	**Criteria:** 1. Activeness in answering 2. accuracy **Form of Assessment** : Participatory Activities	□ Learning Form: Offline lecture □ Learning Method: Case Method Case 3: Given a table of measurement data using certain measuring instruments with a total of 10 data and 25 data. How to find the SD from the measurement results using the weighted average analysis technique and the 2 X 50 graphic method		**Material:** Single and Repeated Measurements **Reference:** *Moris, AS 2001. Measurement and Instrumentation Principles, Third Edition. Butterworth Heinemann*	5%
7	1. Have the ability to read the results of analysis of physical quantity measurement data 2. Have the ability to describe the results of analysis of physical quantity measurement data	1. Have the ability to read the results of analysis of physical quantity measurement data 2. Have the ability to describe the results of analysis of physical quantity measurement data	**Criteria:** 1. Activeness in answering 2. accuracy **Form of Assessment** : Participatory Activities	□ Learning Form: Offline Lecture □ Learning Method: Case Method Case 4: Given a table of measurement data using certain measuring instruments with a total of 10 data and 25 data. How to find SD from the measurement results using SD analysis techniques and graphic methods then interpret the results of the analysis 2 X 50		**Material:** Measurement Uncertainty **References:** *Moris, AS 2001. Measurement and Instrumentation Principles, Third Edition. Butterworth Heinemann*	5%
8	UTS	UTS	**Criteria:** Individual **Form of Assessment** : Test	UTS 2 X 50		**Material:** Physics Measurement Systems **References:** *Moris, AS 2001. Measurement and Instrumentation Principles, Third Edition. Butterworth Heinemann*	20%

9	1. Have skills in applying physical measurement system equipment to physical quantities Length using a ruler (meter) 2. Have skills in applying physical measurement system equipment to long physical quantities using a caliper	1. Have skills in applying physical measurement system equipment to physical quantities Length using a ruler (meter) 2. Have skills in applying physical measurement system equipment to long physical quantities using a caliper	**Criteria:** 1. Activeness in answering 2. accuracy **Form of Assessment** : Participatory Activities, Practice/Performance	□ Learning Form: Offline Lecture □ Learning Method: Case Method Case 5: Video/pictures are provided regarding a motorbike technician who wants to replace a motorbike engine piston. Help the motorbike technician to determine the measuring tool that must be used to produce a precise piston size of 2 X 50		**Material:** Physics Measurement Systems **References:** *Moris, AS 2001. Measurement and Instrumentation Principles, Third Edition. Butterworth Heinemann*	5%
10	1. Have skills in applying physical measurement system equipment to physical quantities of Length using a screw micrometer 2. Have skills in applying physical measurement system equipment to the physical quantity Volume using Measuring Cups	1. Have skills in applying physical measurement system equipment to physical quantities of Length using a screw micrometer 2. Have skills in applying physical measurement system equipment to the physical quantity Volume using Measuring Cups	**Criteria:** 1. Activeness in answering 2. accuracy **Form of Assessment** : Participatory Activities, Practice/Performance	□ Learning Form: Offline Lecture □ Learning Method: Case Method Case 6: An image is given regarding a photo of the results of measuring the volume of a square brass block using a measuring cup and screw micrometer. Compare the results of the 2 measurements? Then conclude which measurement result has the speed of the measurement process and the accuracy (precision) of the measurement. 2 X 50		**Material:** Physics Measurement Systems **References:** *Moris, AS 2001. Measurement and Instrumentation Principles, Third Edition. Butterworth Heinemann*	5%
11	1. Have skills in applying physical measurement system equipment to physical quantities of mass using an Ohaus balance 2. Have skills in applying physical measurement system equipment to physical quantities of time using a stopwatch 3. Have skills in applying physical measurement system equipment to the physical quantity Temperature using a thermometer	1. Have skills in applying physical measurement system equipment to physical quantities of mass using an Ohaus balance 2. Have skills in applying physical measurement system equipment to physical quantities of time using a stopwatch 3. Have skills in applying physical measurement system equipment to the physical quantity Temperature using a thermometer	**Criteria:** 1. Activeness in answering 2. accuracy **Form of Assessment** : Participatory Activities, Practice/Performance	Demonstration Discussion Questions and Answers 2 x 50		**Material:** Electrical Measuring Instruments **Reference:** *Bell, DA 2004. Electronics Instrumentation and Measurement. USA: Springer.*	2%

