UNPAD PHYSICS

ACADEMIC GUIDELINES

MASTER PROGRAM IN PHYSICS

FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNIVERSITAS PADJADJARAN
2021

Table of Contents

CHAPTER I

HISTORY, VISION, MISSION, OBJECTIVES AND TARGETS OF MASTER PROGRAM IN PHYSICS

1.1 HISTORY

A. HISTORY OF FACULTY OF MATHEMATICS AND NATURAL SCIENCES

The Faculty of Mathematics and Natural Sciences originally named the Faculty of Exact and Natural Sciences (FIPIA), was established based on October 22, 1958. Four departments were opened for the first time, namely, Department of Mathematics, Physics, Chemistry and Biology. On November 17, 1959 the President of the Republic of Indonesia (Dr. Ir. Soekarno) was inaugurated, and equipped with the Department of Pharmacy, Geology, and Geography, which then in 1964 the Department of Geography was integrated into the University of Indonesia. Based on Unpad Rector's Decree No. 41 / Kep / UNPAD / 63 in 1963, the Department of Statistics was inaugurated. In its development, the faculty changed its name to the Faculty of Exact Sciences and Natural Sciences. Since 1982 until now its name has become the Faculty of Mathematics and Natural Sciences (FMIPA). In 1985, FMIPA also managed the Diploma III Program in Mathematics, Chemistry, Physics, and Biology, which is a program from DIKTI to educate prospective teachers.

In 1992 the Master of Analytical Chemistry and Organic Chemistry Study Programs were opened, which were further merged into one under the name Master of Chemistry. In 1993 opened the Doctoral Study Program in Chemistry, Diploma III Program: Industrial Chemistry, Chemical Analysis, Computer Science, Information Management, Informatics Engineering, Computer Engineering, Electronics, and Instrumentation.

In 2007, FMIPA opened a Master of Applied Statistics Study Program, while the Department of Pharmacy and Geology separated from FMIPA into a separate faculty. In 2010, the Geophysics Undergraduate Study Program was opened, the next year 2011 the Informatics Engineering Study Program, and in 2015 the Electrical Engineering Study Program. In 2015, the Master of Mathematics Study Program and Master of Biology Study Program were established, and in 2019, Master Program in Physics was established.

Starting from 2016 at FMIPA consists of 8 departments listed below:

1) the Department of Mathematics has Undergraduate and Master Program in Mathematics;

2) The Department of Chemistry has Diploma Chemical Analysis Study Programs, Undergraduate, Master and Doctoral Program i Chemistry;

3) The Department of Physics has Undergraduate and Master Program in Physics;

4) The Department of Biology has Undergraduate and Master Program in Biology;

5) The Department of Statistics has Undergraduate Program in Statistics and Actuarial and Master Program in Applied Statistics;

6) The Department of Computer Science has Undergraduate Program in Informatics Engineering;

7) The Department of Geophysics has Undergraduate Program in Geophysics;

8) The Department of Electrical Engineering has Undergraduate Program in Electrical Engineering.

B. HISTORY OF MASTER PROGRAM OF PHYSICS

The Master Program in Physics is a Study Program in the Department of Physics, Faculty of Mathematics and Natural Sciences (MIPA), Universitas Padjadjaran. The implementation of the program is based on the Decree of the Chancellor of Padjadjaran University Number: 359/UN6.RKT/Kep/HK/2019 dated 21 June 2019. The Master Program in Physics has good accreditation from Nasional Accreditation Agency for Higher Education (BAN PT). The study program started in accepting students in the Even Semester of 2019/2020. All lectures and research of all students have been carried out at the Jatinangor Campus with a building area of 2051 m^2. Currently, the Master Program in Physics has 21 permanent lecturers with 5 professors and 16 associate and assistant professors.

1.2 VISION, MISSION, OBJECTIVES AND TARGETS OF STUDY PROGRAM

A. Vision:

Become a Master Program in Physics that is excellent at the international level in 2024 which focuses on Instrumentation, Materials, Energy and Geophysics and has an Impact on Society.

B. Mission:

1. Realizing education to produce graduates who master physics and its applications, are skilled at communicating and have an entrepreneurial spirit and are competitive at the international level.
2. Building an academic atmosphere that is conducive to the implementation of the education and research process.
3. Increasing the scientific contribution of Physics and its applications to society.

4. Build and develop collaboration with domestic and foreign institutions to improve the quality of education, research and community service.
5. Forming academic people who have a culture of RESPECT (Responsibility, Excellence, Scientific, Professionalism, Encouragement, Creative, and Trust)

C. Objectives of the Study Program:

1. To provide graduates who are able to master advanced physics and its applications, capable of communicating science to the community, have entrepreneurial skills, and are able to compete at the international level.
2. To create an excellent academic atmosphere for the implementation of the education and research process.
3. To provide graduates who contribute to society with their knowledge of physics and its applications.
4. To establish collaboration with domestic and foreign institutions to improve the quality of education, research, and community service.
5. To provide graduates with a culture of RESPECT (Responsibility, Excellence, Scientific, Professionalism, Encouragement, Creative, and Trust).

D. Targets of the Study Program:

1. To generate 80 % of graduates who are able to finish the program in 4 semesters with GPA 3.25.
2. To generate 50 % of graduates who are able to get first job in maximum 3 months.
3. To produce 5 articles per year, published in accredited national journal.
4. To produce 5 articles per year, published in reputable international journal.
5. To produce one product per year that useful for society.

CHAPTER II

CURRICULUM OF MASTER PROGRAM IN PHYSICS

2.1 Graduate Profile

Graduate profiles of the Master Program in Physics are lecturer/university staf/researcher, professional/ working in industry/company, doctoral course student. These profiles matched with a competency level standard (Level 8 on National Standard). These profiles are generally able to:

1. Develop knowledge and technology in the fields of physics by specializing in material physics, energy physics, instrumentation physics, and geophysics to produce innovative and tested works.
2. Manage inter/multi-disciplinary and development research that is beneficial for the community and science, and is able to get recognition national and international.
3. Contribute/assist in solving problems that occur in the community, especially in the fields of material physics, energy physics, physics instrumentation, and geophysics
4. Communicate scientifically both orally and in writing and have the motivation to attend further studies.

Graduate profile of Master Program in Physics will fill the following job positions:

Graduate Profile	Must-have abilities	Must-have knowledge
Lecturer/University staff/Researcher	1. Able to develop knowledge and technology in the field of physics 2. Able to design and analyze systems in the fields of physics by specializing in material physics, energy physics, instrumentation physics, and geophysics 3. Able to convey knowledge well to students 4. Able to communicate scientifically both orally and in writing	1. Knowledge of theoretical concepts of classical and modern physics 2. Knowledge of the principles and applications of physics 3. Knowledge of physical concepts of technology
Professional/ working in industry/company	1. Able to think logically, analytically, systematically to solved the problem in industry	1. Knowledge of theoretical concepts of classical and modern physics

	2. Able to manage inter/multi disciplinary research in industry 3. Able to contribute and communicate for solving the problems in company 4. Able to adapt in various work environments	2. Knowledge of the principles and applications of physics
Doctoral Course Student	1. Able to think logically, analytically and systematically 2. Able to plan, design and implement physics learning 3. Able to develop knowledge and technology in the field of physics 4. Able to communicate scientifically both orally and in writing	1. Knowledge of theoretical concepts of physics 2. Knowledge of the principles and applications of physics

2.2 Learning Outcomes

Learning outcomes (LO) are prepared by referring to Permendikbud no. 3 of 2020 and minimum learning outcomes set by the Indonesian Physics Association (PSI). The learning outcomes of Master Program in Physics amention in section 1.2, are listed below:

1. To be able to formulate and analyze problems in instrumentation, materials, energy, and geophysics (LO1).
2. To be able to apply physics theories, computations, and experimental methods to solve complex problems in instrumentation, materials, energy, and geophysics (LO2).
3. To be able to communicate their works and scientific ideas orally and in writing. (LO3)
4. To be able to collaborate, take responsibility in teamwork, and display academic leadership (LO4).
5. To be able to use long-life learning principles to enhance their knowledge and actual issues in physics in the fields of instrumentation, materials, energy, and geophysics (LO5).
6. To be able to demonstrate a sense of responsibility and commitment to upholding the law, ethics, social norms, and environmental sustainability (LO6).

These LOs have correlation with the graduate profile as shown in Table below.

LO	Lecturer/University staff/Researcher	Professional/Industry/Private company	Doctoral Course Student
LO1	√		√
LO2	√		√
LO3		√	
LO4		√	√
LO5		√	√
LO6		√	√

2.3 Curriculum Structure

The curriculum for the Master Program in Physics is designed to achieve LO which is in accordance with KKNI level 8. The curriculum consists of 36 credits, which is classified into 3 subject groups and divided into 4 semesters in two years. The structure of the curriculum is shown in Figure 1.

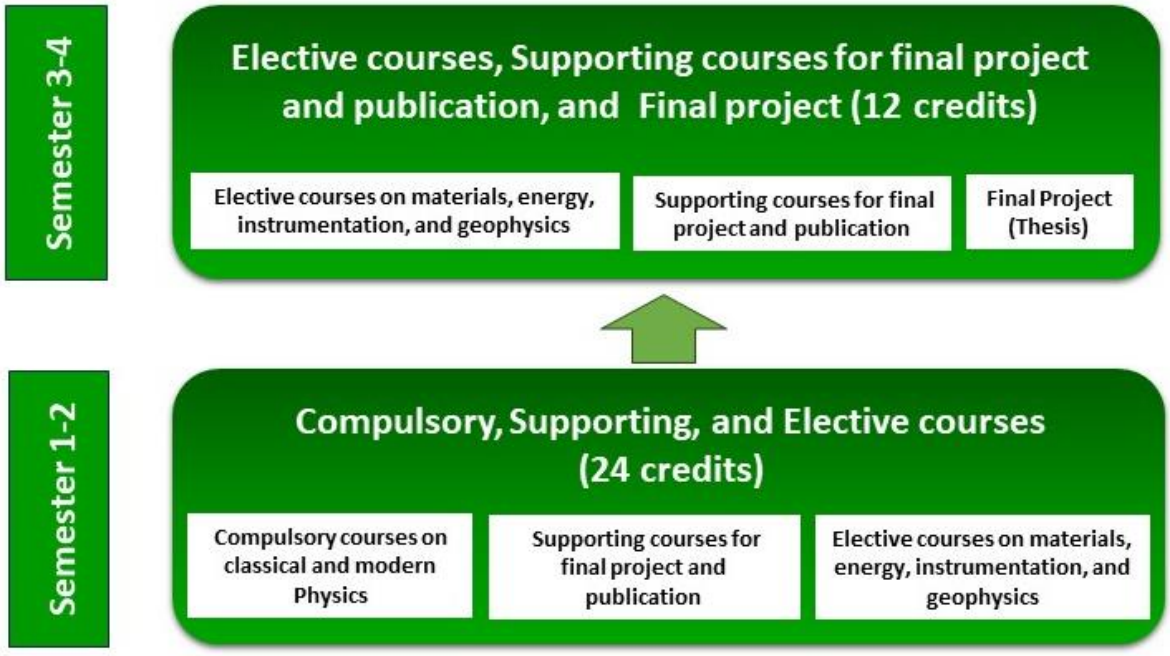

Figure 1. Curriculum structure of Master Program in Physics.

The three subject groups are listed below.

1. Compulsory courses on classical and modern physics which consists of 12 credits.
2. Supporting courses for final project and publication, thesis which consists of 14 credits.
3. Elective courses in each specialization field of material physics, energy physics, instrumentation physics, and geophysics which consist of 10 credits.

A complete list of courses in each subject group is listed below:

List of Courses in Each Subject Group	
Subject Group	**Course**
Compulsory courses on classical and modern physics	Electrodynamics
	Computational Science
	Quantum Mechanics
	Crystallography and Diffraction Techniques
	Transport Phenomena
	Statistical Mechanics
	Sensor Technology and Instrumentation
Supporting courses for final project and publication	Scientific Writing
	Research Proposal Seminar
	Research Progress Seminar
	Thesis
Elective courses	Advanced Materials for Environmental Applications
	Magnetism and Superconductivity
	Computational Materials Science
	Battery Technology
	Information Physics
	Artificial Intelligence
	Computational Earth Science
	Geophysics in Environmental Engineering
	Advanced Materials for Energy and Medical Applications
	Functional Polymer
	Nanotechnology
	Carbon Technology
	Supercapacitor
	Control System and Control Instrumentation
	Big Data
	Signal and Image Analysis
	Global Earth and Planetary Geophysics
	Exploration Geophysics

The elective courses taken are related to the field of expertise and research which will be carried out as a final project. These fields of expertise are instrumentation, materials, energy, and geophysics. These elective courses are provided to meet the intended competency profile. The list of courses in each semester is shown in Table below.

