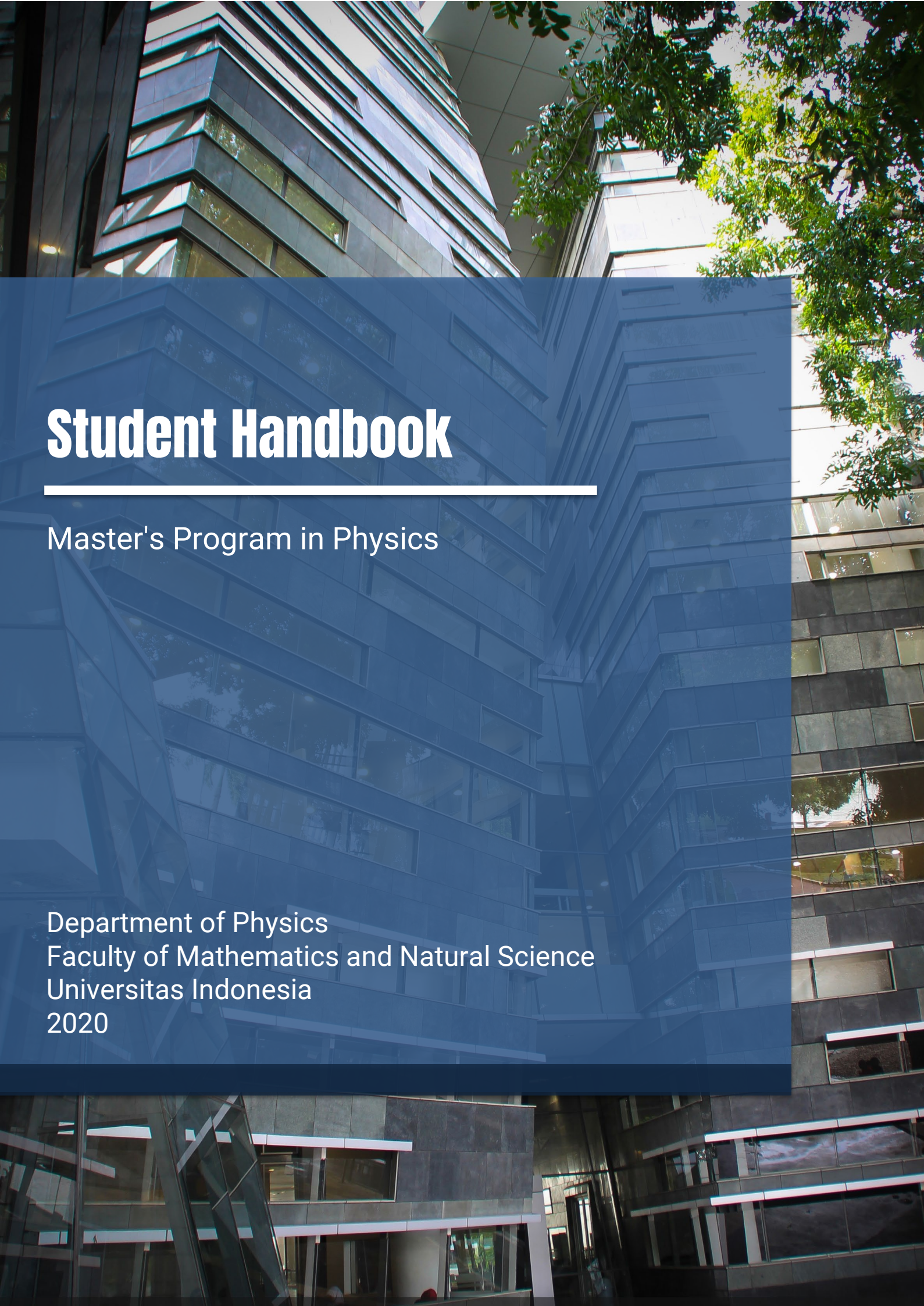

Student Handbook

Master's Program in Physics

Department of Physics
Faculty of Mathematics and Natural Science
Universitas Indonesia
2020

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1. Introduction

The Master of Physics Study Program at the Faculty of Mathematics and Natural Sciences UI always strives to keep up with the times by updating its curriculum. In 2020, in line with the spirit of "Merdeka Belajar" and "Kampus Merdeka" from the Ministry of Education and Culture of the Republic of Indonesia and the commitment of the University of Indonesia to make continuous improvements, the Physics Masters Study Program was also making improvements and adjustments to its curriculum.

The Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 03/2020 is the primary reference in changing the university curriculum towards the independent campus concept. A curriculum is a set of plans and arrangements regarding the objectives, contents, and materials of learning and the methods used as guidelines for implementing learning activities to achieve higher Education goals.

The construction of the curriculum of the Master Program in Physics 2020 (Curriculum 2020) is aligned with the regulations of the National Standards of Higher Education (SN DIKTI), which are contained in the Regulation of the Minister of Research, Technology and Higher Education of the Republic of Indonesia Number 44/2015 and the Indonesian National Qualification Framework (KKNI) which is contained in Presidential Decree Number 08/2012 for the bachelor degree level. Curriculum 2020 is flexible with continuous improvement based on the output evaluation results of learning activities comprehensively by applying a cycle of plan, do, check, and act.

The Master Program in Physics curriculum consists of two programs: by research and by course. The Master's Program in Physics has five specializations: Nuclear Physics, Particles, and Theoretical Astrophysics, Condensed Matter Physics, Instrumentation Physics, Reservoir Geophysics, and Geothermal Exploration. The minimum number of credits that must be taken in the master degree education is 36 credits within three academic years. A one-credit learning course consists of 50 minutes per week per semester of learning process activities, 60 minutes per semester of structured assignment activities, and 60 minutes per semester of independent actions.

1.1. International Programs

The Master's Program in Physics offers international students an international program to study at the University of Indonesia. This program collaborates with the Ministry of Education, Culture, Research, and Technology of the Republic of Indonesia in the Developing Country Partnership

Program (KNB). In addition, there is the UI Great Program organized by the University of Indonesia. These programs allow students outside Indonesia to take a Master's Program in Physics. This International Program is held in conjunction with the Regular Program for students from Indonesia.

1.2. Physics Department Curriculum Team

The Master's Program in Physics evaluates its curriculum every four years by a study program curriculum team that Dean selects. The curriculum review was also performed by assessing the study period of all students, especially in the by-research program. All education administrative records and assessments are documented in academic information systems (https://academic.ui.ac.id). The team used these records and documents to evaluate and assess the curriculum implementation.

The curriculum team involved in the 2020 curriculum review is as follow

Prof. Dr. rer. nat. Terry Mart

Prof. Dr. techn. Djoko Triyono

Adhi Harmoko Saputro, Ph.D.

Djati Handoko, Ph.D.

Ariadne L. Juwono, Ph. D.

Handhika S. Ramadhan, Ph.D.

Imam Fachruddin, Dr.

Muhammad Aziz Majidi, Ph.D.

M. Syamsu Rosid, Dr.

Sastra Kusuma Wijaya, Dr.

Yunus Daud, Dr. Eng.

2. Graduate Profile

2.1. Vision

The Master Program in Physics vision is the vision of the Department of Physics Universitas Indonesia. The vision is

"To become a center for education and research in the field of Physics and Applied Physics that is superior and competitive and able to solve problems and challenges at the national and global levels, towards excellence in Southeast Asia."

2.2. Mission

The Master Program in Physics mission is the mission of the Department of Physics Universitas Indonesia. The mission is

1. To maintain and strengthen the excellence in education and research in Physics and Applied Physics.
2. To improve the internal management that can encourage the active and productive involvement of teaching staff/lecturers and students to increase scientific activities and scientific works in Physics and Applied Physics with national and international qualities.
3. To actively participate in providing services as a manifestation of the dedication and contribution of Physics and Applied Physics to the community.
4. To prepare graduates who are ready to compete in the global market.

2.3. Objective

The Master Program in Physics aims to prepare graduates to achieve the following criteria:

1. Teaching staff and researchers who can teach in undergraduate education programs in physics plan and carry out research in Physics and Applied Physics.
2. Researchers at research institutes who can design and carry out research in the field of Physics and Applied Physics.
3. Professionals or experts in academia/research, industry, hospitals and other multinational companies can learn and adapt quickly to the industrial work environment and solve problems in their work environment by applying physical science and scientific thinking.

2.4. Graduate Profile

Master Program in Physics graduates who can think critically and creatively with a vital mastery of physics to be able to contribute to solving science and technology problems on a national and international level, build professional careers in fields related to Physics or Applied Physics, as well as communicate and collaborate as citizens world.

2.5. Program Learning Outcomes (PLOs)

Master Program in Physics graduates have the following Program Learning Outcomes:

1. Able to conduct scientific research in one of the fields of Physics and Applied Physics (Competence - C)
2. Able to apply Physics and Applied Physics concepts in solving a problem (Knowledge -K)
3. Able to analyze issues comprehensively related to Physics and Applied Physics (C)
4. Able to formulate problems using Physics and Applied Physics methods to solve the cases in their work field (K)
5. Able to produce valuable products related to Physics and Applied Physics for contributing to the community (C)
6. Able to construct systematic reports and research manuscripts to be published in international or national publishers (C)
7. Able to present the results of work and research systematically in a global or national academic forum (Skill – S)

2.6. Learning Outcome Network

Figure 1 shows the learning outcome network for the Master Program in Physics.

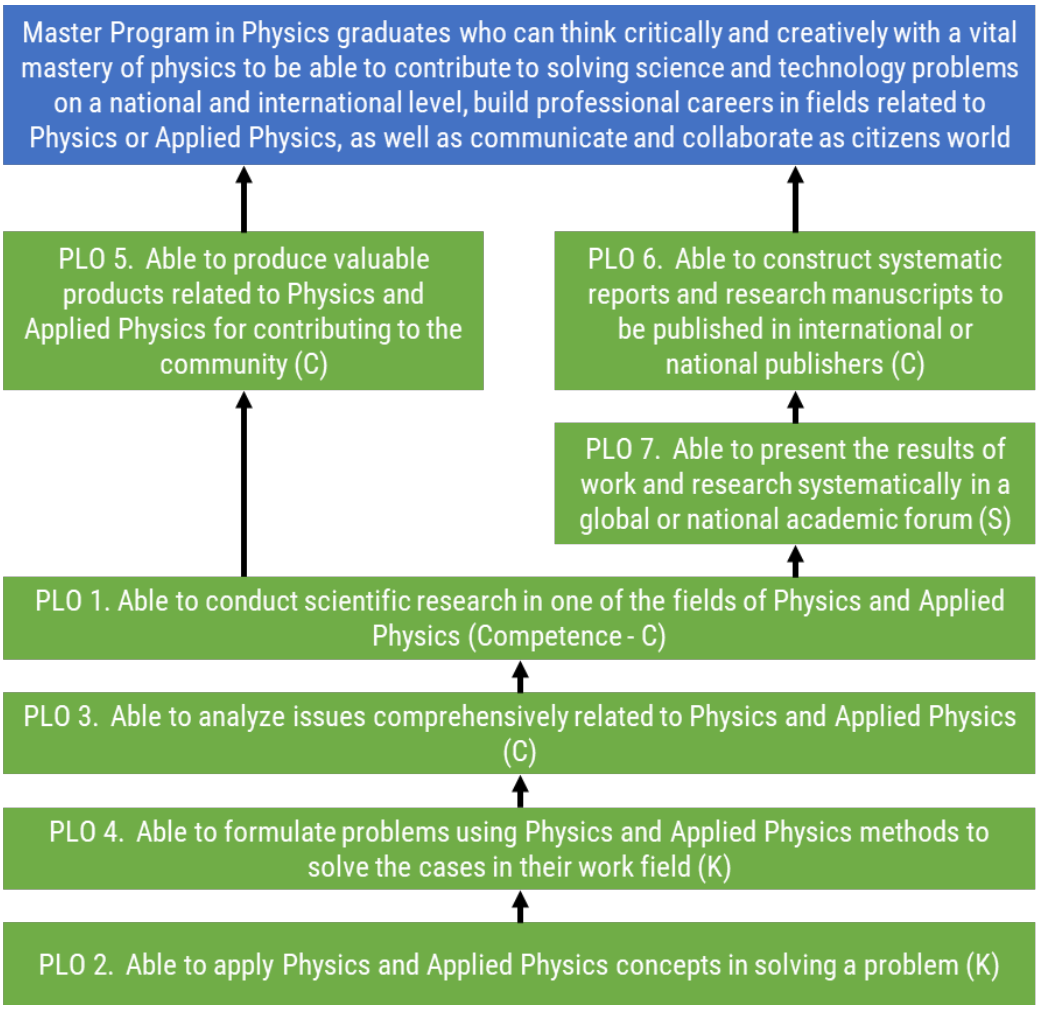


Figure 1. Main Program Learning Outcome Network

3. Structure and Curriculum Content

The Master Program in Physics is organized into two terms (semesters) per academic year, where one period typically spans 16 weeks of educational activities. To weigh the load of courses offered in a period, UI employs a credit unit system known as "SKS." One SKS is equivalent to a 1-hour (50-minute) lecture followed by 60 minutes of structured learning activity (e.g., assignments) and 60 minutes of independent learning activity per week.

