



Universitas Negeri Surabaya
Faculty of Engineering,
Mechanical Engineering Education Undergraduate Study Program

Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Car AC Technology	8320302183		T=2	P=0	ECTS=3.18	3	May 1, 2023
AUTHORIZATION	SP Developer		Course Cluster Coordinator			Study Program Coordinator	
	Dr.A.Grummy Wailanduw, M.Pd., M.T.				Ir. Wahyu Dwi Kurniawan, S.Pd., M.Pd.	

Learning model	Project Based Learning
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Program Learning Outcomes (PLO)	PLO study program that is charged to the course				
	Program Objectives (PO)				
	PO - 1	Students have knowledge about the development of cooling machines in general and car air conditioning in particular			
	PO - 2	Students have the ability to analyze disturbances in car AC systems			
	PO - 3	Students are able to interact and work together in teams, think logically and intelligently in solving problems faced professionally in the field of Car AC engineering			
	PLO-PO Matrix				
	<table border="1" style="margin-left: 40px;"> <tr><td>P.O</td></tr> <tr><td>PO-1</td></tr> <tr><td>PO-2</td></tr> <tr><td>PO-3</td></tr> </table>	P.O	PO-1	PO-2	PO-3
P.O					
PO-1					
PO-2					
PO-3					

PO Matrix at the end of each learning stage (Sub-PO)																																																																																					
	<table border="1" style="margin-left: 40px;"> <tr> <th rowspan="2">P.O</th> <th colspan="16">Week</th> </tr> <tr> <th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th> </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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Short Course Description	Studying cooling technology in general includes a general description of cooling techniques, Mollier diagrams, terms in cooling engineering, 1st law of thermodynamics, and coefficient of performance (COP); History of the development of Car AC, Construction and working principles of Car AC, Car AC Components, Electrical Installation of Car AC, Control Devices for Car AC, Refrigerant (Freon), Charging refrigerant in Car AC, and Car AC Maintenance
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References	Main :	
		<ol style="list-style-type: none"> I Made Muliatna (2010) Materi Ajar AC Mobil, Surabaya: Jurusan PTM, FT Unesa A.Grummy Wailanduw (2013) Modul AC Mobil, Surabaya: Upress Toyota (1989) AirConditioner, Jakarta: Toyota Motor A.Grummy Wailanduw (2017) Penggunaan manifold gauge, Surabaya: Fakultas Teknik VEDC (2015) AC mobil, Malang
	Supporters:	
		1. Moran, M.J. and Shapiro, H.N. (1988) Fundamentals of Engineering Thermodynamics, New York: John Wiley and Sons, Inc

Supporting lecturer	Dr. A. Grummy Wailanduw, M.Pd., M.T.
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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 understand and describe cooling techniques in general	Can explain cooling techniques in general, including cooling principles, technical terms in cooling	<p>Criteria: Participate in questions and answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		<p>Material: Principles of cooling, technical terms in refrigeration</p> <p>Reference: <i>Moran, MJ and Shapiro, HN (1988) Fundamentals of Engineering Thermodynamics, New York: John Wiley and Sons, Inc</i></p>	5%
2	Able to understand Mollier diagrams, first law of Thermodynamics, and COP	Can read and understand Mollier diagrams, first law of Thermodynamics, and COP	<p>Criteria: Correctness and accuracy in answering and carrying out assignments</p> <p>Form of Assessment : Participatory Activities, Portfolio Assessment</p>	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		<p>Material: Mollier diagram, first law of Thermodynamics, COP</p> <p>Bibliography: <i>Moran, MJ and Shapiro, HN (1988) Fundamentals of Engineering Thermodynamics, New York: John Wiley and Sons, Inc</i></p>	10%
3	Able to understand the construction of Car AC and its working principles	Can explain the construction of a car air conditioner and the working principle of a car air conditioner	<p>Criteria: Correctness and accuracy in answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers 2 X 50		<p>Material: Construction and working principles of car AC</p> <p>Reference: <i>A. Grummy Wailanduw (2013) Car AC Module, Surabaya: Upress</i></p> <hr/> <p>Material: Construction and working principles of car AC</p> <p>Reference: <i>I Made Muliatna (2010) Car AC Teaching Materials, Surabaya: PTM Department, FT Unesa</i></p> <hr/> <p>Material: Construction and working principles of car air conditioning</p> <p>Reference: <i>Toyota (1989) AirConditioner, Jakarta: Toyota Motor</i></p>	10%

