

TEACHING INSTRUCTIONAL DESIGN (BRP) COURSE

STATISTICAL PHYSICS

Ву

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Undergraduate Program in Physics Faculty of Mathematics and Natural Sciences Universitas Indonesia Depok, July 20th 2020

	FAKULTAS MA	JNIVERSITA FEMATIKA DA PROGRAM	AS INDONESI AN ILMU PENGI STUDI FISIKA	A ETAHUAN A	LAM		
	T	EACHING DESIGN E	BOOK				
COURSE	Statistical Physics	CREDITS	Prerequisite course(s)	Requisite for course(s)	Integration Between Other Courses		
COURSE CODE	SCPH603124	3					
Course Cluster	Compulsory Course			Solid-State	Intoroduction to		
Semester	5		Thermodynamics	Physics 1,	Solid-State		
Lecturer(s)	Dr. Budhy Kurniawan			Physics 2	Physics, Quantum Physics 1		
Course Description	ption The Statistical Physics course is a continuation of Thermodynamics, this course supports analysis tools for advanced courses such as Solid-State Physics and Quantum Physics. The material provided includes random walks, statistical descriptions of particle systems, statistical thermodynamics, statistical mechanics methods, applications of statistical mechanics, equilibrium between phases and chemical species, quantum statistics, interacting particle systems, magnetism and low temperatures, transport phenomena, and irreversible processes and fluctuations. <i>The language of instruction used in this course is Indonesian</i> .						
Online Course Link	https://emas.ui.ac.id/course	e/view.php?id=9637					

LO-STUDY PROGRAM	charged to the course
CLO-1	Competent in applying classical and modern physics concepts and statistical approaches in thermodynamic problems.
CLO-2	Competent in formulating problems and solving thermodynamics, vibrations, waves, optics, electricity and magnetism.
CLO-3	Competent in deriving specific formulas for the problems being handled.
Course Learning Outcom	nes (CLO)
CLO	After following this course, students are competent in applying the concepts of classical and quantum Statistical Physics to solve calculation problems correctly in condensed matter and nuclear physics.
Sub-CLO	
Sub-CLO 1	Competent in explaining the concept of random walk as a model for the description of particle motion on various conditions. (C2)
Sub-CLO 2	Competent in applying and categorizing statistical thermodynamics classical & quantum and use Statistical Physics for simple applications according to the characteristics of the existing methods in statistical mechanics (C3)
Sub-CLO 3	Competent in applying interphase balance and quantum statistics to analyze phenomena in solids. (C3)
Sub-CLO 4	Competent in calculating Statistical Physics for applications to condensed matter physics problems, magnetism at low temperatures, nuclear physics, particle physics, transport phenomena, irreversible processes, and fluctuations (C3)
Study Materials:	1. Introduction 2. Description of Statistical Particle System
Learning materials	3. Statistical Thermodynamics

	 4. Statistical Mechanics Method 5. Statistical Mechanics Application 6. Equilibrium between Phases and Chemical Species 7. Quantum Statistics 8. Interacting Particle System 9. Magnetism and Low Temperature 10. Transport Phenomenon 11. Process of Irreversible and Fluctuation
References	 Sears, Salinger : Thermodynamics, kinetics theory and statistical thermodynamics Addison Wesley 1975. Pathria, R.K., Beale, P.D. : Statistical Mechanics. Elsevier, Ltd, 2011 Sears, Salinger : Thermodynamics and Statistical Mechanics, Springer-Verlag New York Inc, 1997