3.1. Curriculum Structure

The Master Program in Physics is designed as a 2-year program (4 terms), obtaining 36 - 40 SKS. The Master Program in Physics curriculum consists of two programs: by-research and by-course. Figure 2 shows the Master Program in Physics by research, whereas Figure 3 shows the Master Program in Physics by course.

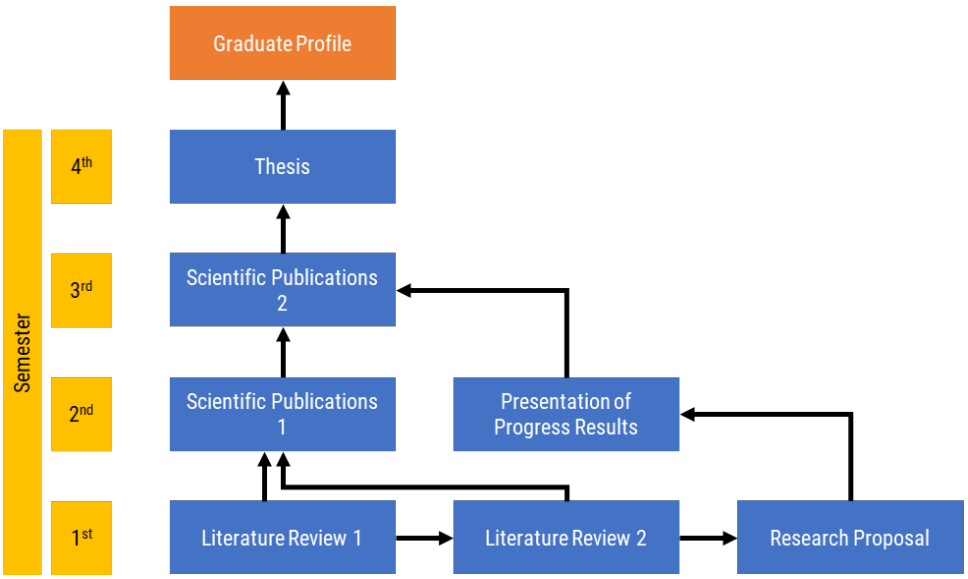


Figure 2. Curriculum Structure of Master Program in Physics by research

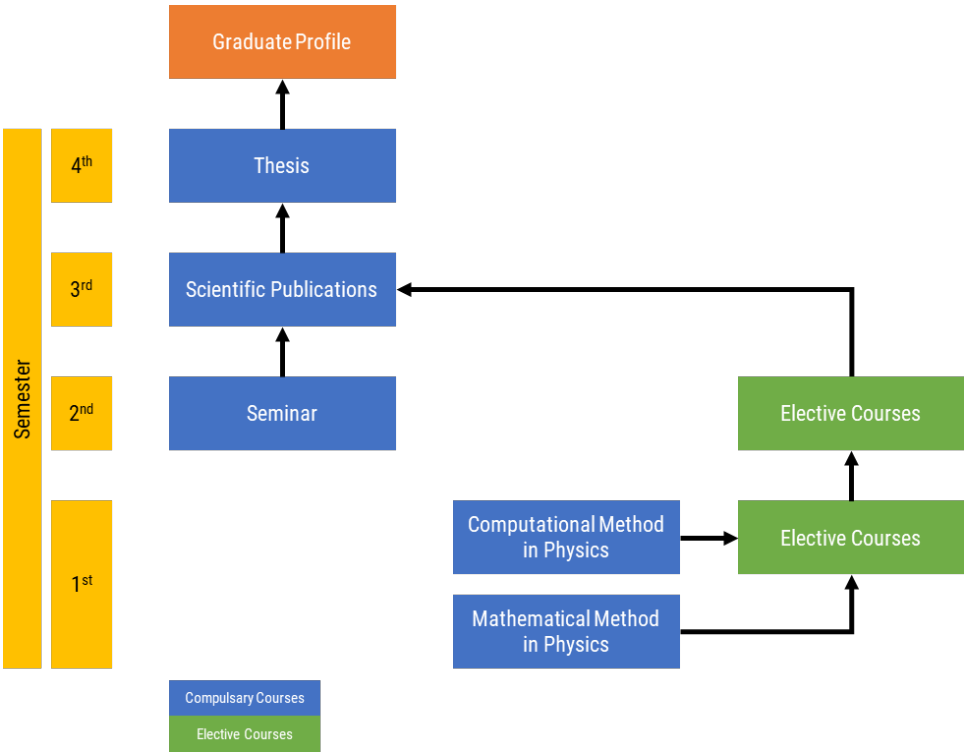


Figure 3. Curriculum Structure of Master Program in Physics by course

3.2. Main Competence Category

Learning Outcomes and its relation to KKNI Level 8 Subpoints

Table 1 shows Matrix 0, which describes learning outcomes correlated with KKNI Level 8.

Table 1. Matrix 0: KKNI Equivalent

KKNI	Description of KKNI (Level 8)	Graduate Profile / Competencies / Learning Outcomes / ELO	Bill
1.	Able to develop knowledge, technology, and/or art in their scientific fields or professional practice through research, to produce innovative and tested works.	Able to conduct scientific research in one of the fields of physics or its application Able to apply physics or its applications in solving work problems	Research Proposal Thesis Scientific Publications
2.	Able to solve problems in science, technology, and/or art in their scientific fields through an inter or multidisciplinary approach.	Able to analyze problems in the field of work related to physics or its application Able to formulate problems in the field of work related to physics or its applications	Research Proposal Thesis Scientific Publications
3.	Able to manage research and development that benefits society and science and get national and international recognition.	Able to make hardware or software products that the community can use Able to produce reports on work results and manuscripts of systematic research results to be published in	Research Proposal Thesis Scientific Publications

KKNI	Description of KKNI (Level 8)	Graduate Profile / Competencies / Learning Outcomes / ELO	Bill
		international, national, or proceedings journals Able to present the results of work and research systematically in front of the public	

Every graduate of the Master Program in Physics must have the following attitudes that follow the attitude formulation in Matrix 0A (SN DIKTI):

1. Be devoted to God Almighty and be able to show a religious mindset.
2. Upholding human values in carrying out duties based on religion, morals, and ethics.
3. Contribute to improving the quality of life in society, nation, state, and the progress of civilization based on Pancasila.
4. Act as proud citizens who love the homeland, have nationalism, and a sense of responsibility to the state and nation.
5. Respect the diversity of cultures, views, religions, and beliefs, as well as the original opinions or findings of others.
6. Work together and have social sensitivity and concern for the community and the environment.
7. Obey the law and discipline in social and state life.
8. Internalize academic values, norms, and ethics.
9. Demonstrate an attitude of responsibility for work in their field of expertise independently; and
10. Internalize the spirit of independence, struggle, and entrepreneurship.

Table 2 shows general skill formation comparing master degree skills (SN DIKTI) and general skills of a master of physics.

Table 2. General Skill Formation

No	Master Degree Skills (SN DIKTI)	General Skills of Master of Physics Level
1.	Able to develop logical, critical, systematic, and creative thinking through scientific research, the creation of designs or works of art in the fields of science and technology that pay attention to and apply humanities values following their areas of expertise, compile scientific conceptions and study results based on scientific rules, procedures, and ethics in the form of a thesis or other equivalent structures, and uploaded on the college website, as well as papers that have been published in accredited	Able to create and design new methods, new approaches and techniques, and new product innovations by paying attention to humanities values that benefit the development of materials science, industry, and society in general
		Able to make written reports and communicate effectively orally in scientific, industrial, and general public groups

No	Master Degree Skills (SN DIKTI)	General Skills of Master of Physics Level
	scientific journals or accepted in international journals	
2.	Able to carry out academic validation or studies according to their field of expertise in solving problems in the relevant community or industry through the development of their knowledge and expertise	Able to understand an integrated solution to any physical problem to critically examine the latest concept and innovations in physics and correlated technology
3.	Able to compile ideas, thoughts, and scientific arguments responsibly and based on academic ethics, and communicate them through the media to the academic community and the wider community	Able to design and implement experimental research methods and mathematical modeling that are responsible for academic ethics, analyze data critically and systematically and draw conclusions
4.	Able to identify the scientific field that is the object of his research and position it into a research map developed through an interdisciplinary or multidisciplinary approach	Able to identify and analyze problems in the field of physical science and able to compile scientifically responsible solution solutions by paying attention to ethics, environment, and socioeconomics
5.	Able to make decisions in the context of solving problems in the development of science and technology that pay attention to and apply humanities values based on analytical or experimental studies of information and data	Able to apply the concept of physical science in solving complex physics problems in any application and theoretical issues through a multidisciplinary approach that pays attention to safety, social and ethical aspects
6.	Able to manage, develop and maintain networks with colleagues, peers within the institution, and the wider research community	Able to function as effective team members together to create a collaborative and inclusive environment to achieve common goals
7.	Able to increase learning capacity independently	Able to increase learning capacity independently
8.	Able to document, store, secure, and rediscover research data to ensure validity and prevent plagiarism	Able to document, store, secure, and rediscover research data to ensure validity and prevent plagiarism

Matrix I: Group and Graduate Competency Level

Table 3 shows matrix 1, which describes the group and graduate competency levels.

Table 3. Matrix I: Group and Graduate Competency Level

State / Clump	Key Competencies	Supporting Competencies
Personality Development	Able to be responsible for academic ethics. Able to pay attention to humanities values that benefit the development of physical science, industry, and society in general.	Able to apply the main rules of other disciplines (C3)

State Clump	Key Competencies	Supporting Competencies
	Able to pay attention to other fields of science and safety, social and ethical aspects	Able to function as an effective team leader together, creating a collaborative and inclusive environment in achieving common goals (A5)
Work Behaviour	Able to identify and analyze problems in physics and its applications and compile solutions by paying attention to humanities values that are beneficial for the development of physical science, industry, and society in general	Able to detail general and specific problems in the field of physics and their application (C4)
		Able to make written reports and communicate orally effectively in scientific, industrial, and general public groups (C6)
	Able to design and implement experimental research methods and mathematical modeling responsible for academic ethics, analyze data critically and systematically and draw conclusions	Able to carry out various techniques and approaches to solve physical problems (P5)
		Able to evaluate data from experiments results (C5)
		Able to develop physical modeling using a numerical approach(P5)
Science and Expertise	Able to understand a comprehensive technique, approaches, methods, and performance of the proposed solution and critically examine the latest developments in knowledge science and technology	Able to string together relationships between the comprehensive technique, approaches, methods, and performance of the proposed solution in physics and its applications (C6)
		Able to select, organize and critically evaluate the latest sources of scientific information (C5)
		Able to apply the main rules of other disciplines (C3)
Craftsmanship	Able to create new techniques, methods, and approaches in physics and its application that are scientifically, ethically, environmentally, and socioeconomically responsible in solving scientific problems and physical industry applications	Able to create new techniques, methods, and approaches in physics and its application with the correct scientific method (C6)
Living in Society	Able to apply the concept of physics in solving complex physical application problems in industry and society by paying attention to other fields of science and safety, social and ethical aspects	Able to apply academic ethics, environmental safety, and socioeconomic impacts (C3)
		Able to function as effective team members together to create a collaborative and inclusive environment in achieving common goals (A5)

Matrix II: Learning Experience

Table 4 shows matrix two which explains the learning experience in the master program physics.

