TEACHING INSTRUCTIONAL DESIGN (BRP)

COURSE

INTRODUCTION TO SOLID STATE PHYSICS

by

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

TEACHING INSTRUCTIONAL DESIGN

Course Name	Introduction to Solid State Physics	**Credit(s)**	**Prerequisite course(s)**	**Requisite for course(s)**	**Integration Between Other Courses**
Course Code	SCPH603117	3	Modern Physics	Solid State Physics 1, Solid State Physics 2	Statistical Physics
Relation to Curriculum	Compulsory Course				
Semester	5th				
Lecturer(s)	Dr. Budhy Kurniawan				
Course Description	This Introduction to Solid State Physics course covers eight major topics, namely statistical physics, the structure of solids, vibration in solids/phonons, electronic structures, superconductivity, magnetism, dielectrics and ferroelectrics, outside crystals (beyond crystaline). Students study this course with a combination of two active learning methods, namely interactive lectures and collaborative learning. Students have the opportunity to practice integrating understanding of the basic concepts of physics, and analytical skills in studying the eight topics above. Students also practice explaining and analyzing phenomena in solid matter systems using basic concepts of physics and their application to technology. In addition, students can develop the ability to synthesize and evaluate both qualitatively and quantitatively phenomena in solid material systems using basic physics concepts. The language of instruction used in this course is Indonesian.				
Online Class Link	https://emas.ui.ac.id/course/view.php?id=9631				

Program Learning Outcome (PLO)	
PLO-1	Able to apply modern physics concepts in Solid Substance Physics problems.
PLO-2	Able to formulate problems and solve mechanics, thermodynamics, vibrations, waves, optics, electricity and magnetism.
PLO-3	Be able to derive specific formulas for the problem being handled.
Course Learning Outcome (CLO)	
CLO-1	After taking this course, students are able to formulate well-defined solutions to simple modern physics problems related to solid matter and material physics.
Sub-CLO(s)	
Sub-CLO 1	Be able to explain the basic concepts of the crystal structure of solid (C2).
Sub-CLO 2	Able to apply vibrational motion in solids (C5) and electronic structures of solids (C3).
Sub-CLO 3	Able to apply superconductivity of solid (C4) and magnetic properties of solid (C3).
Sub-CLO 4	Be able to explain and apply the dielectric and ferroelectric properties of solids and the physical properties of solids other than crystals (C4).
Study Materials	Introduction, the crystal structure of solids, vibrational motion in solids, electronic structure of solids, superconductivity of solids, magnetic properties of solids, dielectric and ferroelectric properties of solids, and physical properties of solids other than crystals.
Reading List	[1] C. Kittle, *Introduction to Solid State Physics* 8th Ed., Wiley, 2005.

I. 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	
1-4	1	- Introduction - Crystal structure of a solid matter	Lecture [200 minutes] Integrated self-learning: 1. Read study materials on EMAS [2x20 minutes] 2. Watch lecture videos on EMAS [2x10 minutes] 3. Do exercise questions on EMAS [50 minutes]	**O (40%)** **Synchronous:** Face-to-face lectures via Ms Teams. **Asynchronous:** Read material and watch video lecture on EMAS. **E (30%)** **Asynchronous:** Doing practice questions on EMAS. **F (30%)** **Synchronous:** Questions and answers in class. **Asynchronous:** Answers to practice questions	After attending lectures (synchronous), reading material and watching videos on EMAS (asynchronous), students can explain the concept of crystal structure appropriately.	Students can apply the concept of crystal structure and its properties.	25
5-7	2	- Motion of vibrations in solid matter - Electronic structure of solids	Lecture [200 minutes] Integrated self-	**O (40%)** **Synchronous:** Face-to-face lectures via Ms Teams.	After attending lectures (synchronous), reading material	Students can derive equations and apply them to various classical	25

