	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
Materials Science	8320302210	Compulsory Curriculum Subjects - National	T=2 P=0 ECTS=3.18	1	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model: Case Studies

Program Learning Outcomes (PLO)

PLO study program which is charged to the course

Program Objectives (PO)

PO - 1	Have a basic understanding of materials science
PO - 2	Able to analyze problems related to materials science in everyday life and in the engineering field

PLO-PO Matrix

P.O
PO-1
PO-2

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																

Short Course Description: Understanding the theory of material formation processes, definition of scope, concepts regarding material formation processes. Understanding of electron nomenclature, atomic and crystal structures, chemical bonds and metallic bonds, classification of engineering materials, mechanical properties of materials, phase diagrams for the formation of materials: ferrous metals, non-ferrous metals, polymers, composites and alloys, as well as treatments: digestion, foundry, casting.

References

Main :

1. Srieati Japri : 1DIlmu dan Teknologi Bahan1D.Avner, Sidney H., 1CIntroduction to Physical Metallurgy1C.Vlak Van. 1DIlmu dan Teknologi Bahan1C .Surdia, Tata. 1CPengetahuan Bahan Teknik1C.
2. Dieter, George E. 1986. “Metalurgi Mekanik jilid 1”. Edisi 3. Diterjemahkan oleh Sriati Djaprie. Jakarta : Erlangga

Supporters:

1. Suherman, Wahid, Ir. 1987. ”Pengetahuan Bahan”. Edisi Pertama. Surabaya : ITS.
2. Smallman, R E and Bishop, R.J. 1999. ”Modern Physical Metallurgy and Materials Engineering” 6thEdition. UK : Butterworth-Heinemann.
3. Avner, Sidney. 1974. “Introduction To Physical Metallurgy” 2nd Edition. Cuny, New York : Mc Graw-Hill.

Supporting lecturer: Novi Sukma Drastiawati, S.T., M.Eng.
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. Know the definition of technical materials and the grouping of technical materials 2. Explain the characteristics of material properties	1. Explain the definition of engineering materials 2. Analyze the usefulness of engineering materials 3. Explain the definition of engineering material groupings 4. Describes the grouping of engineering materials 5. Explain the stages of the engineering materials process 6. Explain the properties of materials 7. Explain the characteristics of material properties	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 2 X 50		**Material:** Definition of engineering materials **Reference:** *Srieati Japri : 1DMaterials Science and Technology1D.Avner, Sidney H., 1CIntroduction to Physical Metallurgy1C.Vlak Van. 1DIMaterials Science and Technology1C .Surdia, Tata. 1CKnowledge of Engineering Materials1C.* **Material:** selection of engineering materials **References:** *Srieati Japri : 1DMaterials Science and Technology1D.Avner, Sidney H., 1CIntroduction to Physical Metallurgy1C.Vlak Van. 1DIMaterials Science and Technology1C .Surdia, Tata. 1CKnowledge of Engineering Materials1C.* **Material:** metal atoms and bonds **References:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.*	3%
2	1. Know how to evaluate the properties of materials 2. Knowledge of mechanical testing 3. Knowledge of NDT testing	1. Explain the mechanical properties of materials 2. Exemplify the mechanical properties of materials 3. Analyze the mechanical properties of materials	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 2 X 50		**Material:** Basic concepts of mechanical properties of materials - Principles of mechanical testing of materials **References:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.* **Material:** Various types of mechanical testing on materials - Tensile testing Hardness testing - Impact testing Fatigue testing - Creep testing **Reader:** *Srieati Japri : 1D Science and Technology of Materials 1D.Avner, Sidney H., 1CIntroduction to Physical Metallurgy1C.Vlak Van. 1DIMaterials Science and Technology1C .Surdia, Tata. 1CKnowledge of Engineering Materials1C.* **Material:** NDT Test **Reference:** *Avner, Sidney. 1974. "Introduction To Physical Metallurgy" 2nd Edition. Cuny, New York : Mc Graw-Hill.*	3%

