	Universitas Negeri Surabaya Faculty of Mathematics and Natural Sciences Undergraduate Physics Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Ceramics	4520102098		T=2	P=0	ECTS=3.18	6	July 18, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	.....	.....	Prof. Dr. Munasir, S.Si., M.Si.

Learning model: Project Based Learning

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: This MK Ceramics aims to introduce one of the advanced materials that has been used in everyday life, but may not be aware of it, namely advanced ceramics, starting from synthesizing powders to ceramic characterization. For this reason, the material of this course consists of four main parts, namely an introduction to the subject of functional and structural advanced ceramics, the structure and atomic bonds in crystalline materials, efforts to fabricate ceramics and the work stages starting from powder synthesis to ceramic printing, as well as characterizing structure and microstructure. The objectives of each work carried out are given clearly in the textbook and conveyed in language that is easy for students to understand.

References

Main :

1.
1. Ermawati, F.U. (2017). *Buku Ajar Mahasiswa: Fisika Bahan Keramik* . UNESA University Press.
2. Ermawati, F.U., Pratapa, S., Suasmoro, S., Hübert, T., Banach, U. (2016). *Preparation and structural study of Mg1-xZnxTiO3 ceramics and their dielectric properties from 1 Hz to 7.7 GHz* . Journal of Materials Science: Materials in Electronics 27 (7), 6637-6645.
3. Ermawati, F.U.,Suasmoro, S.,Pratapa, S.(2015). *A simple dissolved metals mixing route to prepare nanostructured Mg0.8Zn0.2TiO3 solid solution.* Advanced Materials Research 1112, 47-52.
4. Rahaman, M. N. (2003). " *Ceramic processing and sinterin* g". 2nd Edition. CRC Press, Taylor & Francis Group. New York.
5. Guyot, P., Rat, V., Coudert, J. F. , Jay, F., Maître, A., Pradeilles, N. (2012). *Does the Branly effect occur in spark plasma sintering?* Journal of Physics D: Applied Physics 45(9): 092001.
6. Dan seterusnya, seperti tertulis pada bagian akhir dari setiap Bab pada Ref. No. 1 di atas.

Supporters:

Supporting lecturer: Dr. Frida Ulfah Ermawati, M.Sc.

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. Understand the meaning and types of ceramics, understand the differences between advanced functional ceramics and advanced structural ceramics, understand the types of ceramic structures and their influence on the properties of ceramics, as well as various applications of advanced ceramics based on their function.2. Understand the concept of atomic structure based on Bohr's theory, understand the concept of ionic bonds & covalent bonds	Students are able to: - explain the meaning of ceramic materials, mention examples of traditional ceramics, - differentiate between traditional ceramics and advanced ceramics. - Explain functional ceramics and mention examples and their applications - Explain the role of structure in ceramics - The role of structure at the atomic scale and microstructure scale on the properties of ceramics. - Explain the relationship between chemical composition, intrinsic properties, ceramic fabrication, microstructure and ceramic properties - Explain the structure of the atom, the atomic nucleus and the electrons that surround the nucleus in certain shells. - Explains the concept of orbitals where electrons are located and built by the 4 quantum numbers. - Explain orbital shapes for all sub-shells. - Explain the Colulomb attractive interaction force - Explain examples of ionic bonds in NaCl - Explain the Coulomb attractive interaction energy - Explain the Pauli exclusion principle in ionic bond interactions - Explain the relationship between the potential energy of NaCl and the separation distance between the nuclei of Na and Cl-	**Criteria:** Full score if all tasks are completed within the specified time	Lectures, discussions and assignments 4 X 50			0%
2							0%

3	Understand the concept of Van der Waals bonds and metallic bonds	- Explain the concept of Van der Waals bonds - Explain the concept of metallic bonds - Explain the concept of electron sea.	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Lectures, discussions 2 X 50			0%
4	Get to know all stages of ceramic fabrication in general. In particular, understand that powders can be synthesized from starting materials, and the synthesis process can be carried out both in break-down and build-up, mechanisms and final products.	Students are able to: - Explain the stages of ceramic fabrication. - Distinguish between two types of powder synthesis processes: break-down and build-up. - Explain the advantages and disadvantages. - Explain the purpose of calcination & powder refinement - Understand the role of binders in the powder compaction process	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Lectures, discussions and questions and answers 2 X 50			0%
5	Understand the purpose and objectives of sintering in the ceramic fabrication process, six types of sintering mechanisms and distinguish existing nondensifying from densifying mechanisms.	Students are able to: - Explain the sintering process, - The relationship between sintering and ceramic microstructure engineering. - Explain the six sinter mechanisms and their classification. - Densifying mechanism and non-densifying mechanism	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Lectures, discussions and assignments 2 X 50			0%
6	Understand the three types of sintering techniques: SSS, LPS and SPS, and differentiate the compaction mechanisms between the three techniques.	Students are able to: - Explain the process of forming necking, grain boundaries, and closed pores using the SSS technique. - Explain the compaction process using the LPS technique. - Explain the compaction process with SPS.	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Lectures and discussions 2 X 50			0%
7	Explains thermal characterization techniques, chemical bond groups.	Students are able to explain: - Thermal characterization using TGA/DTA - Characterization of chemical bond groups using FTIR	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Discussions, assignment lectures. 2 X 50			0%
8	Understand all concepts and material that have been taught from the 1st to the 7th meeting	Can complete the questions given during the midterm exam	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Midterm exam 2 X 50			0%

9	Explains the technique of structural analysis using XRD, the information obtained from this analysis, especially for phase identification with the Match program!	Students are able to explain: - XRD as a structure characterization tool - Phase identification using the Match program! - 2 factors that influence the accuracy of phase identification results	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Lectures, discussions and assignments 2 X 50			0%
10	Understand the Rietveld method in XRD phase composition analysis and practice simple analysis using single phase samples.	Students are able to: - Understand and be skilled in using the Rietica program based on the Rietveld Method. - Practicing modeling and refinement with single phase materials.	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Rietica program learning workshop based on the Rietveld 2 X 50 method			0%
11	Understand the Rietveld method in XRD phase composition analysis and practice simple analysis using single phase samples.	Students are able to: - Understand and be skilled in using the Rietica program based on the Rietveld Method. - Practicing modeling and refinement with single phase materials.	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Rietica program learning workshop based on the Rietveld 2 X 50 method			0%
12	Demonstrate his skills in refining single phase diffraction patterns in front of the class	- Understand and be skilled in using the Rietica program based on the Rietveld Method. - Practicing modeling and refinement with single phase materials in front of the class.	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Demonstration in front of class 2 X 50			0%
13	Demonstrate his skills in refining single phase diffraction patterns in front of the class	- Understand and be skilled in using the Rietica program based on the Rietveld Method. - Practicing modeling and refinement with single phase materials in front of the class.	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Demonstration in front of class 2 X 50			0%
14	Understand microstructural analysis with SEM, FE-SEM and TEM	- Understand how SEM, FE-SEM work principles - Understand how TEM works - Understand how to analyze SEM, FE-SEM and TEM data	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Lectures and discussions 2 X 50			0%
15	Understand microstructural analysis with SEM, FE-SEM and TEM	- Understand how SEM, FE-SEM work principles - Understand how TEM works - Understand how to analyze SEM, FE-SEM and TEM data	**Criteria:** Full marks will be given if all questions can be answered correctly & satisfactorily	Lectures and discussions 2 X 50			0%
16							0%

Evaluation Percentage Recap: Project Based Learning

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.