



**Universitas Negeri Surabaya**  
**Faculty of Mathematics and Natural Sciences**  
**Undergraduate Physics Study Program**

Document Code

**SEMESTER LEARNING PLAN**

<b>Courses</b>	<b>CODE</b>	<b>Course Family</b>	<b>Credit Weight</b>			<b>SEMESTER</b>	<b>Compilation Date</b>																																																																																			
<b>MATERIAL CHARACTERIZATION METHOD</b>	4520102240	Study Program Elective Courses	T=2	P=0	ECTS=3.18	6	July 17, 2024																																																																																			
<b>AUTHORIZATION</b>	<b>SP Developer</b>		<b>Course Cluster Coordinator</b>			<b>Study Program Coordinator</b>																																																																																				
	Lydia Rohmawati, M.Si.		Diah Hari Kusumawati, M.Si.			Prof. Dr. Munasir, S.Si., M.Si.																																																																																				
<b>Learning model</b>	<b>Project Based Learning</b>																																																																																									
<b>Program Learning Outcomes (PLO)</b>	<b>PLO study program which is charged to the course</b>																																																																																									
	<b>PLO-5</b>	Able to demonstrate as a good scientist, critical thinking skills and innovation in research and professional fields.																																																																																								
	<b>PLO-12</b>	Have the ability to improve their knowledge and be able to continue their studies to a higher level.																																																																																								
	<b>Program Objectives (PO)</b>																																																																																									
	<b>PO - 1</b>	Mastering the theoretical concepts of material characterization methods, namely based on qualitative and quantitative properties of mechanical, thermal, electrical, magnetic and optical properties as well as natural phenomena																																																																																								
	<b>PO - 2</b>	Have knowledge of the material characterization process, working principles of tools, sample preparation, data collection and analysis																																																																																								
	<b>PO - 3</b>	Have the ability to communicate ideas or thoughts from the results of researching scientific articles related to the characterization of material both individually and in groups expressed in written form (narrative reviews/posters) and presentations																																																																																								
	<b>PLO-PO Matrix</b>																																																																																									
		<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td>P.O</td> <td>PLO-5</td> <td>PLO-12</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>PO-1</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>PO-2</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>PO-3</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>						P.O	PLO-5	PLO-12					PO-1							PO-2							PO-3																																																													
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<b>PO Matrix at the end of each learning stage (Sub-PO)</b>																																																																																										
	<table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <td rowspan="2">P.O</td> <td colspan="16">Week</td> </tr> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td> </tr> <tr> <td>PO-1</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>PO-2</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>PO-3</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table>						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																
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PO-3																																																																																										
<b>Short Course Description</b>	Study of the analysis of mechanical, thermal, electrical, magnetic and optical properties of both metallic and non-metallic materials and their applications. Assessment of learning outcomes is carried out through written tests and work presentations in the form of visualized images/posters about characterization tools based on mechanical, thermal, optical, electrical and magnetic properties.																																																																																									
<b>References</b>	<b>Main :</b>																																																																																									
	<ol style="list-style-type: none"> <li>Callister Jr, W.D., 2007 , "Fundamental of Materials Science &amp; Engineering", 7th Edition , John Willey and Son, New York,</li> <li>Carl C Koch, Ilya A., Sudipta Seal, and Stan Veprek, "Structural Nanocrystalline Materials: Fundamental and Application", 2007, Cambridge University Press.</li> <li>Benjamin Crowell, 2009, " Simple Nature: An Introduction to Physics for Engineering and Physical Science Student", www.lightandmatter.com</li> </ol>																																																																																									
	<b>Supporters:</b>																																																																																									
	<ol style="list-style-type: none"> <li>Jurnal Nasional dan Jurnal Internasional tentang nanomaterial, mekanik pada logam dan komposit</li> </ol>																																																																																									
<b>Supporting lecturer</b>	Diah Hari Kusumawati, S.Si., M.Si. Nugrahani Primary Putri, S.Si., M.Si. Lydia Rohmawati, 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	Able to describe material characterization methods based on mechanical, thermal, electrical, magnetic and optical properties	Explains the characterization of materials based on mechanical, thermal, electrical, magnetic and optical properties	<b>Criteria:</b> Quantitative  <b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment	presentation, discussion and question and answer 2 X 50	presentation, discussion and question and answer 2 x 50	<b>Material:</b> Mechanical properties (ch 6), Electrical properties (Ch 18), Thermal properties (ch 19), Magnetic properties (ch 20), Optical properties (ch 21) <b>Bibliography:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science & Engineering", 7th Edition , John Willey and Son, New York,	2%
2	Able to understand the working principles of mechanical characterization, sample preparation, data collection and analysis sourced from search results for articles in national/international journals	Identify and explain the mechanical properties of metal materials based on the characterization of the material in terms of tensile, hardness, compression/shear tests	<b>Criteria:</b> Quantitative  <b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment	presentation, discussion and question and answer 2 X 50	presentation, discussion and question and answer 2 x 50	<b>Material:</b> Mechanical properties (ch 6), Electrical properties (Ch 18), Thermal properties (ch 19), Magnetic properties (ch 20), Optical properties (ch 21) <b>Bibliography:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science & Engineering", 7th Edition , John Willey and Son, New York,  <b>Material:</b> Mechanical properties of materials <b>References:</b> Carl C Koch, Ilya A., Sudipta Seal, and Stan Veprek, "Structural Nanocrystalline Materials: Fundamental and Application", 2007, Cambridge University Press.  <b>Material:</b> characterization of mechanical properties <b>Library:</b> National Journal and International Journal on nanomaterials, mechanics of metals and composites	2%
3	Able to understand the working principles of mechanical characterization, sample preparation, data collection and analysis sourced from search results for articles in national/international journals	Identify and explain the mechanical properties of metal materials based on the characterization of the material in terms of tensile, hardness, compression/shear tests	<b>Criteria:</b> Quantitative  <b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment	presentation, discussion and question and answer 2 X 50	presentation, discussion and question and answer 2 x 50	<b>Material:</b> Mechanical properties (ch 6), Electrical properties (Ch 18), Thermal properties (ch 19), Magnetic properties (ch 20), Optical properties (ch 21) <b>Bibliography:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science & Engineering", 7th Edition , John Willey and Son, New York,  <b>Material:</b> Mechanical properties of materials <b>References:</b> Carl C Koch, Ilya A., Sudipta Seal, and Stan Veprek, "Structural Nanocrystalline Materials: Fundamental and Application", 2007, Cambridge University Press.  <b>Material:</b> characterization of mechanical properties <b>Library:</b> National Journal and International Journal on nanomaterials, mechanics of metals and composites	2%