Table 4. Matrix II: Learning Experience

No	Competence	Learning Experience	Scope	Media and Technology	Courses	Indicator	Assessment
1.	Able to understand a comprehensive technique, approaches, methods, and performance of the proposed solution and critically examine the latest developments in knowledge science and technology Able to identify and analyze problems in physics and its applications and compile solutions by paying attention to humanities values that are beneficial for the development of physical science, industry, and society in general	Able to select scientific articles related to research topics (C4) Able to assess and compare the content of scientific articles (C5) Able to compile various scientific articles into reports on the results of literature reviews (C6)	Breadth and depth of research topics, mastery of the physics, scientific systematics, and scientific attitude	Computer LCD Internet	By Course Track: Thesis By Research Track: Literature Review 1 Literature Review 2	Able to conduct a systematic literature review to prepare research proposals. Able to display the results of literature reviews with an excellent scientific attitude. Able to make scientific papers.	Presentations Scientific Papers
2.	Able to design and implement experimental research	Analyzing problems that occur, compiling solution plans based on	Contents of the proposal: background,	Computer LCD	By Course Track: Seminar	Able to make research proposals that are	Presentations Research proposals

No	Competence	Learning Experience	Scope	Media and Technology	Courses	Indicator	Assessment
	methods and mathematical modeling that are ethically responsible for academic ethics.	the results of literature reviews, analyzing research facilities and infrastructure, and making and presenting research proposals (C4)	problem formulation, hypothesis, goals, update, experimental methods. Mastery of proposal: scientific attitude, the skill of discussion, research readiness, potential publications	Internet	By Research Track: Proposal	clear, effective, and meet scientific principles. Able to explain and argue the feasibility of the research submitted.	
3.	Able to design and implement experimental research methods and mathematical modeling responsible for academic ethics, analyze data critically and systematically and draw conclusions	Able to apply the scientific method in conducting independent research (C3) Able to collect, compile and analyze characterization result data (C4)	A framework of thought, methodology, literature review, results, data analysis, sharpness, and conclusion. Presentation and mastery of the physics. Potential continuation of research.	Computer LCD Internet	By Course Track: Thesis By Research Track: Thesis	Able to display and study research data effectively. Able to discuss scientific: interpretation analysis, argumentation logic, and consistency of thought. Able to continue research to achieve the ultimate research goal.	Presentations Research reports

No	Competence	Learning Experience	Scope	Media and Technology	Courses	Indicator	Assessment
4.	Able to communicate and disseminate research results in scientific events.	Able to make scientific papers according to ethics and writing formats (C6) Able to explain research results to scientific and professional groups (C2)	Abstracts, article frameworks, research methods, results and discussions, conclusions and suggestions, bibliography.	Computer LCD Internet	By Course Track: Scientific Publication By Research Track: Scientific Publication 1 and 2	Able to produce scientific papers worthy of publication in conference proceedings, accredited journals, or international journals.	Publishing status and classification of journals
5.	Able to understand a comprehensive technique, approaches, methods, and performance of the proposed solution and critically examine the latest developments in knowledge science and technology Able to identify and analyze problems in physics and its applications and compile solutions Able to create new techniques, methods, and approaches in physics and its application that are	Able to analyze the problems that occur, draw up a solution plan (C4) Able to implement the principles of physics in the proposal logically and systematically and propose practical solutions using the scientific method (C3) Able to present research reports in scientific discussion (C2) Abe to prepare a thesis as a case study report or the student final project (C6)	The content of scientific documents, how to write scientific papers, presentation materials, scientific attitudes, mastery of the material, and scientific discussion.	Computer LCD Internet	By Course Track: Thesis By Research Track: Thesis	Able to compile and summarize the theories, data, and analysis of research results and conclusions in a thesis that meets scientific rules and ethics. Able to disseminate research materials with an excellent scientific attitude.	Thesis Presentation

No	Competence	Learning Experience	Scope	Media and Technology	Courses	Indicator	Assessment
	scientifically, ethically, environmentally, and socioeconomically responsible in solving scientific problems and physical industry applications Able to apply the concept of physics in solving complex physical application problems in industry and society by paying attention to other fields of science and safety, social and ethical aspects						
6.	Able to design and implement experimental research methods and mathematical modeling responsible for academic ethics, analyze data critically and systematically and draw conclusions	Able to understand the basic concepts of numerical methods (C2) Able to apply numerical methods in the case of computation of a particular physics problem and case (C3)	System of linear equations, Regression Method, Interpolation Method, Differential and Integral Numerical Methods, Ordinary differential equations (PDB), Partial differential equations (PDP), Fast Fourier Transform (FFT), Random Numbers	Face-to-face lectures, Demonstrations, LCD, ICT	By Course Track: Computational Method in Physics	Able to understand the basic concepts of numerical methods Able to apply numerical methods when computing a particular physics problem and case.	Exam Results and Reports

No	Competence	Learning Experience	Scope	Media and Technology	Courses	Indicator	Assessment
7.	Able to design and implement experimental research methods and mathematical modeling responsible for academic ethics, analyze data critically and systematically and draw conclusions	Able to understand the basic concepts of numerical methods (C2) Able to apply basic methods in the case of computation of a particular physics problem and case (C3)	Complex analysis, vector and tensor analysis, ordinary differential equations, partial differential equations, integral equations, integral transformations, and calculus of variations.	Face-to-face lectures, Demonstrations, LCD, ICT	By Course Track: Mathematical Method in Physics	Able to understand the basic concepts of mathematical methods Able to apply mathematical methods when solving a particular physics problem and case.	Exam Results and Reports
8.	Able to create new techniques, methods, and approaches in physics and its application that are scientifically, ethically, environmentally, and socioeconomically responsible in solving scientific problems and physical industry applications Able to apply the concept of physics in solving complex physical application problems in industry and society by paying attention to other	Able to understand the advanced concepts of physics and their application in various specializations such as Nuclear Physics, Particles, and Theoretical Astrophysics, Condensed Matter Physics, Instrumentation Physics, Reservoir Geophysics, and Geothermal Exploration (C2) Able to apply advanced methods in the case of finding a comprehensive solution in a particular	Specializations in physics and their application.	Face-to-face lectures, Demonstrations, LCD, ICT	By Course Track: Statistical Mechanics Quantum Mechanics Symmetry, Energy Bands and Phonons Electromagnetism in Solids Advanced Spectroscopy Special Topics in Condensed Matter Physics Analytical Dynamics	Able to understand the advanced concepts of physics and their application in various specializations Able to apply advanced methods in the case of finding a comprehensive solution to a particular physics problem and case	Exam Results and Reports

No	Competence	Learning Experience	Scope	Media and Technology	Courses	Indicator	Assessment
	fields of science and safety, social and ethical aspects	physics problem and case (C3)			Angular Momentum Theory Relativistic Quantum Field Theory General Relativity and Intro to Astrophysics Measurement Method and Sensor Technology Signal Processing Data Analysis Embedded Instrumentation Instrumentation System Virtual Instrumentation Intelligent Instrumentation Image processing Process Control Structural Geology and Seismic Interpretation Oil Geology Sedimentology		

No	Competence	Learning Experience	Scope	Media and Technology	Courses	Indicator	Assessment
					Seismic Data Processing and Interpretation Well Log Analysis and Formation Evaluation Reservoir Engineering Seismic Stratigraphy and Sequence Geostatistics Geopotential Method Geothermal Systems & Technology Geothermal Geology Geothermal Geochemistry Geothermal Geophysics 1 Geothermal Geophysics 2 Geothermal Drilling Geothermal Reservoir Engineering		

No	Competence	Learning Experience	Scope	Media and Technology	Courses	Indicator	Assessment
					Geothermal Project Evaluation Geothermal Economics & Management		

3.3. Curriculum Detail

Distribution of Courses in 4 Semesters

The courses listed in Table 5 are required to obtain the Master Program in Physics (MPPh) by research. Table 6, Table 7, Table 8, Table 9, and Table 10 show the course list required for obtaining the Master Program in Physics (MPPh) by course with Nuclear Physics, Particles, and Theoretical Astrophysics, Condensed Matter Physics, Instrumentation Physics, Reservoir Geophysics, and Geothermal Exploration Specialization, respectively.

Table 5. The Curriculum of MPPh by research

1st Semester		
Code	**Course Name**	**SKS**
SCPH801001	Literature Review 1	4
SCPH801002	Literature Review 2	4
SCPH801003	Research Proposal	4
	Total	**12**

2nd semester		
Kode	**Course Name**	**SKS**
SCPH801004	Scientific Publications 1	2
SCPH801005	Presentation of Progress Results	6
	Total	**8**

3rd semester		
Kode	**Course Name**	**SKS**
SCPH801006	Scientific Publications 2	8
	Total	**8**

4th semester		
Kode	**Course Name**	**SKS**
SCPH801007	Thesis	8
	Total	**8**

Table 6. The Curriculum of MPPh by course with Nuclear Physics, Particles, and Theoretical Astrophysics Specialization

1st Semester		
Kode	**Course Name**	**SKS**
SCPH802811	Mathematical Method in Physics	3
SCPH802802	Computational Method in Physics	3
SCPH802101	Statistical Mechanics	3
SCPH802201	Quantum Mechanics	3
SCPH802202	Analytical Dynamics	3

1st Semester		
Kode	**Course Name**	**SKS**
	Total	**15**

2nd semester		
Kode	**Course Name**	**SKS**
SCPH802203	Angular Momentum Theory	2
SCPH802204	Relativistic Quantum Field Theory	4
SCPH802205	General Relativity and Introduction to Astrophysics	3
SCPH802805	Seminar	2
	Total	**11**

3rd semester		
Kode	**Course Name**	**SKS**
SCPH801004	Scientific Publications	2
	Total	**2**

4th semester		
Kode	**Course Name**	**SKS**
SCPH801007	Thesis	8
	Total	**8**

Table 7. The Curriculum of MPPh by course with Condensed Matter Physics Specialization

1st Semester		
Kode	**Course Name**	**SKS**
SCPH802811	Mathematical Method in Physics	3
SCPH802802	Computational Method in Physics	3
SCPH802101	Statistical Mechanics	3
SCPH802201	Quantum Mechanics	3
	Total	**12**

2nd semester		
Kode	**Course Name**	**SKS**
SCPH802112	Symmetry, Energy Bands and Phonons	3
SCPH802113	Electromagnetism in Solids	3
SCPH802103	Advanced Spectroscopy	3
SCPH802104	Special Topics	3
SCPH802805	Seminar	2
	Total	**11**

3rd semester		
Kode	**Course Name**	**SKS**
SCPH801004	Scientific Publications	2
	Total	**2**

4th semester		
Kode	**Course Name**	**SKS**
SCPH801007	Thesis	8
	Total	**8**

Table 8. The Curriculum of MPPh by course with Instrumentation Physics Specialization

1st Semester		
Kode	**Course Name**	**SKS**
SCPH802811	Mathematical Method in Physics	3
SCPH802802	Computational Method in Physics	3
SCPH802311	Measurement Method and Sensor Technology	2
SCPH802316	Signal Processing	2
SCPH802317	Data Analysis	2
	Total	**12**

2nd semester		
Kode	**Course Name**	**SKS**
SCPH802312	Embedded Instrumentation	2
SCPH802313	Instrumentation System	2
SCPH802314	Virtual Instrumentation	2
SCPH802315	Intelligent Instrumentation	2
SCPH802316	Image processing	2
SCPH802319	Process Control	2
SCPH802805	Seminar	2
	Total	**14**

3rd semester		
Kode	**Course Name**	**SKS**
SCPH801004	Scientific Publications	2
	Total	**2**

4th semester		
Kode	**Course Name**	**SKS**
SCPH801007	Thesis	8
	Total	**8**

Table 9. The Curriculum of MPPh by course with Reservoir Geophysics Specialization

1st Semester		
Kode	**Course Name**	**SKS**
SCPH802811	Mathematical Method in Physics	3
SCPH802802	Computational Method in Physics	3
SCPH802511	Structural Geology and Seismic Interpretation	2
SCPH802504	Oil Geology	2
SCPH802506	Sedimentology	2
SCPH802508	Seismic Data Processing and Interpretation	2
	Total	**14**

2nd semester		
Kode	**Course Name**	**SKS**
SCPH802502	Well Log Analysis and Formation Evaluation	2
SCPH802503	Reservoir Engineering	2
SCPH802505	Seismic Stratigraphy and Sequence	2
SCPH802507	Geostatistics	2
SCPH802509	Geopotential Method	2
SCPH802805	Seminar	2
	Total	**12**

