	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
Engineering Materials 1	2120102120	Compulsory Curriculum Subjects - National	T=2	P=0	ECTS=3.18	1	April 28, 2022

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Novi Sukma Drastiawati, Mochamad Arif Irfa'i, S.Pd., M.T., Tri Hartutuk Ningsih, S.T., M.T.	Novi Sukma Drastiawati	Ir. Priyo Heru Adiwibowo, S.T., M.T.

Learning model	**Case Studies**	
Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**	
	PLO-5	Work independently and in groups
	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	CO1/CPMK1 a. Ability to Identify specific facts about mathematics, science, and engineering that are needed for a particular situation (What knowledge is needed) b. Able to change real world situations into models that are appropriate to related courses c. Able to demonstrate appropriate use of specific facts of mathematics, science, and engineering to elicit performance behavior given specific input.
	PO - 2	CO2/CPMK2 a. Able to obtain data about appropriate variables in the field of Mechanical Engineering. b. Able to compare experimental data and results with appropriate theoretical models. c. Be able to explain observed differences between models and experiments.
	PO - 3	CO3/CPMK3 a Able to formulate problems (identify and analyze obstacles. b. Ability to set criteria
	PLO-PO Matrix	

P.O	PLO-5	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 discusses theoretical understanding of material formation processes, definition of scope, concepts regarding material formation processes. Understanding electron nomenclature, atomic and crystal structures, chemical bonds and metallic bonds, classification of engineering materials, mechanical properties of materials, mechanical testing, crystal structure, Miller index, crystallization, defects in crystals, phase diagrams, ferrous metals, steel carbon, alloy steel, iron refining, and steelmaking.	
References	**Main :**	

1. Avner, Sidney. 1974
2. Dieter, George E. 1986. "Metalurgi Mekanik jilid 1". Edisi 3
3. Dieter, George E. 1990.
4. Dieter, George E. 1986
5. Smallman, R.E. and Bishop, R.J. 1999
6. Suherman, Wahid, Ir. 1987. "Pengetahuan Bahan". Edisi Pertama

Supporters:

	1. 1. Van Vlack, Djaprie, S., Ilmu dan Teknologi Bahan, Edisi IV, Erlangga, Jakarta. 2. 2. J.F. Shackelford, Introduction to material Science for engineers, 3rd Ed, Macmillan, 1992. 3. 3. Diktat Material 1, Novi Sukma Drastiawati, 2022.
Supporting lecturer	Mochamad Arif Irfa'i, S.Pd., M.T. Tri Hartutuk Ningsih, S.T., M.T. Novi Sukma Drastiawati, S.T., M.Eng.

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	Sub CO/CPMK 1 Describes the classification of materials, classification of material properties (physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, sensor materials , and magnetic materials)	a. Describe the meaning of mechanical stress, chemistry, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, sensor materials and magnetic materials) b. Be able to explain defects crystal glass, material classification, classification of material properties (physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, sensor materials and materials magnet) c. Able to describe crystal defects, material classification, classification of material properties (physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, materials sensors, and magnetic materials)	**Criteria:** 1.1. If you are able to answer all the questions correctly you will get a score of 100. 2.2. If you are able to answer two questions correctly you will get a score of 70. 3.3. If you are able to answer one question correctly you will get 40 points. 4.Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55. **Form of Assessment** : Participatory Activities	Lecture Case study, Discussion in groups Task-1: Explain 3 material properties with examples Explain material selection by taking one of the examples in the industrial world Describe material classification in the form of a chart 2(2x50) minutes 2 X 50		**Material:** a. Describe the meaning of mechanical stress, chemistry, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, sensor materials and magnetic materials) **References:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3* **Material:** Sub CO/CPMK 1 Describes the classification of materials, classification of material properties (physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest developments in materials and their applications (nano materials, sensor materials, and magnetic materials) **References:** *2. JF Shackelford, Introduction to materials Science for engineers, 3rd Ed, Macmillan, 1992.*	1%
2	Sub CO/CPMK 1 Describes the classification of materials, classification of material properties	a. Describe the meaning of mechanical stress, chemistry, thermal, optical and magnetic	**Criteria:** 1.1. If you are able to answer all the questions correctly you will	Lecture Case study, Discussion in groups Task-1:		**Material:** a. Describe the meaning of mechanical stress,	1%