LESSON PLAN

*Wk	Sub-CLO (Expected final competence)	Study Material (Learning materials) [Reference]	Study Method [Time Estimation]	Learning mode	Learning Experience		Outcome Indication Sub-CLO	Quality of
					Orientation; Exercise; Feedback		General Indicators; Special Indicators	application of sub-CLO in the Course
					Online	Offline		
1-2	Sub-CLO 1 Competent in explaining the concept of random walk as a	- Introduction	- Interactive lectures (40 minutes)	Synchronous, ms Team Asynchronous, EMAS	O (40%)- Synchronous: Interactive lectures via ms Team.		General Indicators: after the following lectures (synchronous), reading material and watching	10%

	model for the description of particle motion on various conditions.(C2)		 Structured self- study: Read the material on EMAS (2x20 minutes). Watch lecturing videos on EMAS (2x10 minutes) Exercise questions (50 minutes) 		Asynchronous: reading material and viewing lecturing videos on EMAS. E (30%)- Asynchronous: Doing exercises at EMAS. F (30%)- Synchronous: Q&A in class. Asynchronous: Answers to exercise questions.	videos on EMAS (asynchronous), students can explain the concept of random walk model to describe particle motions in various conditions Special Indicators: Students can apply basic mathematical and statistical equations in understanding the concept of random walk model to describe particle motions in various conditions.	
3	Sub-CLO 2 Competent in applying and categorizing statistical thermodynamics classical & quantum and use Statistical Physics for simple applications according to the characteristics of the existing methods in	- Description of Statistical Particle System	 Interactive lectures (40 minutes) Structured self- study: Read the material EMAS (2x20 minutes). Watch lecturing videos on EMAS (2x10 minutes) Exercise questions (50 minutes) 	Synchronous, ms Team Asynchronous, EMAS	O (40%)- Synchronous: Interactive lectures via ms Team. Asynchronous: reading material and viewing lecturing videos on EMAS. E (30%)- Asynchronous: Doing exercises at EMAS. F (30%)- Synchronous:	General Indicators: after the following lectures (synchronous), reading material and watching videos on EMAS (asynchronous), students can apply and categorize statistical thermodynamics in classical cases. Special Indicators: Students can derive equations and apply them to various classical cases	10%

	statistical			O&A in class			
	mochanics (C2)			Asynchronous:			
	mechanics (CS)			Answers to			
				exercise			
				questions			
4-5	-	- Statistical	Structured Self-	Q (40%)-	F (30%)- Students	General Indicators:	10%
7 5				Synchronous:	look for reading	after reading the	10/0
		Thermodynamic	Elippod class	Interactive	references to	matorials on EMAS	
		8	1 Road the	locturos via mo	answer questions	other reading sources	
			1. Redu the		in the exercises.	and viewing videos on	
				Tedill.			
				Asynchronous:		EIVIAS (asynchronous),	
			minutes).	reading		students can apply and	
			2. Watch lecture	material and		categorize statistical	
			VIDEOS IN EIVIAS	viewing		thermodynamics in	
			(2x10 minutes)	lecturing videos		classical and quantum	
			3. Read other	on EMAS.		cases.	
			reading sources	E (30%)-			
			to answer the	Asynchronous:		Special Indicators:	
			exercise	Doing exercises		Students can apply	
			questions (40	at EMAS.		them to various	
			minutes)	F (30%)-		classical and quantum	
			4. Exercise	Synchronous:		cases.	
			Questions (50	Q&A in class.			
			minutes)	Asynchronous:			
				Answers to			
				exercise			
				questions.			
6-7	-	- Statistical	Structured Self-	O (40%)-	E (30%)- Students	General Indicators:	15%
		Mechanics	Learning	Synchronous:	look for reading	after reading the	
		Method and	Flipped class	Interactive	references to	materials on EMAS,	
		Applications of	1. Read the	lectures via ms	answer questions	other reading sources,	
		Applications of	materials in	Team.	in the exercises.	and viewing videos on	
		Statistical	EMAS (2x20	Asynchronous:		EMAS (asynchronous),	
		Mechanics	minutes).	reading		students can apply and	
			,	material and		use Statistical Physics	
				viewing		for simple applications	