3rd semester		
Kode	**Course Name**	**SKS**
SCPH801004	Scientific Publications	2
	Total	**2**

4th semester		
Kode	**Course Name**	**SKS**
SCPH801007	Thesis	8
	Total	**8**

Table 10. The Curriculum of MPPh by course with Geothermal Exploration Specialization

1st Semester		
Kode	**Course Name**	**SKS**
SCPH802811	Mathematical Method in Physics	3
SCPH802802	Computational Method in Physics	3
SCPH802511	Structural Geology and Seismic Interpretation	2
SCPH802504	Oil Geology	2

SCPH802506	Sedimentology	2
SCPH802508	Seismic Data Processing and Interpretation	2
	Total	**14**

2nd semester		
Kode	**Course Name**	**SKS**
SCPH802502	Well Log Analysis and Formation Evaluation	2
SCPH802503	Reservoir Engineering	2
SCPH802505	Seismic Stratigraphy and Sequence	2
SCPH802507	Geostatistics	2
SCPH802509	Geopotential Method	2
SCPH802805	Seminar	2
	Total	**12**

3rd semester		
Kode	**Course Name**	**SKS**
SCPH801004	Scientific Publications	2
	Total	**2**

4th semester		
Kode	**Course Name**	**SKS**
SCPH801007	Thesis	8
	Total	**8**

3.4. Syllabus

Literature Review 1

Course Code	SCPH801001
SKS	4
Semester	1
Description	Literature Review Course 1 is a course that contains presentation activities to explore one research topic in preparation for making a research proposal. Students are required to search, read and analyze scientific publications in reputable journals, prepare research designs starting from determining the title, problem, background, literature review, and research methods, present the research design and have regular scientific discussions. The subjects in this course include the breadth and depth of research topics, mastery of material and scientific systematics. Scientific attitude in analyzing specific research topics with good scientific systematics.
Reference	1. Hanburry Brown, AC, FRS. (1986). The Wisdom of Science : its relevance to Culture and Reigion. London : Cambridge University Press.

	2. Hawryszkiewycz, I,T. (1984). Database Analysis and Design. Chicago: SRA, INC. 3. Geoff, P and Judy, P. (2004). Key Concepts in Social Research. London: Sage. 4. Sandra lach, A. (1995). Practical Handbook of Spatial Statistics. New York: CRC Press

Literature Review 2

Course Code	SCPH801002
SKS	4
Semester	1
Description	Literature Review Course 2 is a course that contains student activities to produce literature review papers. Students must be able to make presentations for the results of literature review papers and will be tested by two examiners. The subjects in this course include the breadth and depth of research topics, mastery of material and scientific systematics. Scientific attitude in analyzing specific research topics with good scientific systematics at the time of presentation
Reference	1. Hanburry Brown, AC, FRS. (1986). The Wisdom of Science : its relevance to Culture and Reigion. London : Cambridge University Press. 2. Hawryszkiewycz, I,T. (1984). Database Analysis and Design. Chicago: SRA, INC. 3. Geoff, P and Judy, P. (2004). Key Concepts in Social Research. London: Sage. Sandra lach, A. (1995). Practical Handbook of Spatial Statistics. New York: CRC Press

Research Proposal

Course Code	SCPH801003
SKS	4
Semester	1
Description	After following this course, based on the results of the study and the research design made, students are expected to be able to analyze one of the problems to be solved, as well as formulate and define the problem, collect hypotheses, determine data collection methods, data processing, and data analysis to conduct research that then written in the research proposal, and presented it in front of the examiners. This course is delivered in Indonesian using online methods for confirmation and consultation, as well as offline for presentations.
Reference	1. Hanburry Brown, AC, FRS. (1986). The Wisdom of Science : its relevance to Culture and Reigion. London : Cambridge University Press. 2. Hawryszkiewycz, I,T. (1984). Database Analysis and Design. Chicago: SRA, INC.

Scientific Publications 1

Course Code	SCPH801004

SKS	2
Semester	2
Description	Scientific Publication 1 is a study that examines the stages in scientific publication activities, starting with literature search activities, collecting material to be conveyed, making article frameworks and abstracts, processing and analyzing data from final project activities carried out by referring to literature, following the format of writing and submitting procedures as the main author at scientific conferences and published in the minimum proceedings of national conferences with ISBN. The subject matter in this course includes uploading scientific papers composed of abstracts, article frameworks, research methods, results and discussions, conclusions and suggestions, bibliography.
Reference	1. Hanburry Brown, AC, FRS. (1986). The Wisdom of Science : its relevance to Culture and Reigion. London : Cambridge University Press. 2. Hawryszkiewycz, I,T. (1984). Database Analysis and Design. Chicago: SRA,INC.

Scientific Publications 2

Course Code	SCPH801006
SKS	8
Semester	3
Description	Scientific Publication 2 is a study that examines the stages in scientific publication activities starting with literature search activities, collecting material to be conveyed, making article frameworks, abstracts, processing and analyzing data from final project activities carried out by referring to the literature, following the writing format and submitting procedure as the main author accompanied by a supervisor who is accepted at a minimum of a national journal with a SINTA category of 3 or higher, or a minimum of DOAJ indexed international journals. The main topics in this course include uploading scientific papers composed of abstracts, article frameworks, research methods, results and discussions, conclusions and suggestions, bibliography
Reference	1. Hanburry Brown, AC, FRS. (1986). The Wisdom of Science: its relevance to Culture and Reigion. London: Cambridge University Press. 2. Hawryszkiewycz, I,T. (1984). Database Analysis and Design. Chicago: SRA,INC. 3. Geoff, P and Judy, P. (2004). Key Concepts in Social Research. London: Sage. 4. Sandra lach, A. (1995). Practical Handbook of Spatial Statistics. New York: CRC Press

Presentation of Progress Results

Course Code	SCPH801005
SKS	6
Semester	3
Description	Research Results Examination Course is a study that examines the research process carried out. Students will present the results of their research, draw temporary

	conclusions and plan further research. The subject matter in this course includes the framework of thought, methodology, and literature review. The results, the data analysis's sharpness, and the concluding stability. Presentation and mastery of the material and the potential for further research.
Reference	1. Hanburry Brown, AC, FRS. (1986). The Wisdom of Science: its relevance to Culture and Reigion. London: Cambridge University Press. 2. Hawryszkiewycz, I,T. (1984). Database Analysis and Design. Chicago: SRA,INC. 3. Geoff, P and Judy, P. (2004). Key Concepts in Social Research. London: Sage. 4. Sandra lach, A. (1995). Practical Handbook of Spatial Statistics. New York: CRC Press

Mathematical Method in Physics

Course Code	SCPH802811
SKS	3
Semester	1
Description	The Mathematical Methods Course's objective is that students can apply analytical methods in solving physics problems. The topics covered include complex analysis, vector and tensor analysis, ordinary differential equations, partial differential equations, integral equations, integral transformations, and calculus of variations.
Reference	1. G. B. Arfken and H.J. Weber, Mathematical Methods for Physicists, 6th Ed., Elsevier Academic Press, 2005. 2. M.L. Boas, Mathematical Methods in the Physical Sciences, 3rd Rd, John Wiley and Sons, 2006

Computational Method in Physics

Course Code	SCPH802802
SKS	3
Semester	1
Description	The computational methods course studies physics and its application in solving work problems. In addition, numerical methods are applied to solve physics problems. The language of instruction used is English. The pulpit lecture method is used in this study.
Reference	1. P. L. DeVries, A First Course in Computational Physics, John Wiley &Sons, Inc., New York, 1994. 2. W. H. Press, et al., Numerical Recipes in Fortran 77, 2nd Ed., Cambridge University Press, New York, 1992 3. M. Metcalf & J. Reid, Fortran 90/95 Explained, Oxford University Press, New York, 1998.

Statistical Mechanics

Course Code	SCPH802101

SKS	3
Semester	1
Description	The Statistical Mechanics course aims to explain the microscopic modeling behind the principle and macroscopic phenomena of thermodynamics, including kinetic theory, classical statistical mechanics, statistical ensembles, partition functions, quantum statistical mechanics, partition functions, fermion systems, and boson systems. The topics covered include the laws of thermodynamics, kinetic theory, equilibrium, transport phenomena, classical statistical mechanics, canonical ensemble, grand canonical ensemble, partition functions, approximation methods, quantum statistical mechanics, partition functions, fermion systems, boson systems, and other topics. Specialized in statistical mechanics
Reference	1. Kerson Huang, Statistical mechanics, Wiley, 1987 2. F. Reif, Fundamentals of Statistical and Thermal Physics thermodynamics, Kinetic Theory, and Statistical Thermodynamics, McGraw-Hill Book Company, 1985

Quantum Mechanics

Course Code	SCPH802201
SKS	3
Semester	1
Description	Understand the basic concepts of quantum mechanics, quantum dynamics, angular momentum theory, symmetry in quantum mechanics, approximation methods, identical particles, and scattering theory, and be able to use them in applications in the microscopic area. Topics covered include Stern-Gerlach experimental analysis, Dirac notation, wave equations, Schrodinger equations, Heisenberg representations, harmonic oscillators, Feynman path integrals, angular momentum theory, translational symmetry, inversion of space and time inversion, perturbation theory, hydrogen-like atoms, interactions with radiation fields, energy shifts, permutation symmetry, two-electron systems, helium atoms, scattering theory.
Reference	1. Sakurai, J. J., Modern Quantum Mechanics, Add. Wesley, 1994 2. Desai, B.P., Quantum Mechanics with Basic Field Theory, Cambridge University Press, 2010 3. Gasiorowicz, Quantum Physics, John Wiley, 2003 4. Griffiths, D. J., Introduction to Quantum Mechanics, Prentice Hall, 1995

Analytical Dynamics

Course Code	SCPH802202
SKS	3
Semester	1
Description	The objective of the Analytical Dynamics course is to apply Lagrangian and Hamiltonian formalisms in analyzing classical dynamic systems, both relativistic and non-relativistic. The topics covered include a review of Newtonian mechanics, D'Alembert's Principle, Principle of Minimum Action, Euler-Lagrange Equation, Conservation Theorem, Central Force Problems, Multiparticle System Dynamics,

	Kinematics and Dynamics of Rigid Body Motion, Hamilton Equations, Hamilton-Jacobi Theory, Kinematics, and Relativistic Dynamics, Covariance Lagrangian Formulation
Reference	1. Goldstein, C. Poole, and J. Safko, Classical Mechanics, 3rd Ed, Addison Wesley, 2000. 2. L.D. Landau and E.M. Lifshitz, Mechanics, 3rd Ed., Butterworth-Heinenann, 2000. 3. W. Greiner, Classical Mechanics: Point Particles and Relativity, Springer, 1989. 4. W. Greiner, Classical Mechanics: Systems of Particles and Hamiltonian Dynamics, 2nd Ed., Springer, 2010. 5. A.L. Fetter and J.D. Walecka, Theoretical Mechanics of Particles and Continua, Dover Publications, New York, 2003

Measurement Method and Sensor Technology

Course Code	SCPH802311
SKS	2
Semester	1
Description	The measurement method and sensor technology course conducts an in-depth analysis of the concepts and principles of technology measurement methods on sensors, actuators, and signal conditioners. This course discusses digital techniques in measurement mechanisms and can process data to obtain the expected physical quantities. The course consists of Measurement Instrumentation System, Noise and Coherence in Measurement, Physical Principles in detecting physical quantities/stimulus, Measurement methods (Basic Method, Difference Method, Zero Method, Substitution Method, Exchange Method), Sensor Technology (Measurement sensor), Mechanics, Temperature Sensors, Biological and Chemical Sensors, Optical Sensors, Electrical, and Magnetic Sensors, Radiation Sensors), Actuator Technology (Stepper motors, Continuous drive actuators, Electropneumatic and Piezoelectric), Signal Conditioning, Digital Engineering in Mechanisms of Measurement, Display and Data Processing. The language of instruction used is Indonesian. The Student Center Learning method is used in this study.
Reference	1. Robert B. Northrop, Introduction to Instrumentation and Measurements, CRC Press, Taylor Francis Group 2ed, 2005 2. Clarence W. De Silva., Sensors and Actuators - Control Systems Instrumentation, CRC Press, 2007. 3. Alan S Morris, Measurement and Instrumentation Principles, Butterworth-Heinemann, 2001. 4. Webster, John G., Measurement, Instrumentation and Sensors Handbook, CRC Press, 2ed 2014. 5. Fraden, J., GAIP Handbook of Modern Sensors, Physics, Designs and Applications, J American Institute of Physics, 2004. 6. Nathan Ida, Sensors, Actuators, and Their Interfaces, The Institution of Engineering and Technology, London, UK, 2ed , 2020 7. Beckwith, T. G. , Marangoni, R. D. dan J. H. Lienhard V, Mechanical Malan easurements (I. Fundamentals of Mechanical Measurement, II. Applied Mechanical Measurements), Addison-Wesley Publishing Company, 6ed , 2006.