12	1. Have skills in applying physics measurement system equipment using a voltmeter measuring instrument 2. Have skills in applying physics measurement system equipment using an ohmmeter measuring instrument	1. Have skills in applying physics measurement system equipment using a voltmeter measuring instrument 2. Have skills in applying physics measurement system equipment using an ohmmeter measuring instrument	**Criteria:** 1. Activeness in answering 2. accuracy **Form of Assessment** : Participatory Activities, Practice/Performance	Demonstration Discussion Questions and Answers 2 x 50		**Material:** Electrical Measuring Instruments **Reference:** *Bell, DA 2004. Electronics Instrumentation and Measurement. USA: Springer.*	2%
13	Have skills in applying physics measurement system equipment using ammeter measuring instruments	Have skills in applying physics measurement system equipment using ammeter measuring instruments	**Form of Assessment** : Participatory Activities	□ Learning Form: Lecture □ Learning Method: Question and answer & discussion 2 x 50		**Material:** RLC circuit **Reference:** *Bell, DA 2004. Electronics Instrumentation and Measurement. USA: Springer.*	2%
14	Have skills in applying physics measurement system equipment using an oscilloscope measuring instrument	Have skills in applying physics measurement system equipment using an oscilloscope measuring instrument	**Form of Assessment** : Participatory Activities	□ Learning Form: Offline Lecture □ Learning Method: Case Method Case 7: Images are given regarding photos of the results of measuring the AC power supply output using a multimeter (voltmeter) and oscilloscope. Compare the measurement results and conclude that the measurement results are 2 x 50		**Material:** RLC circuit **Reference:** *Bell, DA 2004. Electronics Instrumentation and Measurement. USA: Springer.*	5%
15	1. Have the ability to communicate the results of analysis of physical quantity measurement data orally 2. Have the ability to communicate the results of analysis of physical quantity measurement data in pictures and/or writing	1. Have the ability to communicate the results of analysis of physical quantity measurement data orally 2. Have the ability to communicate the results of analysis of physical quantity measurement data in pictures and/or writing	**Criteria:** 1. Active in presentation and answering 2. accuracy of answers and responsibility **Form of Assessment** : Participatory Activities	From several case studies at the previous meeting... make a good PPT presentation media then present the results for one different case for each group Final Semester Evaluation / Final Semester Exam 2 x 50		**Material:** RLC circuit **Reference:** *Bell, DA 2004. Electronics Instrumentation and Measurement. USA: Springer.*	15%

16	UAS	1. Have skills in applying physical measurement system equipment to physical quantities of mass using an Ohaus balance 2. Have skills in applying physical measurement system equipment to physical quantities of time using a stopwatch 3. Have skills in applying physical measurement system equipment to the physical quantity Temperature using a thermometer 4. Have skills in applying physics measurement system equipment using a voltmeter measuring instrument 5. Have skills in applying physics measurement system equipment using an ohmmeter measuring instrument 6. Have skills in applying physics measurement system equipment using an oscilloscope measuring instrument	**Criteria:** Accuracy of answers **Form of Assessment** : Test	UAS 2 x 50		**Material:** Electrical measuring instruments **Reference:** *Bell, DA 2004. Electronics Instrumentation and Measurement. USA: Springer.*	20%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	50.5%
2.	Portfolio Assessment	2.5%
3.	Practice / Performance	7%
4.	Test	40%
		100%

Notes

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.

6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.