Semester	Code	Courses	Type	Credit
1	D20H3101	Electrodynamics	A	4
	D20H3102	Computational Science	A	2
	D20H3103	Scientific Writing	B	2
	D20H3104	Research Proposal Seminar	B	2
	D20H41XX	Elective Course	C	2
	Total Credit 1st Semester			**12**
2	D20H3201	Quantum Mechanics*	A	4
	D20H3202	Crystallography and Diffraction Techniques*	A	2
	D20H3203	Transport Phenomena*	A	4
	D20H3204	Statistical Mechanics*	A	2
	D20H3206	Sensor Technology and Instrumentation*	A	2
	D20H42XX	Elective Course	C	2
	D20H42XX	Elective Course	C	2
	D20H42XX	Elective Course	C	2
	*at least 6 credits (2 courses) from 14 credits (5 courses)			
	Total Credit 2nd Semester			**12**
3	D20H3301	Research Progress Seminar	B	2
	D20H41XX	Elective Course	C	2
	Total Credit 3rd Semester			**4**
4	D20H3302	Thesis	B	8
	Total Credit 4th Semester			**8**
	Compulsory courses		A	**12**
	Supporting courses for final project and publication, and thesis		B	**14**
	Elective courses		C	**10**
	Total Credit for Master Program in Physics			**36**

Each LO is supported by a number of courses as seen in the LO matrix document for the Master Program in Physics as shown in Table below:

Compulsory/Supporting Courses		Learning Outcomes					
Courses	**Credit**	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**LO6**
Electrodynamics	**4**	√	√				
Computational Science	**2**	√	√				
Scientific Writing	**2**	√	√	√			√
Research Proposal Seminar	**2**	√	√	√	√	√	√
Quantum Mechanics	**4**	√	√				
Crystallography and Diffraction Techniques	**2**	√	√				
Transport Phenomena	**4**	√	√				
Statistical Mechanics	**2**	√	√				
Sensor Technology and Instrumentation	**2**	√	√				
Research Progress Seminar	**2**	√	√	√	√	√	√
Thesis	**8**	√	√	√	√	√	√
Elective Courses							
Courses	**Credit**	**LO1**	**LO2**	**LO3**	**LO4**	**LO5**	**LO6**
Advanced Materials for Environmental Applications	**2**		√		√	√	
Magnetism and Superconductivity	**2**		√		√	√	
Computational Materials Science	**2**		√		√	√	
Battery Technology	**2**		√		√	√	
Information Physics	**2**		√		√	√	
Artificial Intelligence	**2**		√		√	√	
Computational Earth Science	**2**		√		√	√	
Geophysics in Environmental Engineering	**2**		√		√	√	
Functional Polymer	**2**		√		√	√	
Nanotechnology	**2**		√		√	√	
Carbon Technology	**2**		√		√	√	
Supercapacitor	**2**		√		√	√	
Advanced Materials for Energy and Medical Applications	**2**		√		√	√	
Control System and Control Instrumentation	**2**		√		√	√	
Big Data	**2**		√		√	√	
Signal and Image Analysis	**2**		√		√	√	
Global Earth and Planetary Geophysics	**2**		√		√	√	
Exploration Geophysics	**2**		√		√	√	

The content of the curriculum at the Master Program in Physics continues to be adjusted to the needs of the job market and the achievement of LO, as well as provisions from universities, professional organizations, and the government. For example, some courses add practicum content in the learning process, such that it improves student understanding of the course.

1) Meaning of Course Code

The course code is written in the arrangement: D20HWZXX
The meaning of the Code is as follows:

Code	Meaning	Example
D	Faculty	D : Faculty of Mathematics and Natural Sciences
2	Ladder	2: Master Program; 1: Undergraduate Program
0	Class type	0: Regular; 1: International
H	Courses	H: Master Program in Physics
W	Type of Courses	3: Compulsory/ Supporting courses for final project and publication, and thesis 4: Elective courses
Z	Semester	1: odd semester; 2: even semester
XX	Course code	02: Course Code Order

2) Learning Methods

The learning method carried out is a learning approach through ***Student Centered Learning*** (SCL). In its implementation, the learning method is carried out in accordance with the characteristics of the course, the method consists of:

1. *Small Group Discussion* (SGD)
2. *Role-Play &; Simulation* (RPS)
3. Case Study (CS)
4. *Discovery Learning* (DL)
5. *Collaborative Learning* (CbL)
6. *Contextual Instruction* (CI)
7. Project *Based Learning* (PjBL)
8. Problem *Based Learning* (PBL)

Each course can use one or a combination of several learning methods.

Learning Methods		
Method	Role of Lecturer	Learning Activities
Small Group Discussion (**SGD**)	Draft discussion materials and discussion rules. Acts as moderator and reviewer of group discussion results	Learning is carried out by small group discussions to answer the material prepared, presenting the results of discussions to all groups in the class.
Role-Play &; Simulation (**RPS**)	Designing situations or activity models or simulation models with the help of computers. Evaluate/review student performance	Learning is done by carrying out a role in the classroom to get information or practice various computer models that have been prepared
Case Study (**CS)**	Design a case as an application of the material covered. Evaluate/review student performance	Learning is carried out by solving a given case within a certain time intensively, in detail and in depth. Students provide interpretations or explanations of case.
Discovery Learning (**DL)**	Prepare data and methods to explore a material that students must learn. Check and review student self-study outcomes	Learning is carried out independently to understand concepts, meanings, and relationships through intuitive processes, starting from searching, collecting and compiling information to getting conclusions and describing the material studied.
Collaborative Learning (**CbL**)	Prepare/design open-ended tasks. Position yourself as a facilitator and motivator.	Learning is carried out by discussing / completing tasks given in groups and designing the process of completing tasks based on group agreement.

Contextual Instruction (**CI)**	Explain the basic concepts of the material and give examples. Designing/preparing assignments for students to do	Students listen to the explanation of the basic concepts of the material to understand certain study materials then complete the task according to the explanation of the concepts given.
Project Based Learning (**PjBL**)	Create systematic assignment designs so that students learn through structured extracting knowledge and skills. Conduct a mentoring and assessment process.	Students do assignments systematically by exploring supporting knowledge. Show / demonstrate project results and present work results in a discussion forum.
Problem Based Learning (**PBL**)	Design tasks to achieve certain competencies. Make instructions to assist students in solving given problems.	Search for information / supporting materials and utilize this knowledge to solve problems given / designed by lecturers.

3) Learning Management System

The lectures in Master Program in Physics carried out offline or online courses according to a predetermined schedule. Lecturers provide reference lecture materials in the form of e-books, modules, lecturer notes and learning support videos. The lecture and evaluation process are also carried out through the *Learning Management System* (LMS) facility available on the page: https://reguler.live.unpad.ac.id. For certain courses, responses and tutorials are provided by assistants or students appointed by course lecturers and held outside lecture hours. Practicum activities are carried out in laboratories that have been provided according to a predetermined schedule. Lecturers as instructors will be assisted by students as practicum assistants.

4) Thesis

For the master program, students choose research topics offered by the study program from the first year. The procedure of the final project is shown in Figure 2.2. The stage of the final project consists of a research proposal seminar, research progress seminar, thesis seminar, and final defense. In the research progress seminar and final defense, students have to present their final project in front of 3 (three) lecturers as examiners. The assessment components of the

research progress seminar and final defense can be seen in the final project assessment guidelines. The student graduated after completing 36 credits with a minimum GPA of 3.0, no C, D, or E grade, and publishing at least one scientific paper, according to Rector regulation.

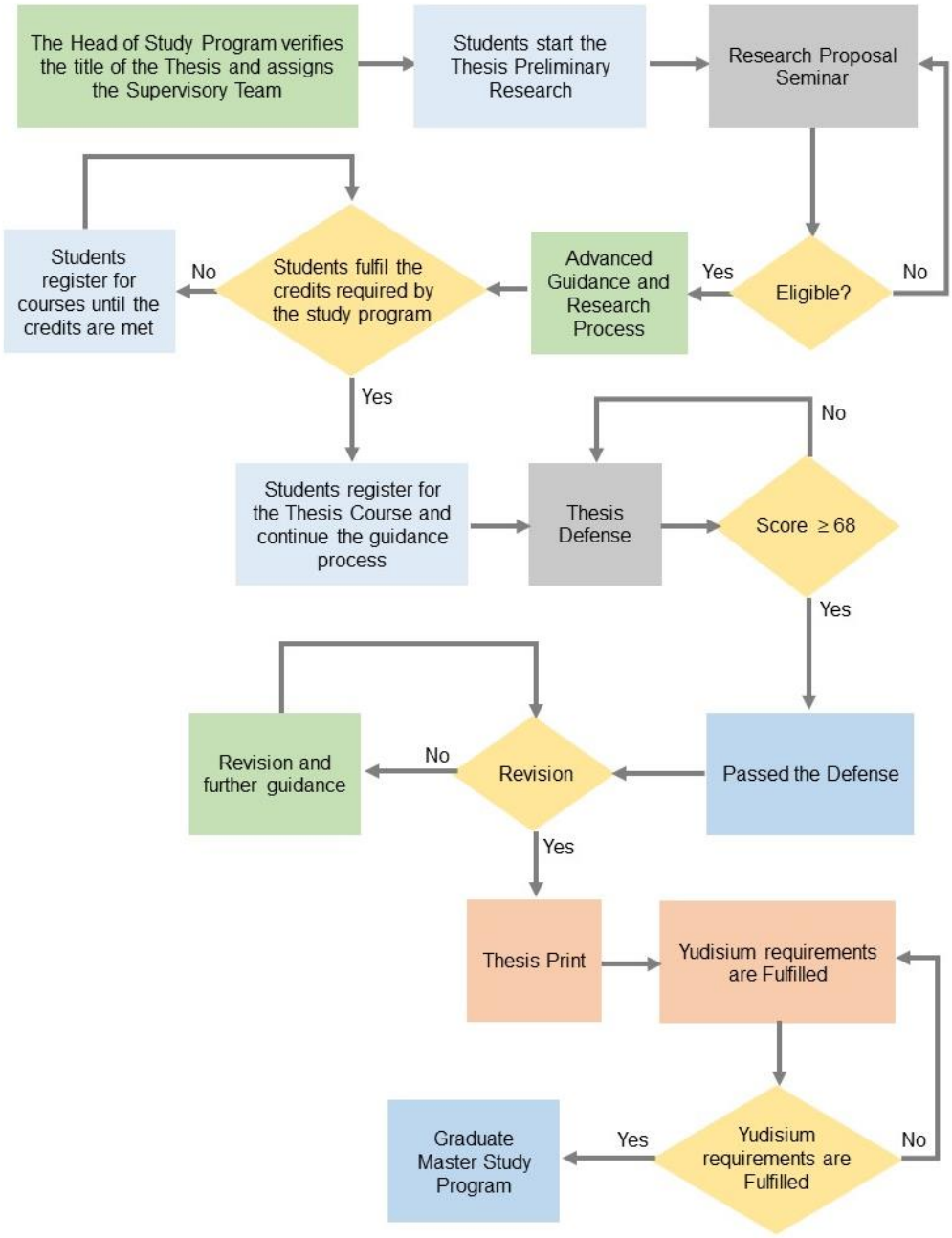

Figure 2. Flowchart of thesis at Master Program in Physics.

5) Course Content

1. D20H3101 - Electrodynamics

Code/ Semester	D20H3101 / Semester 1
Course/ Credit points	Electrodynamics / 4 credits ~ 7.2 ECTS
Language	Indonesian
Contents	Electrodynamics is a compulsory course for students in the Master's Program in Physics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran (UNPAD). The Electrodynamics course is designed for graduate students who already have a fundamental knowledge of electric and magnetic fields. The course content begins with a review of the basic theory of electromagnetic waves and then delves into waveguides, covering topics such as waveguide structure, propagation mechanisms, modes in waveguides, and waveguide characteristics. It also includes discussions on scattering and diffraction, covering topics like scattering of plane waves by spheres and Rayleigh scattering, as well as diffraction theory. The course further explores radiation fields, including antenna systems, radiation fields of charged particles, and Vavilov-Cherenkov radiation. Topics covered include: Basic Theory of Electromagnetic Waves (C3), Wave Propagation in Waveguides (C4), Scattering and Diffraction (C5), Radiation Fields (C5)
Objectives	1. To be able to understand electrodynamics wave theory with systematic independent work and measurable discussions 2. To be able to understand wave propagation in waveguides with systematic independent work and measurable discussions 3. To be able to analyze various case related to scattering and diffraction with systematic independent work and measurable discussions 4. To be able to analyze various case related to radiation fields with systematic independent work and measurable discussions
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Classical Electrodynamics, Third Edition, by John David Jackson, John Wiley and Sons, (1998). 2. Tjia, M.O. 1998. Teori Elektrodinamika Klasik, Dept. Fisika ITB, Bandung.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

2. D20H3102 - Computational Science

Code/ Semester	D20H3102 / Semester 1
Course/ Credit points	Computational Science / 2 credits ~ 3.6 ECTS

Language	Indonesian
Contents	Computational Science is a compulsory course for students in the Master's Program in Physics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran (UNPAD). The course covers classical and quantum approaches to predict the mechanical, electronic, and magnetic properties of materials. Atomic-scale classical approach is done using the Molecular Dynamics (MD) method, while the electronic-scale quantum approach is conducted using the Density Functional Theory (DFT) approach [C3-C6]. Topics covered include Introduction, Solid-State Structure, Atom-Atom Interactions, Particle Motion Equations, Metal Melting Phenomena, Quantum Physics and Many-Particle Schrödinger Equations, Born-Oppenheimer Approximation, Hartree and Hartree-Fock, Density Functional Theory Approximations (Hohenberg-Kohn and Kohn-Sham), DFT Simulations using Quantum Espresso (Basis, Pseudopotential, SCF, Structure Optimization, Density of State, Band Structure, and Spin).
Objectives	1. To be able to analyze the foundation and fundamentals and modeling of physical systems, with systematic independent work and measurable discussion [C4]. 2. To be able to analyze the structure of solids and interactions between atoms with measurable independent work [C4]. 3. To be able to analyze and calculate particle motion equations with systematic independent work and measurable discussions [C5]. 4. To be able to analyze and reconstruct the phenomenon of metal melting with systematic independent work and measurable discussion [C6]. 5. To be able to analyze the need for a many-particle Schrodinger equation for certain cases with systematic independent work and measurable discussion [C4]. 6. To be able to analyze the need for approximation in abintio and DFT simulation approaches with systematic independent work and measurable discussion [C4]. 7. To be able to analyze and design predictions of physical properties using the DFT approach with systematic independent work and measurable discussions [C6].
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Michael de Podesta. 1996. Understanding the Properties of Matter. UCL Press, London. 2. Daan Frenkel & Berend Smit. 1996. Undertsnading Molecular Simulation. Academic Press. London. 3. Roger Smith et. Al. 1997. Atomic and Ionic Collisions in Solids and at Surface. Cambridge University Press. 4. Mike Finnis. 2005. Interatomic Forces in Condesed Matter. Oxford University Press. 5. Peter W. Atkins & Ronald S. Friedman. 2010. Molecular Quantum Mechanics 5th Edition. Oxford University Press. 6. Richard M. Martin. 2012. Electronic Structure - Basic Theory and Practical Methods. Cambridge University Press.

Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

3. D20H3103 - Scientific Writing

Code/ Semester	D20H3103 / Semester 1
Course/ Credit points	Scientific Writing / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	This course is a compulsory course for students in the Master's Program in Physics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran (UNPAD). The course covers the methods for searching scientific articles that are relevant to the research to be conducted, reviewing predetermined scientific articles, and composing a review article with a theme that aligns with the planned research. After completing this course, students will have knowledge about research conducted by other researchers worldwide. This knowledge will help students identify research gaps and determine the state of the art in their field of study during their Master's program in Physics. Topics covered include Formulating Review Questions (Keywords) and Literature Searching (C3), Literature Analysis (C4), Systematic Review Structuring (C5), and Submitting Systematic Reviews (C5).
Objectives	1. To be able to analyze and select scientific publications that have been published in reputable journals with systematic independent work and measurable discussions. 2. To be able to review scientific articles from scientific publications related to the theme of the research to be carried out with measurable independent work. 3. To be able to compile article reviews with systematic independent work and measurable discussions.
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Lame, Guillaume, Systematic Literature Review:An Introduction, International Conference on Engineering Design, ICED19, Delf, The Netherlands. 2. Angela Boland, Gemma Cherry, Rumona Dikson, Doing a Systematic Review, Second edition, Sage Publishing. 3. Andrew Booth, Anthea Sutton, Mark Clower, Marrissa Martyn-St James, Systematic Approaches to a Successful Literature Review, ISBN: 1529711843.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

4. D20H3104 - Research Proposal Seminar

Code/ Semester	D20H3104 / Semester 1

Course/ Credit points	Research Proposal Seminar / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	Research Proposal Seminar is a compulsory course for students in the Master's Program in Physics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran (UNPAD). The course includes the preparation of research proposals and the presentation of research proposals. Topics covered include the preparation of research proposals (C5) and the presentation of research proposals (C5).
Objectives	1. To be able to design research to be carried out (C5) with systematic independent work and measurable discussion. 2. To be able to present the research design to be carried out (C5) with measurable independent work.
Course Method	Student prepare the research proposal and discuss intensively with supervisors. Presentation of research proposal will be held at certain period at the end of this semester
Reading list	1. Pedoman umum penyusunan proposal penelitian Unpad. 2. J. W. Creswell, Research Design, Sage Publications, 2014. 3. Bahasa Indonesia Ejaan yang Disempurnakan.
Assessment Guidance	Proposal Research content (50%); Presentation content (10%); Discussion (30%); Performance of Presentation (10%)

5. D20H3201- Quantum Mechanics

Code/ Semester	D20H3201/ Semester 2
Course/ Credit points	Quantum Mechanics / 4 credits ~ 7.2 ECTS
Language	Indonesian
Contents	1. Concept and Linear Vector Space 2. Basic Principles of Quantum Mechanics 3. Quantum Dynamics, 4. Angular Momentum, 5. Invariance Principle and the Law of Conservation, 6. Many-Particle System, 7. Scattering Theory, Approximation Method, 8. Identical Particles, 9. Relativistic Wave Equation, 10. Quantitation Field, 11. Introduction to Molecular Quantum Structure, 12. Quantum Mechanics of solids.
Objectives	1. Able to understand (C2) and be able to classify and explain (C3) the historical aspects of the concept of quantum mechanics, the uncertainty principle and Copenhagen interpretation. 2. Able to understand (C2) and be able to classify and explain (C3) Schrödinger's equation of motion, Heisenberg's equation of motion, application of the equation of motion to the interpretation of the Hydrogen atom and harmonic oscillator.

	3. Able to understand (C2) and explain (C3) the definition of angular momentum, be able to solve and calculate problems and determine/classify Eigenvalues and vectors, orbital angular momentum, angular momentum and rotation, spherical tensor. 4. Able to understand (C2), explain (C3) the principle of invariance and the law of conservation, including system symmetry and the law of conservation and symmetry of space and time. 5. Able to understand (C2), explain (C3), conclude quantum mechanical phenomena in single and multiple electron systems including low energy and high energy scattering, Zeeman effect and stark effect. 6. Able to understand (C2), explain (C3), conclude on advanced quantum systems including identical particles, relativistic wave equations, and field quantization theory. 7. Able to understand (C2), explain (C3), conclude on advanced quantum systems in solid systems.
Course Method	At the beginning of the lecture, it is carried out with the lecture method and the next meeting is carried out with the CL (Contextual Learning) Small Group Discussion method, evaluation (CbL-Collaborative Learning) and provided supporting material for lecture notes.
Reading list	1. V.K. Thankappan, Quantum Mechanics, New Age Internatiinal New delhi. 1995. 2. Mekanika Kuantum, M.O. Tjia, ITB press. 3. Modern Quantum Mechanics, J.J. Sakurai, Third Edition. Cambridge University Pres. 4. David Tong; Quantum Mechanics.
Assessment Guidance	SGD Rubric (25); Assignment/Evaluation (25%); Midterm Exams (25%); Final Exams (25%)

6. D20H3202- Crystallography and Diffraction Techniques

Code/ Semester	D20H3202/ Semester 2
Course/ Credit points	Crystallography and Diffraction Techniques / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	Crystallography and Diffraction Techniques course is a compulsory course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Padjadjaran (UNPAD). This course contains the basics of crystallography and diffraction techniques, including data analysis and evaluation. Diffraction techniques introduced in this course are Rietveld smoothing method, neutron diffraction, electron diffraction and XPS. After completing the crystallography and Diffraction Techniques course, students are able to understand crystallography and classify aspects of crystal geometry and crystal structure, analyze crystal symmetry, point group and space group, validate X-ray diffraction measurement results through the Rietveld method, detail diffraction techniques and interpret crystal diffraction data. Crystallography and crystal structure - C3, Crystal symmetry and group theory - C4, X-ray diffraction,

	crystal system identification, and Rietvield-C5, Diffraction techniques and data analysis - C5.
Objectives	1. Able to master the concept of crystallography and classify aspects of crystal geometry and crystal structure, with systematic independent work and measurable discussions, P2, KU1, KU2 (C4). 2. Able to analyze crystal symmetry, point group and space group with measurable independent work, P2, KU1, KU2 (C5). 3. Able to validate the results of X-ray diffraction measurements through the Rietveld method with systematic independent work and measurable discussions, P2, KU1, KU2 (C5). 4. Able to detail diffraction techniques and interpret crystal diffraction data with systematic independent work and measurable discussions, P2, KU1, KU2 (C5).
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes.
Reading list	1. B.D . Cullity dan SR Stock, Element of X-ray Diffraction, Prentice Hall, 2001. 2. F.C. Phillips, An Introduction to Crystallography, Longman, London 1970. 3. Giacovazzo et. Al., Fundamental of Crystallography, IUCr, Oxford Science, 2001.
Assessment Guidance	Quiz/Task/Assignments (80%); Midterm Exams (10%); Final Exams (10%)

7. D20H3203- Transport Phenomena

Code/ Semester	D20H3203/ Semester 2
Course/ Credit points	Transport Phenomena / 4 credits ~ 7.2 ECTS
Language	Indonesian
Contents	This course is a compulsory course for the Earth concentration that provides an understanding of the concept of transport phenomena from three main foundations: momentum transport, energy transport and mass transport in analyzing the dynamics of physical systems. The course provides participants with the foundations of transport phenomena needed in analyzing earth cases. The course concludes with an environmental geophysics case study to implement the learnt fundamentals on a real case. Introduction to transport phenomena, Momentum Transport: viscosity and laminar flow, Momentum Transport: isothermal systems and turbulent flow, Energy Transport: thermal conductivity and non-isothermal systems, Energy Transport in laminar and turbulent flow, Mass Transport: mass transport in laminar and turbulent flow, Darcy's Law and subsurface water flow, Case study.
Objectives	1. Able to understand the concept of equilibrium in transport phenomena: momentum transport, energy transport and mass transport in physics.

	2. Able to implement the concept of transport phenomena in the analysis of physical systems. 3. Able to analyze earth cases using the concepts of transport phenomena.
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes.
Reading list	1. Bird, R. B. (2002). Transport phenomena. Appl. Mech. Rev., 55(1), R1-R4. 2. Turcotte, D. L., & Schubert, G. (2002). Geodynamics. Cambridge university press.
Assessment Guidance	Assignments (70%); Midterm Exams (15%); Final Exams (15%)

8. D20H3204- Statistical Mechanics

Code/ Semester	D20H3204/ Semester 2
Course/ Credit points	Statistical Mechanics / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	The Statistical Mechanics course is a compulsory course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Padjadjaran (UNPAD). This course contains classical and quantum statistical mechanics consisting of the Laws of Thermodynamics, Gas Kinetic Theory, Classical Statistical Mechanics, Canonical Ensembles and Large Canonical Ensembles, Quantum Statistical Mechanics, Fermi System, Bose System, and Special Topics on Superfluid and Ising Model. Laws of Thermodynamics - C3, Kinetic Theory of Gases - C4, Classical Statistical Mechanics -C5, Canonical Ensembles and Large Canonical Ensembles - C3, Quantum Statistical Mechanics - C4, Fermi System - C5, Bose System - C5, Special Topics: Superfluid and Ising Model - C5.
Objectives	1. Able to understand and analyze the theory of classical statistical mechanics (C5) with systematic independent work and measurable discussion. 2. Able to understand and analyze the theory of quantum statistical mechanics (C5) with systematic independent work and measurable discussion.
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes.
Reading list	1. Kerson Huang, Statistical Mechanics. 2. Mikrajuddin Abdullah, Mekanika Statistik.
Assessment Guidance	Assignments (60%); Midterm Exam (20%); Final Exam (20%)

9. D20H3206- Sensor and Instrumentation Technology

Code/ Semester	D20H3206/ Semester 2
Course/ Credit points	Sensor and Instrumentation Technology / 2 credits ~ 3.6 ECTS
Language	Indonesian
Lecturer	I Made Joni, Andri Abdurrochman, Ferry Faizal
Workload	1. Lectures: 2 x 50 = 100 minutes per week. 2. Assignments: 2 x 60 = 120 minutes per week. 3. Private learning: 2 x 60 = 120 minutes per week.
Contents	(1) Design and classify sensor and instrumentation systems. (2) Analyzing the performance of sensor and instrumentation systems. (3) Application of Sensor and Instrumentation Systems to Physical Systems. (4) Testing and Validation of Sensors and Instrumentation Systems
Objectives	1. Able to design and classify sensor and instrumentation systems with systematic independent work and measurable discussions. 2. Able to analyze sensor and instrumentation systems with measurable independent work. 3. Able to give consideration and recommendation of sensor and instrumentation systems for experimental or physics research applications with systematic independent work and measurable discussions 4. Able to test and validate sensor and instrumentation systems with systematic independent work and measurable discussions
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes.
Prerequisites	-
Requirements according to the examination regulations	Registered in this course Minimum 80% attendance in this course
Reading list	1. Sabrie Soloman, SENSORS HANDBOOK, 2nd, McGraw Hill, New York, 2009. 2. Jacob Fraden, Handbook of Modern Sensors: Physics, Designs, and Applications, Fourth Edition, Springer, New York, 2010 3. William C. Dunn, Fundamentals of Industrial Instrumentation and Process Control, McGraw-Hill, 2005
Assessment Guidance	Resume Papers and Presentation (80%); Final Exams (20%)

10. D20H3104 - Research Progress Seminar

Code/ Semester	D20H3301 / Semester 3
Course/ Credit points	Research Progress Seminar / 2 credits ~ 3.6 ECTS
Language	Indonesian

Contents	Research Progress Seminar is a compulsory course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA) at UNPAD. The course includes the preparation of research proposals and the presentation of research proposals. Topics covered include the preparation of research progress drafts (C5) and the presentation of research progress- C5.
Objectives	1. To be able to compile research reports (C5) with systematic independent work and measurable discussions. 2. To be able to present research results (C5) with measurable independent work.
Course Method	Student prepare the progress and discuss intensively with supervisors. Presentation of research proposal will be held at certain period at the end of this semester
Reading list	1. Pedoman umum penyusunan proposal penelitian Unpad.
Assessment Guidance	Research content (50%); Presentation content (10%); Discussion (30%); Performance of Presentation (10%)

11. D20H3302- Thesis

Code/ Semester	D20H3302/ Semester 4
Course/ Credit points	Thesis / 8 credits ~ 14.5 ECTS
Language	Indonesian
Contents	Thesis is a compulsory course for students in the Master's Program in Physics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran (UNPAD). After completing the thesis course, students are able to complete a thesis document containing research results and are able to present their research results and be able to answer questions posed by examiners in progress seminars, study program seminars, and thesis seminars. Research Design, Data Analysis, Presentation Techniques, Thesis Writing.
Objectives	1. To be able to carry out research with systematic independent work and measurable discussions 2. To be able to analyze research data with measurable independent work 3. To be able to present research results with systematic and measurable discussions 4. To be able to write research results and data analysis and interpretation in the form of thesis documents with systematic independent work and measurable discussions
Course Method	Student prepare the research progress and discuss intensively with supervisors. Presentation of research proposal will be held at certain period at the end of this semester
Reading list	1. Panduan penulisan Tesis Unpad. 2. Bahasa Indonesia Ejaan yang Disempurnakan. 3. J. W. Creswell, Research Design, Sage Publications, 2014.
Assessment Guidance	Research content (50%); Presentation content (10%); Discussion (30%); Performance of Presentation (10%)

12. 20H4101 - Advanced Materials for Environmental Applications

Code/ Semester	D20H4101 / Semester 1
Course/ Credit points	Advanced Materials for Environmental Applications / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	Advanced Materials for Environmental Applications is an elective course for students in the Master's Program in Physics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran (UNPAD). This course provides explanations and introductions regarding the definition/classification of advanced materials, especially for environmental applications. Environmental applications mentioned include water treatment systems that use specific materials as photocatalysts, membranes, and absorbent materials. The types of materials discussed are primarily focused on carbon-based and semiconductor materials. Other environmental applications such as gas sensors, self-healing materials, and their relevance to environmentally friendly energy sources are also studied in this course. Topics covered include: Introduction; Definition and classification of advanced materials, Synthesis and characterization of carbon-based advanced materials, Use of carbon-based advanced materials in environmental applications, Synthesis and characterization of semiconductor-based advanced materials, Use of semiconductor-based advanced materials for environmental.
Objectives	1. To be able to know and understand (C2) and classify (C3) types of materials categorized as advanced materials, especially carbon-based ones for environmental applications including water purification systems (photocatalysts, membranes, absorbent materials) with systematic independent work and measurable discussions. 2. To be able to explain (in detail) and analyze (C4) the characteristics of carbon materials as advanced materials for environmental applications, especially in water treatment systems (photocatalysts, membranes, absorbance materials), with measurable independent work. 3. To be able to know and understand (C2) and classify (C3) types of advanced materials, especially those based on semiconductor materials for environmental applications such as photocatalysts in water treatment systems, gas sensors, and environmentally friendly clean energy sources with systematic independent work and measurable discussions. 4. To be able to explain (in detail) and analyze (C4) semiconductor-based materials as advanced materials for environmental applications, especially as photocatalysts in water purification systems, gas sensors, and clean energy sources with systematic independent work and measurable discussions.
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Smart Materials for Adnvanced Environmental Applications, RSC Smart Materias, Edited by Peng Wang, 2020.