Signal Processing

Course Code	SCPH802316
SKS	2
Semester	1
Description	The Signal Processing course conducts an in-depth analysis of the concept and application of signal processing through a review of scientific literature, provides criticism, and proposes developing a Signal Processing design using more advanced methods. The course discusses the concepts and methods of Signal Processing and its application in physical instrumentation. Signal Processing Methods and Techniques covered include discrete signal transformation, Z transformation, signal filter, FIR and IIR filter design, adaptive filter, quantitation and compression, 2D signal processing, and software and hardware. The language of instruction used is Indonesian. The Student Center Learning method is used in this study.
Reference	1. Lizhe Tan, Jean Jiang, Digital Signal Processing, Fundamentals and Applications 3rd, Academic Press, 2019 2. Robert J. Schilling and Sandra L. Harris, Digital Signal Processing Using MATLAB® Third Edition, Cengage Learning, 2017 3. Vinay K. Ingle, John G. Proakis, Digital Signal Processing Using MATLAB® 4th Edition, Cengage Learning, 2015 4. Dimitris G. Manolakis, Vinay K. Ingle, Applied Digital Signal Processing, Cambridge University Press, 2011 5. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, Gatesmark Publishing, 2009

Data Analysis

Course Code	SCPH802317
SKS	2
Semester	1
Description	The Data Analysis course applies data analysis and visualization methods to find information, patterns and relationships contained in it. This course discusses data transformation, data cleaning, handling lost data, extracting patterns and relationships in data, visualization; linear dimensionality reduction: principal component analysis (PCA), singular value decomposition (SVD), Fischer's linear discriminant, nearest neighbor approach, maximum likelihood approach; nonlinear dimensionality reduction: multidimensional scaling, manifold learning, artificial neural network approach, stochastic neighbor embedding; data inspection methods: interpolation, projection, Posse chi-square index, moment index, independent component analysis (ICA); clustering: hierarchical, k-means, spectral, minimum spanning tree, model-based clustering; smoothing of scatter plots; visualization of clusters; visualization of data distribution forms; multivariate data visualization; data visualization in the form of categories.
Reference	1. W.L.Martinez, A.R.Martinez and J.L. Solka, Exploratory Data Analysis with Matlab, 3rd edition, CRC Press, 2017. 2. G.J.Myatt, W.P.Johnson, Making Sense of Data, 2nd edition, Wiley, 2007

Structural Geology and Seismic Interpretation

Course Code	SCPH802511
SKS	2
Semester	1
Description	Structural geology and seismic interpretation courses study structural geology and its reciprocal relationship with seismic reflection interpretation in oil and gas exploration and exploitation. The topics discussed related to geological structures, fractures, and faults, principles of folds and fault associations, geotectonic and basin structures, basic knowledge of seismic waves, seismic data collection and processing, seismic "trace" anatomy, reflectors and correlations, basics of basic interpretation and procedures, as well as seismic and geological interpretation. The language of instruction used in this course is English and Indonesian
Reference	1. Davis, G. H. and Reynolds, S. J., 1996, Structural Geology of Rock and Regions : 2nd edition, John and Wiley and Sons, Inc., 776 p. 2. Fossen, H.,2010: Structural Geology: CAMBRIDGE UNIVERSITY PRESS 3. Keary, P., and Vine, F. J., 1990, Global Tectonics; Blackwell Scientific Pub. 4. Lowell, J. D., 1985, Structural Styles in Petroleum Exploration: OGCI Publication, 480 p 5. Park, R. G., 1988, Geological Structures and Moving Plates: Blackie, Glasgow and London, 337 p 6. Sharma, PV, 1990, Geophysical Methods in Geology, 2nd, Elsevier 7. Sheriff, RE, 1995, Encyclopedic Dictionary of Exploration Geophysics, 3th ed, SEG 8. Suppe, J., 1985, Principles of Structural Geology: Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 537p 9. Telford, WM., Geldart, LPm, Sherriff, RE., 1990, Applied Geophysics, 2nd ed, Cambridge University Press. 10. Twiss, R. J., and Moores, E. M., 1992, Structural Geology: W. H. Freeman and Company, New York, 532 p 11. Zhou, H.W.,2014. Practical Seismic Data Analysis. Cambridge University Press

Oil Geology

Course Code	SCPH802504
SKS	2
Semester	1
Description	The Oil Geology course provides knowledge and understanding of the "petroleum system" and the geological concepts that control the existing oil and gas system associated with understanding the configuration of the basin. Oil Geology covered includes reservoirs, seal rocks, source rocks, trapping systems and migration systems that work in the oil and gas system; several workshops covering the interpretation of structure and stratigraphy, direct hydrocarbon indication, forward and backward seismic modeling, as well as final projects for the assessment of an area of oil and gas potential. The language of instruction used is Indonesian. The learning method used in this course is Problem-based Learning/Project-based Learning/Collaborative Learning/Active Learning.
Reference	1. Selley, R.C., Elements of Petroleum Geology, Academic Press inc., 1997.

	2. North, FK, Petroleum Geology, Routledge, 1985. 3. Journal and Proceeding Seminars

Sedimentology

Course Code	SCPH802506
SKS	2
Semester	1
Description	Sedimentology courses study and apply the basic concepts of sedimentology, including lithostratigraphy and biostratigraphy, covering how rocks are formed, especially sedimentary rocks, sedimentary rocks, sedimentary rock-forming materials, modes of transportation and deposition, sedimentary structures, diagenetic processes, and depositional environments. Another thing is the role of sedimentary rock as source rock, reservoir rock, and cover or seal layer in the petroleum system as well as its role in hydrocarbon exploration and production activities. The language of instruction used in this course is Indonesian.
Reference	1. Boggs, S., Jr 1995, Principles of Sedimentology and Stratigraphy 2nd., Prentice hall, Inc. 2. Selley, R. C., 1992, Applied Sedimentology, Academic Press, 2nd printing. 3. Scholle, P. A., and Spearing, 1982, Sandstone Depositional Environment, The American Association of Petroleum Geologists

Seismic Data Processing and Interpretation

Course Code	SCPH802508
SKS	2
Semester	1
Description	The application of analytical tools in seismic data processing ensures that the data is processed using the proper methods and techniques so that the final results can be used optimally for qualitative and quantitative interpretation purposes. Studies in this course include data analysis, frequency, amplitude, phase, and geometry, and the advantages and limitations of each tool in data processing. An understanding of the concept of imaging is also studied in this course, including the role of speed in imaging.
Reference	1. Yilmaz, O., Seismic Data Analysis, Society of Exploration Geophysicist, 2001 2. Sheriff, R.E., Encyclopedic Dictionary of Applied Geophysics, Society of Exploration Geophysicist, 2002

Geothermal Systems & Technology

Course Code	SCPH802611
SKS	2
Semester	1
Description	The course studies the definition of geothermal systems, types/types of systems, manifestations, geothermal resources in Indonesia, exploration, and exploitation

	(production) technology, as well as environmental aspects and regulations for geothermal development in Indonesia. The course consists of Definition/definition of geothermal systems, Plate tectonics, and geothermal system formation, Type/type of geothermal system, Types of surface manifestations of geothermal systems, Stages of developing geothermal energy, and introduction to geothermal technology (exploration, production, monitoring), the introduction of environmental aspects in the development of geothermal energy, and introduction of regulatory aspects that apply in the development of geothermal energy.
Reference	1. Harvey, C. And Beardsmore, G., Geothermal Exploration – Global Strategies and Applications, IGA Academy Books, 2016. 2. DiPippo, R., Geothermal Power Plants (2nd edition): Principles, Applications, Case Studies, and Environmental Impact. Amazon, 2008. 3. Saptadji, N., Teknik Geotermal. Penerbit ITB, 2019.

Geothermal Geology

Course Code	SCPH802602
SKS	2
Semester	1
Description	The Geothermal Geology course studies tectonic concepts, volcanism, geothermal system formation, geological survey methods for geothermal exploration: Remote Sensing data analysis, field survey methods, rock sample analysis, geological and structural map making, geological modeling of geothermal systems, and case studies. The language of instruction used is Indonesian.
Reference	1. Harvey, C. And Beardsmore, G., Geothermal Exploration – Global Strategies and Applications, IGA Academy Books, 2016. 2. Boden, D.R., Geologic Fundamentals of Geothermal Energy. CRC Press, 2017. 3. Chandrashekaram, D., Low-Enthalpy Geothermal Resources for Power Generation, Taylor and Francis Group, 2008.

Geothermal Geochemistry

Course Code	SCPH802603
SKS	2
Semester	1
Description	Geothermal geochemistry course studies the origin of geothermal fluids, types and composition of geothermal fluids, fluid and gas sampling techniques, fluid and isotope sample analysis techniques, interpretation of geochemical data, hydrology, and geochemical modeling of geothermal systems. The language of instruction used in this course is Indonesian.
Reference	1. Atkins, Peter, Julio De Paula, and James Keeler. 2017. Physical Chemistry. 11th ed. London, England: Oxford University Press. 2. Ellis, A. J., and W. A. J. Mahon. 1977. Chemistry and geothermal systems. New York: Academic Press. 3. Marini L. 2000. Geochemical techniques for the exploration and exploitation of geothermal energy. Italy: University of Genua.

	4. Giggenbach, W. F., and R. L. Goguel. 1989. Collection and analysis of geothermal and volcanic water and gas discharges. Petone, NZ.: Chemistry Division, Dept. of Scientific and Industrial Research. 5. R.O. Fournier, 1991, Water geothermometers applied to geothermal energy: Center on Small Energy Resources

Geothermal Geophysics 1

Course Code	SCPH802608
SKS	2
Semester	1
Description	Geothermal Geophysics 1 studied the electrical properties of rocks, fundamental concepts of EM and MT technology. In addition, it explains how MT data processing, MT data modeling, and MT data interpretation. This course cover Electrical Properties of Rocks, Fundamental Concept of EM, Fundamental Concept of MT Technology, MT Data Processing, MT Data Modeling, MT Data Interpretation
Reference	1. Blakely, R.J., 1995, Potential Theory in Gravity & Magnetic Application, Cambridge University Press. 2. Udias, Agustin, 1999, Principles of Seismology, Cambridge University Press, UK. 3. Telford, W.M., Geldart, L.P. and Sheriff, RE, 1990, Applied Geophysics, Cambridge University Press, New York. 4. Mussett, A.E. and Khan, M.A., 2000, Looking Into the Earth: An Introduction to Geological Geophysics, Cambridge University Press, Oct 23, 2000.