			 Watch lecture videos in EMAS (2x10 minutes) Read other reading sources to answer the exercise questions (40 minutes) Exercise Questions (50 minutes) 		lecturing videos on EMAS. E (30%)- Asynchronous: Doing exercises at EMAS. F (30%)- Synchronous: Q&A in class. Asynchronous: Answers to exercise questions		according to the characteristics of the methods in statistical mechanics Special Indicators: Students can apply mathematical equations to statistical mechanics correctly.	
8				Midterm	Exam			
9-10	Sub-CLO 3	- Equilibrium	- Interactive	Synchronous, ms	O (40%)-		General Indicators:	10%
	Competent in applying interphase balance and quantum statistics to analyze phenomena in solids. (C3)	between Phases and Chemical Species	lectures (40 minutes) - Structured self- study: 1. Read the material on EMAS (2x20 minutes). 2. Watch lecturing videos on EMAS (2x10 minutes) 3. Exercise questions (50 minutes)	Team Asynchronous, EMAS	Synchronous: Interactive lectures via ms Team. Asynchronous: reading material and viewing lecturing videos on EMAS. E (30%)- Asynchronous: Doing exercises at EMAS. F (30%)- Synchronous: Q&A in class. Asynchronous: Answers to exercise questions.		after the following lectures (synchronous), reading material and watching videos on EMAS (asynchronous), students can apply the balance between phases and chemical species Special Indicators: Students can derive equations regarding the balance between phases and chemical species	

11-12	- Quantum	Structured Self-	O (40%)-	E (30%)- Students	General Indicators:	10%
	Statistics	Learning	Synchronous:	look for reading	after reading the	
		Flipped class	Interactive	references to	materials on EMAS,	
		1. Read the	lectures via ms	answer questions	other reading sources,	
		materials in EMAS	Team.	in the exercises.	and watching videos	
		(2x20 minutes).	Asynchronous:		on EMAS	
		2. Watch lecture	reading		(asynchronous),	
		videos in EMAS	material and		students can explain	
		(2x10 minutes)	viewing		quantum statistics	
		3. Read other	lecturing videos		correctly.	
		reading sources	on EMAS.			
		to answer the	E (30%)-		Special Indicators:	
		exercise	Asynchronous:		Students can apply	
		questions (40	Doing exercises		quantum statistical	
		minutes)	at EMAS.		equations	
		4. Exercise	F (30%)-		appropriately.	
		Questions (50	Synchronous:			
		minutes)	Q&A in class.			
			Asynchronous:			
			Answers to			
			exercise			
			questions.			
7	- Interaction of	Structured Self-	O (40%)-	E (30%)- Students	General Indicators:	10%
	Particle Systems	Learning	Synchronous:	look for reading	after reading the	
		Flipped class	Interactive	references to	materials on EMAS,	
		1. Read the	lectures via ms	answer questions	other reading sources,	
		materials in	Team.	in the exercises.	and watching videos	
		EMAS (2x20	Asynchronous:		on EMAS	
		minutes).	reading		(asynchronous),	
		2. Watch lecture	material and		students can analyze	
		videos in EMAS	viewing		phenomena in solids	
		(2x10 minutes)	lecturing videos		correctly.	
		3. Read other	on EMAS.			
		reading sources	E (30%)-		Special Indicators:	
		to answer the	Asynchronous:		Students can apply	
		exercise	Doing exercises		interphase balance	

			questions (40		at EMAS.		and quantum statistics	
			minutes)		F (30%)-		to analyze phenomena	
			4. Exercise		Synchronous:		in solids.	
			Questions (50		O&A in class.			
			minutes)		Asynchronous			
			matesy		Answers to			
					exercise			
					questions			
13	Sub-CLO 4	Magnatiam	- Interactive	Synchronous ms	0 (40%)	F (30%)- Students	General Indicators:	10%
15	Compotent in		lectures (40 minutes)	Team	Synchronous:	look for reading	after the following	1070
		and Low	lectures (40 minutes)	ream	Interactive	references to	lectures	
	calculating	Temperature	Structured colf	Asynchronous	locturos via mo	answer questions	(synchronous) reading	
	Statistical		- Structureu Seit-	EMAS	Toom	in the exercises.	material and watching	
	Physics for		1 Road the material	-	Asynchronous:			
	applications to		1. Redu the material		Asylicii olious.		(asynchronous)	
	condensed		on ElviAS (2X20		matorial and		(asynchronous),	
	matter physics		11111ules).		viewing		statistical physics for	
			2. Watch lecturing		Viewing		statistical physics for	
	nuclear physics,						magnetism and low	
	particle physics		(2x10 minutes)		on EIVIAS.		temperatures	
			3. Exercise questions		E (30%)-			
			(50 minutes)		Asynchronous:		Special Indicators:	
					Doing exercises		Students can derive	
					at EMAS.		equations for the	
					F (30%)-		phenomenon of	
					Synchronous:		magnetism and low	
					Q&A in class.		temperature	
					Asynchronous:			
					Answers to			
					exercise			
					questions.			
14		- Transport	Structured Self-		O (40%)-	E (30%)- Students	General Indicators:	5%
		Phenomena	Learning		Synchronous:	look for reading	after the following	
			Flipped class		Interactive	references to	lectures	
			1. Read the		lectures via ms	answer questions	(synchronous), reading	
			materials in EMAS		Team.	in the exercises.	material and watching	
		1	(2x20 minutes).		Asynchronous:		videos on EMAS	