4	Able to understand the working principles of thermal characterization, sample preparation, data collection and analysis sourced from search results for articles in national/international journals	Able to explain the mechanism for characterizing the thermal properties of materials	<p><b>Criteria:</b> Quantitative</p> <p><b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment</p>	presentation, discussion and question and answer 2 X 50	presentation, discussion and question and answer 2 x 50	<p><b>Material:</b> Mechanical properties (ch 6), Electrical properties (Ch 18), Thermal properties (ch 19), Magnetic properties (ch 20), Optical properties (ch 21)</p> <p><b>Bibliography:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science &amp; Engineering", 7th Edition , John Willey and Son, New York,</p> <hr/> <p><b>Material:</b> thermal properties <b>References:</b> Carl C Koch, Ilya A., Sudipta Seal, and Stan Veprek, "Structural Nanocrystalline Materials: Fundamental and Application", 2007, Cambridge University Press.</p> <hr/> <p><b>Matter:</b> thermal properties <b>Reference:</b> Benjamin Crowell, 2009, "Simple Nature: An Introduction to Physics for Engineering and Physical Science Students", <a href="http://www.lightandmatter.com">www.lightandmatter.com</a></p> <hr/> <p><b>Material:</b> characterization of thermal properties <b>Library:</b> National Journal and International Journal on nanomaterials, mechanics of metals and composites</p>	2%
5	Able to understand the working principles of thermal characterization, sample preparation, data collection and analysis sourced from search results for articles in national/international journals	Able to explain the mechanism for characterizing the thermal properties of materials	<p><b>Criteria:</b> Quantitative</p> <p><b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment</p>	presentation, discussion and question and answer 2 X 50	presentation, discussion and question and answer 2 x 50	<p><b>Material:</b> Mechanical properties (ch 6), Electrical properties (Ch 18), Thermal properties (ch 19), Magnetic properties (ch 20), Optical properties (ch 21)</p> <p><b>Bibliography:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science &amp; Engineering", 7th Edition , John Willey and Son, New York,</p> <hr/> <p><b>Material:</b> thermal properties <b>References:</b> Carl C Koch, Ilya A., Sudipta Seal, and Stan Veprek, "Structural Nanocrystalline Materials: Fundamental and Application", 2007, Cambridge University Press.</p> <hr/> <p><b>Matter:</b> thermal properties <b>Reference:</b> Benjamin Crowell, 2009, "Simple Nature: An Introduction to Physics for Engineering and Physical Science Students", <a href="http://www.lightandmatter.com">www.lightandmatter.com</a></p> <hr/> <p><b>Material:</b> characterization of thermal properties <b>Library:</b> National Journal and International Journal on nanomaterials, mechanics of metals and composites</p>	2%

