TEACHING INSTRUCTIONAL DESIGN (BRP) COURSE

APPLIED MATERIAL PHYSICS

by

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UNIVERSITAS INDONESIA
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
PHYSICS UNDERGRADUATE STUDY PROGRAM

TEACHING INSTRUCTIONAL DESIGN

Course Name	Applied Material Physics	**Credit(s)**	**Prerequisite course(s)**	**Requisite for course(s)**	**Integration Between Other Courses**
Course Code	SCPH603704	3	Modern Physics, Advanced Physics Practicum 1 & 2, and Introduction to Solid Physics		
Relation to Curriculum	-				
Semester	5				
Lecturer(s)	Ariadne L. Juwono				
Course Description	The Applied Material Physics course is a semester 5 elective course. Students are expected to be able to apply physics to polymer, ceramic, metal and composite-based materials, both conventional and advanced materials. In addition, students are able to analyze the synthesis process, physical properties, chemical properties and mechanical properties of materials and are able to characterize materials based on the principles of physics. Topics covered include polymer-based materials, ceramics, metals, and composites, and their properties. This lecture is delivered face-to-face and online (EMAS); with the flipped class room method, cooperative learning and collaborative writing Wiki in EMAS. The language of instruction for this course is Indonesian.				

Program Learning Outcome (PLO)

PLO-1	Apply the concepts of one of the following fields of Physics or Applied Physics: a. Nuclear Physics & Theoretical Particles b. Material Physics c. Condensed Matter Physics d. Physical System & Instrumentation e. Medical Physics & Biophysics
PLO-2	Formulating problems and solving Physics and its application, as well as interdisciplinary problems related to science and mathematics clumps critically, creatively, and innovatively
PLO-3	Solve simple scientific problems and present them orally and in writing.
Course Learning Outcome (CLO)	
CLO	After attending the Applied Materials Physics course, 5th semester students are expected to be able to analyze the synthesis process, physical properties, chemical properties and mechanical properties of polymer-based materials, ceramics, metals, and composites, both conventional and advanced materials and to be able to characterize materials based on the rules. physics. (C4)
Sub-CLO(s)	
Sub- CPMK 1	Be able to identify various techniques and thermodynamic principles in metal alloy preparation (C4).
Sub- CPMK 2	Be able to study various kinds of phase diagrams (C4).
Sub- CPMK 3	Be able to use X-rays to determine metal and alloy phases (C4).
Sub- CPMK 4	Able to identify various types of polymers, polymerization process and associated with their properties (C4)

Sub- CPMK 5	Be able to identify various techniques for making ceramics and related to their properties (C4).
Sub- CPMK 6	Able to apply Rules of Mixture for various types of composites and related to their physical and mechanical properties (C3)
Study Materials	**Metal**: The principle of mass conservation in the preparation of metal alloys; Induction melting technology, arc melting, mechanical alloying¸powder metallurgy for the preparation of metal alloys and blast furnace technology for metal reduction; Thermodynamics overview of the process of forming metal alloys (entropy and free energy); Solidification process; homogeneous, heterogeneous nucleation; nucleation rate, alloy system, solubility limit, Hume-Rothery rules; microstructure; Alloy system binary phase diagram (miscibility gap, eutectic, eutectoid, pretectic, pretectoid, intermediate phase, intermetallic phase, lever rule); Ternary system phase diagram (introduction); Alloy system Fe-C (steel, hypo and hyper eutectoid steel, cast iron); Heat treatment process in the system; microstructure evolution; grain growth kinetics; recrystallization kinetics, mechanical and magnetic properties of alloy systems. The use of x-rays for phase identification, determination of the volume fraction of the phase in alloy systems. **Polymer**: Basic concepts of polymer science (differences in polymer physics and polymer chemistry). Describe the mechanism and kinetics of polymerization reactions (initiation, propagation, termination). Classification of polymers based on their properties: Thermoplastic, thermoset and elastomer. Polymer material synthesis techniques. Synthetic polymers: PVC, PS, PE (LDPE and HDPE), PP, PTFE, PMMA, PET, Nylon. Polymer morphology and characterization using SEM / TEM. The rheology and mechanical properties of polymers. Physical properties of polymer materials. Analysis of polymer thermal properties (DTA, TGA, DSC). Characterization of polymer mechanical properties (tensile strength, compressive strength, flexural strength, impact resistance, fatigue / fatigue, hardness, flexibility, Young's Modulus) **Ceramic**: 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 optical properties. **Composite**: Introduction, various types of composites and their applications, various types of matrices and reinforcements, selection of matrix and reinforcing materials, matrix-reinforcing interfaces, mechanical properties of isotropic composites and Rule of Mixtures, as well as introduction of anisotropic models on uninterrupted fiber reinforcement.