3	1. Know how to evaluate the properties of materials 2. Knowledge of mechanical testing 3. Knowledge of NDT testing	1. Explain the mechanical properties of materials 2. Exemplify the mechanical properties of materials 3. Analyze the mechanical properties of materials	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 2 X 50		**Material:** Basic concepts of mechanical properties of materials - Principles of mechanical testing of materials **References:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.* **Material:** Various types of mechanical testing on materials - Tensile testing Hardness testing - Impact testing Fatigue testing - Creep testing **Reader:** *Srieati Japri : 1D Science and Technology of Materials 1D.Avner, Sidney H., 1CIntroduction to Physical Metallurgy1C.Vlak Van. 1DIMaterials Science and Technology1C .Surdia, Tata. 1CKnowledge of Engineering Materials1C.* **Material:** NDT Test **Reference:** *Avner, Sidney. 1974. "Introduction To Physical Metallurgy" 2nd Edition. Cuny, New York : Mc Graw-Hill.*	3%
4	Understanding atomic bonds	1. Explain the types of atomic bonds 2. Describe the types of atomic bonds	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 4 X 50		**Materials:** Atoms - Ionic bonds - Covalent bonds - Metallic bonds **Library:** *Srieati Japri : 1DMaterials Science and Technology1D.Avner, Sidney H., 1CIntroduction to Physical Metallurgy1C.Vlak Van. 1DIMaterials Science and Technology1C .Surdia, Tata. 1CKnowledge of Engineering Materials1C.* **Material:** Atoms - Ionic bonds - Covalent bonds - Metallic bonds **References:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3. Translated by Sriati Djaprie. Jakarta : Erlangga*	3%

5	Understand crystal structure	Explain the crystal structure of materials	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 4 X 50		**Material:** Concept of crystal structure - Face centered cubic - Body centered cubic - Hexagonal closed packed - Unit cell - Lattice Space lattice - Crystal lattice **References:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.* **Material:** Concept of crystal structure - Face centered cubic - Body centered cubic - Hexagonal closed packed - Unit cell - Lattice Space lattice - Crystal lattice **Reference:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3. Translated by Sriati Djaprie. Jakarta : Erlangga* **Material:** Concept of crystal structure - Face centered cubic - Body centered cubic - Hexagonal closed packed - Unit cell - Lattice Space lattice - Crystal lattice **Reference:** *Smallman, RE and Bishop, RJ 1999. "Modern Physical Metallurgy and Materials Engineering" 6thEdition. UK : Butterworth-Heinemann.*	3%

6	1. Understanding shear fields in crystal structures 2. Know how to determine the length of the side of a cube in the crystal plane 3. Know how to determine the Miller index on the crystal plane	1. Explaining shear planes in crystal structures Describing shear planes 2. Describe how to determine the length of the side of a cube in the crystal plane 3. Explains how to determine the Miller index 4. Describe the crystal plane using the Miller index	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 2 X 50		**Material:** Shear planes in crystals Length of sides of cubes in crystals Miller index Drawing direction of crystal planes with miller indices Calculating crystal planes with miller indices **References:** *Avner, Sidney. 1974. "Introduction To Physical Metallurgy" 2nd Edition. Cuny, New York : Mc Graw-Hill.* **Material:** Shear plane on a crystal Side length of a cube on a crystal Miller index Draw the direction of the crystal plane using the Miller index Calculating the crystal plane using the Miller index **Reference:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.* **Material:** Shear planes in crystals Length of sides of cubes in crystals Miller index Draw the direction of the crystal plane using the Miller index Calculating the crystal plane with the Miller index **Reference:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3. Translated by Sriati Djaprie. Jakarta : Erlangga*	3%

7	1. Understanding shear fields in crystal structures 2. Know how to determine the length of the side of a cube in the crystal plane 3. Know how to determine the Miller index on the crystal plane	1. Explaining shear planes in crystal structures Describing shear planes 2. Describe how to determine the length of the side of a cube in the crystal plane 3. Explains how to determine the Miller index 4. Describe the crystal plane using the Miller index	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 2 X 50		**Material:** Shear planes in crystals Length of sides of cubes in crystals Miller index Drawing direction of crystal planes with miller indices Calculating crystal planes with miller indices **References:** *Avner, Sidney. 1974. "Introduction To Physical Metallurgy" 2nd Edition. Cuny, New York : Mc Graw-Hill.* **Material:** Shear plane on a crystal Side length of a cube on a crystal Miller index Draw the direction of the crystal plane using the Miller index Calculating the crystal plane using the Miller index **Reference:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.* **Material:** Shear planes in crystals Length of sides of cubes in crystals Miller index Draw the direction of the crystal plane using the Miller index Calculating the crystal plane with the Miller index **Reference:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3. Translated by Sriati Djaprie. Jakarta : Erlangga*	5%

