TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

CERAMIC PHYSICS

by

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Depok, July 2016

PENGANTAR

This Teaching Instructional Design (BRP) contains a learning plan for the Ceramic Physics course for one semester for the Physics Undergraduate Study Program, Department of Physics, FMIPA UI.

The Ceramics Physics course is one of the compulsory subjects for students majoring in material physics who are given in semester 7. This means that students majoring in Materials Physics have taken compulsory courses in the previous semester, namely Introduction to Materials Science, Material Properties, Material Thermodynamics, Methods. Material Research, and Material Characterization Methods.

The delivery of this course material is through the active student learning method (Student Centered Learning), namely the Collaborative Learning method. Students are divided into several Home Group groups. In this Home Group, students are given a topic and have a discussion according to the learning objectives of that topic. Different Home Groups discuss different topics. At the following meeting,

students exchange information (through discussions or presentations) with other group students in the Discussion Group. Students also make assignments prepared on certain topics.

After completing this course, students are expected to be able to explain the effects of chemical bonds on physical properties, diffusion and electrical conductivity, formation, structure and properties of glass, sintering of solids, sintering of liquids and grain growth, mechanical properties, thermal properties, dielectric properties, magnetic properties and properties. optical ceramic material.

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I. Informasi Umum

1.	Name of Program / Study Level	:	Physics / Undergraduate
2.	Course Name	:	Ceramic Physics
3.	Course Code	:	SCFI604512
4.	Semester	:	7
5.	Credit	:	3 credits
6.	Teaching Method(s)	:	Collaborative Learning
7.	Prerequisite course(s)	:	Introduction to Materials Science
8.	Requisite for course(s)	:	-
9.	Integration Between Other Courses	:	-
10.	Lecturer	:	1. Dr. Bambang Soegijono 2. Dra. Ariadne L. Juwono, M.Eng., Ph.D.
11.	Course Description	:	In this Ceramic Physics course students will study the effects of chemical bonds on physical properties, diffusion and electrical conductivity, formation, structure and properties of glass, sintering of solids, sintering of fluids and grain growth, mechanical properties, thermal properties, dielectric properties, magnetic properties and properties. optics.

II. Course Learning Outcome (CLO) and Sub-CLOs

A. CLO

After completing this course, students of Physics semester 73 are able to explain the definition of ceramics, crystal structure and general properties of ceramics, the effects of chemical bonds on physical properties, diffusion and electrical conductivity, glass properties, sintering, mechanical properties, thermal properties, dielectric properties, magnetic properties. and optical properties of ceramic materials. **(ELO 3,5,6,7)**

B. Sub-CLOs

1. Describe the definition of ceramics, crystal structure and general properties of ceramics (C2)
2. Describe the melting point relationship, the thermal expansion coefficient relationship, Young's modulus, surface energy with ionic and covalent bonds, (C2)
3. Describe the diffusion and electrical conductivity of ceramic materials (C2)
4. Applying the Law of Fick I, II and the law of conductivity (C3)
5. Describe the stages of formation, structure, glass properties, crystal growth (C2)Membedakan network formers dan network modifier (C2)
6. Describe the sintering process, grain growth kinetics, sintering kinetics, densification in solid-state sintering (C2)Menganalisis faktor-faktor yang mempengaruhi solid-state sintering (C4)
7. Describe brittle and ductile mechanical properties, fracture toughness, Griffith's criteria, stress intensity factor (C2).Membedakan crack deflection, crack bridging, dan transformation toughning (C2)
8. Using the Weibull distribution in structured problems (C3)
9. Explain thermal properties, the concept of residual stress, thermal shock, tempering (C2)
10. Apply the formula for thermal expansion and thermal conductivity (C3)

11. Explain dielectric properties, polarization concept, power dissipation factor, dielectric spectrum (C2)
12. Applying the formulas for capacitor, polarization, dipole moment to the structured problem (C3)
13. Explain the concept of magnetic fields, hysteresis curves, and microscopic magnets (C2)
14. Distinguishing magnetic materials, namely diamagnetic, paramagnetic, ferromagnetic, ferrimagnetic and antriferromagnetic (C2)
15. Describe the spectrum of electromagnetic waves, electromagnetic radiation, absorption / transmission phenomena, Rayleigh scattering and critical angle phenomena (C2)
16. Apply electromagnetic formulas (intensity equations, Snellius's Law, Freelance equations, Beer-Lambert) (C3)

III. Teaching Plan

Week	Sub-CLO	Study Materials	Teaching Method	Time Required	Learning Experiences (*O-E-F)	Sub-CLO Weight on Course (%)	Sub-CLO Achievement Indicator	References
1	1	Introduction (definition, microstructure, general properties, applications)	Collaborative Learning	50 minutes	O: Orientation (70%) E: Exercise (20%) F: Feedback (10%)	6	Describes the definition of ceramics, constituent elements, crystal structure, applications and general properties of ceramics	Ref.1 bab 1
2	2	Effects of chemical bonds on physical properties	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	6	Describe the melting point relationship, the thermal expansion coefficient relationship, Young's modulus, surface energy with ionic and covalent bonds,	Ref. 1 bab 4
3	3	Diffusion and electrical conductivity	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	7	Describes the diffusion and electrical conductivity of ceramic materials	Ref.1 bab 7
4	4	Difusi dan kondutivitas listrik	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	8	Applying the Law of Fick I, II and the law of conductivity to structured problems	