			learning: 1.Read study materials on EMAS [2x20 minutes] 2.Watch lecture videos on EMAS [2x10 minutes] 3.Do exercise questions on EMAS [50 minutes]	**Asynchronous:** Read material and watch video lecture on EMAS. **E (30%)** **Asynchronous:** Doing practice questions on EMAS. **F (30%)** **Synchronous:** Questions and answers in class. **Asynchronous:** Answers to practice questions	and watching videos on EMAS (asynchronous), students can apply vibrational motion to solids and electronic structures appropriately.	cases.	
8	**Mid-Term Exam**						
9-12	3	- Superconductivity of solids - Magnetic properties of solids	Lecture [200 minutes] Integrated self-learning: 1.Read study materials on EMAS [2x20 minutes] 2.Watch lecture videos on EMAS [2x10 minutes] 3.Do exercise	**O (40%)** **Synchronous:** Face-to-face lectures via Ms Teams. **Asynchronous:** Read material and watch video lecture on EMAS.	After attending lectures (synchronous), reading material and watching videos on EMAS (asynchronous), students can apply superconductivity and magnetic properties of solids.	Students can derive equations related to superconductivity and magnetism.	25

			questions on EMAS [50 minutes]	**E (30%)** **Asynchronous:** Doing practice questions on EMAS. **F (30%)** **Synchronous:** Questions and answers in class. **Asynchronous:** Answers to practice questions			
13-15	4	- Dielectric properties - Ferroelectric properties of solids - Physical properties of solids other than crystals	Lecture [200 minutes] Integrated self-learning: 1. Read study materials on EMAS [2x20 minutes] 2. Watch lecture videos on EMAS [2x10 minutes] 3. Do exercise questions on EMAS [50 minutes]	**O (40%)** **Synchronous:** Face-to-face lectures via Ms Teams. **Asynchronous:** Read material and watch video lecture on EMAS. **E (30%)** **Asynchronous:** Doing practice questions on EMAS. **F (30%)** **Synchronous:** Questions and answers in class.	After attending lectures (synchronous), reading material and watching videos on EMAS (asynchronous), students are able to explain dielectric properties, ferroelectric properties and physical properties of solids other than crystals.	Students can get students to derive equations related to dielectric properties, ferroelectric properties and physical properties of solids other than crystals.	25

				Asynchronous: Answers to practice questions			
16	**Final Exam**						

*) O : Orientation
E : Exercise
F : Feedback

Synchronous : learning interactions between lecturers and students are carried out at the same time, using video conferencing or chat technology.

Asynchronous : learning interactions are carried out flexibly and not necessarily at the same time, for example using a discussion forum or independent study/student assignments.

II. Assignment Design

Week	Assignment Name	Sub-CLOs	Assignment	Scope	Working Procedure	Deadline	Outcome
1	Exercise 1	1	Problem set	Introduction to solid matter	Online via EMAS	50 minutes	Score online
2	Exercise 2	1	Problem set	Crystal structure of solids	Online via EMAS	50 minutes	Score online
3	Exercise 3	1	Problem set	Vibrational motion in solids	Online via EMAS	50 minutes	Score online
	Group Discussion	1,2,3,4	Discussion materials	All study materials	Online via EMAS, divided to 5 groups	60 minutes	Discussion rubric
4	Exercise 4	1	Problem set	Electronic structure of solids	Online via EMAS	50 minutes	Score online
	Homework 1	1	Problem set	Electronic structure of solids	Individual at home		Answer sheet
5	Exercise 5	2	Problem set	Superconductivity of solids	Online via EMAS	50 minutes	Score online
6	Exercise 6	2	Problem set	Magnetic properties of solids	Online via EMAS	50 minutes	Score online
	Group Discussion	1,2,3,4	Discussion materials	All study materials	Online via EMAS, divided to 5 groups	60 minutes	Discussion rubric
7	Exercise 7	2	Problem set	Dielectric properties of solids	Online via EMAS	50 minutes	Score online
	Homework 2	2	Problem set	Statistical quantum	Individual at home		Answer sheet
8	**Mid-Term Exam**						
9	Exercise 8	2	Problem set	Ferroelectric properties of solids	Online via EMAS	50 minutes	Score online