Angular Momentum Theory

Course Code	SCPH802203
SKS	2
Semester	2
Description	The Angular Momentum Theory course aims to explain concepts related to angular momentum and apply them to systems with angular momentum. The topics covered include Operators and unitary transformations, diagonalization and exponential forms of operators, Formal definition of angular momentum, eigenvalues, commutation relations, physical interpretation of angular momentum, the addition of two angular momentums, the definition of Clebsch-Gordan coefficients, relations of Clebsch-Gordan coefficients. Gordan, Clebsch-Gordan coefficient calculations, Symbols 3j, 6j, and 9, Rotation operators and orthogonality properties of spherical harmonic functions, Irreducible tensors, Wigner-Eckart theorem, Racah coefficients, Maxwell's equations and multipole fields, Static interactions and interactions spin 1/2 and Applications on nuclear systems.
Reference	1. M. E. Rose, Elementary Theory of Angular Momentum, Dover Books on Physics, Reprint edition, 2011. 2. R. Edmonds, Angular Momentum in Quantum Mechanics, Princeton University Press, Reissue edition,1996. 3. de-Shalit and I. Talmi, Nuclear Shell Theory, Dover Publications, 2004

Relativistic Quantum Field Theory

Course Code	SCPH802204
SKS	4
Semester	2
Description	Relativistic Quantum Field Theory Course Explains quantum phenomena at high energy and quantization of fundamental fields to be applied in solving nuclear and particle physics problems. Relativistic Quantum Field Theory discussed it includes Lorentz transform, Maxwell covariance equation, Klein-Gordon equation, Dirac equation, Dirac matrix, spin, Coulomb scattering, nucleon structure, canonical quantization, perturbation theory, S-matrix, Feynman diagram, renormalization, integral quantization trajectory, symmetry and group theory, weak and electromagnetic interactions, Yang-Mills field, spontaneous symmetry breaking, electroweak theory, strong interaction, grand unification theory. The language of instruction used is Indonesian. The learning method used in this course is Problem-based Learning/Project-based Learning/Collaborative Learning/Active Learning using the Learning Management System (LMS) EMAS or EMAS2.
Reference	1. W. Greiner, Relativistic Quantum Mechanics: Wave Equations, Springer, 3rd edition, 2000. 2. L. Maiani and O. Benhar, Relativistic Quantum Mechanics, Routledge, 1 edition, 2015. 3. D. Bjorken and SD. Drell, Relativistic Quantum Mechanics, McGraw-Hill, 1964. 4. Halzen and A. D. Martin, Quarks and Leptons, John Wiley & Sons, 1984. 5. Gross, Relativistic Quantum Mechanics and Field Theory, John Wiley & Sons, 1993. 6. J. R. Aitchison, Relativistic Quantum Mechanics, Macmillan, 1982. 7. J. R. Aitchison and A. J. G. Hey, Gauge Theories in Particle Physics, Adam Hilger, 1989. 8. Lahiri and P.B. Pal, A First Book of Quantum Field Theory, 2nd Ed., Alpha Science International Ltd., 2005. 9. Guidry, Gauge Field Theory: An Introduction with Applications, Wiley VCH Verlag GmbH, 2004. 10. Maggiore, A Modern Introduction to Quantum Field Theory, Oxford University Press, 2005

General Relativity and Introduction to Astrophysics

Course Code	SCPH802205
SKS	3
Semester	2
Description	General Relativity and Introduction to Astrophysics discuss the introduction of general relativity theory and its application in compact astrophysical objects, which are the final result of stellar evolution (compact stellar remnants), such as white dwarf stars, neutron stars, and black holes. The language of instruction used is Indonesian. The learning method used in this course is Collaborative Learning/Active Learning using the Learning Management System (LMS) and synchronous media using Microsoft Teams.

Reference	1. Norman K Glendenning, Compact Stars: Nuclear Physics, Particle Physics, and General Relativity, Springer International Publishing (1997) 2. P. Haensel, Neutron Stars 1: Equation of State and Structure, Springer International Publishing (2020) 3. Stuart L. Shapiro, Saul A. Teukolsky, Black Holes, White Dwarfs, and Neutron Stars, WILEY-VCH Verlag GmbH & Co. KGaA (2004) 4. Luciano Rezzolla, Pierre Pizzochero, David Ian Jones, Nanda Rea, Isaac Vidana, The Physics and Astrophysics of Neutron Stars. Springer International Publishing (2018) 5. Max Camenzind, Compact Objects in Astrophysics, Springer International Publishing (2007)

Symmetry, Energy Bands, and Phonons

Course Code	SCPH802112
SKS	3
Semester	2
Description	This incompressible Physics course covers three major topics related to crystal structure, electronic structure, and crystal vibrations. Students study this course with a combination of two active learning methods, namely interactive lectures and collaborative learning which are combined in flip classroom learning models by utilizing the asynchronous online class facilities at Emas2.ui.ac.id and synchronous online classes at MsTeams. Students have the opportunity to practice unifying their understanding of the basic concepts of physics and analytical skills in studying the four topics. Students also practice explaining and analyzing phenomena in incompressible systems with their technical application and their crystal structures, electron structures, and lattice vibrations. In addition, students can develop the ability to synthesize and evaluate qualitatively and quantitatively phenomena in incompressible physics using basic physics concepts. After completing this course, first-year students in the second semester can compile an explanation of crystal structure, electronic structure, and lattice vibrations in compressed matter systems when faced with a known problem in incompressible matter physics. This course is delivered in the country's official language, namely Indonesian. Even though. learning resources will be taken and displayed in the source's original language (English) and/or Indonesian.
Reference	1. Neil W . Ashcroft dan N. David Mermin, Solid State Physics, Harcourt Inc, 1976. 2. C. Kittle, Introduction to Solid State Physics 8th Ed., Wiley, 2005. 3. R. Hook and H. E. Hall, Solid State Physics 2nd Ed., Wiley, 1991. 4. Michael P . Marder, Condensed Matter Physics. 2nd Ed, John Wiley, New Jersey, 2010. 5. Leonard M. Sander, Advanced Condensed Matter Physics, Cambridge University Press, 2009.

Electromagnetism in Solids

Course Code	SCPH802113
SKS	3

Semester	2
Description	This course explains phenomena in the properties of solids and the related mechanisms behind them, including the motion of electrons, the periodic crystal lattice structure and the vibrations of atoms in solids. The discussion includes Drude theory, Sommerfeld theory, free electron theory, crystal lattice, reciprocal lattice, determination of crystal structure by X-ray diffraction, Bravais lattice classification and crystal structure, electron energy levels at periodic potential, electrons in weak periodic potential, tight-fit method. binding, methods for calculating band structures, semi-classical electron dynamics models, semi-classical metal conduction theory, measuring Fermi surfaces, metal band structures, electron scattering and Boltzmann equations, Hartree-Fock equations, surface effects, classification of solids, cohesive energy , dynamic lattice model, semi-classical harmonic lattice theory, quantum harmonic lattice theory, phonon dispersion relations, anharmonic effects in crystals, phonons in metals, dielectric properties of insulators, semiconductors, defects in crystals, diamagnetism and paramagnetism, electron interactions and magnetic structures, magnetic ordering, superconductivity.
Reference	1. N. W. Ashcroft and N. D. Mermin, Solid State Physics, Saunders College Publishing, 1976 2. C. Kittle, Introduction to Solid State Physics 8th Ed., Wiley, 2005. 3. R. Hook and H. E. Hall, Solid State Physics 2nd Ed., Wiley, 1991.

Advanced Spectroscopy

Course Code	SCPH802103
SKS	3
Semester	2
Description	The Advanced Spectroscopy course explains atomic and molecular spectroscopy methods, including rotational, vibrational, electronic, photoelectronic spectroscopy, laser magnetic spectroscopy, electron and nuclear spin resonance, as well as Moessbauer spectroscopy, thermal analysis, and electron microscopy, and analyzes the results of these spectroscopic experiments. . The topics covered include the interaction of light with matter and its experimental methods, rotational spectroscopy, vibrational spectroscopy, electronic spectroscopy, photoelectronic spectroscopy, laser spectroscopy, magnetic spectroscopy, electron spin resonance (ESR), nuclear spin resonance (NMR) spectroscopy, Moessbauer spectroscopy, analysis thermal, electron microscopy.
Reference	1. M. Hollas, Modern Spectroscopy, 4th Ed., Wiley, 2004. 2. DR Vij, Handbook of Applied Solid State Spectroscopy, Springer, 2006. 3. G. Gaulitz dan T. Vo-Dinh, Handbook of Spectroscopy, Wiley-VCH Verlag GmbH & Co, 2003

Special Topics

Course Code	SCPH802104
SKS	3
Semester	2

Description	Course Name Topik-topik Khusus menjelaskan konsep terkini, metode analitik dan numerik untuk menghitung besaran-besaran fisis yang terkait dengan fenomena-fenomena terkini dalam bidang fisika materi terkondensasi dan aplikasinya dalam perkembangan teknologi modern. Pokok-pokok bahasan meliputi Fisika material elektronik, plasmonik, fotonik, meta material, sistem elektron terkorelasi kuat, nanosains, sistem mesoskopik, metode analitik dan numerik seperti fungsi Green, teori respon linier, pendekatan medan rata-rata statik dan dinamik.
Reference	1. Michele Cini, Topics and Methods in Condensed Matter Theory: From Basic Quantum Mechanics to the Frontiers of Research, Springer, 2007 2. Relevan journal or scientific article

Embedded Instrumentation

Course Code	SCPH802312
SKS	2
Semester	2
Description	Embedded instrumentation analyzes and applies embedded system concepts on FPGAs and microcontrollers related to basic architecture and programming structures and implements them in an application. This course explains the basic concepts of embedded systems, their objectives and characteristics; recognizes and understands the position of FPGAs and microcontrollers in the digital electronics family; understands the basic architecture of FPGAs and their programming structures; implements basic VHDL (concurrent and sequential statements) commands in an application; understand and apply the concept of the finite state machine (FSM) in an FPGA-based application; understand 32 bit ARM microcontroller architecture and programming; utilization of GPIO; Timer/Counter, Real-Time Clock (RTC); Interrupts and Power Management; Analog to Digital Converter (ADC) & Digital to Analog Converter (DAC); Serial Communication: UART, SPI, I2C. The language of instruction used is Indonesian.
Reference	1. Kleitz, W., Digital Electronics, A Practical Approach with VHDL 9th ed, Pearson Publishing, 2012. 2. Pedroni,V.A., Circuit Design with VHDL, 3rd ed, MIT Press, 2020. 3. Ünsalan,C., Gürhan,H.D, and Yücel,M.E., Embedded System Design with ARM Cortex-M Microcontroller, Springer, 2022. 4. Pakdel, M., Advanced Programming with STM32 Microcontrollers, Elektor International Media, 2020.

Instrumentation System

Course Code	SCPH802313
SKS	2
Semester	2
Description	The instrumentation system course teaches about the knowledge and application needed in an instrumentation system that is applied to analytical instruments with the latest technology. The course content is Elements of the instrument system, performance requirements of analytical instruments, instrument calibration and validation techniques, intelligent analytical instrumentation system, PC-based analytical instruments, MEMS-based analytical instruments, optical instrumentation

	in spectrophotometers, mass spectrometer, radiation methods for spectrometry, thermo-analytical instruments, instrumentation for microscopy, electrochemical instruments, on-chip lab technology, on-chip lab design, smartphone instrumentation, lab-in-a-phone. The language of instruction used is Indonesian. The Student Center Learning method is used in this study.
Reference	1. Khandpur RS, Handbook of Analytical Instruments, Third Edition, McGraw Hill Education (India) Private Limited, 2015. 2. Eugenio Iannone, Lab on Chips: Principle, Design and Technology, CRC Press, Taylor & Francis Group, 2015. 3. Abbas Jamalipour and Md Arafat Hossain, Smartphone Instrumentations for Public Health Safety, Springer Nature Switzerland AG, 2019

Virtual Instrumentation

Course Code	SCPH802314
SKS	2
Semester	2
Description	Virtual instrumentation analyzes concepts and applies computers to build an instrumentation system, both traditional instrumentation and instrumentation systems for a particular application. For that, it is necessary to add the input and output sides in the form of a data acquisition system. On the process side, LabVIEW-based virtual programming is used. The language of instruction used is Indonesian. Virtual instrumentation learns the basics of LabVIEW programming, such as subVI creation, loop structure, chart and graphics creation, use of File IO, using Mathscript RT, and Analysis of a measurement system, Data acquisition, especially on USB 6008/9, myDAQ, ELVIS II , myRIO, using Linx built into the Arduino, and Raspberry Pi, introduce the LabVIEW application of the capacitance tomography case.
Reference	1. Bishop, R. H. (2015). Learning with LabVIEW. Upper Saddle River, New Jersey, Pearson. 2. Doering, E. (2016). NI myRIO Project Essentials Guide, National Instruments.. 3. Singh, R., et al. (2017). Arduino-based embedded systems: interfacing, simulation, and LabVIEW GUI, CRC Press. 4. Silviu, F., Ed. (2011). LabVIEW-Practical Applications and Solutions. Rijeka, Croatia, InTech.