4	Able to understand the components of a car AC and how they work: compressor	explains each component of a car AC and how it works: compressor	<p>Criteria: Correctness and accuracy in answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers 2 X 50		<p>Material: Types of compressors and their working principles Reference: <i>A. Grummy Wailanduw (2013) Car AC Module, Surabaya: Upress</i></p> <hr/> <p>Material: Types of compressors and their working principles Reference: <i>I Made Muliatna (2010) Car AC Teaching Materials, Surabaya: PTM Department, FT Unesa</i></p> <hr/> <p>Material: Types of compressors and their working principles Reference: <i>VEDC (2015) Car AC, Malang</i></p>	10%
5	Able to understand the components of a car AC and how they work: condenser, receiver, expansion valve	Can explain each component of a car AC and how it works: condenser, receiver, expansion valve	<p>Criteria: Correctness and accuracy in answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers 2 X 50		<p>Material: Condenser, receiver, expansion valve Reference: <i>A. Grummy Wailanduw (2013) Car AC Module, Surabaya: Upress</i></p> <hr/> <p>Material: Condenser, receiver, expansion valve Reference: <i>I Made Muliatna (2010) Car AC Teaching Material, Surabaya: PTM Department, FT Unesa</i></p> <hr/> <p>Material: Condenser, receiver, expansion valve Reference: <i>VEDC (2015) Car AC, Malang</i></p>	5%

6	Able to understand the components of a car AC and how they work: evaporator, thermostat, HPS/LPS	Can explain each component of a car AC and how it works: evaporator, thermostat, HPS/LPS	<p>Criteria: Correctness and accuracy in answering and carrying out assignments</p> <p>Form of Assessment : Participatory Activities, Portfolio Assessment</p>	Lectures, discussions, questions and answers, assignments 2 X 50		<p>Material: Evaporator, thermostat, HPS/LPS Reference: <i>A. Grummy Wailanduw (2013) Car AC Module, Surabaya: Upress</i></p> <hr/> <p>Material: Evaporator, thermostat, HPS/LPS Library: I Made Muliatna (2010) Car AC Teaching Material, Surabaya: PTM Department, FT Unesa</p> <hr/> <p>Material: Evaporator, thermostat, HPS/LPS Reference: <i>VEDC (2015) Car AC, Malang</i></p>	10%
7	Able to understand and describe AC electrical installations	Can explain and draw AC electrical installations	<p>Criteria: Correctness and accuracy in answering and carrying out assignments</p> <p>Form of Assessment : Participatory Activities, Portfolio Assessment</p>	Lectures, discussions, questions and answers, practice 2 X 50		<p>Material: AC electrical installation Reference: <i>A. Grummy Wailanduw (2013) Car AC Module, Surabaya: Upress</i></p> <hr/> <p>Material: AC electrical installation Reference: I Made Muliatna (2010) Car AC Teaching Material, Surabaya: PTM Department, FT Unesa</p> <hr/> <p>Material: AC electrical installation Reference: <i>VEDC (2015) Car AC, Malang</i></p> <hr/> <p>Material: AC electrical installation Reference: <i>Toyota (1989) AirConditioner, Jakarta: Toyota Motor</i></p>	10%