Reading List	**Compulsory:** 1. Callister, Introduction of Materials Science, edisi ke-7, 2007 2. Peter Hassen, Physical Metallutgy, Cambridege University Press, London (ISBN: 0-521-29183-6) 3. Suryanarayana, Grant Norton, X-Ray Diffraction: Practical Approach, Plenum Press, New York and London (ISBN: 0-306-45744-X) **Additional:** 4. M. W. Barsoum, *Fundamentals of Ceramics*, Inst. of Publishing, 2003. 5. Stevens, M.P., 1975 : Polimer Chemistry and Introduction, Addison Wesley, N.Y. 6. F.W. Billmeyer, JR. (1998) Textbook of Polymer Science, Amerika : John Wiley & Sons, Inc. 7. Various articles from selected journals

Teaching Plan

Week	Sub-CLO	Study Materials [with reference]	Teaching Method [with est. time]	Learning Experiences (*O-E-F)	Sub-CLO Achievement Indicator		Sub-CLO Weight on Course (%)
					General	Specific	
1-3	Sub-CLO-1: Able to identify various techniques and thermodynamic principles in metal alloy preparation	The principle of mass conservation in the preparation of metal alloys; Induction melting technology, arc melting, mechanical alloying,powder metallurgy for the preparation of metal alloys and blast furnace technology for metal reduction; Thermodynamics overview of the process of forming metal alloys	College contract Interactive lecture: Introduction (150 minutes) Cooperative learning: FG 180 minutes (at the EMAS discussion forum)	O 30% (interactive lectures by lecturers) L 60% (discussion in class and in the Discussion	Able to explain well about the techniques and principles of thermodynamics in metal alloy preparation.	Able to make presentation files according to academic standards	20%

		(entropy and free energy); Solidification process; homogeneous, heterogeneous nucleation; nucleation rate, alloy system, solubility limit, Hume-Rothery rules; microstructure; Callister and Peter Hassen	HG 180 minutes Self-study 360 minutes Presentation and clarification (2 X 150 minutes)	Forum in EMAS) U 10% (student presentations and lecturers provide clarification)			
4 and 5	Sub-CLO-2: Able to study various kinds of phase diagrams	Alloy system binary phase diagram (miscibility gap, eutectic, eutectoid, pretectic, pretectoid, intermediate phase, intermetallic phase, lever rule); Ternary system phase diagram (introduction); Alloy system Fe-C (steel, hypo and hyper eutectoid steel, cast iron); Heat treatment process in the system; microstructure evolution; grain growth kinetics; recrystallization kinetics, mechanical and magnetic properties of alloy systems. Callister and Peter Hassen	Collaborative Wiki writing in EMAS (including answering the questions given and the answers written in an integrated manner on the Wiki) Structured learning (2 X 150 minutes) Independent study (2 X 180 minutes) Writing in EMAS (2 X 180 minutes)	O 10% (lecturer gave an introduction) L 80% (Co-authored Wiki in EMAS) U 10% (lecturer gave input on EMAS)	Be able to write well about phase diagrams	Able to write Wiki according to academic standards	15 %
6 and 7	Sub-CLO-3:	The use of x-rays for phase identification, determination of	Interactive lecture:	O 10% (lecturer gave	Able to explain well about the	Able to make presentation	15 %

	Able to use X-rays to determine metal and alloy phases	the volume fraction of the phase in alloy systems Suryanarayana	Introduction (150 minutes) Cooperative learning: FG 120 minutes (at the EMAS discussion forum) HG 120 minutes Independent study 300 minutes Presentation and clarification (1 X 150 minutes)	an introduction) L 80% (group discussion) U 10% (lecturer provides clarification)	use of X-rays to determine the function of metals and alloys	files according to academic standards	
8	Mid Term Exam						
9 - 11	Sub-CLO-4: Able to identify various types of polymers, polymerization process and associated with their properties	Basic concepts of polymer science (differences in polymer physics and polymer chemistry). Describe the mechanism and kinetics of polymerization reactions (initiation, propagation, termination). Classification of polymers based on their properties: Thermoplastic, thermoset and elastomer. Polymer material synthesis	Collaborative Wiki writing in EMAS (including answering the questions given and the answers written in an integrated manner on the Wiki)	O 10% (lecturer gave an introduction) L 80% (Co-authored Wiki in EMAS)	Able to write well on different types of polymers, polymerization processes, and properties of polymers in relation to types of polymers and their	Able to write Wiki according to academic standards	20 %

		techniques. Synthetic polymers: PVC, PS, PE (LDPE and HDPE), PP, PTFE, PMMA, PET, Nylon. Polymer morphology and characterization using SEM / TEM. The rheology and mechanical properties of polymers. Physical properties of polymer materials. Analysis of polymer thermal properties (DTA, TGA, DSC). Characterization of polymer mechanical properties (tensile strength, compressive strength, flexural strength, impact resistance, fatigue / fatigue, hardness, flexibility, Young's Modulus) Stevens, M.P and Billmeyer	Structured learning (3 X 150 minutes) Independent study (3 X 180 minutes) Writing in EMAS (3 X 180 minutes)	U 10% (lecturer gave input on EMAS)	polymerization processes.		
12 – 13	Sub-CLO-5: Able to identify various ceramic manufacturing techniques and	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,	Interactive lecture: Introduction (150 minutes) Cooperative learning:	O 10% (lecturer gave an introduction) L 80% (group discussion)	Be able to explain well about the properties of ceramic manufacturing techniques	Able to make presentation files according to academic standards	15 %