	2. Environmental applications of graphene-based nanomaterials, F Perreault, AF De Faria, M Elimelech - Chemical Society Reviews, 2015,44, 5861.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

13. D20H4102 - Magnetism and Superconductivity

Code/ Semester	D20H4102 / Semester 1
Course/ Credit points	Magnetism and Superconductivity / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	Magnetic Physics and Superconductivity" is an elective course for students in the Master's Program in Physics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran (UNPAD). This course covers topics related to the properties of magnetism, the measurement of magnetic material susceptibility, characteristics and applications of ferromagnetic materials, as well as the characteristics and data analysis of superconducting materials. Topics covered include: Magnetic Properties of Materials - C3, Measurement of Magnetic Material Susceptibility - C4, Ferromagnetic Materials - C4, Superconducting Materials and Analysis of Superconducting Material Magnetic Properties - C5.
Objectives	1. To be able to understand the magnetic properties of materials and classify materials according to their magnetic properties with systematic independent work and measurable discussions 2. To be able to validate susceptibility measurement results with systematic independent work and measurable discussions 3. To be able to analyze the magnetic properties of ferromagnetic materials with measurable independent work 4. To be able to detail the typical properties of superconducting materials and interpret the susceptibility data of superconducting materials with systematic independent work and measurable discussion
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. D. Jiles (1998), Introduction to Magnetism and Magnetic Materials, Chapman & Hall/CRC. 2. S. Blundell (2003), Magnetism in Condensed Matter, Oxford University Press. 3. A. Mourachkine (2003), Room-Temperature Superconductivity, Cambridge. 4. Risdiana (2015), Sifat dan Bahan Superkonduktor, Unpad Press.
Assessment Guidance	Assignments (60%); Midterm Exams (20%); Final Exams (20%)

14. D20H4103 - Computational Materials Science

Code/ Semester	D20H4103 / Semester 1
Course/ Credit points	Computational Materials Science / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	This course is an independent elective course, but proficiency in numerical methods and signal processing is highly necessary as prerequisites. The course provides an explanation of the definition, problems, types, and methods of artificial intelligence. Students are expected to understand the approaches required for specific cases in artificial intelligence. Introduction and Review of Quantum Mechanics, Many-Particle Hamiltonian, Born-Oppenheimer Approximation, Hartree and Hartree-Fock, Electron Correlation, Post-Hartree-Fock Approximations, Hohenberg-Kohn and Kohn-Sham Approximations (Density Functional Theory), Exchange and Correlation, Spherical and Plane Wave Basis Sets, Pseudopotentials, Self-Consistent Field (SCF) and Structure Optimization, Density of States and Band Structure, Case Studies.
Objectives	1. To be able to know and understand the concept of material computing science in science 2. To be able to understand and solve simple many-particle hamiltonian cases 3. To be able to understand several approximations used in the density functional theory (DFT) approach 4. To be able to design and calculate the physical properties of a material using DFT
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Atkins and Friedman. 2011. Molecular Quantum Mechanics. 4th Ed. Oxford University Press. 2. Martin. 2004. Electronic Structure: Basic Theory and Practical Methods. Cambridge University Press. 3. Kittel. 1996. Introduction to Solid State Physics, 7th Ed. John Wiley & Sons. 4. Ashcroft & Mermin. 1976. Solid State Physics. Brook & Cole Cengage Learning.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

15. D20H4104 - Teknologi Baterai

Code/ Semester	D20H4104 / Semester 1
Course/ Credit points	Battery Technology / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	The Battery Technology course is an elective course for students in the Master's Program in Physics, Faculty of Mathematics and Natural Sciences,

	Universitas Padjadjaran (UNPAD). This course covers the principles of battery operation and the latest developments in battery technology. The topics covered include the basic concepts of batteries, electrochemical reactions in batteries, factors affecting battery performance, methods for testing battery performance, types of batteries, examples of primary and secondary batteries, the principles of lithium-ion batteries, and the principles of metal/air batteries. Towards the end, we will study the thermodynamics of batteries and the influence of temperature on battery performance. Battery Operation Principles - C2, Primary Batteries - C3, Secondary Batteries - C3, Testing Battery Performance Characteristics - C4, Factors Affecting Battery Performance - C4, Battery Thermodynamic Systems - C5
Objectives	1. Understand and be able to explain the principles of battery operation, common terminology of battery characteristics, and electrochemical reactions of batteries (C2) 2. To be able to identify the types of primary batteries and derive redox reaction equations for primary batteries (C3) 3. To be able to determine the types of secondary batteries and derive redox reaction equations for secondary batteries (C3) 4. To be able to determine correlations between battery performance parameters and capable of determining methods for assessing the performance of primary and secondary batteries. (C4) 5. To be able to determine correlations between physical parameters that affect battery performance and the lifespan of the battery (C4) 6. To be able to analyze and conclude the influence of temperature on battery performance in battery thermodynamic systems and energy balance in batteries (C5)
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Handbook of Batteries 3th edition, David Linden, Thomas B. Reddy. McGraw-Hill, 2002. 2. Electrochemical Energy Storage, Expert Verlag 2003.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

16. D20H4105- Informatics Physics

Code/ Semester	D20H4105/ Semester 1
Course/ Credit points	Informatics Physics / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	The course Information Physics is an elective course for students in the Master's Program in Physics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran (UNPAD). This course covers the latest developments in the application of physics in the field of information technology, which in the future will replace the binary system that has been used until now. This system is known as Quantum bit, which is based on the

	logic and memory storage of electron spin states, enabling faster data storage and processing. This technology will be revolutionary in the future. Natural systems as information processors (C3 & C4), Computers as natural system information processors (C5).
Objectives	1. To be able to understand and analyze the concept and show examples of information processing in natural systems (C3) with systematic independent work and measurable discussions. 2. To be able to analyze the classical physics system of Hamiltonian and Thermodynamics and its application to the physics information system (C4) with measurable independent work. 3. To be able to provide system analysis with Quantum Physics (Qbit) and apply it to information systems (C5) with systematic independent work and measurable discussions. 4. To be able to build computational algorithms from Qbit logic and test them for various applications (C5) with systematic independent work and measurable discussion
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Rajkumar Buyya, dkk, Big Data Principles and Paradigms, Elsevier, 2019, ISBN: 978-0-12-805394-2. 2. Shai Shalev-Shwartz and Shai Ben-David, Understanding Machine Learning:From Theory to Algorithms. 3. Y. Polyanskiy, Y. Wu, Lecture note on Information Theory, (2017). 4. Roberto Togneri, Christopher J.S. deSilva, Fundamental of Information Theory and Coding Design, 2002, CHAPMAN & HALL/CRC. 5. Thomas M. Cover, Joy A. Thomas, Elements of Information Theory, John Wiley&Sons INC., 1991. 6. Peter D. Gr¨unwald & Paul M.B. Vit´anyi, Algorithmic Information Theory, July 30, 2007. 7. Paul A. LaViolette, ENTROPY and NEGENTROPY, Portland State University, 2013.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

17. D20H4106- Artificial Intelligence

Code/ Semester	D20H4106/ Semester 1
Course/ Credit points	Artificial Intelligence / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	This course is an independent elective course, but proficiency in numerical methods and signal processing is highly necessary as prerequisites. The course provides an explanation of the definition, problems, types, and methods of artificial intelligence. Students are expected to understand the approaches required for specific cases in artificial intelligence.

	History and Fundamentals of Artificial Intelligence, Agents and Environments, Machine Learning, Artificial Neural Networks: Basics, Artificial Neural Networks: Backpropagation Learning, Other Neural Network Architectures (CNN and RNN), Tips for Building Artificial Neural Networks, Input Formation for Artificial Neural Networks, Overview of Digital Signal and Image Processing, Unsupervised Learning 1 (Hebbian Learning, Simple Competitive Learning), Unsupervised Learning 2 (k-Mean Clustering, Adaptive Resonance Theory, and Hopfield Auto-Associative Model), Case Examples
Objectives	1. To be able to understand the concepts of artificial intelligence in general and specific terms, as well as several approaches of artificial intelligence that can be used. 2. To be able to design mathematical equations and find solutions for simple artificial intelligence cases. 3. To be able to create and process input for use in artificial intelligence, especially artificial neural network types. 4. To be able to design artificial neural network architectures for specific cases.
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Russel, Norvig. 1995. Artificial Intelligence: A Modern Approach. 2. Tim Jones. 2008. Artificial Intelligence: A System Approach.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

18. D20H4107- EARTH SCIENCE COMPUTATION

Code/ Semester	D20H4107/ Semester 1
Course/ Credit points	Earth Science Computation / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	This course is a standalone elective course, but a proficiency in numerical methods is highly necessary as a prerequisite. This course provides an explanation of finite difference modeling to solve partial differential equations in Earth science cases. Students are expected to be capable of modeling and analyzing Earth's physical systems and Earth's response to simple source excitations using the finite difference approach. Introduction and Review, Finite difference diffusion equations, Finite difference elliptic equations, Finite difference parabolic equations, Finite difference in the time domain for EM waves, Case studies in Earth science 1, Case studies in Earth science 2.

Objectives	1. To be able to recognize and comprehend the concepts of computational science in Earth science 2. To be able to understand the principles of finite difference modeling for solving differential equations in Earth science cases 3. To be able to calculate the Earth's response to simple source excitations of fields and/or waves using finite difference modeling 4. To be able to simulate and analyze simple Earth physical systems using the finite difference approach
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Taflove A., and Hagness S.C., & Piket-May, M. 2005. Computational Electrodynamics: The Finite Difference Time Domain Method. The Electrical Engineering Handbook, 3. 2. LeVeque, R.J. 2007. Finite Difference Methods for Ordinary and Partial Differential Equations. SIAM. 3. Turcotte, D.L., & Schubert, G. 2002. Geodynamics. Cambridge University Press 4. Telford, W.M., Geldart, L.P., & Sheriff, R.E. 1990. Applied Geophysics. Cambridge University Press.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

19. D20H4108- Geophysics in Environmental Engineering

Code/ Semester	D20H4108/ Semester 1
Course/ Credit points	Geophysics in Environmental Engineering / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	Geophysics in Environmental Engineering is an elective course for students in the Master's Program in Physics, Faculty of Mathematics and Natural Sciences, Universitas Padjadjaran (UNPAD). This course covers explanations and understanding of various geophysical methods and their applications in the field of environment. The geophysical methods discussed include gravity method, geomagnetic method, geoelectric method, electromagnetic method, and rock magnetism method. When applying geophysical methods in the environmental field, it is important to understand which method is most suitable for the specific problem being studied. The course includes an introduction to geophysics in the environmental field, potential field-based geophysical methods and their applications in the environment, magnetism-based geophysical methods and their applications in the environment, electric-based geophysical methods and their applications in the environment, and electromagnetic geophysical methods and their applications in the environment
Objectives	1. To be able to identify and comprehend (C2) the concepts of geophysical methods and their fundamental physical properties 2. To be able to explain (in detail) and comprehend (C2) geophysical methods, including data acquisition, data processing, and interpretation

	3. To be able to recognize and comprehend (C2) and analyze (C4) various environmental studies based on the physical properties of Earth materials 4. To be able to recognize and comprehend (C2) and analyze (C4) the appropriate applications of geophysical methods according to the environmental studies being reviewed
Course Method	At the beginning of the course, it is conducted using the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. An Introduction to Applied and Environmental Geophysics, 2nd ed, John M. Reynolds, 2011.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

20. D20H4201- Functional Polymers

Code/ Semester	D20H4201/ Semester 2
Course/ Credit points	Functional Polymers / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	The Functional Polymers course is an elective course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Padjadjaran (UNPAD). After completing the Functional Polymers course, students are able to explain the types of monomers, polymer configuration/conformation, viscoelastic properties and polymer classification, understand the mechanism and process of polymerization and copolymerization, understand the correlation of structure and properties of conjugated polymers, and demonstrate the application of conjugated polymers for Solar Cell, Anticorrosion, Superconductor, Membrane, Sensor and Drug Delivery applications. Overview of Polymers, Mechanism and Process of Polymerization and Copolymerization, Structure and Properties of Conjugated Polymers, Applications (Solar Cells, Anticorrosion, Superconductors, Membranes, Sensors and Drug Delivery).
Objectives	1. Able to explain the types of monomers, polymer configuration/conformation, viscoelastic properties and polymer classification, with systematic independent work and measurable discussion (C1). 2. Able to understand the mechanism and process of polymerization and copolymerization, with systematic independent work and measurable discussion (C2). 3. Able to understand the correlation of structure and properties of conjugated polymers, with systematic independent work and measurable discussion (C2). 4. Able to demonstrate the application of conjugated polymers for Solar Cell, Anticorrosion, Superconductor, Membrane, Sensor and Drug Delivery applications, with systematic independent work and measurable discussion (C3).

Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes.
Reading list	1. Polymer: Chemistry and Physics of Modern Materials, J.M.G. Cowie and Valeria Arrighi, Third Edition, CRC Press, 2008. 2. Handbook of Conducting Polymer, Terje A. Skotheim, Ronald L. Elsenbaumer and John R. Reynolds, Second Edition, New Yorl, Marcel Dekker, 1998. 3. Elham Abbasi el.al, Dendrimers: synthesis, applications, and properties, Nanoscale Research Letters 2014, 9:247. 4. Hongbo Feng et.al, Block copolymers: synthesis, self-assembly and applications, Polymers 2017, 9, 494; doi:10.3390/polym9100494. 5. An Introduction to Polymer Science, Hans-Georg Elias, 1-ed., Wenheim, New York, Basel, Cambridge, Tokyo, 1997. 6. Handbook of Polymer Synthesis, Characterization, and Processing, Editor(s): Enrique Saldívar-Guerra Eduardo Vivaldo-Lima, Print ISBN:9780470630327.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

21. D20H4202-Nanotechnology

Code/ Semester	D20H4202/ Semester 2
Course/ Credit points	Nanotechnology / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	Nanotechnology is a technology that manipulates matter at the atomic scale and molecular scale. Nanotechnology involves the design, characterization, production, and application of nanoscale structures, devices, and systems. It builds structures, devices, and systems with at least one new characteristic or property. Nanotechnology has a considerable impact in almost all areas of industry, technology, research, and development. Nanotechnology in general provides longer-lasting, safer, cleaner, better-built, and smarter products for communication, industry, home, agriculture, transportation, and medicine. This course covers nanotechnology from theory to application and to provide experience for students in processing nanomaterials, the course will combine students' activities in the classroom and in the laboratory.
Objectives	Able to synthesize one of the nanomaterials with simple methods, characterize and communicate the results both verbally and written (C5, A3, P4)
Course Method	Collaborative Learning (CbL) Project Based Learning (PBL) Discovery Learning
Reading list	1. Bharat Bhushan, Dan Luo, Scott R. Schricker • Wolfgang Sigmund, Stefan Zauscher (Eds), Handbook of Nanomaterials Properties, Springer Heidelberg New York Dordrecht London, 2014

	2. C. Dupas P. Houdy M. Lahmani (Eds.), Nanoscience Nanotechnologies and Nanophysics, Springer, Berlin 2006 3. Dieter Vollath, Franz Dieter Fischer, and David Holec, Surface energy of nanoparticles – influence of particle size and structure, J. Nanotechnol. 2018, 9, 2265–2276.
Assessment Guidance	Collaborative learning rubric (25%); Laboratory work (50%); discovery learning (25%)

22. D20H4203- Carbon Technology

Code/ Semester	D20H4203/ Semester 2
Course/ Credit points	Carbon Technology / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	This course is an elective course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Padjadjaran (UNPAD). This course is given to 2nd semester students with a weight of 2 credits. The course discusses carbon technology, microstructure of materials, carbon in life, carbon hybridisation, carbon allotropes, carbon phase diagram, graphite processing, activated carbon, activated carbon characterisation, physical activation process, chemical activation process, activated carbon applications for batteries/supercapacitors, activated carbon applications for the environment, graphene oxide synthesis and graphene oxide applications. Lectures are held using the group discussion method, where students will be given references of teaching materials before the lecture and questions to be discussed at the next meeting. During lecture hours, students will discuss how to answer the questions given and each student summarizes the answers with their own descriptions. Students will be divided into groups to guide the discussion at each meeting. Resumes of discussion results are collected by each student through the Learning Management System (regular live UNPAD). Lecturers monitor and direct the discussion to answer any questions given and assess students' abilities with the rubric that has been prepared. Microstructure of Materials and Carbon in life - C4, Carbon Hybridisation- C4, Carbon Allotropes-C4, Synthesis of various carbon allotropes (C5), Analysis of the physical properties of Carbon Allotropes.
Objectives	1. Able to describe the importance of carbon in life and its application in various technologies with systematic independent work and measurable discussion (C4). 2. Able to identify the factors that cause carbon hybridisation and able to explain the kinds of carbon hybridisation with systematic independent work and measurable discussion (C4). 3. Able to explain the types of carbon allotropes and their physical chemical characteristics with systematic independent work and measurable discussion (C4). 4. Able to explain the synthesis procedures of various carbon allotropes with systematic independent work and measurable discussions (C5).

	5. Able to analyze various characterisation results of carbon allotropes with systematic independent work and measurable discussion (C5).
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes.
Reading list	1. Marsh, H. & Rodríguez-Reinoso, F. Activated carbon. (Elsevier, 2006). 2. Soroush Nazarpour and Stephen: Graphene Technology; from laboratory to Fabrication. (Wiley-VCH, 2016). 3. Wonbong Choi and Jo-won Lee. Graphene; Synthesis and Applications. (Taylor & Francis Group, 2012).
Assessment Guidance	Assignments (65%); Midterm Exams (15%); Final Exams (20%)

23. D20H4204- Supercapacitors

Code/ Semester	D20H4204/ Semester 2
Course/ Credit points	Supercapacitors / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	The Supercapacitor course is an elective course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Padjadjaran (UNPAD). The subject matter in this course includes: differences between supercapacitors and capacitors and batteries, types of supercapacitors and their charge storage methods, supercapacitor performance parameters, supercapacitor materials, and supercapacitors in integrated devices.
Objectives	1. Able to classify supercapacitors from other types of energy storage such as batteries and capacitors with systematic independent work and measurable discussions. 2. Able to classify the types of supercapacitors and their charge storage mechanisms with systematic independent work and measurable discussion. 3. Able to analyze parameters in supercapacitor performance, with measurable independent work. 4. Able to analyze electrode materials that suitable for supercapacitors, with systematic independent work and measurable discussion. 5. Able to project supercapacitors in an integrated device, with systematic independent work and measurable discussion.
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes.
Reading list	1. F. Beguin and E. Frackowiak, "Supercapacitors: Materials, Systems, and Applications", Wiley-VCH Verlag GmbH & Co KGaA, Weinheim, Germany, 2013.

	2. V. S. Bagotsky, A. M. Skundin, Y. M. Volfkovich, “Electrochemical Power Sources: Batteries, Fuel Cells, and Supercapacitors”, John Wiley & Sons, Inc, New York, USA, 2015. 3. K. K. Kar (Ed.), "Handbook of Nanocomposite Supercapacitor Materials II", Springer, Cham., 2020. 4. Artikel-artikel ilmiah terkini tentang superkapasitor.
Assessment Guidance	Case-based rubric (40%); Assignments (30%); Midterm Exams (15%); Final Exams (15%)

24. D20H4205- Control Systems and Instrumentation

Code/ Semester	D20H4205/ Even Semester
Course/ Credit points	Control Systems and Instrumentation / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	The Control System course is an elective course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Padjadjaran (UNPAD). After completing the control system course, students are able to explain the basics of laplace transformation, bode function, nyquist, and state space, formulate laplace transformation applications, and analyze PID (proportional, integrated, derivative) control with systematic independent work and measurable discussions. Fundamentals of Laplace transformation (theory and matlab simulation), Bode function, nyquist, and state space, Laplace transformation application (spring, rc circuit), PID control and system modeling with State Space.
Objectives	1. Able to model linear physical systems with transfer functions and solve them with Laplace Transformation with systematic and measurable independent/group work. 2. Able to analyze the stability of physical systems through those modeled with transfer functions. 3. Able to apply classical PID control methods and analyze and report the results. 4. Able to apply the State Space approach in control systems.
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes.
Reading list	
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

25. D20H4206- Big Data

Code/ Semester	D20H4206/ Semester 2
Course/ Credit points	Big Data / 2 credits ~ 3.6 ECTS
Language	Indonesian

Contents	The Big Data course is an elective course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Padjadjaran (UNPAD). This course covers the phenomenon of processing and managing extremely large data (big data), which includes storage management (HDFS), processing (Map-reduce), and visualization using Hadoop and PySparks. The detailed course materials include Data, Information, Data Storage and Processing, Big Data (History, Characteristics, Benefits, and Potential), Data Types (Structured and Unstructured), Data Mining, Parallel & Distributed Processing, Hadoop (HDFS, Map-Reduce, Architecture, Ecosystem, Installation and Configuration), Spark, Data Visualization, and Final Project.
Objectives	1. Able to analyze data and information with systematic independent work and measurable discussion [C4]. 2. Able to analyze data structures with systematic independent work and measurable discussion [C4]. 3. Able to analyze and process data in parallel with systematic independent work and measurable discussion [C4]. 4. Able to create big data architecture using Hadoop with systematic independent work and measurable discussion [C5]. 5. Able to process streaming data with systematic independent work and measurable discussion [C6].
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes. After all the materials and practices have been completed, students will engage in project-based learning as their final assignment.
Reading list	1. Rajkumar Buyya et. al. 2016. Big Data: Principles and Paradigms. Morgan Kaufmann. 2. Alan Nugent, Fern Halper & Judith S. Hurwitz. 2013. Big Data For Dummies. For Dummies.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

26. D20H4207- Signal and Image Analysis

Code/ Semester	D20H4207/ Semester 2
Course/ Credit points	Signal and Image Analysis / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	Signal and Image Analysis course is an elective course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Padjadjaran (UNPAD). After attending this course, students are expected to be able to perform processing for the analysis and interpretation of signals and images in accordance with the needs and appropriate methods. This course covers topics related to the real-time signal processing, analogue-discrete (digital) transformation, discrete

	& z transformation, correlation and convolution, digital filtering which will discuss FIR and IIR, as well as spectrum estimation and analysis.
Objectives	1. Able to analyze analogue-discrete (digital) transformation with systematic independent work and measurable discussion. 2. Able to analyze discrete & z transformations with systematic independent work and measurable discussions. 3. Able to analyze convolution and Correlation theory with systematic independent work and measurable discussion. 4. Able to analyze digital filters with systematic independent work and measurable discussion. 5. Able to analyze and estimate spectrum with systematic independent work and measurable discussion.
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes.
Reading list	1. Digital Signal Processing: A Practical Approach (Ifeachor & Jervis, 1995, Addison-Wesley) 2. Analog and Digital Signal Processing (Ambardar, A., 1999, Brooks/Cole Publishing
Assessment Guidance	Assignments (80%); Final Exams (20%)

27. D20H4208- Global and Planetary Geophysics

Code/ Semester	D20H4208/ Semester 2
Course/ Credit points	Global and Planetary Geophysics / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	Global and Planetary Geophysics is an elective course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Padjadjaran (UNPAD). The course covers topics related to the shape and dynamics of planetary surfaces, the history of Earth's formation, Earth's structure, rheology, global tectonics and volcanism, and weather and climate. Topics covered include: Shape and Dynamics of Planetary Surfaces (C4), Formation and Structure of Earth (C4), Rheology, Global Tectonics, and Volcanism (C4). Weather and Climate (C5)
Objectives	1. Able to analyze the shape and dynamics of planetary surfaces with systematic independent work and measurable discussions (C4). 2. Able to analyze the formation and structure of the earth with systematic independent work and measurable discussion (C4). 3. Able to analyze global rheology, tectonics and volcanism with systematic independent work and measurable discussion (C4). 4. Able to compare and analyze weather and climate characteristics with systematic independent work and measurable discussion (C5).
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method,

	with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Astrophysics of planet formation, philip j. armitage. 2. Planetary surface processes, jay melosh. 3. Introduction to physics of the earth's interior, jean-paul poirier. 4. The Solid Earth: An Introduction to Global Geophysics. 5. The Solid Earth: An Introduction to Global Geophysics.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

28. D20H4209- Exploration Geophysics

Code/ Semester	D20H4209/ Semester 2
Course/ Credit points	Exploration Geophysics / 2 credits ~ 3.6 ECTS
Language	Indonesian
Contents	Exploration Geophysics is an elective course for students in the Master's program in Physics at the Faculty of Mathematics and Natural Sciences (FMIPA), Universitas Padjadjaran (UNPAD). The course covers exploration geophysics as a whole and its various types, geophysical exploration techniques, including geological and geophysical methods such as gravity, magnetic, seismic, electric, and electromagnetic methods. It also includes a flowchart of using geophysical methods in research, and case studies based on various literature sources. Topics covered include: Exploration Geophysics as a Whole and Its Types (C3), Geophysical Exploration Techniques (C4), Flowchart of Using Geophysical Methods in Research (C5), Case Studies Based on Literature (C5)
Objectives	1. Able to classify the types of exploration with systematic independent work and measured discussion. 2. Able to analyze geophysical exploration techniques with measurable independent work 3. Able to validate usage and research flow charts using Geophysical methods with systematic independent work and measurable discussions. 4. Able to interpret and conclude various geophysical exploration cases from literature with systematic independent work and measurable discussions.
Course Method	At the beginning of the course, it is conducted through the lecture method, and subsequent meetings are carried out using the case-based study method, with supplementary learning materials provided in the form of instructional videos and lecture notes
Reading list	1. Mamdouh R. Gadallah, Ray Fisher, Exploration Geophysics, 2009, Springer. 2. A. E. Beck, Physical Principles of Exploration Methods: An Introductory, 1981, John Wiley & Sons. 3. T F Gaskell, Techniques of geophysical exploration, British Journal of Applied Physics, 1962, Volume 13, Number 11, IOP Publishing Ltd.
Assessment Guidance	Case-based rubric (25%); Assignments (25%); Midterm Exams (25%); Final Exams (25%)

6) Lecturer

No	Full Name	ID
1	Prof. Dr. I Made Joni, M.Sc.	0001067202
2	Prof. Dr. Risdiana, M. Eng	0005057501
3	Prof. Dr. Camellia Panatarani	0003037406
4	Prof. Dr.rer.nat. Ayi Bahtiar	0029107002
5	Prof. Dr.rer.nat. Yudi Rosandi	008087106
6	Dr. Fitrilawati, M.Sc.	0008026501
7	Dr. Sahrul Hidayat, M.Si.	0030077305
8	Dr. Togar Saragi	0026086803
9	Lusi Safriani, S.Si., M.Si., Ph.D.	0010037301
10	Dr. Andri Abdurochman, MT	0026057405
11	Dr. Annisa Aprilia	0011048202
12	Dr. Otong Nurhilal, M.Si.	0028086903
13	Dr. Irwan Ary Dharmawan, M.Si.	031057202
14	Dr. Dini Fitriani, M.Si.	004107504
15	Dr. Kartika Hajar Kirana, M.Si.	025098504
16	Nowo Riveli, Ph.D.	0029118206
17	Dr. Budi Adiperdana, M.Si	0017058206
18	Ferry Faizal, Ph.D	0031058207
19	Dr. Eleonora Agustine, M.Si.	0001087107
20	Dr. Imran Hilman Mohammad, M.Si.	0014088111
21	Dr. Asep Harja	0019046901

CHAPTER III

GRADING SYSTEM AND ASSESSMENT REPORT

Evaluation of student learning outcomes in a course is at least a combination of 3 (three) types of assessments:

4.1. Midterm Exam (UTS)

4.2. Final Semester Exam (UAS)

4.3. Other values include: assignments (homework, papers, referats, and translations); quizzes (both scheduled and unscheduled), presentation, reports, resume.

