	Universitas Negeri Surabaya Faculty of Engineering, Mechanical Engineering Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Material Treatment	2120102147	Compulsory Study Program Subjects	T=2	P=0	ECTS=3.18	5	July 16, 2024

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 that is charged to the course	
PLO-5	Work independently and in groups
PLO-6	Experimentation and data analysis
PLO-11	Design and development of solutions that take into account the environment and sustainability
PLO-14	Science and engineering knowledge

Program Objectives (PO)	
PO - 1	a. Ability to identify specific facts regarding mathematics, science and engineering required for the heat treatment process of metal, namely the heating, holding, cooling process
PO - 2	a. Able to design experimental plans
PO - 3	a. Able to formulate problems (identify heat treatment processes for metal, namely heating, holding, cooling processes) and analyze obstacles.

PLO-PO Matrix

P.O	PLO-5	PLO-6	PLO-11	PLO-14
PO-1				
PO-2				
PO-3				

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																

Short Course Description	This course studies the basics of heat treatment processes for metals, namely the heating, holding, cooling processes and the condition of materials that have gone through the heat treatment process including diffusion and coating processes.

References

Main :

1. Suherman, W. 2003. Ilmu Logam 1. Penerbit ITS: Surabaya.
2. Callister, William D. 2003. Material Science and Engineering An Introduction. Sixth Edition. Jhon Wiley & Sons, Inc: USA.
3. Smith, William F. Hashemi, Javad. 2006. Foundations of Material Science and Engineering. Fourth Edition. Mc-Graw-Hill Companies, Inc: New York.
4. Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc-Graw-Hill Companies, Inc: New York.

Supporters:

Supporting lecturer	Tri Hartutuk Ningsih, S.T., M.T. Hanna Zakiyya, S.T., M.T.

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. Able to understand the Iron Carbon Phase Diagram 2. Understand structural transformations and heating and cooling rates	1. Understanding the Iron Carbon Phase Diagram 2. Understand structural transformations and heating and cooling rates	**Criteria:** mastery of material, communication skills **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Carbo-Iron Phase Diagram, structural transformation and heating and cooling rates **References:** *Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc-Graw-Hill Companies, Inc: New York.*	3%
2	1. Understanding the Definition of Austenite, critical areas of austenite 2. Able to predict transformation mechanisms in cooling and heating	1. Understanding the Definition of Austenite, critical areas of austenite 2. Able to predict transformation mechanisms in cooling and heating	**Criteria:** mastery of material, communication skills **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Austenite, austenite critical region **Reference:** *Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc-Graw-Hill Companies, Inc: New York.* **Material:** transformation in cooling and heating areas of Austenite **Reference:** *Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya.*	3%
3	1. Understanding the Definition of Austenite, critical areas of austenite 2. Able to predict transformation mechanisms in cooling and heating	1. Understanding the Definition of Austenite, critical areas of austenite 2. Able to predict transformation mechanisms in cooling and heating	**Criteria:** mastery of material, communication skills **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Austenite, austenite critical region **Reference:** *Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc-Graw-Hill Companies, Inc: New York.* **Material:** transformation in cooling and heating areas of Austenite **Reference:** *Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya.*	5%

4	1. Understand the definition, purpose of annealing and normalization 2. Skilled in understanding the annealing and homogenization processes	Understand the definition, purpose of annealing and normalization Skilled in understanding the annealing and homogenization processes	**Criteria:** mastery of material, communication skills **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Anneling, homogenization and spheroidization processes **Reference:** *Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya.* **Materials:** Anneling, homogenization and spheroidization processes **References:** *Callister, William D. 2003. Materials Science and Engineering An Introduction. Sixth Edition. John Wiley & Sons, Inc: USA.*	3%
5	1. Understand the definition, purpose of annealing and normalization 2. Skilled in understanding the annealing and homogenization processes	Understand the definition, purpose of annealing and normalization Skilled in understanding the annealing and homogenization processes	**Criteria:** mastery of material, communication skills **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Anneling, homogenization and spheroidization processes **Reference:** *Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya.* **Materials:** Anneling, homogenization and spheroidization processes **References:** *Callister, William D. 2003. Materials Science and Engineering An Introduction. Sixth Edition. John Wiley & Sons, Inc: USA.*	3%

