	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
Physical Metallurgy	2120102052		T=2	P=0	ECTS=3.18	6	July 18, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	.....	.....	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**
	Program Objectives (PO)
	PLO-PO Matrix

	P.O

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

Short Course Description	Understanding the concepts of atomic theory, metal defects (crystal defects), dislocation theory: edges and screws, substitute and interstitial solid solutions: impurities and alloys. Elastic & plastic deformation theory, mechanical and physical properties of metals: strength, hardness, toughness, wear, fatigue and creep. Rules and various phase diagrams, solidification processes, homogeneous and heterogeneous nucleation, nucleation rates, alloy solidification processes, diffusion transformation, growth and crystallization, strengthening mechanisms: strain strengthening, deposition and agehardening.
References	**Main :**
	1. RobertW Cahn and Peter Haasen, *PhysicalMetallurgy* , Fourth, Revised Enhanced Edition, Vol. I, 1996D.Hull and D.J. Bacon, *Introduction toDislocation 4 th.Ed* ., Butterworth-Heineman, 2001Smallman,R.E. and Bishop, R.J., *Metal andMaterials* , Butterworth 13 Heinemann, 11. Porter, D. A.,Bahan-bahan dari Internet dan kepustakaan lain
	Supporters:
Supporting lecturer	Mochamad Arif Irfa'i, S.Pd., 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	Understand the crystal structure of metals	· Understand the crystal structure of BCC · Understand the crystal structure of FCC · Understand the crystal structure of HCP		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
2	Understanding the Miller Index	· Understand crystal direction · Understand crystal planes · Understand steorographic projections		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
3	Understanding dislocations in metals	· Understanding edge dislocations in metal · Understanding screw dislocations in metal		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
4	Understand plastic deformation in crystals	· Understanding the direction and plane of slip (slip system) in crystals · Understanding plastic deformation through slip mechanisms · Understanding critical shear stress breakdown in single crystals		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
5	Understanding item boundaries I	· Understand classification, shape and size of grains · Understand small angle grain boundaries		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
6	Understanding item boundaries II	· Understanding coherent grain boundaries · Understanding twin grain boundaries · Understanding energy balance at grain boundaries		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
7	Understanding emptiness	· Understand the process of vacancy formation · Understand the model of vacancy in crystals		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
8	Midterm Exam (UTS)	· Understand the material from meetings 1 -7		Written test 2 X 50			0%
9	Understanding substitution diffusion in solid solutions	· Understand Fick‘s first law · Understand the Kirkendal effect · Understand Fick‘s second law		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%

10	Understanding interstitial diffusion	· Understand the Snoek effect · Understand the measurement of relaxation time		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
11	Understanding phases	· Understand the thermodynamics of solutions · Understand two-phase equilibrium · Understand ideal solutions and non-ideal solutions		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
12	Understand phase diagrams	· Understand binary phase diagrams · Understand ternary phase diagrams · Understand three-phase equilibrium		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
13	Understanding nucleation	· Understanding homogeneous nucleation · Understanding heterogeneous nucleation		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
14	Understanding freezing	· Understand solidification in pure metals · Understand solidification in alloy metals		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
15	Understand recovery and recrystallization	· Understand changes in physical and mechanical properties · Understand recovery mechanisms · Understand recovery kinetics		Lectures, discussions, questions and answers, exercises and assignments 2 X 50			0%
16							0%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
		0%

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.