The weight of each type of assessment used can be set the same or different, depending on the weight of the questions / tasks given by the Course Caregiver Lecturer.

1. Final Grades

The Quality letters obtained by students are based on the following table:

Quality Letter (HM)	**Quality Score (AM)**
A	4
B	3
C	2
D	1
E	0

2. The letter T (Incomplete Assessment Component)

A student is declared to have obtained the Quality Letter T if he meets the following conditions:

a. Given to students who have not fulfilled one of the student learning outcomes evaluations conducted at the end of the semester;

b. After the evaluation in point 1 is fulfilled by students within 2 (two) weeks from the UAS of the relevant course, the Quality Letter T must be changed to the grade according to its acquisition on a scale of 0-100;

c. If the evaluation in point 1 is not fulfilled within the time limit of 2 (two) weeks, then the quality letter becomes Quality Letter E (with a quality score of 0); or Course supervisors can process according to the weight of each specified evaluation section, so as to produce other quality scores;
d. The letter Quality T cannot be changed to the letter Quality K, unless the student cannot take the follow-up UAS (through remedial) on the basis of justifiable reasons (illness, accident, or disaster that requires long treatment).
e. Quality letters T and K are not used in GPA calculations, where the Quality Letter T must be changed according to the grade gain within two weeks after the Quality Letter T is announced.

3. The letter K (No Grading Component)

A course can be declared with the letter K if it meets the following conditions:

a. Students withdraw from lecture activities after passing the KRS change deadline (2 (two) weeks after academic activities run) for justifiable reasons and proven by the Dean's Certificate;
b. Imposed on 1 (one) or several courses in the semester concerned in the event that students cannot take part in UAS on the basis of justifiable reasons so that they cannot take part in follow-up UAS (through remedial);
c. Given in the Final Project Report or Thesis course that is not completed in 1 (one) semester.
d. Justifiable reasons for giving the Quality Letter K are: illness or accident that requires treatment or a long healing process, which is stated by a certificate from the specialist doctor or hospital that treats it; family disasters that require students to leave their learning activities for a long time, with the necessary certificate corroborated;
e. Another justifiable reason for giving a Quality Letter K is an abnormal childbirth condition or other reasons that can be justified by the Dean beyond the two reasons in point d above, but the student is considered to have temporarily stopped his studies for 1 (one) semester with the permission of the Dean;
f. Courses that have a Quality Letter K, are not used for calculating social studies or GPA;
g. For students who obtain the K Quality Letter for the entire study load in the semester concerned, it is taken into account in the study time limit and is not considered as a temporary termination of study;

h. If point e above occurs for the second time, then the semester concerned is considered as a temporary termination of study with the permission of the Dean, so that it will reduce the student's allotment to apply for a temporary termination of study;

i. If point e above occurs for the third time (consecutively or separately), then the semester concerned is considered as a temporary termination of study with the permission of the Dean for the second time. This is not taken into account in the time limit of their studies, but invalidates the student's right to the opportunity to terminate their studies with the permission of the Dean;

j. Temporary termination of study after passing the period in point g above for reasons such as in point d, is allowed, but taken into account in the study time limit;

k. If the course that obtained the K Quality Letter has been taken again in another semester, then the Quality Letter can change according to its acquisition;

l. The provisions as above, do not apply to e-learning learning.

4. Value Correction

Value correction can be done:

a. If students improve the quality letters E, D, and C, then the GPA calculation used is the best Quality Letter.

b. If students improve the grade letter B, then the GPA calculation used is the last Quality Letter.

c. Improvement of E grades is carried out by retaking the relevant courses in the next semester.

d. Improvement of Quality Letters E and D can be done by remedial in the current semester or by retaking the relevant courses and listing the courses in KRS.

5. Performance Index (IP)

Grade point average each semester (IP) is a number that shows student achievement or learning progress in one semester. IP is calculated at the end of each semester. The calculation formula is as follows (rounding down when less than 0.05, rounding up when equal/more than 0.05):

$$\text{IP} = \frac{\text{AMxCredits}}{\text{Total Credits each semester}}$$

6. Grade Point Average (GPA)

Grade Point Average (GPA) is a number that shows student achievement or learning progress cumulatively starting from the first semester to the last semester that has been taken. GPA is calculated at the end of each semester. The calculation formula is as follows (rounding down when less than 0.05, rounding up when equal/more than 0.05):

$$\text{GPA} = \frac{\text{Total (AMxCredits)}}{\text{Total Credits}}$$

GPA is used to determine the study load of the next semester.

GPA range and the maximum number of credits students are allowed to take in the next semester:

GPA Range	Maximum number of credits
3,00 – 4,00	24
2,50 – 2,99	21
2,00 – 2,49	18
1,50 – 1,99	15
< 1.50	< 12

7. Graduation Requirements

Students are declared to have completed and graduated from Master Program in Physics if they meet the following conditions:

1. Pass all courses within the set cumulative study load;
2. Have a GPA of at least 3.00;
3. There is no letter of quality D;
4. Have completed the preparation and writing of a thesis or the like, and declared worthy of the test by the Supervisor;
5. Pass the Thesis Examination as the final examination;
6. Have compiled or written a Thesis; and
7. Have at least 1 (one) scientific article with accepted status in reputable international journals or accredited national journals

8. Temporary Study Termination

Conditions for temporary termination of studies:

1. The maximum number of temporary study terminations is 2 (two) semesters, either consecutively or separately.
2. Mechanism for applying for temporary study termination permit:
    a. Students submit an application letter to the Head of Study Program, which is known to the guardian lecturer/academic supervisor by signing their signature.
    b. The application letter is submitted no later than 2 (two) weeks before the lecture activity.
    c. After considering the academic aspect (GPA and amount of credit savings), the Study Program forwarded the application to the Dean.
    d. If the Dean gets permission, then during the period of temporary study termination, students are exempt from BPP.
    e. Temporary suspension of study is not taken into account in the maximum time limit of the student's study period.
    f. The flow of procedures for obtaining a Temporary Study Termination Permit (IPSUS) is regulated in the Rector's Decree.
    g. Students who are granted permission to temporarily suspend their studies are not entitled to academic services.
3. Temporary termination of studies without the permission of the Dean is subject to the following sanctions:
    a. To re-register must submit a written application to the Rector, through the Dean.
    b. The period of temporary termination of study without the permission of the Dean is taken into account in the maximum time limit of his Study Program.
    c. Pay the outstanding BPP, and for the next semester payment is charged in accordance with the applicable tariff decree.
4. Stopping studies (including not doing herregistration) for 2 (two) semesters either consecutively or separately without permission, is subject to termination of study.
5. Stopping study for 2 (two) consecutive semesters or separately, for reasons as mentioned in point 3 after the previous semester obtained the letter K for all semester loads, is considered to temporarily stop studying with the permission of the Dean for 2 (two) semesters; Thus, the student concerned is no longer allowed to stop his studies temporarily.
6. For all levels of study, temporary termination of study should not be made on:
    a. Semester I (first), and/or
    b. Semester II (second), and/or

c. 1 (one) and/or 2 (two) semesters before the permitted study deadline. Thus, students are not allowed to stop their studies temporarily, either with or without permission: Students who temporarily stop their studies without permission in the above semesters are considered to have resigned.

9. Termination of Study

1. Termination of study is imposed if:
   a. at the end of the second semester have a GPA below 3.00 and/or;
   b. credit savings (the number of courses that have a Quality Letter C and above) does not reach 24 credits;
2. Termination of study is imposed on Undergraduate Education students if:
   a. at the end of semester 2 have a GPA below 3.00, and/or;
   b. credit savings (the number of courses that have Quality Letter C and above) does not reach 24 credits;
3. Termination of study is imposed if they exceed the stipulated study time limit.

10. Judicium

The Judicium "Excellent", is given to students, if they have other additional requirements, namely having at least 1 (one) scientific article with accepted status in an accredited national journal with at least SINTA 2 (two) accreditation or a reputable international journal or give a presentation at international scientific seminar. Students who meet the "Excellent" judicium based on GPA, but do not meet these additional requirements, then the graduation judicium is only determined as "Very Satisfactory", according to the Rector Regulation No. 46 of 2016 . The list of judicium is listed in the table below.

Judicium for master program

No.	GPA	Judicium
1	3.00 - 3.50	Satisfactory
2	3.51 - 3.75	Very Satisfactory
3	3.76 - 4.00	Excellent (with additional requirements)

CHAPTER IV
EXAMINATION REGULATION AND ACADEMIC SANCTIONS

1. Examination Regulation

a. Attendance and Tardiness

- Students must attend on time on a specified schedule.
- If students attend late, they need to contact invigilator
- Invigilator will give a decision whether or not you are able to take the exam
- If students are not able to attend for a particular reason, for instance due to illness or another undeniable reason, they need to inform the study program and the lecturer for scheduling the make-up exam.

b. Cheating

- Students are not allowed to cheat during the exam, for instance asking for answer, communicating with another participant, or using non-permitted items.
- Students are not allowed to bring or use any non-permitted items such as electronic device, book, notes, or material.
- Students who commit cheating will be subject to academic penalties and be disqualified from the exam and receive an E (fail) grade or other penalty.

c. Plagiarism

- Plagiarism is an act of taking idea, writing, or someone's work without consent and claim it to be his/her work.
- Students must follow the writing guidelines which refer the applicable citation writing rules.
- Plagiarism violation will result in academic penalty in the forms of grade reduction or exam disqualification.

d. Exam Supervision

- Exam will be closely supervised by invigilator or lecturer to prevent any cheating.
- Invigilator has the authority to take disciplinary action towards students who violate exam regulations.

e. Complain Procedure

Students who feel they have been treated unfairly or wish to file a complaint towards the decision during the exam can contact the chair of study program to find a solution.

2. Academic Sanctions

1. Students who have registered administratively in the first (first) or second (second) semesters may be subject to termination of study if:
   a. fill in KRS but do not participate in teaching and learning activities;
   b. does not charge KRS.
2. Students who have registered or re-registered administratively, but do not fill in the KRS (not participating in teaching and learning activities) without justifiable reasons are subject to sanctions in the form of warnings by the system and the abandoned semester is taken into account in the maximum time limit for completing their studies and if this action is repeated again, both in the next semester and in other semesters, students are subject to termination of study.
3. Students who withdraw from one or more courses after the KRS change deadline passes without justifiable reasons (for example, illness, accident, or disaster) will be warned by the system, and then the course left behind is declared not to have passed (given a Quality Letter E, with a quality score of 0).
4. The letter Quality E obtained according to point 3 is used in calculating GPA.
5. The semester left as in point 3 is taken into account in determining the maximum deadline for completion of their studies.
6. Foreign students who violate immigration regulations are subject to sanctions in accordance with applicable laws and regulations.

3. Sanctions for Non-Academic Violations

1. Students who commit criminal violations are subject to special sanctions in the form of academic suspensions during the legal process, after discussion with the Faculty Senate, while the handling of criminal matters is handed over to the authorities.
2. Students who violate the law and have been determined legally guilty by a court that has permanent legal force, will be subject to sanctions in the form of termination of study by the Rector in accordance with applicable regulations.
3. Students who violate moral ethics, profession (examining patients/clients without supervision, making prescriptions, conducting consultations without supervision, etc.), forging signatures and the like, will be subject to sanctions in the form of academic suspension by the Dean until termination of study by the Rector.

4. Students who violate academic ethics, including cheating, plagiarizing (papers, reports, Final Project Reports, Thesis, Dissertation, and so on), plagiarism, leaking questions or the like will be subject to sanctions in the form of academic suspension by the Dean until termination of study by the Rector.
5. All activities that disturb public order and immoral acts in the campus environment are subject to sanctions in the form of warnings until the termination of study.
6. In certain cases, the faculty may issue its own decisions that do not conflict with the provisions of the law or regulations above.

CHAPTER V

FACILITIES AND INFRASTRUCTURE

The Master Program in Physics at Department of Physics has a suitable building consisting of lecture halls, educational laboratories, research laboratories, libraries, lecturer rooms, seminar rooms, administration rooms, common rooms and other infrastructure with adequate area and good quality. In addition, for learning basic courses, study programs use shared building facilities at PPBS Unpad.

The lecturer's workspace has Area of about 6 - 8 m^2 for each lecturer. Each lecturer room has been facilitated with internet network access. Physics Study Program has six lecture rooms, each with a capacity of 40 people. Each lecture room is equipped with LCD facilities *Projector*, *motorized screen*, air conditioning, and internet network. Laboratory rooms are also available with adequate area and good equipment. Educational laboratories consisting of Basic Physics Laboratory, Computer Laboratory, Experimental Physics Laboratory and Electronics Laboratory serve practicum supporting physics core courses, the use of which averages 15 hours / week. While the research laboratory (group of expertise) serves practicum related to study courses and its use averages 9 hours / week, and is also used for student and lecturer research activities. PS also provides good library room facilities equipped with reading room facilities, computers, internet access and air conditioning. The library is equipped with textbooks, scientific papers, journals, proceedings, and theses / theses / dissertations with a total of 4,118 titles and 6,911 copies.

The Department of Physics provides laptop facilities that are used for the implementation of lectures, Study Program seminars, and student seminars. Almost every lecturer room has been equipped with computer facilities and internet access to support the learning and research process. Each lecture room has also been equipped with an LCD projector and motorized screen that supports the learning process. To support the learning process, the Department of Physics has an adequate number of computer laboratories and is equipped with licensed software. The laboratory at KBK also has computer facilities that are used for practicum and research. The Department of Physics has two server units that are used for simulation/modeling research activities. To support the learning and research process, the Department of Physics provides internet access for students which is available through hotspot facilities that can be accessed in all areas of the Physics Study Program building.