8	MIDDLE SEMESTER EXAMINATION (UTS)	MIDDLE SEMESTER EXAMINATION (UTS)	Criteria: ACCORDING TO THE ASSESSMENT RUBRIC AND ANSWER KEY	MIDDLE SEMESTER EXAMINATION (UTS) 2 X 50		<p>Material: Cooling techniques, construction and working principles, components and working principles, AC electrical installations</p> <p>Reference: <i>A. Grummy Wailanduw (2013) Car AC Module, Surabaya: Upress</i></p> <hr/> <p>Material: Cooling techniques, construction and working principles, components and working principles, AC electrical installations</p> <p>Reference: <i>I Made Muliatna (2010) Car AC Teaching Materials, Surabaya: PTM Department, FT Unesa</i></p> <hr/> <p>Material: Cooling techniques, construction and working principles, components and working principles, AC electrical installations</p> <p>Reference: <i>VEDC (2015) Car AC, Malang</i></p> <hr/> <p>Material: Principles of refrigeration, technical terms in refrigeration, first law of Thermodynamics, COP</p> <p>Bibliography: <i>Moran, MJ and Shapiro, HN (1988) Fundamentals of Engineering Thermodynamics, New York: John Wiley and Sons, Inc</i></p> <hr/> <p>Material: Construction and working principles, components and working principles, AC electrical installations</p> <p>Reference: <i>Toyota (1989) AirConditioner, Jakarta: Toyota Motor</i></p>	10%
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9	Able to understand refrigerants and their characteristics used in car air conditioners	Can explain about refrigerants and their characteristics	<p>Criteria: Correctness and accuracy in answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers 2 X 50		<p>Material: Refrigerant and its characteristics Reference: A.Grummy Wailanduw (2013) Car AC Module, Surabaya: Upress</p> <hr/> <p>Material: Refrigerants and their characteristics Reference: Toyota (1989) AirConditioner, Jakarta: Toyota Motor</p> <hr/> <p>Material: Refrigerants and their characteristics Reference: VEDC (2015) Car AC, Malang</p>	5%
10	Able to understand the importance of vacuuming the AC system and how to vacuum	Can explain the importance of vacuuming and how to vacuum a car AC	<p>Criteria: Correctness and accuracy in answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, questions and answers, discussions 2 X 50		<p>Material: Vacuuming the AC system Reference: A.Grummy Wailanduw (2017) Use of manifold gauge, Surabaya: Faculty of Engineering</p> <hr/> <p>Material: Vacuuming the AC system Reference: VEDC (2015) Car AC, Malang</p>	5%
11	Able to understand about charging refrigerant through high pressure in the AC system	Can explain how to fill refrigerant through high pressure in the AC system	<p>Criteria: Correctness and accuracy in answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers 2 X 50		<p>Material: Filling refrigerant in AC systems Reference: A.Grummy Wailanduw (2017) Use of manifold gauge, Surabaya: Faculty of Engineering</p> <hr/> <p>Material: Filling refrigerant in the AC system Reference: VEDC (2015) Car AC, Malang</p>	2%
12	Able to understand about charging refrigerant through low pressure in the AC system	Can explain about charging refrigerant through low pressure in the AC system	<p>Criteria: Correctness and accuracy in answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers 2 X 50		<p>Material: Filling refrigerant in AC systems Reference: A.Grummy Wailanduw (2017) Use of manifold gauge, Surabaya: Faculty of Engineering</p> <hr/> <p>Material: Filling refrigerant in the AC system Reference: VEDC (2015) Car AC, Malang</p>	3%

13	Able to understand how to maintain and care for car AC	Can explain how to maintain and maintain routine and periodic maintenance on car AC	<p>Criteria: Correctness and accuracy in answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers 2 X 50		<p>Material: AC system care and maintenance Reference: <i>Toyota (1989) AirConditioner, Jakarta: Toyota Motor</i></p> <hr/> <p>Material: AC system maintenance and maintenance Reference: <i>VEDC (2015) Car AC, Malang</i></p>	2%
14	Able to understand damage and problems with car AC	Can explain damage and problems with car AC	<p>Criteria: Correctness and accuracy in answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers 2 X 50		<p>Material: Damage and problems in the AC system Reference: <i>Toyota (1989) AirConditioner, Jakarta: Toyota Motor</i></p> <hr/> <p>Material: Damage and problems in the AC system Reference: <i>VEDC (2015) Car AC, Malang</i></p>	2%
15	Able to understand how to overcome problems with car AC	Can explain about overcoming problems with car AC	<p>Criteria: Correctness and accuracy in answers and discussions</p> <p>Form of Assessment : Participatory Activities</p>	Lectures, discussions, questions and answers 2 X 50		<p>Material: How to overcome problems with the AC system Library: <i>Toyota (1989) AirConditioner, Jakarta: Toyota Motor</i></p> <hr/> <p>Material: How to overcome problems in the AC system Reference: <i>VEDC (2015) Car AC, Malang</i></p>	1%
16	FINAL SEMESTER EXAMINATION (UAS)	FINAL SEMESTER EXAMINATION (UAS)	<p>Criteria: ACCORDING TO THE ASSESSMENT RUBRIC AND ANSWER KEY</p>	FINAL SEMESTER EXAMINATION (UAS) 2 X 50		<p>Material: Vacuuming, filling refrigerant, disturbances and damage, how to overcome disturbances in the AC system Reference: <i>A. Grummy Wailanduw (2017) Use of manifold gauge, Surabaya: Faculty of Engineering</i></p> <hr/> <p>Material: Vacuuming, filling refrigerant, disturbances and damage, how to overcome disturbances in the AC system Reference: <i>Toyota (1989) AirConditioner, Jakarta: Toyota Motor</i></p> <hr/> <p>Material: Vacuuming, filling refrigerant, problems and damage, how to overcome problems in the AC system Reference: <i>VEDC (2015) Car AC, Malang</i></p>	10%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	65%
2.	Portfolio Assessment	15%
		80%

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** abilities in the process and student learning outcomes are specific and measurable statements that identify the abilities 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.