6	Able to understand the working principles of magnetic characterization, sample preparation, data collection and analysis sourced from search results for articles in national/international journals	Able to explain the mechanism for characterizing the magnetic properties of materials	<b>Criteria:</b> Quantitative  <b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment	presentation, discussion and question and answer 2 X 50	presentation, discussion and question and answer 2 x 50	<b>Material:</b> Mechanical properties (ch 6), Electrical properties (Ch 18), Thermal properties (ch 19), Magnetic properties (ch 20), Optical properties (ch 21) <b>Bibliography:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science & Engineering", 7th Edition, John Willey and Son, New York, <hr/> <b>Material:</b> characterization of magnetic properties <b>Library:</b> National Journal and International Journal on nanomaterials, mechanics of metals and composites <hr/> <b>Matter:</b> magnetic properties of materials <b>Reference:</b> Benjamin Crowell, 2009, "Simple Nature: An Introduction to Physics for Engineering and Physical Science Students", <a href="http://www.lightandmatter.com">www.lightandmatter.com</a>	4%
7	Able to understand the working principles of magnetic characterization, sample preparation, data collection and analysis sourced from search results for articles in national/international journals	Able to explain the mechanism for characterizing the magnetic properties of materials	<b>Criteria:</b> Quantitative  <b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment	presentation, discussion and question and answer 2 X 50	presentation, discussion and question and answer 2 x 50	<b>Material:</b> Mechanical properties (ch 6), Electrical properties (Ch 18), Thermal properties (ch 19), Magnetic properties (ch 20), Optical properties (ch 21) <b>Bibliography:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science & Engineering", 7th Edition, John Willey and Son, New York, <hr/> <b>Material:</b> characterization of magnetic properties <b>Library:</b> National Journal and International Journal on nanomaterials, mechanics of metals and composites <hr/> <b>Matter:</b> magnetic properties of materials <b>Reference:</b> Benjamin Crowell, 2009, "Simple Nature: An Introduction to Physics for Engineering and Physical Science Students", <a href="http://www.lightandmatter.com">www.lightandmatter.com</a>	5%
8	UTS	able to do UTS questions completely	<b>Criteria:</b> written test with a total of 5 essay questions  <b>Form of Assessment :</b> Portfolio Assessment, Test	written test 2 X 50	written test 2 x 50	<b>Material:</b> Mechanical, thermal, electrical, optical, magnetic properties of materials <b>Reference:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science & Engineering", 7th Edition, John Willey and Son, New York,	20%

9	Able to understand the working principles of electrical conductivity/characterization, sample preparation, data collection and analysis sourced from search results for articles in national/international journals	Able to explain the mechanism for characterizing the electrical properties of materials	<b>Criteria:</b> Quantitative  <b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment	Presentation, discussion and questions and answers 2 X 50	Presentations, discussions and questions and answers 2 x 50	<b>Matter:</b> Electrical properties of materials <b>Reference:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science & Engineering", 7th Edition, John Willey and Son, New York,  <b>Material:</b> characterization of electrical properties <b>Library:</b> National Journal and International Journal on nanomaterials, mechanics of metals and composites	2%
10	Able to understand the working principles of electrical conductivity/characterization, sample preparation, data collection and analysis sourced from search results for articles in national/international journals	Able to explain the mechanism for characterizing the electrical properties of materials	<b>Criteria:</b> Quantitative  <b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment	Presentation, discussion and questions and answers 2 X 50	Presentations, discussions and questions and answers 2 x 50	<b>Matter:</b> Electrical properties of materials <b>Reference:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science & Engineering", 7th Edition, John Willey and Son, New York,  <b>Material:</b> characterization of electrical properties <b>Library:</b> National Journal and International Journal on nanomaterials, mechanics of metals and composites	2%
11	Able to understand the working principles of optical property characterization starting from sample preparation, collection and analysis of data sourced from search results for articles in national/international journals	Able to explain the mechanism for characterizing the optical properties of materials	<b>Criteria:</b> Quantitative  <b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment	Presentation, discussion and questions and answers 2 X 50	Presentations, discussions and questions and answers 2 x 50	<b>Material:</b> optical properties <b>Bibliography:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science & Engineering", 7th Edition, John Willey and Son, New York,  <b>Material:</b> characterization of optical properties <b>Library:</b> National Journal and International Journal on nanomaterials, mechanics of metals and composites	2%
12	Able to understand the working principles of optical property characterization starting from sample preparation, collection and analysis of data sourced from search results for articles in national/international journals	Able to explain the mechanism for characterizing the optical properties of materials	<b>Criteria:</b> Quantitative  <b>Forms of Assessment :</b> Participatory Activities, Project Results Assessment / Product Assessment	Presentation, discussion and questions and answers 2 X 50	Presentations, discussions and questions and answers 2 x 50	<b>Material:</b> optical properties <b>Bibliography:</b> Callister Jr, WD, 2007, "Fundamentals of Materials Science & Engineering", 7th Edition, John Willey and Son, New York,  <b>Material:</b> characterization of optical properties <b>Library:</b> National Journal and International Journal on nanomaterials, mechanics of metals and composites	3%