	(physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, sensor materials , and magnetic materials)	properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, sensor materials and magnetic materials) b. Be able to explain defects crystal glass, material classification, classification of material properties (physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, sensor materials and materials magnet) c. Able to describe crystal defects, material classification, classification of material properties (physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, materials sensors, and magnetic materials)	get a score of 100. 2. 2. If you are able to answer two questions correctly you will get a score of 70. 3. 3. If you are able to answer one question correctly you will get 40 points. 4. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55. **Form of Assessment** : Participatory Activities	Explain 3 material properties with examples Explain material selection by taking one of the examples in the industrial world Describe material classification in the form of a chart 2(2x50) minutes 2 X 50		chemistry, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, sensor materials and magnetic materials) b. Be able to explain crystal defects, material classification, classification of material properties (physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, sensor materials, and magnetic materials) c. Able to describe crystal defects, material classification, classification of material properties (physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, materials sensors, and magnetic materials) **Bibliography:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3* **Material:** Able to explain crystal defects, material classification, classification of material properties	

						(physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials , sensor material, and magnetic material) c. Able to describe crystal defects, material classification, classification of material properties (physical, mechanical, chemical, thermal, optical and magnetic properties), the relationship between material properties and design and production, the latest material developments and their applications (nano materials, materials sensors, and magnetic materials) **References:** *Smallman, RE and Bishop, RJ 1999*	

3	Sub CO./CPMK 1 Describe atomic structure, crystal structure, and crystal defects	a. Describe the atomic structure, crystal structure, and crystal defects b. Explain atomic structure, crystal structure, and crystal defects c. Describe atomic structure, crystal structure, and crystal defects	**Criteria:** 1. 1. If you are able to answer 4 questions correctly you will get a score of 100. 2. 2. If you are able to answer 3 questions correctly you will get a score of 75. 3. 3. If you are able to answer 2 questions correctly you will get 50 points. 4. 4. If you are able to answer 1 question correctly you will get 25 points. 5. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55 **Form of Assessment** : Participatory Activities, Tests	Lectures and written assignments Task-2: Describe the various defects in crystals Describe the various crystal structures in steel Name at least 5 types of crystal lattices. 2x50 minutes 2 X 50		**Material:** a. Describe the atomic structure, crystal structure, and crystal defects b. Explain atomic structure, crystal structure, and crystal defects c. Describe atomic structure, crystal structure, and crystal defects. **Reference:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3* **Material:** Describe atomic structure, crystal structure and crystal defects b. Explain atomic structure, crystal structure, and crystal defects c. Describe atomic structure, crystal structure, and crystal defects. **References:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition*	3%
4	Sub CO/CPMK 2 Able to carry out calculations related to crystal structures	a. Able to carry out calculations related to crystal structures	**Criteria:** 1. 1. If you are able to answer all the questions correctly you will get a score of 100. 2. 2. If you are able to answer 3 questions correctly you will get a score of 75. 3. 3. If you are able to answer 2 questions correctly you will get 50 points. 4. 4. If you are able to answer 1 question correctly you will get 25 points. 5. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55. **Form of Assessment** : Participatory Activities, Tests	Live lecture and question and answer Task-3: Find the Miller index for the crystal lattice Describe the crystal lattice using the Miller Index Calculate the APF and VPF values for the BCC and FCC crystal structures 2x50 minutes. 2 X 50		**Material:** calculations related to crystal structures with Miller indices. **Reference:** *Avner, Sidney. 1974.* **Material:** calculations related to crystal structures with Miller indices **References:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3* **Material:** calculations related to crystal structures with Miller indices. **Reference:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition*	5%

