



Universitas Negeri Surabaya
Faculty of Engineering,
Electrical Engineering Undergraduate Study Program

Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date																																																			
Renewable energy	2020102038	Compulsory Study Program Subjects	T=2	P=0	ECTS=3.18	7	April 10, 2023																																																			
AUTHORIZATION	SP Developer		Course Cluster Coordinator			Study Program Coordinator																																																				
	Dr. Ir. Achmad Imam Agung, M.Pd.		Prof. Dr. Bambang Suprianto, M.T.			Dr. Lusia Rakhmawati, S.T., M.T.																																																				
Learning model	Case Studies																																																									
Program Learning Outcomes (PLO)	PLO study program that is charged to the course																																																									
	Program Objectives (PO)																																																									
	PO - 1	Able to apply knowledge of mathematics, natural sciences, information technology, and electrical engineering to gain a thorough understanding of engineering principles																																																								
	PLO-PO Matrix																																																									
		<table border="1" style="margin: auto;"> <tr><td style="padding: 5px;">P.O</td></tr> <tr><td style="padding: 5px;">PO-1</td></tr> </table>						P.O	PO-1																																																	
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PO-1																																																										
PO Matrix at the end of each learning stage (Sub-PO)																																																										
	<table border="1" style="margin: auto;"> <tr> <td style="padding: 5px;">P.O</td> <td colspan="16" style="text-align: center;">Week</td> </tr> <tr> <td></td> <td style="padding: 5px;">1</td><td style="padding: 5px;">2</td><td style="padding: 5px;">3</td><td style="padding: 5px;">4</td><td style="padding: 5px;">5</td><td style="padding: 5px;">6</td><td style="padding: 5px;">7</td><td style="padding: 5px;">8</td><td style="padding: 5px;">9</td><td style="padding: 5px;">10</td><td style="padding: 5px;">11</td><td style="padding: 5px;">12</td><td style="padding: 5px;">13</td><td style="padding: 5px;">14</td><td style="padding: 5px;">15</td><td style="padding: 5px;">16</td> </tr> <tr> <td style="padding: 5px;">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><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																	
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	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16																																										
PO-1																																																										
Short Course Description	In this course students will study the main topics of renewable energy, namely the definition, types of renewable energy and the differences between them and sustainable energy. Apart from that, students also learn about techniques and technology for converting energy from various types of renewable energy into electrical energy.																																																									
References	Main :																																																									
	<ol style="list-style-type: none"> 1. Anonymous. 2009. Renewable Energy Handbook . San Diego : Elsevier Inc. 2. Sorensen B. 2004. Renewable Energy Its Physics, Engineering, Use, Environmental Impacts, Economy and Planning Aspects, Third Edition. Denmark : Elsevier Science 3. Lund H. 2010. Renewable Energy Systems The Choice and Modeling of 100% Renewable Solutions. San Diego : Elsevier Inc. 4. Masters GM. 2004. Renewable and Efficient Electric Power Systems . New Jersey : Wiley-Interscience. 5. Patel MR. 1999. Wind and Solar Power System . New York : CRC Press. 6. Markvart T dan Castaner L. 2003. Practical Handbook of Photovoltaics Fundamentals and Applications. New York : Elsevier. 																																																									
	Supporters:																																																									
	<ol style="list-style-type: none"> 1. Khaligh A dan Onar OC. 2010. Energy Harvesting, Solar, Wind, and Ocean Energy Conversion Systems. Boca Raton : CRC Press. 																																																									
Supporting lecturer	Dr. Ir. Achmad Imam Agung, M.Pd. Dr. Subuh Isnur Haryudo, S.T., M.T. Mahendra Widyartono, S.T., M.T.																																																									
Week-	Final abilities of each	Evaluation			Help Learning, Learning methods, Student Assignments, [Estimated time]			Learning materials	Assessment Weight (%)																																																	