13	Able to design posters and communicate individually about the characterization of tool materials which includes: tool working principles, measurement methods and data analysis sourced from relevant article references	<ol style="list-style-type: none"> <li>1.suitability of poster content (related to the topic of characterization of mechanical, electrical, thermal, optical and magnetic properties)</li> <li>2.originality of the poster</li> <li>3.The poster format is in accordance with the theme, theoretical framework and concept and is unique</li> <li>4.suitability of image composition, color, layout of objects in the poster</li> <li>5.posters are able to attract the reader's attention and can be understood by the reader</li> </ol>	<b>Criteria:</b> Quantitative  <b>Form of Assessment :</b> Project Results Assessment / Product Assessment	project, investigation, discussion, guided discovery 2 X 50	project, investigation, discussion, guided discovery 2 x 50	<b>Materials:</b> characterization of mechanical, optical, electrical, thermal and magnetic properties <b>Library:</b> <i>National Journal and International Journal on nanomaterials, mechanics of metals and composites</i>	8%
14	Able to design posters and communicate individually about the characterization of tool materials which includes: tool working principles, measurement methods and data analysis sourced from relevant article references	<ol style="list-style-type: none"> <li>1.suitability of poster content (related to the topic of characterization of mechanical, electrical, thermal, optical and magnetic properties)</li> <li>2.originality of the poster</li> <li>3.The poster format is in accordance with the theme, theoretical framework and concept and is unique</li> <li>4.suitability of image composition, color, layout of objects in the poster</li> <li>5.posters are able to attract the reader's attention and can be understood by the reader</li> </ol>	<b>Criteria:</b> Quantitative  <b>Form of Assessment :</b> Project Results Assessment / Product Assessment	project, investigation, discussion, guided discovery 2 X 50	project, investigation, discussion, guided discovery 2 x 50	<b>Materials:</b> characterization of mechanical, optical, electrical, thermal and magnetic properties <b>Library:</b> <i>National Journal and International Journal on nanomaterials, mechanics of metals and composites</i>	9%

15	Able to design posters and communicate individually about the characterization of tool materials which includes: tool working principles, measurement methods and data analysis sourced from relevant article references	<ol style="list-style-type: none"> <li>suitability of poster content (related to the topic of characterization of mechanical, electrical, thermal, optical and magnetic properties)</li> <li>originality of the poster</li> <li>The poster format is in accordance with the theme, theoretical framework and concept and is unique</li> <li>suitability of image composition, color, layout of objects in the poster</li> <li>posters are able to attract the reader's attention and can be understood by the reader</li> </ol>	<b>Criteria:</b> Quantitative  <b>Form of Assessment :</b> Project Results Assessment / Product Assessment	project, investigation, discussion, guided discovery 2 X 50	project, investigation, discussion, guided discovery 2 x 50	<b>Materials:</b> characterization of mechanical, optical, electrical, thermal and magnetic properties <b>Library:</b> <i>National Journal and International Journal on nanomaterials, mechanics of metals and composites</i>	5%
16	Able to communicate individually about the characterization of tool materials which includes: tool working principles, measurement methods and data analysis sourced from relevant article references	<ol style="list-style-type: none"> <li>suitability of poster content (related to the topic of characterization of mechanical, electrical, thermal, optical and magnetic properties)</li> <li>originality of the poster</li> <li>The poster format is in accordance with the theme, theoretical framework and concept and is unique</li> <li>suitability of image composition, color, layout of objects in the poster</li> <li>posters are able to attract the reader's attention and can be understood by the reader</li> </ol>	<b>Criteria:</b> Quantitative  <b>Form of Assessment :</b> Project Results Assessment / Product Assessment	presentation, discussion and question and answer 2 X 50	presentation, discussion and question and answer 2 x 50	<b>Materials:</b> characterization of mechanical, optical, electrical, thermal and magnetic properties <b>Library:</b> <i>National Journal and International Journal on nanomaterials, mechanics of metals and composites</i>	30%

#### Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	14%
2.	Project Results Assessment / Product Assessment	66%
3.	Portfolio Assessment	10%
4.	Test	10%
		100%

#### Notes

- 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.
- 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.
- 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.
- 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.
- 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.