| | Universitas Negeri Surabaya<br>Faculty of Mathematics and Natural Sciences<br>Undergraduate Physics Study Program | Document Code |
|---|---|---|

# SEMESTER LEARNING PLAN

| Courses | CODE | Course Family | Credit Weight | | | SEMESTER | Compilation Date |
|---|---|---|---|---|---|---|---|
| Censorship | 4520102250 | Study Program Elective Courses | T=2 | P=0 | ECTS=3.18 | 8 | January 23, 2024 |

| AUTHORIZATION | SP Developer | Course Cluster Coordinator | Study Program Coordinator |
|---|---|---|---|
| | Endah Rahmawati, S.T., M.Si. | Endah Rahmawati, S.T., M.Si. | Prof. Dr. Munasir, S.Si., M.Si. |

| | | |
|---|---|---|
| **Learning model** | **Case Studies** | |
| **Program Learning Outcomes (PLO)** | **PLO study program that is charged to the course** | |
| | **PLO-3** | Develop logical, critical, systematic and creative thinking in carrying out specific work in their field of expertise and in accordance with work competency standards in the field concerned |
| | **PLO-4** | Develop yourself continuously and collaborate. |
| | **PLO-5** | Able to demonstrate as a good scientist, critical thinking skills and innovation in research and professional fields. |
| | **PLO-7** | Communicate their ideas and/or research results in academic writing and speaking effectively. |
| | **PLO-8** | Able to make decisions based on data and information in order to fulfill and evaluate responsibilities according to their duties. |
| | **PLO-10** | Analyze physical systems by applying mathematics and computing/ICT tools. |
| | **PLO-12** | Have the ability to improve their knowledge and be able to continue their studies to a higher level. |
| | **PLO-15** | Solve problems in physical systems comprehensively using mathematics and computational tools. |
| | **Program Objectives (PO)** | |
| | **PO - 1** | Able to analyze and explain measurements of physical quantities, sensors and transducers |
| | **PO - 2** | Able to apply appropriate instrumentation system concepts to obtain quantitative problem solutions in physical systems |
| | **PO - 3** | Able to communicate the concepts and application of physical system analysis effectively during the learning process |
| | **PO - 4** | Able to work independently effectively and collaborate in groups on lecture and practicum assignments |
| | **PO - 5** | Able to demonstrate a scientific attitude and critical thinking in solving problems faced both academically and socially |
| | **PLO-PO Matrix** | |

| P.O | PLO-3 | PLO-4 | PLO-5 | PLO-7 | PLO-8 | PLO-10 | PLO-12 | PLO-15 |
|---|---|---|---|---|---|---|---|---|
| PO-1 | | | | | | | | |
| PO-2 | | | | | | | | |
| PO-3 | | | | | | | | |
| PO-4 | | | | | | | | |
| PO-5 | | | | | | | | |

**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 | | | | | | | | | | | | | | | | |
| PO-5 | | | | | | | | | | | | | | | | |

| | |
|---|---|
| **Short Course Description** | Sensor systems are courses that discuss the basic principles of measuring physical quantities, characteristics of sensors, signal conditioning circuits and sensor interfaces, working principles of sensors (motion sensors: measurement of position, speed, acceleration; optical sensors, thermal sensors, acoustic sensors, and pressure sensors ), how to characterize and calibrate the sensor. Learning is carried out using discussion methods and project based learning (creating a project in the form of a simple measurement system using sensors complete with system calibration and characterization). |
| **References** | **Main :** |
| | 1. Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.<br>2. Wilson, J. S. 2005. Sensor Technology Handbook. Elsevier.<br>3. Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science. |
| | **Supporters:** |
| | 1. Jurnal-jurnal terkait materi |
| **Supporting lecturer** | Endah Rahmawati, S.T., M.Si.<br>Meta Yantidewi, S.Si., M.Si. |