	learning stage (Sub-PO)	Indicator	Criteria & Form	Offline (offline)	Online (online)	[References]	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Understand and explain the basic concepts of renewable energy	<ol style="list-style-type: none"> 1.Explain the meaning of renewable energy 2.Explain the various types of energy that include renewable energy 3.Explain the difference between renewable energy and sustainable energy 4.Analyzing the condition of renewable energy and fossil energy in Indonesia and the world 	Criteria: Completeness of the paper on energy problems in Indonesia	Lectures, discussions and questions and answers 2 X 50		Material: Meeting material 1 Reference: Anonymous. 2009. <i>Renewable Energy Handbook</i> . San Diego: Elsevier Inc.	5%
2	Understand and explain the conversion of solar energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of solar energy resources in the world and Indonesia 2.Explain the conversion of solar energy into electrical energy 3.Explain solar power technology 4.Explain the characteristics of the current-voltage curve in a photovoltaic system 5.Calculate the capacity of the solar home system 6.Explain the sun tracking system 7.Explain the various power electronic interface systems for PV systems 8.Explain the various applications of PV systems 	Criteria: Full marks are obtained if you do all the questions correctly Form of Assessment : Participatory Activities	Lectures, discussions, questions and answers and practice questions 2 X 50		Material: Meeting material 2 References: Lund H. 2010. <i>Renewable Energy Systems The Choice and Modeling of 100% Renewable Solutions</i> . San Diego: Elsevier Inc.	5%

3	Understand and explain the conversion of solar energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of solar energy resources in the world and Indonesia 2.Explain the conversion of solar energy into electrical energy 3.Explain solar power technology 4.Explain the characteristics of the current-voltage curve in a photovoltaic system 5.Calculate the capacity of the solar home system 6.Explain the sun tracking system 7.Explain the various power electronic interface systems for PV systems 8.Explain the various applications of PV systems 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers and practice questions 2 X 50		<p>Material: Meeting material 3</p> <p>References: <i>Lund H. 2010. Renewable Energy Systems The Choice and Modeling of 100% Renewable Solutions. San Diego: Elsevier Inc.</i></p>	10%
4	Understand and explain the conversion of solar energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of solar energy resources in the world and Indonesia 2.Explain the conversion of solar energy into electrical energy 3.Explain solar power technology 4.Explain the characteristics of the current-voltage curve in a photovoltaic system 5.Calculate the capacity of the solar home system 6.Explain the sun tracking system 7.Explain the various power electronic interface systems for PV systems 8.Explain the various applications of PV systems 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers and practice questions 2 X 50		<p>Material: Meeting material 4</p> <p>Reader: <i>Patel MR. 1999. Wind and Solar Power Systems. New York : CRC Press.</i></p>	0%

5	Understand and explain the conversion of wind energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of wind energy resources in the world and Indonesia 2.Explain the conversion of wind energy into electrical energy 3.Explain wind power technology 4.Explain the wind turbine system 5.Explain wind speed and energy distribution 6.Explain the relationship between wind speed and the electrical power produced 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers, practice questions. 2 X 50		<p>Material: Meeting material 5 Reader: Patel MR. 1999. <i>Wind and Solar Power Systems.</i> New York : CRC Press.</p>	10%
6	Understand and explain the conversion of wind energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of wind energy resources in the world and Indonesia 2.Explain the conversion of wind energy into electrical energy 3.Explain wind power technology 4.Explain the wind turbine system 5.Explain wind speed and energy distribution 6.Explain the relationship between wind speed and the electrical power produced 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers, practice questions. 2 X 50		<p>Material: Meeting material 6 Reader: Patel MR. 1999. <i>Wind and Solar Power Systems.</i> New York : CRC Press.</p>	5%