10	Exercise 9	2	Problem set	Physical properties of solids other than crystals	Online via EMAS	50 minutes	Score online
11	Exercise 10	3	Problem set	Discussion on the use of amorphous materials	Online via EMAS	50 minutes	Score online
12	Exercise 11	3	Problem set	Discussion on the development of superconducting materials	Online via EMAS	50 minutes	Score online
	Homework 3	3	Problem set	Discussion on the development of superconducting materials	Individual at home		Answer sheet
13	Exercise 12	3	Problem set	Discussion about advanced materials	Online via EMAS	50 minutes	Score online
14	Exercise 13	4	Problem set	Discussion of electronic materials	Online via EMAS	50 minutes	Score online
	Group Discussion	1,2,3,4	Discussion materials	Discussion of electronic materials	Online via EMAS, divided to 5 groups	60 minutes	Disccussion rubric
15	Exercise 14	4	Problem set	Discussion of the alloys of several samples	Online via EMAS	50 minutes	Score online
	Homework 4	4	Problem set	Applications in medical physics, instrumentation, etc.	Individual at home		Answer sheet
	Group Assignment Presentation	1,2,3,4	Discussion materials	All study materials	Video conference via Ms Teams	60 minutes	Presentation video
16	**Final Exam**						

III. Assessment Criteria (Learning Outcome Evaluation)

Evaluation Type	Sub-CLO	Assessment Type	Frequency	Evaluation Weight (%)
Mid-Term Exam	1, 2	Written test via EMAS	1	20
Final Exam	2, 3, 4	Written test via EMAS	1	20
Weekly assignments	1, 2, 3, 4	Online test via EMAS (multiple choice and short answer) with online scoring	14	30
Homework problem set	1, 2, 3, 4	Homework answer sheet	4	10
Online discussion	1, 2, 3, 4	Discussion assesment rubric via EMAS	3	10
Final presentation	1, 2, 3, 4	Final presentation assesment rubric	1	10
			Total:	100

IV. Rubric(s)

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.

A. Conversion of the student's final score

Score	Grade	Equivalent
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 - < 50	D	1.00
< 40	E	0.00

B. Assessment rubric: Individual assignments and Exams

Score	Answer Quality
100	The answer is very precise and all the concept and main component are explained completely
76-99	The answer is fairly precise and the concept and main component are explained fairly complete
51-75	The answer is less precise and the concept and main component are explained less complete
26-50	The answer is poorly precise and the concept and main component are explained poorly complete
<25	Wrong answer

C. Assessment rubric: Group presentation

No.	Category	4	3	2	1
1	Group member cooperation	Cooperate well with members in the group and become a facilitator for the group	Less cooperation with the group	Very individual and only work with one person	Does not cooperate well with group members
2	Mastery of the material	Mastering the material well and without text when presenting	Less good at material and without text when presenting	Not mastering the material and using text when presenting	Not mastering the material
3	Delivery of material	The material is easy to understand with good body language	Partial material can be understood with good body language	The material is less understandable	The material cannot be understood

Presentation score = (total score/12) x 100

D. Assessment rubric: Group discussion

No.	Category	4	3	2	1
1	Involvement of group members	All members are involved in the discussion	Most of the members were involved in the discussion and a few were not	A few were involved in the discussion and most were not	All members showed no intention and effort to discuss
2	Discussion results	Answer all the questions given correctly	Answering most of the questions correctly and a few incorrectly	Answering a small number of questions given and mostly imprecise	Absolutely not answering the questions given correctly
3	Reference use	Using references appropriately to answer the problems in the discussion material	Most of them use references to answer the problems in the discussion material	A small proportion use references in answering the problems in the discussion material	Do not use references in answering problems in the discussion material

Discussion score = (total score/12) x 100