| **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** | Students understand the basic principles of measuring physical quantities, sensors and transducers | 1. Distinguish between transducers and sensors<br>2. Explain the basic principles of measuring physical quantities (electric charge, electric potential, magnetic field, Hall effect, capacitance, resistance, inductance, thermal, and light).<br>3. Classify sensors based on their measurement principles. | **Criteria:** Complete tasks (project design portfolio) completely<br><br>**Form of Assessment** : Participatory Activities, Portfolio Assessment | Form: Classical classroom<br><br>Method: discussion, Project Based Learning (2 x 50 minutes) | | **Material:** Basic principles of measuring physical quantities, sensors and transducers **References:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.*<br><br>**Material:** Basic principles of measuring physical quantities, sensors and transducers **Reference:** *Wilson, JS 2005. Sensor Technology Handbook. Elsevier.*<br><br>**Material:** Basic principles of measuring physical quantities, sensors and transducers **References:** *Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science.* | 2% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **2** | Students understand the basic principles of measuring physical quantities, sensors and transducers | 1. Distinguish between transducers and sensors<br>2. Explain the basic principles of measuring physical quantities (electric charge, electric potential, magnetic field, Hall effect, capacitance, resistance, inductance, thermal, and light).<br>3. Classify sensors based on their measurement principles. | **Criteria:**<br>Complete tasks (project design portfolio) completely<br><br>**Form of Assessment** :<br>Participatory Activities, Portfolio Assessment | Form:<br>Classical classroom<br><br>Method:<br>discussion, Project Based Learning (2 x 50 minutes) | | **Material:** Basic principles of measuring physical quantities, sensors and transducers<br>**References:**<br>*Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.*<br><br>**Material:** Basic principles of measuring physical quantities, sensors and transducers<br>**Reference:**<br>*Wilson, JS 2005. Sensor Technology Handbook. Elsevier.*<br><br>**Material:** Basic principles of measuring physical quantities, sensors and transducers<br>**References:**<br>*Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science.* | 2% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **3** | Students understand the basic principles of measuring physical quantities, sensors and transducers | 1. Distinguish between transducers and sensors<br>2. Explain the basic principles of measuring physical quantities (electric charge, electric potential, magnetic field, Hall effect, capacitance, resistance, inductance, thermal, and light).<br>3. Classify sensors based on their measurement principles. | **Criteria:**<br>Complete tasks (project design portfolio) completely<br><br>**Form of Assessment** :<br>Participatory Activities, Portfolio Assessment | Form:<br>Classical classroom<br><br>Method:<br>discussion, Project Based Learning (2 x 50 minutes) | | **Material:** Basic principles of measuring physical quantities, sensors and transducers<br>**References:**<br>*Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.*<br><br>**Material:** Basic principles of measuring physical quantities, sensors and transducers<br>**Reference:**<br>*Wilson, JS 2005. Sensor Technology Handbook. Elsevier.*<br><br>**Material:** Basic principles of measuring physical quantities, sensors and transducers<br>**References:**<br>*Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science.* | 2% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **4** | Students understand the basic principles of measuring physical quantities, sensors and transducers | 1. Distinguish between transducers and sensors<br>2. Explain the basic principles of measuring physical quantities (electric charge, electric potential, magnetic field, Hall effect, capacitance, resistance, inductance, thermal, and light).<br>3. Classify sensors based on their measurement principles. | **Criteria:**<br>Complete tasks (project design portfolio) completely<br><br>**Form of Assessment** :<br>Participatory Activities, Portfolio Assessment | Form:<br>Classical classroom<br><br>Method:<br>discussion, Project Based Learning (2 x 50 minutes) | | **Material:** Basic principles of measuring physical quantities, sensors and transducers<br>**References:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.*<br><br>**Material:** Basic principles of measuring physical quantities, sensors and transducers<br>**Reference:** *Wilson, JS 2005. Sensor Technology Handbook. Elsevier.*<br><br>**Material:** Basic principles of measuring physical quantities, sensors and transducers<br>**References:** *Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science.* | 2% |
| **5** | Students have the ability to determine the appropriate signal conditioning circuit for the sensor. | 1. Explain the various types of signal conditioning circuits.<br>2. Design the conditioning circuit needed for a sensor based on its characteristics. | **Criteria:**<br>Complete tasks (project design portfolio) completely<br><br>**Form of Assessment** :<br>Participatory Activities | Form:<br>Classical classroom<br><br>Method:<br>discussion, Project Based Learning (2 x 50 minutes) | | **Material:** Signal conditioning circuit<br>**Reference:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.*<br><br>**Material:** Signal conditioning circuit<br>**Reference:** *Wilson, JS 2005. Sensor Technology Handbook. Elsevier.*<br><br>**Material:** Signal conditioning circuit<br>**Reference:** *Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science.* | 2% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **6** | Students have the ability to determine the appropriate signal conditioning circuit for the sensor. | 1. Explain the various types of signal conditioning circuits.<br>2. Design the conditioning circuit needed for a sensor based on its characteristics. | **Criteria:**<br>Complete tasks (project design portfolio) completely<br><br>**Form of Assessment** : Participatory Activities | Form: Classical classroom<br><br>Method: discussion, Project Based Learning (2 x 50 minutes) | | **Material:** Signal conditioning circuit<br>**Reference:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.*<br><br>**Material:** Signal conditioning circuit<br>**Reference:** *Wilson, JS 2005. Sensor Technology Handbook. Elsevier.*<br><br>**Material:** Signal conditioning circuit<br>**Reference:** *Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science.* | 2% |