Lecture facilities and laboratories available in the Department of Physics can meet the needs of the teaching and learning process and practicum. For the implementation of PBM, the Program has six lecture rooms with a capacity of 40 students each and the average area per student is around 1.2 m^2. The availability of practicum rooms has been sufficient, currently gradually the Physics Study Program is trying to complete practicum equipment adapted to the lecture material. In addition, the program already has a special room for student activities (*Student Center*) and lecturer research activities, although it is still insufficient.

CHAPTER VI

RESEARCH, COMMUNITY SERVICE AND COOPERATION

Research and Community Service (PPM) as stated in the Tri Dharma of Higher Education, is an important part that is very closely related in improving the overall quality of education. Research conducted by lecturers is encouraged to always involve students as part of research for student theses in an effort to support the improvement of the achievement of the study period on time.

With good support and cooperation, the amount of research conducted by lecturers of the Physics Study Program is quite a lot which is funded both from domestic funding sources through the Ministry of Research, Technology and Higher Education and Unpad Internal Grants (HIU), as well as from abroad which are offered competitively and research funds from cooperation. The amount of research funding obtained by Department of Physics always increases every year.

In addition to research, PPM activities of lecturers at Department of Physics also support the educational process, namely by involving students in implementing the results of lecturer research directly to the community. Strong financial support from Unpad through the Directorate of Research, Community Service and Innovation (DRPMI) by providing PPM Prioritas grants has supported the implementation of PPM in the Physics Study Program. In 2016, as many as 17 PPM activities were funded by Unpad, while in 2017 there were 8 activities that received funds for the implementation of PPM activities in various regions in West Java.

In line with the vision and mission of the Faculty and University, the Department of Physics collaborates with various institutions both at home and abroad by involving the entire academic community of the Department of Physics. This collaboration includes higher education tridharma activities, both in the fields of education, research, and community service. The cooperation is outlined in various Memorandums of Understanding (MoU) or Letters of Agreement (LoA), with various activities such as *Student Exchange*, *Lecturer Exchange*, *Research Collaboration*, *Joint Publication*, implementation of thesis guidance, and others. Table 5.2 shows the cooperation between the Department of Physics and several domestic institutions both government and private / industry, while in Table 5.3 shows the cooperation of the Department of Physics with several foreign institutions.

Table 6.1 Domestic Cooperation of Department of Physics

No.	Instance Name	Types of Activities	Benefits That Have Been Obtained
1	PT. Grafindo Nusantara	Graphite processing and analysis	* Employment
			* Additional research facilities
			* Student internship
			* Increased research networks with industry
2	PT. Trans Java Sulawesi	Graphite processing and analysis	* Employment
			* Additional research facilities
			* Student internship
			* Increased research networks with industry
3	PT. Mekongga Sejahtera	Graphite processing and analysis	* Employment
			* Additional research facilities
			* Student internship
			* Increased research networks with industry
4	Eagle Rich Nusantara	Graphite processing and analysis	* Employment
			* Additional research facilities
			* Increased research networks with industry
5	PT. IoL	Material analysis	* Increased research networks with industry
6	Corrosion Lab, Sepuluh Nopember Institute of Technology	Material processing research	* Sharing research facilities
			* Sharing experts
			* Improved research network
7	PT. Control System	Research collaboration in the field of instrumentation	* Employment
			* Student internship
			* Increased research networks with industry
8	PT. Semesta Teknologi Indonesia	Research collaboration in the field of instrumentation	* Employment
			* Increased research networks with industry
10	PT. Indowira Putra	Cooperation in the field of paint material engineering	* Provision of paint research materials and industrial-scale paint testing
11	CV. Abdi Insan Mandiri	Research collaboration on the application of micro/nano bubble technology to increase the productivity of catfish crops in the recirculating aquaculture system (RAS)	* Provision of industrial-scale research facilities
12	BATAN	Student thesis, student internship, guest lecturer, joint publication, joint seminar organization, research	* Employment
			* Provision of research facilities
			* Student internship
			* Increased research network
13	LIPI		* Employment

		Student thesis, student internship, guest lecturer, joint publication, joint seminar organization, research	* Provision of research facilities
			* Student internship
			* Increased research network
14	BPPT	Student thesis, student internship, guest lecturer, joint publication, joint seminar organization, research	* Employment
			* Provision of research facilities
			* Student internship
			* Increased research network

Table 6.2 Foreign Cooperation of Physics Study Program

No.	Instance Name	Types of Activities	Benefits That Have Been Obtained
1	Okuyama Lab, Hroshima University, Japan	Material processing	* Use of research facilities
			* Sending lecturers for further studies
2	Owada Lab, Waseda University, Japan	Mineral processing	* Use of mineral analysis facilities
2	Lenggoro Lab, Tokyo University of Agriculture Technology, Japan	Material processing	* Use of research facilities
			* Sending alumni for further studies with scholarships from TUAT
3	Ohkawara Kakohki Co., Ltd., Japan	Powder processing	* Overseas industry cooperation network
4	Makino Mfg.Co.,Ltd, Japan	Powder processing	* Overseas industry cooperation network
5	Tokuju Corporation, Japan	Powder processing	* Overseas industry cooperation network
6	Eriez Magnetics Japan Co.Ltd	Powder processing	* Overseas industry cooperation network
7	The physical and Chemical Research Institute (RIKEN), Wako Japan (Dr. I. Watanabe)	Material Science, Use of RIKEN-RAL Muon Facility	* Research facilities
8	Graduate School of Advanced Science and Engineering, Waseda University, Japan (Prof. Y. Furukawa)	Research Collaboration on Organic Solar Cells	* Research facilities
9	Tohoku University, Japan (Prof. Y. Koike)	Research Collaboration on Superconducting and Magnetic Materials and Student Exchange	* Research facilities * Student exchange
10	Saitama University, Japan (Prof. Taniguchi)	Superconducting Materials	* Research facilities * Student exchange
11	Max-Plnack Institute for Polymer Research, Germany (Prof. C. Bubeck)	Graphene oxide	* Research facilities
12	National University of Singapore (Dr. Andrivo Rusydi and Dr. Ariando)	Research collaboration on oxide materials	* Research facilities

CHAPTER VII

STUDENT FACILITIES AND ALUMNI

A. Student Facilities

Universitas Padjadjaran has provided an integrated academic information system, namely the SIAT, in order to simplify the administration for students to plan their semester activities. The study plan is solely performed with the help of digital technology to leverage the effectiveness of the study program. The technology is used early from the admission process, the semester registration procedures, the study plan, as well as the graduation process of the student. Beside the administration processes, Universitas Padjadjaran has provided a digital based learning platform, namely the Unpad Luhung Platform (https://luhung.unpad.ac.id/) for the both degree and non-degree programs. Other digital infrastructure are the following:

- Hybrid lecture infrastructure, https://live.unpad.ac.id/
- Unpad Digital Library, https://library.unpad.ac.id/
- Access to academic resources, such as e-journal and academic reference searching, https://pintu.unpad.ac.id/

These platforms and digital infrastructures are developed to obtain the effective learning process with respect to the academic success of all students in Universitas Padjadjaran. To support students in their research and final project activities, the university has provided the laboratories related to the disciplines conducted by each study program. Among them,

- The Functional Nano Powder University Center of Excellence, for research related to physics studies (see link:https://www.finder.ac.id/).
- The Basic Science Service Center for fundamental studies in physics (see link: https://www.unpad.ac.id/universitas/fasilitas/fasilitas-penunjang-pendidikan/pusat-pelayanan-basic-science/).
- The central laboratory, for analysis and characterization of substances in advance research, especially for the graduate students (see link: https://www.unpad.ac.id/universitas/fasilitas/laboratorium-central/).

In case of campus life and future carrier support, Universitas Padjadjaran has provided a consultary system, which consists of,

- Academic counselor in the study program level
- Psychological counseling in university level by The Center of Psychology Innovation (Pusat Inovasi Psikologi, https://pip.unpad.ac.id/)

- Scholarship for Indonesian students (https://beasiswa.unpad.ac.id), scholarship for Indonesian master students (https://smup.unpad.ac.id/beasiswa-unggulan-pascasarjana-padjadjaran/), scholarship for international students (https://www.admission.unpad.ac.id/possma-asean)
- Healthcare services, sport center library and campus transportation (https://international.unpad.ac.id/about/accomodation-and-campus-facilities/)
- Development of future career for fresh graduates by The Career Development Center (CDC, https://karier.unpad.ac.id/)

All support is openly published to the student and stakeholders. There is a possibility that the intended information is missed by the students. In this case, the university continuously encourages the students to gather actual information on their study and future career in the website along with the related official social media.

B. Alumni

The Physics Study Program already has an alumni association organization, namely the Physics Alumni Association (IKA Physics). Automatically, every graduate of the Physics Study Program becomes a member of IKA Physics Unpad. Although the existence of IKA members of the Physics Study Program is spread throughout Indonesia and abroad, for coordination and communication IKA Physics has mailing lists and groups on social networking sites Facebook, WA, etc. Grand meeting activities attended by almost all members are held regularly every three years. The agenda in the meeting was in addition to developing networks between IKA members, also to establish more intensive communication between the Physics Study Program and alumni.

For the progress of the Physics Study Program, so far IKA Physics has held several activities that help students in developing scientific insights and practices in the field as resource persons. Events such as workshops and seminars are regularly held every semester. In addition, some alumni often provide final project vacancies and internships specifically for students of the Physics Study Program.

ATTACHMENT

Appendix I: Internship/internship program

A. Internship/Internship Program Implementation Flow

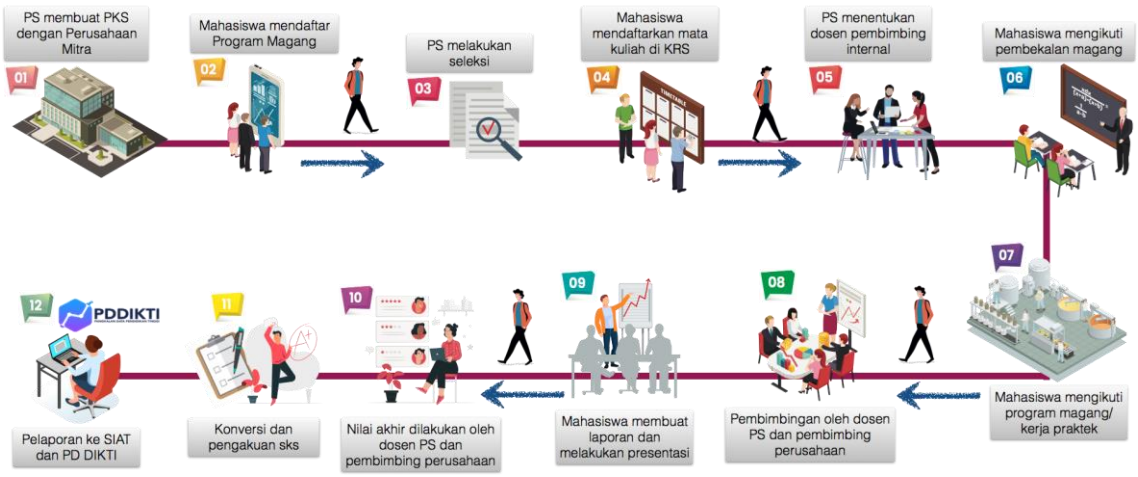

Figure 1. Internship/Internship Program Flow.

B. SOP for Internship/Internship Program Implementation

1. **PURPOSE**
   The readiness of prospective graduates in facing the real world of work armed with mastery of theoretical and applied knowledge, in order to prepare Bachelor of Physics graduates who not only master physics in theory but also application

2. **SCOPE**
   Includes: registration of internships / work practices and implementation of internships / work practices. This procedure will be effective if accompanied by active participation from students, supervisors, field supervisors/supervisors, academic staff, and department administration staff.

3. **RELATED DOCUMENTS**
   UNPAD Education Implementation

   Guidelines for Preparing and Writing Internship/Work Practice Reports

4. **DEFINITION**
   Internship is part of job training, internship is carried out by level students as one of the main requirements to complete the educational process.

5. **PERSON IN CHARGE**
   Head of Study Program, Internship/Work Practice Supervisor

6. DETAILED PROCEDURES/PROCESSES

No	Actions/Activities	Person in Charge
1	• Register for an Internship / Work Practice at TUJ, by meeting the administrative completeness requirements • Registered as an active Physics Study Program Student • Have passed 110 credits • Have taken internship/work practice support courses • Students enroll in courses at KRS • Students fill out Form A and signed by the Head of Department • Students fill out Form B and signed by the Company Supervisor / Supervisor • Students fill out Form C and signed by the Study Program Supervisor • Students fill out Form D to request Validation/approval to the Company's Supervisor/Supervisor (along with the clear name and position of the Company's Supervisor/Supervisor) • Students fill out Form E (Form grade from the Company Supervisor) • Students fill out Form F (Form indigo from Study Program Supervisor) • Students fill out Form H • Students MUST take part in the Internship/Work Practice Debriefing • Students take part in the Internship/Work Internship Program • Every week students participating in the Internship / Work Practice MUST submit a daily report / logbook filled with the Trello Application • Every period of time, students make reports and submit them to the Company Supervisor / Supervisor and Study Program Supervisor and conduct the necessary discussions • Students make reports and make presentations • Students understand and are willing to comply with various regulations that apply to Internship / Work Practice activities	Student
2	• Check the completeness and verify statements with the Integrated Academic Information System (SIAT) • Process Form A to be signed by the Head of Study Program and then make a cover letter to the Partner Company	Secretary of Study Program
3	• Prepare Facilities and Infrastructure for Test activities (If any/needed) • Receive a Research Letter and submit it to the Study Program • Receive Form E submitted by Company Advisor	Secretary of Study Program

	• Receive Form F submitted by Study Program Supervisor • Receive Form H (Report Writing Form) • Converting and Acknowledging Credits • Reporting to SIAT and PD DIKTI	
4	• Conducting Guidance to each student • Provide final grade of Internship/Work Practice to each student • The Corporate Advisor signs Form B submitted by the student • The Company's supervisor provides approval/validation in Form D • The Company's Supervisor gives a grade after all evaluation processes are complete, and returns Form E to the Study Program	Company Supervisor/Advisor
	• Conducting Guidance to each student • Provide final Research grade to each student • The Study Program Supervisor signs Form C submitted by the student • The Study Program Supervisor gives grades after all evaluation processes are complete, and returns Form F to the Study Program	Supervisor Courses
5	• Study Program makes PKS with Partner Companies • Study Program conducts Selection • The Study Program determines Internal Supervisors	Head of Study Program
6	• Receive Form H given by TU Department (complete) • Recapitulates all administrative files and provides a recap of grades and is included in the SIAT	Department Secretary