7	Understand and explain the conversion of wind energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of wind energy resources in the world and Indonesia 2.Explain the conversion of wind energy into electrical energy 3.Explain wind power technology 4.Explain the wind turbine system 5.Explain wind speed and energy distribution 6.Explain the relationship between wind speed and the electrical power produced 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers, practice questions. 2 X 50		<p>Material: Meeting 7 materials</p> <p>Bibliography: <i>Markvart T and Castaner L. 2003. Practical Handbook of Photovoltaics Fundamentals and Applications. New York : Elsevier.</i></p>	0%
8	Sub Summative Exam		<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Test</p>	written test 2 X 50		<p>Material: Meeting material 1-7</p> <p>Reader: <i>Khaligh A and Onar OC. 2010. Energy Harvesting, Solar, Wind, and Ocean Energy Conversion Systems. Boca Raton : CRC Press.</i></p>	10%
9	Understand and explain the conversion of geothermal energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of geothermal energy resources in the world and Indonesia. 2.Explain geothermal power technology. 3.Explain the types of geothermal energy. 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions and questions and answers 2 X 50		<p>Material: Meeting material 9</p> <p>References: <i>Lund H. 2010. Renewable Energy Systems The Choice and Modeling of 100% Renewable Solutions. San Diego: Elsevier Inc.</i></p>	5%
10	Understand and explain the conversion of geothermal energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of geothermal energy resources in the world and Indonesia. 2.Explain geothermal power technology. 3.Explain the types of geothermal energy. 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions and questions and answers 2 X 50		<p>Material: Meeting material 9</p> <p>References: <i>Lund H. 2010. Renewable Energy Systems The Choice and Modeling of 100% Renewable Solutions. San Diego: Elsevier Inc.</i></p>	5%

11	Understand and explain the conversion of geothermal energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of geothermal energy resources in the world and Indonesia. 2.Explain geothermal power technology. 3.Explain the types of geothermal energy. 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions and questions and answers 2 X 50		<p>Material: Meeting material 9</p> <p>References: <i>Lund H. 2010. Renewable Energy Systems The Choice and Modeling of 100% Renewable Solutions. San Diego: Elsevier Inc.</i></p>	10%
12	Understand and explain the conversion of geothermal energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of geothermal energy resources in the world and Indonesia. 2.Explain geothermal power technology. 3.Explain the types of geothermal energy. 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions and questions and answers 2 X 50		<p>Material: Meeting material 9</p> <p>References: <i>Lund H. 2010. Renewable Energy Systems The Choice and Modeling of 100% Renewable Solutions. San Diego: Elsevier Inc.</i></p>	5%
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14	Understand and explain the conversion of geothermal energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of geothermal energy resources in the world and Indonesia. 2.Explain geothermal power technology. 3.Explain the types of geothermal energy. 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions and questions and answers 2 X 50		<p>Material: Meeting material 9</p> <p>References: <i>Lund H. 2010. Renewable Energy Systems The Choice and Modeling of 100% Renewable Solutions. San Diego: Elsevier Inc.</i></p>	10%
15	Understand and explain the conversion of geothermal energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of geothermal energy resources in the world and Indonesia. 2.Explain geothermal power technology. 3.Explain the types of geothermal energy. 	<p>Criteria: Full marks are obtained if you do all the questions correctly</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions and questions and answers 2 X 50		<p>Material: Meeting material 9</p> <p>References: <i>Lund H. 2010. Renewable Energy Systems The Choice and Modeling of 100% Renewable Solutions. San Diego: Elsevier Inc.</i></p>	5%

16	Understand and explain the conversion of geothermal energy into electrical energy.	<ol style="list-style-type: none"> 1.Explain the potential of geothermal energy resources in the world and Indonesia. 2.Explain geothermal power technology. 3.Explain the types of geothermal energy. 	Criteria: Full marks are obtained if you do all the questions correctly Form of Assessment : Participatory Activities	written test 2 X 50		Material: Meeting material 9 References: Lund H. 2010. <i>Renewable Energy Systems The Choice and Modeling of 100% Renewable Solutions. San Diego: Elsevier Inc.</i>	5%
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Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	80%
2.	Test	10%
		90%

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.