| **7** | Students have the ability to determine the appropriate signal conditioning circuit for the sensor. | 1. Explain the various types of signal conditioning circuits.<br>2. Design the conditioning circuit needed for a sensor based on its characteristics. | **Criteria:**<br>Complete tasks (project design portfolio) completely<br><br>**Form of Assessment** : Participatory Activities | Form: Classical classroom<br><br>Method: discussion, Project Based Learning (2 x 50 minutes) | | **Material:** Signal conditioning circuit<br>**Reference:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.*<br><br>**Material:** Signal conditioning circuit<br>**Reference:** *Wilson, JS 2005. Sensor Technology Handbook. Elsevier.*<br><br>**Material:** Signal conditioning circuit<br>**Reference:** *Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science.* | 2% |
| **8** | Midterm Evaluation / Midterm Exam | | **Form of Assessment** : Participatory Activities, Portfolio Assessment | | | | 14% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **9** | Able to master the working principles of control systems for physical systems | Design and manufacture a series of physical measurement systems (sensors, signal conditioning and data acquisition) | **Criteria:**<br>Complete the assignment (portfolio in the form of design results) completely<br><br>**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment | Form: Classical classroom<br><br>Method: discussion, Project Based Learning (2 x 50 minutes) | | **Material:** Working principles of control systems for physical systems **Reference:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.*<br><br>**Material:** Working principles of control systems for physical systems **Reference:** *Wilson, JS 2005. Sensor Technology Handbook. Elsevier.*<br><br>**Material:** Working principles of control systems for physical systems **Reference:** *Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science.* | 6% |
| **10** | Able to master the working principles of control systems for physical systems | Design and manufacture a series of physical measurement systems (sensors, signal conditioning and data acquisition) | **Criteria:**<br>Complete the assignment (portfolio in the form of design results) completely<br><br>**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment | Form: Classical classroom<br><br>Method: discussion, Project Based Learning (2 x 50 minutes) | | **Material:** Working principles of control systems for physical systems **Reference:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.*<br><br>**Material:** Working principles of control systems for physical systems **Reference:** *Wilson, JS 2005. Sensor Technology Handbook. Elsevier.*<br><br>**Material:** Working principles of control systems for physical systems **Reference:** *Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science.* | 6% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **11** | Able to master the working principles of control systems for physical systems | Design and manufacture a series of physical measurement systems (sensors, signal conditioning and data acquisition) | **Criteria:**<br>Complete the assignment (portfolio in the form of design results) completely<br><br>**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment | Form: Classical classroom<br><br>Method: discussion, Project Based Learning (2 x 50 minutes) | | **Material:** Working principles of control systems for physical systems **Reference:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.*<br><br>**Material:** Working principles of control systems for physical systems **Reference:** *Wilson, JS 2005. Sensor Technology Handbook. Elsevier.*<br><br>**Material:** Working principles of control systems for physical systems **Reference:** *Boyes, W. 2003. Instrumentation Reference Book. Third Edition. Elsevier Science.* | 6% |
| **12** | Able to calibrate and characterize the measurement system that has been designed | Calibrate and characterize the measurement system that has been designed | **Criteria:**<br>Complete the assignment (portfolio in the form of design results) completely<br><br>**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment | Calibrate and characterize the designed measurement system (2 x 50 minutes) | | **Material:** measurement systems **References:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.* | 6% |
| **13** | Able to calibrate and characterize the measurement system that has been designed | Calibrate and characterize the measurement system that has been designed | **Criteria:**<br>Complete the assignment (portfolio in the form of design results) completely<br><br>**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment | Calibrate and characterize the designed measurement system (2 x 50 minutes) | | **Material:** measurement systems **References:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.* | 6% |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **14** | Able to calibrate and characterize the measurement system that has been designed | Calibrate and characterize the measurement system that has been designed | **Criteria:** Complete the assignment (portfolio in the form of design results) completely<br><br>**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment | Calibrate and characterize the designed measurement system (2 x 50 minutes) | | **Material:** measurement systems<br>**References:** *Fraden, J. 2003. Handbook of Modern Sensors. Physics, Design and Applications. AIP Press.* | 6% |
| **15** | Able to design and explain a measurement system that applies sensors and conditioning systems | | **Criteria:** Presenting project results<br><br>**Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment | Form: Classical classroom<br><br>Method: discussion, Project Based Learning (2 x 50 minutes) | | | 18% |
| **16** | End of Semester Evaluation | | **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment | | | | 18% |

**Evaluation Percentage Recap: Case Study**

| No | Evaluation | Percentage |
|---|---|---|
| 1. | Participatory Activities | 41% |
| 2. | Project Results Assessment / Product Assessment | 24% |
| 3. | Portfolio Assessment | 35% |
| | | 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.