		 Watch lecture videos in EMAS (2x10 minutes) Read other reading sources to answer the exercise questions (40 minutes) Exercise Questions (50 minutes) 	reading material and viewing lecturing videos on EMAS. E (30%)- Asynchronous: Doing exercises at EMAS. F (30%)- Synchronous: Q&A in class. Asynchronous: Answers to exercise questions.	(asynchronous), students can explain statistical physics on transport phenomena Special Indicators: Students can apply statistical physics in transport phenomena appropriately.
15	- Process of Irreversible and Fluctuation	Structured Self- Learning Flipped class 1. Read the materials in EMAS (2x20 minutes). 2. Watch lecture videos in EMAS (2x10 minutes) 3. Read other reading sources to answer the exercise questions (40 minutes) 4. Exercise Questions (50 minutes)	O (40%)-E (30%)- StudentsSynchronous:look for readingInteractivelook for readingInteractiveanswer questionsiectures via msanswer questionsTeam.answer questionsAsynchronous:readingmaterial andviewinglecturing videoson EMAS.E (30%)-Asynchronous:Doing exercisesat EMAS.F (30%)-Synchronous:Q&A in class.Asynchronous:Answers toAnswers to	General Indicators:5%after the following lectures (synchronous), reading material and watching videos on EMAS (asynchronous), students can explain statistical physics on irreversible processes and fluctuations5%Special Indicators: Students can explain and apply statistical physics equations on irreversible processes and fluctuations5%

			exercise		
			questions.		
16		Final Term	Exam		

*) Wk: Week

**) 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 do not have to be at the same time, for example using discussion forums or independent study/student assignments.

RANCANGAN TUGAS DAN LATIHAN

Week	Assignment Name	Sub-CLO	Assignment	Scope	Working Procedure	Deadline	Outcome
1	Exercise 1	1	Problem Set	 Introduction a. Random walk b. Probability c. Gaussian Distribution 	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
2	Exercise 2	1	Problem Set	Statistical Description of Particle System	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
3	Exercise 3	1	Problem Set	Statistical Thermodynamics	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
	Group Discussion	1, 2, 3, 4	Bahan diskusi	All Materials	Online via EMAS by 5 groups	60 minutes	Discussion Rubric
4	Exercise 4	1	Problem Set	Statistical Mechanics Method	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
4	Homework 1	1	Problem Set	Statistical Mechanics Method	Individual Assignment at home		Answer Sheet
5	Exercise 5	2	Problem Set	Statistical Mechanics Application	Online via EMAS	Exercise time 50 minutes (Questions	Online Score

						open 24 hours)	
6	Exercise 6	2	Problem Set	Equilibrium between Phases and Chemical Species	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
	Group Discussion	1, 2, 3, 4	Discussion	All Materials	Online via EMAS by 5 groups	60 minutes	Discussion Rubric
7	Exercise 7	2	Problem Set	Quantum System	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
	Homework 2	2	Problem Set	Quantum Statistics	Individual Assignment at home		Answer Sheet
9	Exercise 8	2	Problem Set	Interacting Particle Systems	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
10	Exercise 9	2	Problem Set	Magnetism and Low Temperature	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
11	Exercise 10	3	Problem Set	Transport Phenomena	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
12	Exercise 11	3	Problem Set	Irreversible and Fluctuation Processes	Online via EMAS	Exercise time 50 minutes (Questions	Online Score