Intelligent Instrumentation

Course Code	SCPH802315
SKS	2
Semester	2
Description	The Intelligent Instrumentation course conducts an in-depth analysis of Intelligent instrumentation applications through a review of scientific literature, provides criticism, and proposes developing intelligent instrumentation designs using more advanced methods. The course discusses the concepts and techniques of artificial intelligence and its application in the field of instrumentation. Intelligent Instrumentation Methods covered include Intelligent Instruments, Intelligent Sensors, Cogent Sensors in Intelligent Instruments, Virtual Sensors in Intelligent Instruments, Indirect Sensing Systems, Multidimensional Instrument Systems, Prognostic

	Instrument Systems, Intelligent System Standards, and Protocols. The language of instruction used is Indonesian. The Student Center Learning method is used in this study.
Reference	1. Bhuyan, Manabendra, Intelligent Instrumentation: Principles and Applications, CRC Press (2010) 2. Ameet V Joshi, Machine Learning and Artificial Intelligence, Springer International Publishing (2020) 3. Stuart J. Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Global Edition, Pearson (2021) 4. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer International Publishing (2018) 5. Ethem Alpaydin, Introduction to Machine Learning, The MIT Press (2009) 6. K. R. Chowdhary, Fundamentals of Artificial Intelligence, Springer-Nature New York Inc (2020) 7. Ulisses Braga-Neto, Fundamentals of Pattern Recognition and Machine Learning, Springer (2020) 8. Ranjan Parekh, Fundamentals of Image, Audio, and Video Processing Using MATLAB With Applications to Pattern Recognition, CRC Press (2021)

Image Processing

Course Code	SCPH802316
SKS	2
Semester	2
Description	The image processing course conducts an in-depth analysis of image processing applications in physical instrumentation through a review of scientific literature, provides criticism, and proposes the development of image processing designs for measurement applications using more advanced methods. The course discusses concepts and techniques in image processing and their application in instrumentation and measurement. The study also examines examples of image processing implementations in everyday life and work problems using the latest technology and algorithms. Integration with other related methods, such as artificial intelligence, is also discussed in this course. The language of instruction used is Indonesian. The Student Center Learning method is used in this study to explore various problems in the field of image processing for measurement.
Reference	1. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision, CL Engineering (2014) 2. Johan Pehcevski, Machine Vision and Image Recognition, Arcler Press (2020) 3. Hornberg, Alexander, Handbook of machine and computer vision; the guide for developers and users, Wiley VCH (2017) 4. Muthukumaran Malarvel, Machine Vision Inspection Systems, Machine Learning-Based Approaches, John Wiley & Sons (2021) 5. Krishnendu Kar, Mastering Computer Vision with TensorFlow 2.x_ Build advanced computer vision applications using machine learning and deep learning techniques, Packt Publishing (2020) 6. Valliappa Lakshmanan, Practical Machine Learning for Computer Vision; End-to-End Machine Learning for Images, O'Reilly Media (2021)

Process Control

Course Code	SCPH802319
SKS	2
Semester	2
Description	
Reference	7.

Well Log Analysis and Formation Evaluation

Course Code	SCPH802502
SKS	2
Semester	2
Description	The course of Well Log Analysis and Formation Evaluation aims to provide an understanding of open well log analysis, able to explain the history of well logs, able to determine the best logs to use, able to calculate well logs in practice, knowing future logging research. Topics include an introduction to petrophysical logging; SP applications, gamma rays, porosity and resistivity logs; Log interpretation skills; Log quality control; Lithological identification from log and mapping techniques; Computerized log analysis; Special log techniques and interpretation; Development of new logging and its applications
Reference	1. Asquith, D. A., Basic Well Log Analysis, AAPG, 1982. 2. Schlumberger, Log Interpretation Principle and Application, 1989

Reservoir Engineering

Course Code	SCPH802503
SKS	2
Semester	2
Description	In this reservoir engineering course, students are trained and expected to understand how to calculate oil and gas reserves, both volumetric and material balance. Because in the oil and gas industry, reserves are the main thing we must know before they can be produced. Because in the oil and gas industry, reserves are company assets that can be used as collateral to obtain funds for the development of production facilities and calculate the economics of an oil and gas field. Therefore, the role of reservoir science is very important to calculate initial reserves or residual reserves after the field is produced.
Reference	1. L.P. Dake : Fundamental Reservoir Engineering 2. John Lee : Gas Reservoir Engineering 3. John Lee : Well Testing 4. Mc Cain : The Properties of Petroleum Fluids 5. BC Craft and M. Hawkins : Applied Petroleum Reservoir Engineering 6. Boyun Gao : Petroleum Production Engineering Elsevier 2007 7. Amyx : Petroleum Reservoir Engineering 8. Economides M and Hills A: Petroleum Production System

	9. Heriot Watt University: Production Technology I and II 10. Petro Skill: Well Test Design and Analysis

Seismic Stratigraphy and Sequence

Course Code	SCPH802505
SKS	2
Semester	2
Description	Seismic and sequence stratigraphy courses study changes in sedimentary sequences vertically and laterally in space and time and understand their application in geological exploration and development. The topics discussed were related to the review of the depositional environment, introduction (lithostratigraphy, allostratigraphy, etc.), tectonics, sea level changes, paleontology applications for stratigraphic sequences, depositional sequences, system tracts, parasequence and accommodation, seismic facies and seismic sequences. The language of instruction used in this course is English and Indonesian.
Reference	1. Bally, A.W., 1987: Atlas of Seismic Stratigraphy. AAPG Studies in Geology # 27, V1 2. Galloway, W.E., 1989: Genetic Stratigraphic Sequences in Basin Analysis I: Architecture and Genesis of Flooding-Surface Bounded Depositional. AAPG Bulletin 73(2) 3. Embry, A., 2009; Practical Sequence Stratigraphy 4. Embry, A., Johannessen, E., Owen, Donald, Beauchamp, B., Gianolla, P., 2007: Sequence Stratigraphy as a “Concrete” Stratigraphic. Report of the ISSC Task Group on Sequence Stratigraphy 5. Hunt, D., Tucker, M.E., 1992, Stranded parasequences and the forced regressive wedge systems tract: deposition during base-level fall. Sedimentary Geology 81, 1–9 6. Kendal, C, G, C., 2008: Sequence Stratigraphy – Introduction. 7. Matenco, L.C., and Haq, B.U., 2020: Multi-scale depositional successions in tectonic settings. Earth-Science Reviews 200 (2020) 102991 8. Posamentier, H.W., Allen, P.G., James, D.P and Tesson, M., 1992: Force Regressions in a Sequence Stratigraphic Framework: Concept, Example and Exploration Significance. AAPG Bulletin, V 6, No. 11 9. SEPM. 2002, Sequence Stratigraphic Framework. 10. Octavian, C., 2017: Sequence Stratigraphy: Guidelines for a Standard Methodology. University of Alberta, Edmonton, AB, Canada 11. Veeken, P.C.H., 2007: Seismic Stratigraphy, Basin Analyses and Reservoir Characterization. Handbook of geophysical Exploration. Volume 37 12. Zecchin, M., Catuneanu, O., 2015: High-resolution sequence stratigraphy of clastic shelves III: Applications to reservoir geology. Marine and Petroleum Geology 62 (2015) 13. Zhang, M, Jinliang,, Z., Xu, F., Liu, J., Hou., G. 2014; Paleocene sequence stratigraphy and depositional systems in the Lishui Sag, East China Sea Shelf Basin. Marine and Petroleum Geology 59 (2015) 390-405

Geostatistics

Course Code	SCPH802507
SKS	2
Semester	2
Description	The Geostatistics course explains the concept of geostatistics for the characterization of oil reservoirs, with the integration of static and dynamic data. Geostatistical concepts discussed include Regression Analysis, Descriptive Statistics & Uncertainties, Simple Statistical Methods for Reservoir Correlation, T and F Tests for reservoir Correlations, Monte Carlo Simulation, Markov Chains & Applications, Geostatistics & Reserves Booking, Spatial Interpretation, Semivariogram, Kriging, Ordinary and Indicator Kriging, Sequential Gaussian Simulation, and Sequential Indicator Simulation. The language of instruction used is English.
Reference	1. Isaak, E. H. and R. M. Srivastava, An Introduction to Applied Geostatistics, Oxford University Press, New York, 1989. 2. Chiles J. and P. Delfiner, Geostatistics : Modeling Spatial Uncertainty, John Wiley & Sons, New York, 1999.

Geopotential Method

Course Code	SCPH802509
SKS	2
Semester	2
Description	This course focuses on using the Geopotential Method in HC (hydrocarbon) exploration in particular and earth issues in general (exploration, geotechnical, environmental, and disaster mitigation). These methods include gravity, magnetic, seismic (passive), and geoelectric. The course discusses the Concept of Exploration of Gravity, Gravity Instruments, and Acquisition, Gravity Data Analysis, Gradiometry and Microgravity, Exploration of Geomagnetic Concepts, Geomagnetic Instruments and Acquisition, Seismic Transmission/Refraction Concepts, Analysis of Vp, Vs, Poisson Ratio, Microseismic, ANT, RF, and Applications in exploration
Reference	1. Blakely, R.J., 1995, Potential Theory in Gravity & Magnetic Application, Cambridge University Press. 2. Udias, Agustin, 1999, Principles of Seismology, Cambridge University Press, UK. 3. Telford, W.M., Geldart, L.P. and Sheriff, RE, 1990, Applied Geophysics, Cambridge University Press, New York. 4. Mussett, A.E. and Khan, M.A., 2000, Looking Into the Earth: An Introduction to Geological Geophysics, Cambridge University Press, Oct 23, 2000.

Geothermal Geophysics 2

Course Code	SCPH802609
SKS	2
Semester	2
Description	This course focuses more on the use of the Gravity Method and MEQ (micro earthquake) in geothermal exploration, both for exploration in green field areas and

	for monitoring and development in production zones. Both methods are explained from concept to acquisition, data processing and data analysis-interpretation. However, the discussion of the two methods is more focused on the aspect of data interpretation.
Reference	1. Blakely, R.J., 1995, Potential Theory in Gravity & Magnetic Application, Cambridge University Press. 2. Udias, Agustin, 1999, Principles of Seismology, Cambridge University Press, UK. 3. Telford, W.M., Geldart, L.P. and Sheriff, RE, 1990, Applied Geophysics, Cambridge University Press, New York. 4. Mussett, A.E. and Khan, M.A., 2000, Looking Into the Earth: An Introduction to Geological Geophysics, Cambridge University Press, Oct 23, 2000.

Geothermal Drilling

Course Code	SCPH802604
SKS	2
Semester	2
Description	Geothermal Drilling course studies geothermal drilling strategies, drilling prognosis, drilling techniques, drilling instrumentation, drilling data analysis. The courses cover geothermal drilling strategy, drilling planning and drilling prognosis, drilling design (casing and cementing), drilling fluids, drilling tools, instrumentation and logging, drilling problem solving and drilling data analysis.
Reference	1. Finger, J. and Blankenship, D., Handbook of Best Practices for Geothermal Drilling, Sandia National Laboratories, 2010. 2. DiPippo, R., Geothermal Power Plants (2nd edition): Principles, Applications, Case Studies and Environmental Impact. Amazon, 2008. 3. Watson, A., Geothermal Engineering: Fundamentals and Applications. Springer, 2014.

Geothermal Reservoir Engineering

Course Code	SCPH802605
SKS	2
Semester	2
Description	Geothermal Reservoir Engineering Provides an understanding of the model concept, character and parameters of a geothermal reservoir and the thermodynamic behavior of the fluids in it. Mastering the understanding of geothermal reservoirs through the application of geoscience, physics, mathematics methods to analyze and interpret model concepts, characters, parameters and reservoir capabilities in producing fluids for both exploration and exploitation purposes.
Reference	1. Grant, M.A., Donaldson I.G., Bixley P.F (1982): Geothermal Reservoir Engineering, Academic Press, 369 pp. 2. D'Sullivan M.J & McKibbin R. (1989) : Geothermal Reservoir Engineering, a Manual for Geothermal Reservoir Engineering Course at the Geothermal Institute – University of Auckland.