	related their properties	magnetic properties and optical properties. Barsoum	FG 120 minutes (at the EMAS discussion forum) HG 120 minutes Independent study 300 minutes Presentation and clarification (1 X 150 minutes)	U 10% (lecturer provides clarification)			
14 - 15	Sub-CLO-6: Able to apply Rules of Mixture for various types of composites and related to their physical and mechanical properties	Introduction, various types of composites and their applications, various types of matrices and reinforcements, selection of matrix and reinforcing materials, matrix-reinforcing interfaces, mechanical properties of isotropic composites and Rule of Mixtures, as well as introduction of anisotropic models on uninterrupted fiber reinforcement Callister	Interactive lecture: Introduction (150 minutes) Cooperative learning: FG 120 minutes (at the EMAS discussion forum) HG 120 minutes Independent study 300 minutes Presentation and clarification (1 X 150 minutes)	O 10% (lecturer gave an introduction) L 80% (group discussion) U 10% (lecturer provides clarification)	Able to explain well about various types of composites, Rules of Mixture, physical and mechanical properties of composites use of X-rays	Able to make presentation files according to academic standards	15 %
16	Final Exam						

Assignment Design

Week	Assignment Name	Sub-CLOs	Assignment	Scope	Working Procedure	Deadline	Outcome
3	Homework	Sub-CLO-1	Answer essay questions	Metals and alloys	Individual assignment	1 week	Homework answers
6	Homework	Sub CLO-2 and sub CLO-3	Answer essay questions	Phase diagram and phase determination with X-ray	Individual assignment	1 week	Homework answers
11	Homework	Sub-CLO-4	Answer essay questions	Polymer	Individual assignment	1 week	Homework answers
15	Homework	Sub CLO-5 and sub CLO-6	Answer essay questions	Ceramic and composite	Individual assignment	1 week	Homework answers

Assessment Criteria (Learning Outcome Evaluation)

Evaluation Type	Sub-CLO	Assessment Type	Frequency	Evaluation Weight (%)
Homework	Sub-CLO 1 - 6	Assessment form	4	20
Presentation	Sub-CLO 1, 3, 5, 6	Assessment form	4	5
Discussion	Sub-CLO 1, 3, 5, 6	Assessment form	4	5
Wiki writing	Sub CLO 2 dan 4	Assessment form	2	10
Mid term exam	Sub-CLO 1 - 3	Assessment form	1	30
Final exam	Sub-CLO 4 - 6	Assessment form	1	30
Total				**100**

Rubrik

This rubric is used as a guideline for assessing or giving levels of student performance results. a rubric usually consists of assessment criteria that include the dimensions / aspects that are assessed based on indicators of learning achievement. This assessment rubric is useful for clarifying the basics and aspects of the assessment so that students and lecturers can be guided by the same thing regarding the expected performance demands. Lecturers can choose the type of rubric according to the assessment given.

Number Score	Letter Score	Letter Score
85-100	A	4,00
80—<85	A-	3,70
75—<80	B+	3,30
70—<75	B	3,00
65—<70	B-	2,70
60—<65	C+	2,30
55—<60	C	2,00
40—<55	D	1,00
<40	E	0,00

RUBRIC ASSESSMENT OF HOMEWORK, MID TERM EXAM AND FINAL EXAM

No	Criteria	Score
1	Answering questions systematically, completely and correctly	85 - 100
2	Answering questions not systematically	75 - < 85
3	Answer part of the question	55 - < 75
4	Answer a little part of the question	40 - < 55
5	Not answering questions	< 40

RUBRIC DISCUSSION ASSESSMENT

No	Criteria	Score
1	able to explain strong arguments supported by evidence from reference materials	85 - 100
2	able to explain strong arguments that are supported without evidence from reference materials	75 - < 85
3	explain arguments that are not so strong even though they are supported by evidence from reference materials	65 - < 75
4	explain arguments that are not so strong without evidence from reference materials	55 - < 65
5	does not explain the argument	< 55

RUBRIC PRESENTATION ASSESSMENT

No	Criteria	Score
1	able to convey explanations logically, smoothly and on time and able to answer questions from fellow students and teachers	85 - 95
2	able to convey explanations logically and smoothly and be able to answer questions from fellow students and teachers, but not able to manage time well	75 - < 85
3	able to convey explanations smoothly but unable to convey the logic of reasoning	65 - < 75
4	less able to convey explanations smoothly and on time and unable to convey the logic of reasoning	55 - < 65
5	Not able to convey well	< 55

RUBRIC ASSESSMENT OF WIKI WRITING

No	Criteria	Score
1	Contains an introduction, content and cover in a comprehensive manner, uses good and correct Indonesian, and is easy to understand.	85 - 100

2	Contains an introduction, content and closing comprehensively, using good and correct Indonesian, but not easy to understand	75 - < 85
3	Contains an introduction, content and conclusion comprehensively, uses Indonesian that is not correct, and is not easy to understand.	55 - < 75
4	Contains introduction, content and conclusion, uses Indonesian that is incorrect, and cannot be understood.	40 - < 55
5	Contains incomprehensible short writing	< 40