8	UTS	SUB SUMATIVE EXAMINATION	**Criteria:** 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, Portfolio Assessment	Lectures, discussions and questions and answers 2 X 50		**Material:** UTS **Library:** *Srieati Japri : 1DMaterials Science and Technology1D.Avner, Sidney H., 1CIntroduction to Physical Metallurgy1C.Vlak Van. 1DIMaterials Science and Technology1C .Surdia, Tata. 1CKnowledge of Engineering Materials1C.* **Material:** UTS **Bibliography:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3. Translated by Sriati Djaprie. Jakarta : Erlangga* **Material:** UTS **Reader:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.* **Material:** UTS **Bibliography:** *Smallman, RE and Bishop, RJ 1999. "Modern Physical Metallurgy and Materials Engineering" 6thEdition. UK : Butterworth-Heinemann.* **Material:** UTS **Reader:** *Avner, Sidney. 1974. "Introduction To Physical Metallurgy" 2nd Edition. Cuny, New York : Mc Graw-Hill.*	20%
9	1. 2. Understand the recrystallization process 3. Understand the meaning of iron and steel 4. Understand how to refine iron	1. Explain the recrystallization process 2. Describe the recrystallization process 3. Explain the manufacture of iron and steel 4. Describes the manufacture of iron and steel 5. Analyzing iron refining Describe how iron is refining	**Form of Assessment** : Participatory Activities	Lectures and Discussions 2 X 50		**Material:** Concept of recrystallization Recrystallization process Visualization of recrystallization Changes in microstructure due to the recrystallization process Iron and steel Differences between iron and steel Iron refining Visualization of iron refining **Reference:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.*	1%

10	1. Understand about steelmaking 2. Understand the uses of steel	1. Describe how steel is made 2. Analyze how steel is made 3. Explain the uses of steel 4. Demonstrate the use of steel 5. Analyze the uses of steel in the industrial world	**Form of Assessment** : Participatory Activities, Tests	Lectures, discussions and questions and answers 2 X 50		**Material:** The concept of steel making Steel making using a converter Steel making using a Siemens Martin kitchen Steel making using an electric kitchen Characteristics of steel General uses of steel Uses of steel in the industrial world **Reference:** *Srieati Japri : 1DMaterials Science and Technology1D.Avner, Sidney H., 1CIntroduction to Physical Metallurgy1C. Vlak Van. 1DIMaterials Science and Technology1C .Surdia, Tata. 1CKnowledge of Engineering Materials1C.* **Material:** Concept of steel making Steel making using a converter Steel making using a Siemens Martin kitchen Steel making using an electric kitchen Characteristics of steel Uses of steel in general Uses of steel in the industrial world **Reference:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.*	5%
11	1. Understanding the composition of alloys in a material 2. Understand phase diagrams	1. Explains the composition of a material's alloy 2. Describes the alloy composition of a material 3. Explain phase diagrams 4. Draw a phase diagram 5. Analyzing phase diagrams	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions and questions and answers 2 X 50		**Material:** Basic principles of alloy composition Pure metal concept Compound concept Basic solid solution concept Factors influencing solubility-solidity Phase diagram concept Pollymorphism Allotrophy **Library:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.*	5%
12	1. Understand the iron-iron carbide balance diagram 2. Using the iron carbide diagram to determine the carbon content in a material	1. Explain the iron-iron carbide balance diagram 2. Draw an iron-iron carbide balance diagram 3. Analyze the iron-iron carbide balance diagram to determine the value of carbon content in a material	**Form of Assessment** : Participatory Activities, Tests	Lectures, discussions and questions and answers 2 X 50		**Material:** Concept of phase diagram for two components that dissolve in infinite solids. Phase diagram for two components that do not dissolve in solids. Phase diagram for two components with limited solubility. Solids. Peritectid, eutectoid reactions. Hypoeutectoid, eutectoid, and hypereutectoid transformations. **Reference:** *Suherman, Wahid, Ir . 1987. "Materials Knowledge". First Edition. Surabaya: ITS.*	3%