6	Understand and understand the hardening process, austenization temperature, holding time, cooling rate,	Understand and understand the hardening process, austenization temperature, holding time, cooling rate,	**Criteria:** mastery of material, communication skills **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Hardening process, austenization temperature, holding time, cooling rate, surface condition, impact and weight **References:** *Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc-Graw-Hill Companies, Inc: New York.* **Material:** Hardening process, austenization temperature, holding time, cooling rate, surface condition, impact and weight **References:** *Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya.*	8%
7	Understand and understand the hardening process, austenization temperature, holding time, cooling rate,	Understand and understand the hardening process, austenization temperature, holding time, cooling rate,	**Criteria:** mastery of material, communication skills **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Hardening process, austenization temperature, holding time, cooling rate, surface condition, impact and weight **References:** *Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc-Graw-Hill Companies, Inc: New York.* **Material:** Hardening process, austenization temperature, holding time, cooling rate, surface condition, impact and weight **References:** *Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya.*	3%

8	USS (attached)	Working independently	**Criteria:** USS (attached) **Form of Assessment** : Project Results Assessment / Product Assessment	USS (attached) 2 X 50		**Material:** All materials at meetings 1-7 **References:** *Suherman, W. 1999. Material testing. ITS Publisher: Surabaya.* **Material:** All material at meetings 1-7 **References:** *Smith, William F. Hashemi, Javad. 2006. Foundations of Materials Science and Engineering. Fourth Edition. Mc-Graw-Hill Companies, Inc: New York.*	3%
9	Understand hardening techniques and tempering methods	Understand hardening techniques and tempering methods	**Criteria:** mastery of material, communication skills **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** hardening techniques and tempering methods **Reference:** *Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya.* **Material:** hardening techniques and tempering methods **References:** *Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc-Graw-Hill Companies, Inc: New York.*	2%

10	Understand hardening techniques and tempering methods	Understand hardening techniques and tempering methods	**Criteria:** mastery of material, communication skills **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** hardening techniques and tempering methods **Reference:** *Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya.* **Material:** hardening techniques and tempering methods **References:** *Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc-Graw-Hill Companies, Inc: New York.* **Material:** hardening techniques and tempering methods **Reference:** *Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya.*	3%
11	Able to classify the types of fulorescence and dye penetrant testing	1.Understand the definitions of Austemper and Martemper 2.Skilled in applying Austemper and Martemper	**Criteria:** According to the Rubric **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 50 X 2		**Material:** Austemper and Martemper **Reference:** *Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya.* **Material:** Austemper and Martemper **Library:** *Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya.*	20%
12	Able to understand the definitions of Austemper and Martemper	1.Understand the definitions of Austemper and Martemper 2.Skilled in applying Austemper and Martemper	**Criteria:** According to the Rubric **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 50 X 2		**Material:** Austemper and Martemper **Reference:** *Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya.* **Material:** Austemper and Martemper **Library:** *Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya.*	20%

13	Understand the definition and be able to carry out surface hardening	Understand and be able to carry out surface hardening of metal	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Surface hardening techniques for metals **Reference:** *Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya.* **Material:** Surface hardening techniques for metals **Reference:** *Callister, William D. 2003. Materials Science and Engineering An Introduction. Sixth Edition. John Wiley & Sons, Inc: USA.*	17%
14	Understand the definition and be able to carry out surface hardening	Understand and be able to carry out surface hardening of metal	**Criteria:** According to the Rubric **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Surface hardening techniques for metals **Reference:** *Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya.* **Material:** Surface hardening techniques for metals **Reference:** *Callister, William D. 2003. Materials Science and Engineering An Introduction. Sixth Edition. John Wiley & Sons, Inc: USA.*	3%
15	Understand the process of adding elements to metals using Cyaniding and Carbonitriding techniques	Understand the process of adding elements to metals using Cyaniding and Carbonitriding techniques	**Criteria:** According to the Rubric **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** addition of elements to metal Cyaniding and Carbonitriding techniques **Library:** *Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya.* **Material:** addition of elements to cyaniding and carbonitriding engineering metals. **Reference:** *Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc-Graw-Hill Companies, Inc: New York.*	4%

16		Ability to work and punctuality	**Criteria:** According to the Rubric	Working independently 2 x 50		**Material:** All material at meeting 9-15 **References:** *Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya.* **Material:** All materials at meeting 9-15 **References:** *Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc-Graw-Hill Companies, Inc: New York.*	5%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	34.5%
2.	Project Results Assessment / Product Assessment	65.5%
		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.