5	Sub CO/CPMK 2 Describes tensile tests, hardness tests, bending tests, impact tests, torsion tests, and metallographic observations.	a. Able to calculate tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results b. Able to explain the calculation results of tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results c. test results after carrying out theoretical calculations with the results of trial data in a study (article).	**Criteria:** 1. 1. If you are able to answer all the questions correctly you will get a score of 100. 2. 2. If you are able to answer 4 questions correctly you will get a score of 80. 3. 3. If you are able to answer 3 questions correctly you will get a score of 60. 4. 4. If you are able to answer 2 questions correctly you will get 40 points. 5. 5. If you are able to answer 1 question correctly you will get 20 points. 6. 6. If you are able to answer 0 questions correctly you will get 0 marks. 7. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55. **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions and questions and answers Task-4: Explain hardness testing using the Rockwell method. Explain the meallography method and describe the microstructure of low carbon steel. Draw stress and strain diagrams 3 (2 x 50 minutes). 2 X 50.		**Material:** calculation of tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results, explaining the results of calculations of tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results, test results after carrying out theoretical calculations with the results of trial data in a study (article). **Bibliography:** *Dieter, George E. 1986.* **Material:** calculation results of tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results, test results after carrying out theoretical calculations with the results of trial data in a study (article) **References:** *2. JF Shackelford, Introduction to materials science for engineers, 3rd Ed, Macmillan, 1992.*	5%

6	Sub CO/CPMK 2 Describes tensile tests, hardness tests, bending tests, impact tests, torsion tests, and metallographic observations	a. Able to calculate tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results b. Able to explain the calculation results of tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results c. test results after carrying out theoretical calculations with the results of trial data in a study (article)	**Criteria:** 1. 1. If you are able to answer all the questions correctly, you will get a score of 100. 2. 2. If you are able to answer 2 questions correctly, you will get a score of 70. 3. 3. If you are able to answer 1 question correctly, you will get 35 points. 4. 4. If you are unable to answer all questions correctly, you will get a score of 0. 5. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55. **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers Task-4: Explain hardness testing using the Rockwell method Explain the meallography method and describe the microstructure of low carbon steel Draw stress and strain diagrams 3 (2 x 50 minutes) 2 X 50		**Material:** explains the calculation results of tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results. **Reference:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition* **Material:** explains the calculation results of tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results. **References:** *1. Van Vlack, Djaprie, S., Materials Science and Technology, Edition IV, Erlangga, Jakarta.* **Material:** explains the calculation results of tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results. **References:** *3. Materials Diktat 1, Novi Sukma Drastiawati, 2022.*	4%

7	Sub CO/CPMK 2 Describes tensile tests, hardness tests, bending tests, impact tests, torsion tests, and metallographic observations	a. Able to calculate tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results b. Able to explain the calculation results of tensile strength, bending strength, impact strength, hardness values, torsional strength, and scale of metallography test results c. test results after carrying out theoretical calculations with the results of trial data in a study (article).	**Criteria:** 1. 1. If you are able to answer all the questions correctly, you will get a score of 100. 2. 2. If you are able to answer 3 questions correctly, you will get a score of 75. 3. 3. If you are able to answer 2 questions correctly, you will get 50 points. 4. 4. If you are able to answer 1 question correctly, you will get 25 points. 5. 4. If you cannot answer all the questions you will get a score of 0. 6. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55. **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions and questions and answers Task-4: Explain hardness testing using the Rockwell method. Explain the meallography method and describe the microstructure of low carbon steel. Draw stress and strain diagrams 3 (2 x 50 minutes). 2 X 50		**Material:** test results after carrying out theoretical calculations with the results of trial data in a study (article). **Bibliography:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition* **Material:** test results after carrying out theoretical calculations with the results of trial data in a study (article). **References:** *3. Material Diktat 1, Novi Sukma Drastiawati, 2022.*	2%
8	Sub Summative Exam.	Sub Summative Exam	**Criteria:** Sub Summative Exam. **Form of Assessment** : Participatory Activities	Written test. 2 X 50		**Material:** SUB SUMATIVE TEST **Reference:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition* **Material:** SUB SUMATIVE TEST **Reference:** *Avner, Sidney. 1974.* **Material:** SUB SUMATIVE TEST **Reference:** *Smallman, RE and Bishop, RJ 1999.*	19%