13	1. Understanding about non-ferrous metals 2. Understand non-metallic materials	1. Explaining non-ferrous metals Analyzing non-ferrous metals 2. Describe non-metallic materials 3. Examples of non-metallic materials 4. Classifying non-metallic materials	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions and questions and answers 2 X 50		**Material:** Concept of non-ferrous metals Characteristics of non-ferrous metals Examples of non-ferrous metals Use of non-ferrous metals in industry **References:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.* **Material:** Basic concepts of non-metallic materials Various types of non-metallic materials Uses of non-metallic materials in general Uses of non-metallic materials in the industrial world **Bibliography:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.*	2%
14	1. Understanding about non-ferrous metals 2. Understand non-metallic materials	1. Explaining non-ferrous metals Analyzing non-ferrous metals 2. Describe non-metallic materials 3. Examples of non-metallic materials 4. Classifying non-metallic materials	**Criteria:** According to the Rubric **Forms of Assessment** : Participatory Activities, Practical Assessment, Practical / Performance, Tests	Lectures, discussions and questions and answers 2 X 50		**Material:** Concept of non-ferrous metals Characteristics of non-ferrous metals Examples of non-ferrous metals Use of non-ferrous metals in industry **References:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.* **Material:** Basic concepts of non-metallic materials Various types of non-metallic materials Uses of non-metallic materials in general Uses of non-metallic materials in the industrial world **Bibliography:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.*	6%
15	1. Understanding about non-ferrous metals 2. Understand non-metallic materials	1. Explaining non-ferrous metals Analyzing non-ferrous metals 2. Describe non-metallic materials 3. Examples of non-metallic materials 4. Classifying non-metallic materials	**Criteria:** According to the Rubric **Forms of Assessment** : Participatory Activities, Practical Assessment, Practical / Performance, Tests	Lectures, discussions and questions and answers 2 X 50		**Material:** Concept of non-ferrous metals Characteristics of non-ferrous metals Examples of non-ferrous metals Use of non-ferrous metals in industry **References:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.* **Material:** Basic concepts of non-metallic materials Various types of non-metallic materials Uses of non-metallic materials in general Uses of non-metallic materials in the industrial world **Bibliography:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.*	5%

16	SUMATIVE EXAMINATION	SUMATIVE EXAMINATION	**Criteria:** According to the Rubric **Form of Assessment** : Participatory Activities	WRITTEN TEST 2 X 50		**Material:** Summative Exam **Reader:** *Srieati Japri : 1DMaterials Science and Technology1D.Avner, Sidney H., 1CIntroduction to Physical Metallurgy1C.Vlak Van. 1DIMaterials Science and Technology1C .Surdia, Tata. 1CKnowledge of Engineering Materials1C.* **Material:** Summative Examination **Reader:** *Suherman, Wahid, Ir. 1987. "Materials Knowledge". First Edition. Surabaya: ITS.* **Material:** Summative Examination **Bibliography:** *Dieter, George E. 1986. "Mechanical Metallurgy volume 1". Edition 3. Translated by Sriati Djaprie. Jakarta : Erlangga* **Material:** Summative Examination **Bibliography:** *Smallman, RE and Bishop, RJ 1999. "Modern Physical Metallurgy and Materials Engineering" 6thEdition. UK : Butterworth-Heinemann.* **Material:** Summative Exam **Bibliography:** *Avner, Sidney. 1974. "Introduction To Physical Metallurgy" 2nd Edition. Cuny, New York : Mc Graw-Hill.*	30%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	74.25%
2.	Portfolio Assessment	10%
3.	Practical Assessment	2.75%
4.	Practice / Performance	2.75%
5.	Test	10.25%
		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** 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.