Appendix II: Research Program

A. Flow of Research / Research Implementation

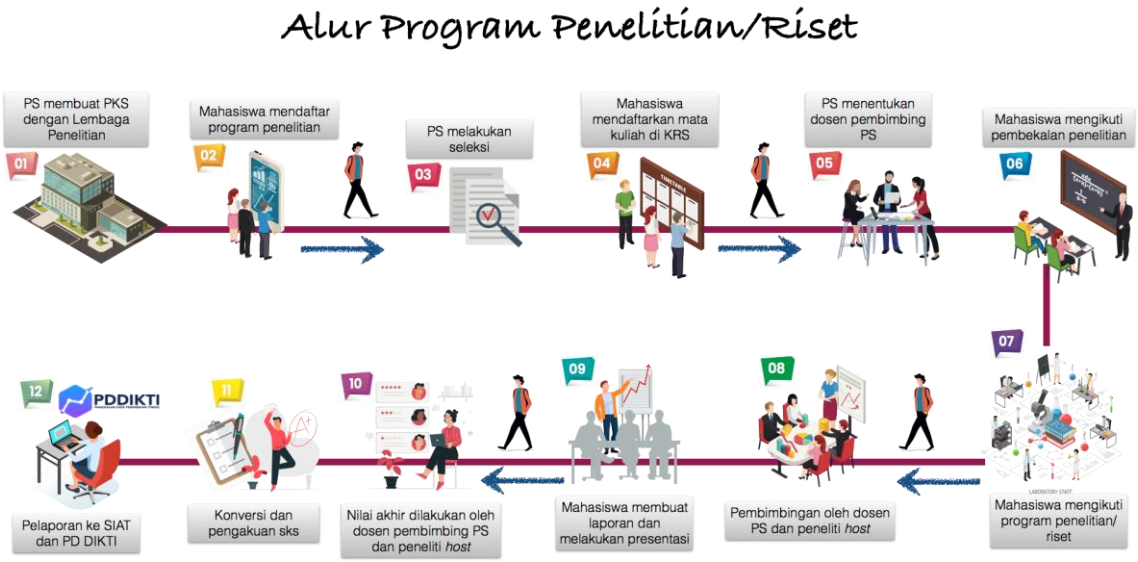

Figure 2. Flow of Research / Research Program.

B. SOP for Research Program Implementation

1. **PURPOSE**
   With research, students are honed to be able to identify and formulate problems and solve problems to find solutions. The process that students go through in a research will be an important experience in forming a critical thinking framework that is expected to improve the quality of students.

2. **SCOPE**
   Includes: registration of Research / Research and implementation of Research / Research. This procedure will be effective if accompanied by active participation from students, supervisors, researchers/hosts, academic staff, and administrative staff of the department.

3. **RELATED DOCUMENTS**
   UNPAD Education Implementation

   Guidelines for Preparing and Writing Research Reports

4. **DEFINITION**
   An application of the scientific approach in a problem study in obtaining useful information and the results obtained can be accounted for. (According to Donald Ary)

5. **PERSON IN CHARGE**
   Head of Study Program, Research / Research Supervisor

6. **DETAILED PROCEDURES/PROCESSES**

No	Actions/Activities	Person in Charge
1	• Register for Research at TUJ, by meeting the administrative completeness requirements • Students fill out Form A as registration for the Research / Research course • Students fill out Form B signed by the Researcher/Host • Students fill out Form C signed by the Study Program Supervisor • Students fill out Form D to request Approval/Validation to the Researcher/Host • Students fill out Form E (Form grade from the Researcher/Host) • Students fill out Form F (Form indigo from Study Program Supervisor) • Students fill out Form H • Registered as an active Physics Study Program Student • Have completed 110 credits of compulsory and elective courses • Have taken elective courses relevant to the topic of study as much as 10-14 credits • Students enroll in courses at KRS • Students conduct Research / Research for 6 months / 1 semester equivalent to 20 credits or 1 year / 2 semesters equivalent to 40 credits • Students take part in Research Debriefing • Students take part in the Research Program • Students make reports and make presentations • Students understand and are willing to comply with various regulations that apply to Research / Research activities	Student
2	• Check the completeness and verify statements with the Integrated Academic Information System (SIAT) • Process Form A to be signed by the Head of Study Program and then make a cover letter to the Research Institute	Secretary of Study Program
3	• Prepare Facilities and Infrastructure for Test activities (If any/needed) • Receive a Research Letter and submit it to the Study Program • Receive Form E submitted by Researcher/Host • Receive Form F submitted by Study Program Supervisor • Receive Form H (Report Writing Form) • Converting and Acknowledging Credits • Reporting to SIAT and PD DIKTI	Secretary of Study Program
4	• Conducting Guidance to each student • Provide final Research grade to each student • The Researcher/Host signs Form C submitted by the student • The Researcher/Host gives approval/validation in Form D	Study Program Supervisor and Researcher/Host

	• The Researcher/Host assigns a grade after all evaluation processes are complete, and returns Form E to the Study Program • The Study Program Supervisor gives grades after all evaluation processes are complete, and returns Form F to the Study Program	
5	• Study Program makes PKS with Research Institute • Study Program conducts Selection • Study Program determines Study Program Supervisor	Head of Study Program
6	• Receive Form H given by TU Department (complete) • Recapitulates all administrative files and provides a recap of grades and is included in the SIAT	Secretary of Study Program

Appendix III: *Student Exchange Program*

A. Student Exchange *Program Implementation Flow*

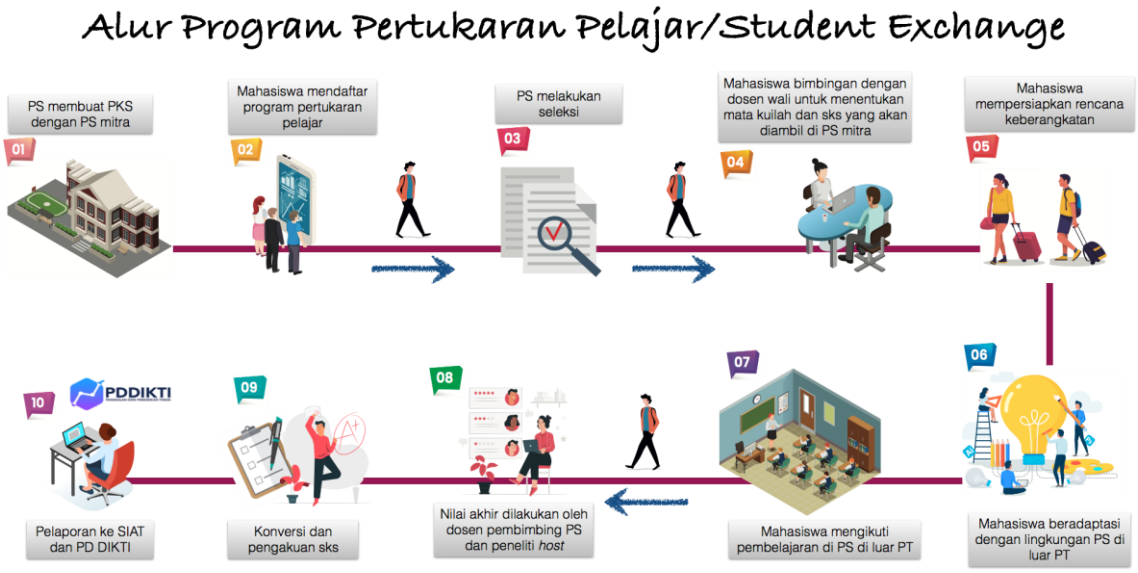

Figure 3. Student Exchange Program Flow.

B. SOP for Student Exchange Program Implementation

1. **PURPOSE**
   Study exchange programs will provide benefits for students to broaden their horizons, provide opportunities to study in different environments, expand networks by getting to know students from other universities or countries and can strengthen personalities, increase confidence and foster a global perspective in students.

2. **SCOPE**
   Includes: student exchange registration / study exchange and implementation of student exchange / study exchange. This procedure will be effective if accompanied by active participation from students, guardian lecturers, Mitra Study Program supervisors, academic staff, and department administration staff.

3. **RELATED DOCUMENTS**
   UNPAD Education Implementation

   Guide to Preparing and Writing Student Exchange Reports

4. **DEFINITION**
   It is a program that provides opportunities for students to experience studying in other schools and schools abroad, absorbing various disciplines and technology, and as a place for cultural exchange.

5. **PERSON IN CHARGE**
   Head of Study Program, Guardian Lecturer

6. DETAILED PROCEDURES/PROCESSES

No	Actions/Activities	Person in Charge
1	• Register for Student Exchange / *Study Exchange* at TUJ, by meeting the administrative completeness requirements • Registered as an active Physics Study Program Student • Have passed 110 credits • Students fill out Form A and signed by the Head of Department • Students fill out Form B and signed by the Partner Advisor • Students fill out Form C and signed by the Study Program Guardian Lecturer • Students fill out Form H • Students are guided by the Study Program Guardian Lecturer to determine the courses and credits to be taken in the Partner Study Program • Students preparing for departure • Students participate in learning activities in Study Programs outside of Higher Education • Students can take part in Student Exchange activities / *Study Exchange* 1 or 2 semesters (with a total credit load between 20-24 credits) • Every period of time, students MUST provide a study progress report through a written report or consult with the Study Program Guardian Lecturer • Students understand and are willing to comply with various regulations that apply to Student Exchange / *Study Exchange activities*	Student
2	• Check the completeness and verify statements with the Integrated Academic Information System (SIAT) • Process Form A to be signed by the Head of Study Program and then make a cover letter to the intended Study Program	Secretary Courses
	• Check completeness and verification with the Integrated Academic Information System (SIAT) • Prepare facilities and infrastructure for student exchange test activities: rooms, LCDs, and others.	
3	• Sign Form C • Guardian lecturers give consideration in taking courses • Every period of time, students MUST provide a study progress report through a written report or consult with the Study Program Guardian Lecturer	Guardian Lecturer
4	• Study Program makes PKS with PS Partners • Study Program conducts Selection • Sign Form A as a condition for student exchange registration / *Study Exchange*	Head of Study Program
5	• Receive Form H given by TU Department (complete) • Recapitulates all administrative files and provides a recap of grades and is included in the SIAT	Secretary of Study Program

Appendix IV: Teaching Assistance Program

A. Flow of Implementation of the Teaching Assistance Program

Figure 4. Teaching Assistance Program Flow.

B. SOP for Teaching Assistance Program Implementation

1. **PURPOSE**
   Students have experience in teaching which is expected to motivate students to continue learning in their scientific fields and hone their abilities in transferring their knowledge

2. **SCOPE**
   Includes: registration and implementation of Teaching Assistance. This procedure will be effective if accompanied by active participation from students, study programs, supervisors, accompanying teachers, schools, academic staff, and administrative staff of the department.

3. **RELATED DOCUMENTS**

4. **DEFINITION**
   The Teaching Assistance Program provides opportunities for students who are interested in the field of Education to participate in improving the quality of primary and secondary education.

5. **PERSON IN CHARGE**
   Head of Study Program, Teaching Assistance Supervisor

6. DETAILED PROCEDURES/PROCESSES

No	Actions/Activities	Person in Charge
1	• Register for Teaching Assistance at TUJ, by meeting the administrative completeness requirements • Registered as an active Physics Study Program Student • Have passed 110 credits • Have taken internship/work practice support courses • Students enroll in courses at KRS • Students fill out Form A and signed by the Head of Department and a Letter of Introduction is made to the intended School • Students fill out Form B and are signed by the School Accompanying Teacher • Students fill out Form C and signed by the Guardian Dose of the Study Program • Students fill out Form D to request Validation/approval from the School Accompanying Teacher (along with the clear name and position of the School Accompanying Teacher) • Students fill out Form E (Form grade from the School Teacher Leader) • Students fill out Form F (Form indigo from Study Program Supervisor) • Students fill out Form H • Students MUST take part in the Teaching Assistance Briefing • Students take part in the Internship/Work Internship Program • Every week students participating in Teaching Assistance MUST submit a daily report / logbook filled with the Trello Application • Every period of time, students make reports and submit them to the School Assistance Teacher and Study Program Supervisor and conduct the necessary discussions • Every period of time, students make progress reports that are sent to the supervisor after approval by the School Accompanying Teacher. • Students make reports and make presentations • Students understand and are willing to comply with various regulations that apply to Teaching Assistance activities.	Student
2	• Check the completeness and verify statements with the Integrated Academic Information System (SIAT) • Process Form A to be signed by the Head of Study Program and then make a cover letter to the intended School	Secretary Courses
3	• Prepare Facilities and Infrastructure for Test activities (If any/needed)	Secretary Courses

	• Receive a Teaching Assistance Letter and submit it to the Study Program • Receive Form E submitted by the School Accompanying Teacher • Receive Form F submitted by Study Program Supervisor • Receive Form H (Report Writing Form) • Converting and Acknowledging Credits • Reporting to SIAT and PD DIKTI.	
4	• Conducting Guidance to each student • Provide the final grade of Teaching Assistance to each student • The School Accompanying Teacher signs Form B submitted by the student • The School Accompanying Teacher gives approval/validation on Form D • The School Accompanying Teacher gives grades after all evaluation processes are complete, and returns Form E to the Study Program	Teacher School Companion
5	• Conducting Guidance to each student • Provide final Research grade to each student • The Study Program Supervisor signs Form C submitted by the student • The Study Program Supervisor gives grades after all evaluation processes are complete, and returns Form F to the Study Program	Supervisor Courses
	• Study Program makes PKS with Education Unit (SD, SMP, SMA/SMK) • Study Program conducts Selection • Study Program determines Study Program Supervisor	Head of Study Program
	• Receive Form H given by TU Department (complete) • Recapitulates all administrative files and provides a recap of grades and is included in the SIAT	Secretary of Study Program