5	5	Formation of the structure and properties of glass	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	7	Describe the formation stages, structure, glass properties, crystal growth, formation kinetics using the TTT curve and Avrami equation, glass transition temperature.	No. 1 bab 9
6	6	Formation of the structure and properties of glass	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	6	Distinguish network formers and network modifiers	
7	**Mid Term Exam**							
8	7	Sintering and grain growth	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	6	Describe the sintering process, grain growth kinetics, sintering kinetics, densification in solid-state sintering	No. 1 bab 10
9	8	Sintering and grain growth	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	8	Analyzing the factors that influence solid-state sintering, the relationship between growth and solid state sintering	
10	9,10,11	Mechanical properties	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	8	Describe brittle and ductile mechanical properties, fracture toughness, Griffith's criteria, stress intensity factor, Distinguishing crack deflection, crack bridging, and transformation toughning. Using the Weibull distribution on structured problems	No. 1 bab 11
11	12,13	Thermal Properties	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	8	Describe thermal properties, residual stress concepts, thermal shock, tempering, Applies the formula for thermal expansion and thermal conductivity	Ref. 1 bab 13
12	14	Dielectric properties	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	6	Describes dielectric properties, polarization concept, power	Ref.1 bab 14

							dissipation factor, dielectric spectrum	
13	15	Dielectric properties	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	8	Applying the capacitor, polarization, dipole moment formulas to a structured problem	Ref.1 bab 14
14	16,17	Magnetic properties	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	8	Describe the concept of magnetic fields, hysteresis curves, and microscopic magnets of magnets, Distinguishing magnetic materials, namely diamagnetic, paramagnetic, ferromagnetic, ferrimagnetic and antriferromagnetic	Ref.1 bab 15
15	18,19	Optical properties	Collaborative Learning	150 minutes	O: Orientation (10%) E: Exercise (80%) F: Feedback (10%)	8	Describe the spectrum of electromagnetic waves, electromagnetic radiation, absorption / transmission phenomena, Rayleigh scattering and critical angle phenomena, Apply electromagnetic formulas (intensity equation, Snellius's Law, Fresnel equation, Beer-Lambert)	Ref.1 bab 16
16	**Final Exam**							

*) O : Orientation
L : Exercise
U : Feedback

References:

1. M. W. Barsoum, *Fundamentals of Ceramics*, Inst. of Publishing, 2003.
2. W.D Kingery, H.K. Bowen dan D.R. Uhlmann, *Introduction to Ceramics*, John Wiley & Son 1976.

IV. Assignment Design and Exercises

Week	Assignment Name	Sub-CLOs	Assignment	Scope	Working Procedure	Deadline	Outcome
1-4	Individual Assignment 1	1, 2, 3,4	Problem	Definition, microstructure, general properties, application of ceramic materials. Melting point relationship, thermal expansion coefficient relationship, Young's modulus, surface energy with ionic and covalent bonds. Diffusion and electrical conductivity of ceramic materials, Fick's Laws I, II and condutivity laws	Homework	1 week	Answer Sheet
5-6	Group Assignment 1	5, 6	Problem	Stages of formation, structure, glass properties, crystal growth, network formers and network modifiers	In the classroom, group and independent discussions	100 minutes	Lecturer power points, independent and group answer sheeet
7	Ujian Tengah Semester						
8-11	Individual Assignment 2	7-13	Problem	The sintering process, grain growth kinetics, sintering kinetics, densification in solid-state sintering, factors that influence solid-state sintering. Mechanical properties are brittle and ductile, fracture toughness, Griffith's criteria, stress intensity factor, crack deflection, crack bridging, and transformation toughning, Weibull distribution. Thermal properties, the concept of residual stress, thermal shock, tempering, thermal expansion and thermal conductivity	Homework	1 week	Answer Sheet
12,13	Group Assignment 1	14-19	Problem	Dielectric properties, polarization concept, power dissipation factor, dielectric spectrum, capacitor, dipole moment The concept of magnetic fields, hysteresis curves, and microscopic magnitudes of magnets, diamagnetic, paramagnetic, ferromagnetic, ferrimagnetic and antriferromagnetic electromagnetic wave spectrum, electromagnetic radiation, absorption / transmission phenomena, Rayleigh scattering and critical angle phenomena, Snellius's Law, Fresnel equation, Beer-Lambert	In the classroom, group and independent discussions	100 minutes	Lecturer power points, independent and group answer sheeet
14,15	Individual Presentation Assignment	9-19	Individual Presentation	mechanical properties, thermal properties, electrical properties, magnetic properties and optical properties of ceramic materials	In the classroom	200 minutes	Student power points, scientific writing assignments or papers
16	Ujian Akhir Semester						

V. Assessment Criteria (Learning Outcome Evaluation)

Evaluation Type	Sub-CLOs	Assessment Type	Frequency	Evaluation Weight (%)
Individual Assignment	1-4, 7-13	Answer Sheet	4	20
Discussion/Presentation	5-6, 14-19	Assessment Sheet	3	20
Mid Term Exam	1-6	Answer Sheet	1	30
Final Exam	7-19	Answer Sheet	1	30
Total				**100**

VI. Rubric(s)

A. Presentation Score Criteria

Score	Delivering the Presentation
85-90	The group is able to convey explanations logically, smoothly, and on time and is able to answer questions from fellow students and teachers
75-84	The group is able to convey explanations logically and smoothly and can answer questions from fellow students and teachers, but cannot manage time well
65-74	The group is able to convey explanations fluently but cannot convey the logic of their reasoning
55-64	The group is less able to convey explanations smoothly and on time and is less able to convey the logic of their reasoning
<55	

B. Essay Score Criteria

Score	Answer Quality
100	The answer is very precise, all the definitions and main components are complete
76-99	The answer is quite precise, the meaning and the main components are almost complete
51-75	Inaccurate answers, incomplete understanding and main components
26-50	The answer is very inaccurate, the meaning and the main components are very incomplete

<25	Wrong answer