9	Sub CO/CPMK 1 Describe isomorphous and eutechic phase diagrams	Be able to explain isomorphous and eutechic phase diagrams c. Be able to draw isomorphous and eutectic phase diagrams.	**Criteria:** 1.4 2.The presentation was carried out coherently, with appropriate intonation and emphasis, showing a good understanding of the concept, with the help of ppt media according to media criteria, correct answers to the questioner, able to formulate suggestions for improvement 3.3 4.The presentation was carried out coherently, intonation and emphasis were appropriate, but lacking in understanding some concepts, assistance can be provided via ppt media according to media criteria, answers from the questioner are generally correct,, able to formulate suggestions for improvement 5.2 6.The presentation was carried out, was not coherent and/or showed a lack of understanding of several concepts, assistance via ppt media but did not meet the media criteria, answers from the questioner were generally incorrect, able to formulate suggestions for improvement 7.1 8.The presentation was carried out, but was not coherent and/or showed a lack of understanding of many concepts, did not use ppt media, the answer from the questioner was incorrect, unable to formulate suggestions for improvement 9.Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55. **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers Task-5: Draw the Fe-C or Fe-Fe3C phase diagram along with an explanation of the phase transformation. 2 X 50		**Material:** isomorphous and eutectic phase diagrams and describing isomorphous and eutectic phase diagrams **References:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition* **Material:** isomorphous and eutectic phase diagrams and describing isomorphous and eutectic phase diagrams **References:** *2. JF Shackelford, Introduction to materials Science for engineers, 3rd Ed, Macmillan, 1992* **Material:** isomorphous and eutectic phase diagrams and describing isomorphous and eutectic phase diagrams **References:** *Avner, Sidney. 1974*	5%

10	Sub CO/CPMK 2 Perform phase diagram calculations.	a. Able to calculate phase diagrams (percentage of ferrite and pearlite) b. Able to explain the results of phase diagram calculations (percentage of ferrite and pearlite).	**Criteria:** 1.4 2.The presentation was carried out coherently, with appropriate intonation and emphasis, showing a good understanding of the concept, with the help of ppt media according to media criteria, correct answers to the questioner, able to formulate suggestions for improvement 3.3 4.The presentation was carried out coherently, intonation and emphasis were appropriate, but lacking in understanding some concepts, assistance can be provided via ppt media according to media criteria, answers from the questioner are generally correct,, able to formulate suggestions for improvement 5.2 6.The presentation was carried out, was not coherent and/or showed a lack of understanding of several concepts, assistance via ppt media but did not meet the media criteria, answers from the questioner were generally incorrect, able to formulate suggestions for improvement 7.1 8.The presentation was carried out, but was not coherent and/or showed a lack of understanding of many concepts, did not use ppt media, the answer from the questioner was incorrect, unable to formulate suggestions for improvement 9.Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55. **Form of Assessment** : Participatory Activities	Lecture, discussion and question and answer Task-6: Find the percentage of ferrite and pearlite. 2 X 50		**Material:** calculating explaining the results of phase diagram calculations (percentage of ferrite and pearlite) **References:** *3. Materials Diktat 1, Novi Sukma Drastiawati, 2022* **Material:** calculating explaining the results of phase diagram calculations (percentage of ferrite and pearlite) **References:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3* **Material:** calculating explaining the results of phase diagram calculations (percentage of ferrite and pearlite) **Reference:** *Smallman, RE and Bishop, RJ 1999*	5%