						open 24 hours)	
	Homework 3	3	Problem Set	Irreversible and Fluctuation Processes	Individual Assignment at home	noursy	Answer Sheet
13	Exercise 12	3	Problem Set	Applications in Condensed Matter Physics	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
13	Exercise 13	4	Problem Set	Applications in Particle Physics	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
	Group Discussion	1, 2, 3, 4	Discussion	Applications in Particle Physics	Online via EMAS by 5 groups	60 minutes	Discussion Rubric
14	Exercise 14	4	Problem Set	Applications in Medical Physics, Instrumentation, etc.	Online via EMAS	Exercise time 50 minutes (Questions open 24 hours)	Online Score
	Homework 4	4	Problem Set	Applications in Medical Physics, Instrumentation, etc.	Individual Assignment at home		Answer Sheet
	Group Presentation	1, 2, 3, 4	Discussion	All Materials	Vidcon, msTeam	60 minutes	Presentation Video

Assessment Criteria (Evaluation of Learning Outcomes)

Sub-CLO	Evaluation Form	Assessment Instrument	Frequency	Evaluation Quality (%)
1, 2	- Midterm Exam	Written test via EMAS	1x	20
2, 3, 4	- Final Term Exam	Written test via EMAS	1x	20
1, 2, 3, 4	- Weekly Assignment	Online test via EMAS (multiple choice and short answer question) with online scoring directly at EMAS	14x	30
1, 2, 3, 4	- Problem Set Homework	Homework Answer Sheet	4x	10
1, 2, 3, 4	- Online Discussion	Discussion scoring rubric via EMAS	3х	10
1, 2, 3, 4	- Final Presentation via video conference.	Final presentation grading rubric	1x	10
Total		·	·	100

Guidance of Grading Criteria

Conversion of student final grades based on the applicable provisions at the University of Indonesia. The conversion grades are:

Score	Grade	Quality
85 — 100	A	4. 00
80 — < 85	A-	3. 70
75 — < 80	В +	3. 30
70 — < 75	В	3.00

65 — < 70	В-	2. 70
60 — < 65	C +	2. 30
<u>55 — < 60</u>	С	2.00
40 — < 50	D	1.00
< 40	E	0.00

Rubric:

a. Essay Question Assessment Criteria (Assignments, UTS, and UAS)

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

b. Group Presentation Assessment Rubric Nilai

No	Category	4	3	2	1
1	Group member	Collaborate well	Collaborate less with	Very individual. Only	Does not
	collaboration	with members in the	the group	collaborate with one	collaborate well
		group and become a		person	with group
		facilitator for the			members
		group			
2	Material Understanding	Understand the	Understand less of	Understand less of	Does not
		material well and	the material and no	the material and use	understand the
		without text when	text when	of text when	material.
		presenting.	presenting.	presenting.	
3	Material Delivery	The material is easy	Part of the material	The material is not	The material
		to understand with	can be understood	understandable.	cannot be
		good body language.			understood.

languago	with good body	
anguage.	language.	

Presentation Grade = (total score/12) x 100

c. Assessment Rubric Group Discussion

No	Category	4	3	2	1
1	Involvement of group	All of the members	Most of the	Some of the	All of the members
	member	of the group are	members of the	members of the	of the group does
		involved in the	group are involved in	group are involved	not intend and put
		discussion	the discussion	in the discussion	the effort to discuss
2	Discussion Result	Answers all of the	Answer most of the	Answers some of	Does not answer
		given questions	given questions	the given questions	the given question
		correctly	correctly.	and most of them	at all
				were less correct	
3	References use	Using the	Using the most	Using a little part of	Does not use any
		appropriate	appropriate	the references in	references in
		references to answer	references to answer	answering the	answering
		the problems in the	the problems in the	problems in the	questions in the
		discussion materials	discussion materials	discussion	discussion
				materials.	materials.

Discussion Grade = (total score/12) x 100