11	Sub CO/CPMK 1 Able to describe the classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials	1. Able to describe the classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials 2. Able to explain the classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials 3. Able to describe the classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials	**Criteria:** 1. 4 2. The presentation was carried out coherently, with appropriate intonation and emphasis, showing a good understanding of the concept, with the help of ppt media according to media criteria, correct answers to the questioner, able to formulate suggestions for improvement 3. 3 4. The presentation was carried out coherently, intonation and emphasis were appropriate, but lacking in understanding some concepts, assistance can be provided via ppt media according to media criteria, answers from the questioner are generally correct,, able to formulate suggestions for improvement 5. 2 6. The presentation was carried out, was not coherent and/or showed a lack of understanding of several concepts, assistance via ppt media but did not meet the media criteria, answers from the questioner were generally incorrect, able to formulate suggestions for improvement 7. 1 8. The presentation was carried out, but was not coherent and/or showed a lack of understanding of many concepts, did not use ppt media, the answer from the questioner was incorrect, unable to formulate suggestions for improvement 9. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55 **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers Task-7: Explain the process of refining iron and making steel Describe the process of refining pig iron and making open hearth furnace steel Describe the heat treatment process for steel in at least 2 processes 3 (2x50) minutes 2 X 50		**Material:** classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials. **Reference:** *3. Diktat Material 1, Novi Sukma Drastiawati, 2022* **Material:** classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials. **Reference:** *Smallman, RE and Bishop, R. J. 1999.* **Material:** classification of ferrous metal materials, iIron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials. **Reference:** *2. JF Shackelford, Introduction to materials science for engineers, 3rd Ed, Macmillan, 1992.*	5%

12	Sub CO/CPMK 1 Able to describe the classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials	1. Able to describe the classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials 2. Able to explain the classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials 3. Able to describe the classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials	**Criteria:** 1. 4 2. The presentation was carried out coherently, with appropriate intonation and emphasis, showing a good understanding of the concept, with the help of ppt media according to media criteria, correct answers to the questioner, able to formulate suggestions for improvement 3. 3 4. The presentation was carried out coherently, intonation and emphasis were appropriate, but lacking in understanding some concepts, assistance can be provided via ppt media according to media criteria, answers from the questioner are generally correct,, able to formulate suggestions for improvement 5. 2 6. The presentation was carried out, was not coherent and/or showed a lack of understanding of several concepts, assistance via ppt media but did not meet the media criteria, answers from the questioner were generally incorrect, able to formulate suggestions for improvement 7. 1 8. The presentation was carried out, but was not coherent and/or showed a lack of understanding of many concepts, did not use ppt media, the answer from the questioner was incorrect, unable to formulate suggestions for improvement 9. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55 **Forms of Assessment** : Participatory Activities, Portfolio Assessment, Tests	Lectures, discussions and questions and answers Task-7: Explain the process of refining iron and making steel. Describe the process of refining pig iron and making open hearth furnace steel. Describe the heat treatment process for steel in at least 2 processes of 3 (2x50) minutes. 2 X 50		**Material:** classification of ferrous metal materials, iron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials. **Reference:** *3. Diktat Material 1, Novi Sukma Drastiawati, 2022* **Material:** classification of ferrous metal materials, iIron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials. **Reference:** *2. JF Shackelford, Introduction to materials science for engineers, 3rd Ed, Macmillan, 1992* **Material:** classification of ferrous metal materials, iIron making, steel making, carbon steel and alloy steel, cast iron, crystal structure of ferrous metals, Fe phase diagram, heat treatment of steel, mechanical properties of ferrous metals, and standardization of steel materials. **References:** *1. Van Vlack, Djaprie, S., Materials Science and Technology, Edition IV, Erlangga, Jakarta.*	5%

13	Sub-CO/CPMK3 Designing the manufacture of specimens for practical heat treatment on steel Laboratory practice on heat treatment on steel Designing procedures for carrying out hardness testing on steel materials after the heat treatment process	1. a. Able to formulate problems (identify "needs") and analyze constraints on making specimens for heat treatment and practical process constraints. 2. b. Ability to establish "appropriate" criteria for solutions in the evaluation process in carrying out practicums and testing after the heat treatment process. 3. c. Produce reports on the results of heat treatment practicums and instructions on how to carry out practicums and hardness testing.	**Criteria:** 1. 1. If you are able to answer all the questions correctly you will get a score of 100. 2. 2. If you are able to answer 1 question correctly you will get 50 points. 3. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55 **Forms of Assessment** : Participatory Activities, Practical Assessment, Practical / Performance	Lectures, discussions and questions and answers. Discussion (presentation) - Question and answer Case Method/PBL 2 X 50		**Material:** Paraktikum **Bibliography:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3* **Material:** Practical **Literature:** *Dieter, George E. 1986.* **Material:** Practical **Literature:** *Smallman, RE and Bishop, RJ 1999*	5%
14	Sub-CO/CPMK3 Designing the manufacture of specimens for practical heat treatment on steel Laboratory practice on heat treatment on steel Designing procedures for carrying out hardness testing on steel materials after the heat treatment process	1. a. Able to formulate problems (identify "needs") and analyze constraints on making specimens for heat treatment and practical process constraints. 2. b. Ability to establish "appropriate" criteria for solutions in the evaluation process in carrying out practicums and testing after the heat treatment process. 3. c. Produce reports on the results of heat treatment practicums and instructions on how to carry out practicums and hardness testing.	**Criteria:** 1. 1. If you are able to answer all the questions correctly you will get a score of 100. 2. 2. If you are able to answer 1 question correctly you will get 50 points. 3. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55 **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment, Practical Assessment, Practice / Performance	Lectures, discussions and questions and answers. Discussion (presentation) - Question and answer Case Method/PBL 2 X 50		**Material:** Paraktikum **Bibliography:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3* **Material:** Practical **Literature:** *Dieter, George E. 1990.* **Material:** Practical **Literature:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition*	2%

15	Sub-CO/CPMK3 Designing the manufacture of specimens for practical heat treatment on steel Laboratory practice on heat treatment on steel Designing procedures for carrying out hardness testing on steel materials after the heat treatment process	1. a. Able to formulate problems (identify "needs") and analyze constraints on making specimens for heat treatment and practical process constraints. 2. b. Ability to establish "appropriate" criteria for solutions in the evaluation process in carrying out practicums and testing after the heat treatment process. 3. c. Produce reports on the results of heat treatment practicums and instructions on how to carry out practicums and hardness testing	**Criteria:** 1. 1. If you are able to answer all the questions correctly you will get a score of 100 2. 2. If you are able to answer 1 question correctly you will get 50 points 3. Score criteria: Special: 90 to 100; Very good: 76 to 89; Average: 56 to 75; Below average: 0 to 55 **Forms of Assessment** : Participatory Activities, Project Results Assessment / Product Assessment	Lectures, discussions and questions and answers Discussion (presentation) - Questions and answers Case Method/PBL 2 X 50		**Material:** Paraktikum **Bibliography:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3* **Material:** Practical **Literature:** *1. Van Vlack, Djaprie, S., Materials Science and Technology, Edition IV, Erlangga, Jakarta* **Material:** Practical **Library:** *2. JF Shackelford, Introduction to materials Science for engineers, 3rd Ed, Macmillan, 1992.*	2%
16	Final exams.	Final exams	**Criteria:** Written Exam. **Form of Assessment** : Participatory Activities	Written Exam. 2 X 50		**Material:** Summative Examination **Reader:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition* **Material:** Summative Exam **Bibliography:** *Avner, Sidney. 1974.* **Material:** Material at meeting 9-15 **References:** *2. JF Shackelford, Introduction to materials Science for engineers, 3rd Ed, Macmillan, 1992* **Material:** Material at meeting 9-15 **References:** *3. Diktat Material 1, Novi Sukma Drastiawati, 2022.*	30%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	82.24%
2.	Project Results Assessment / Product Assessment	1.4%
3.	Portfolio Assessment	2.07%
4.	Practical Assessment	2.07%
5.	Practice / Performance	2.07%
6.	Test	9.17%
		99.02%

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.