	3. McGuinness, M. (1996): Interference Testing, Lecture Notes, Geothermal Institute - University of Auckland. 4. Grant, M. (1996): Geothermal Resource Management, Geothermal Energy New Zealand Limited, 131 pp 5. Handbook of Geothermal Energy,Editors: Edwards, L.M., Chilingar, G.V. et al. , Gulf Publishing Company, 1982, 6 6. Bodvarsson G.S. and Whiterspoon P.A. (1989): Geothermal Reservoir Engineering, Geotherm. Sci. & Tech., Volum2(1) pp. 1-68. 7. Sanyal, KS (2005): Geothermal Resource Characteristics, Development, Assessment and Management, Course Material of the 2005 World Geothermal Conference. 8. Nenny Miryani Saptadji (2001): Teknik Reservoir Panas Bumi, Diktat Kuliah TM-ITB 9. O'Sullivan, M.J. (1987) Geothermal Reservoir Simulation. Applied Geothermics, John Wiley & Sons, Ltd., 111-124. 10. DiPippo, R. (2008):Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact, Elsevier, Second Edition, 493 pp

Geothermal Project Evaluation

Course Code	SCPH802606
SKS	2
Semester	2
Description	Evaluasi Prospek Geotermal mempelajari konsep evaluasi prospek geothermal dari aspek teknis (teknologi eksplorasi sumberdaya dan strategi pemboran), aspek keekonomian dan lingkungan. Course Name menjelaskan Konsep strategis evaluasi prospek geothermal, Aspek teknis evaluasi prospek geothermal (geologi, geokimia, geofisika), Pembuatan model konseptual sistem geothermal dan penentuan batas daerah prospek, Strategi penentuan lokasi pemboran eksplorasi geothermal, Penghitungan potensi sumber daya dan cadangan energi geothermal, Aspek ekonomis dalam evaluasi prospek geothermal dan Aspek lingkungan dalam evaluasi prospek geothermal.
Reference	1. Harvey, C. And Beardsmore, G., Best Practices Guide for Geothermal Exploration, Sandia IGA Academy Book, 2014. 2. DiPippo, R., Geothermal Power Plants (2nd edition): Principles, Applications, Case Studies and Environmental Impact. Amazon, 2008. 3. Harvey, C. And Beardsmore, G., Geothermal Exploration – Global Strategies and Applications, IGA Academy Books, 2016.

Geothermal Economics & Management

Course Code	SCPH802607
SKS	2
Semester	2
Description	The Geothermal Management and Economics course conducts in-depth learning and analysis of geothermal business processes, geothermal project management, problem analysis and resolution in organizing, executing and planning as well as

	making project timelines in a barchart using a project management program and closing geothermal projects according to the rules of thermal engineering. precise and measurable earth. Meanwhile, to understand the economics of geothermal, it is necessary to know the principles of Engineering Economics, its application to the economic analysis of geothermal to run a business so that geothermal energy can be developed in accordance with an adequate economy. The Geothermal Management and Economics course discusses the concepts of Teaching Concepts in the Introduction section and other methods to be able to understand Business Concepts, Regulation & Management, Decision Management, Projects, Organizations and Organizational Work Relations, Create Project Management using Gant Chart – Bar Chart, Manage Projects, and integrated project closure. Knowledge and application methods of Engineering Economics are the second part that is also needed in conducting geothermal economic analysis, Project Feasibility Analysis (Feasibility Study), analytical methods, Project Financing Component Functions (direct costs, overhead, etc.). In addition, knowledge and ability to analyze how the geothermal investment climate is, Geothermal investment risk analysis, analysis of key factors determining geothermal electricity prices, calculates geothermal prices and economics, understands and is able to analyze the influence of risk factors on the geothermal economy, analyze sources of financing for geothermal businesses earth. The language of instruction used is Indonesian. The Student Center Learning and Case Study methods are used in this study.
Reference	1. Mary H. Dickson and Mario Fanelli, 2004: What is Geothermal Energy, Istituto di Geoscienze e Georisorse, CNR , Pisa, Italy. 2. ARMSTEAD, HCH, 1983. Geothermal Energy. E. & F. N. Spon, London, 404 pp. 3. BROWN, K. L., 2000. Impacts on the physical environment. In: Brown, K.L., ed., Environmental Safety and Health Issues in Geothermal Development, WGC 2000 Short Courses, Japan, 43—56. 4. Widjajono Partowidagdo, 2009: Migas dan Energi di Indonesia, Permasalahan dan Analisis Kebijakan, Development Studies Foundation, Pertamina, Jakarta. 5. Panasbumi: Energi Kini dan Masa Depan, Asosiasi Panas Bumi Indonesia – 2004, 232 hal. 6. Iman Soeharto (1995): Manajemen Proyek: Dari konseptual sampai Operasional, Penerbit Erlangga, 755 hal. 7. Ministry of Planning, 2014: Geothermal Handbook, for Indonesia 8. GeothermEx Inc., 2010. An Assessment Of Geothermal Resource Risks in Indonesia, 9. [Online], www.ppiaf.org/.../REPORT_Risk_Mitigation_Options_Indonesia.pdf. 10. Mansyur, 2010: Manajemen Pembiayaan Proyek, LaksBang Pressindo, Yogyakarta. 11. UU No.27 Tahun 2003 dan UU No.21/2014 tentang Panas bumi, PP59 Tahun 2007 serta UU No. 30 Tahun 2007 tentang Energi 12. DiPippo, R. (2016):Geothermal Power Generation: Development and Innovation,, Elsevier, First Edition, 822 pp 13. Surya Darma, (2022): Manajemen Proyek dan Keekonomian Geotermal – Best Practice Dalam Pengusahaan Panas bumi, Jakarta

Seminar

Course Code	SCPH802805
SKS	2

Semester	2
Description	This course studies how to communicate scientifically, understand the philosophy and criteria for research problems. The aim of this course is that students are able to write research proposals, and write scientific papers. The language of instruction used is Indonesian. The pulpit lecture method is used in this lesson
Reference	1. Young, Felina C., Fundamentals of Research Writing, IPWI Publishing Co., Jakarta, 1999 2. Surat Keputusan Rektor UI nomor 628/SK/R/UI/2008, tentang Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia, 16 June 2008. 3. Format dokumen Naskah Ringkas Tugas Akhir, Perpustakaan Universitas Indonesia, Desember 2012 4. R. Weissberg dan S. Buker, Writing Up Research; Experimental Research, Report Writing for Students of English, Prentice-Hall, Inc, 1990. 5. R. A. Day, How to Write and Publish a Scientific Paper, 3rd ed., Cambridge Univeristy Press, 1991.

Scientific Publications

Course Code	SCPH802806
SKS	2
Semester	3
Description	Scientific publication is a study that examines the stages in scientific publication activities, starting with literature search activities, collecting material to be conveyed, making article frameworks and abstracts, processing and analyzing data from final project activities carried out by referring to literature, following the format of writing and submitting procedures as the main author at scientific conferences and published in the minimum proceedings of national conferences with ISBN. The subject matter in this course includes uploading scientific papers composed of abstracts, article frameworks, research methods, results and discussions, conclusions and suggestions, bibliography.
Reference	1. Hanburry Brown, AC, FRS. (1986). The Wisdom of Science : its relevance to Culture and Reigion. London : Cambridge University Press. 2. Hawryszkiewycz, I,T. (1984). Database Analysis and Design. Chicago: SRA,INC.

Thesis

Course Code	SCPH801007
SKS	8
Semester	4
Description	Thesis subject is a study that examines the study that examines the research process carried out, students will present the results of their research, draw temporary conclusions and plan further research. The subject matter in this course includes the framework of thought, methodology and literature review. The results, the sharpness of data analysis, the stability of drawing conclusions. Presentation and mastery of the material as well as the potential for further research

Reference	1. Hanburry Brown, AC, FRS. (1986). The Wisdom of Science : its relevance to Culture and Reigion. London : Cambridge University Press. 2. Hawryszkiewycz, I,T. (1984). Database Analysis and Design. Chicago: SRA,INC. 3. Geoff, P and Judy, P. (2004). Key Concepts in Social Research. London: Sage. 4. Sandra lach, A. (1995). Practical Handbook of Spatial Statistics. New York: CRC Press

4. Student Facilities

Universitas Indonesia has various facilities supporting student learning, such as a health center, student accommodation, transportation, student clubs, information and technologies, laboratories, and a library.

4.1. Information and Technology

To support the information needs of students, UI offers an advanced campus network with the highest technology. Universitas Indonesia develops several IT facilities which could be used by students and staff of Universitas Indonesia, especially students, such as Free Wi-Fi with LDAP-based Single Sign On (SSO), Academic Information System (SIAK NG), UI Webmail, and Web-based Tuition Fee Information System. Table 3 shows a list of information and technology facilities for all students.

Table 11. List of Information and Technology Facilities for Student

No	Information and Technology Facilities	Web Link
1.	Single	https://sso.ui.ac.id
2.	User Management, Change Password	https://beranda.ui.ac.id
3.	Academic Information System (SIAK NG)	https://academic.ui.ac.id
4.	Student Email	https://webmail.ui.ac.id
5.	Google Suite for Student Free Storage of up to 1TB	https://gmail.ui ac id https://drive.ui ac id
6.	Microsoft Office 365 for Student Free Storage of up to 1TB	https://office365.ui.ac.id https://onedrive.live.com
7.	Journal Web and Indexing Access from Outside	https://remote-lib.ui.ac.id
8.	Faculty of Mathematics and Natural Science Website	https://sci.ui.ac.id
9.	Physics Department Website	https://physics.ui.ac.id

4.2. Health Center

All UI students can access free healthcare services from the satellite clinic. The clinic offers general health services, dental, and orthodontic services. To access these health care services, students must register in a satellite clinic by completing the health requirements, consisting of a student card, tuition receipt, and two student photographs (2 cm x 3 cm). Additionally, the clinic provides a pharmacy, ambulance, emergency unit, and radiology service.

UI Hospital

Rumah Sakit Universitas Indonesia (RSUI) (UI Hospital) is the first State University Hospital (RS-PTN) in Indonesia with Green Hospital Concept that is environment-friendly and patient's safety oriented. It is located in the Rumpun Ilmu Kesehatan (RIK) buildings, UI Depok Campus, with a sky bridge connecting RSUI and RIK Building.

Student Health Center (PKM)

International students must carry medical insurance from their home country in case of illness and injury while in Indonesia. Students with minor health-related problems may visit this center to check their health. It also provides consultation services during scheduled hours. Since the medical facility is equipped to provide only first aid assistance, major health problems are treated at the nearby hospitals or the university hospital at the Salemba Campus. To obtain free medication at PKM, students must register and show their student ID card or reference letter from the International Office.

Integrated Clinic

Klinik Terpadu (Integrated Clinic) is a confidential and professional service designed for students. To talk confidently about any problems of concern to you, feel free to contact Klinik Terpadu to arrange the schedule of meeting prolific psychology experts.

4.3. Accommodation

Student Dormitory

The dormitory is intended for UI students outside Jakarta/Depok so they can settle in quickly. Students can access their faculties conveniently as the dormitory is located inside UI. The transportation system is supported by the campus busses and Ojek 24 hours.

In this accommodation, students can choose one of three types of room. The available rooms are Non- AC, AC, and VIP. The dormitory also provides a sports hall, canteen, mini market, copy and print center, and laundry service.

Makara Lodge

Universitas Indonesia Makara Lodge is a well-known one as of the best accommodations in South Jakarta and Depok. This place is appropriate for public activities such as seminars, training, and workshops. The atmosphere is quiet and pleasant, surrounded by a natural forest and a blue lake.

4.4. Private Accommodation (Rumah Kos)

Besides accommodations that Universitas Indonesia provides, private accommodation (Rumah kos) could be an alternative option for students. They are located close to UI, such as Beji,

Kukusan, and Margonda. Private accommodation offers a range price from 500.000 IDR/month to above 1.000.000 IDR/month with various facilities. The location is also surrounded by many photocopy centers, restaurants, bookstores, and minimarkets so students can quickly get their daily needs.

4.5. Transportation

The Yellow Bus

Twenty buses serve no-fare transportation around campus for students, staff, and visitors. The busses operate from 7.00 am – 9.00 pm Mon-Fri, 7.00 am – 02.00 pm Sat

The Executive Bus

The executive bus offers a transportation service for outside-campus activities related to the study, such as field trips, study tours, field research, and others.

Free Bicycle Hire

It is one of the alternative means of transportation in the campus area. Students and faculty members can access this free bicycle. Students need to show their student ID cards to enjoy the fun of campus tours by cycling.

4.6. Student Clubs

There are more than 30 clubs that represent students' interests. You will find sports teams, music and art clubs, theater groups, student radio stations, cultural and religious associations, and academic societies. Some student clubs have performed in various national and international events.

4.7. Sport Facilities

Facilitating the students' interest, Universitas Indonesia established a wide range of sports facilities on campus: A jogging track, Stadium, Gymnasium, Swimming Pool, and Indoor and outdoor courts (basketball, tennis, volleyball, badminton, and hockey).

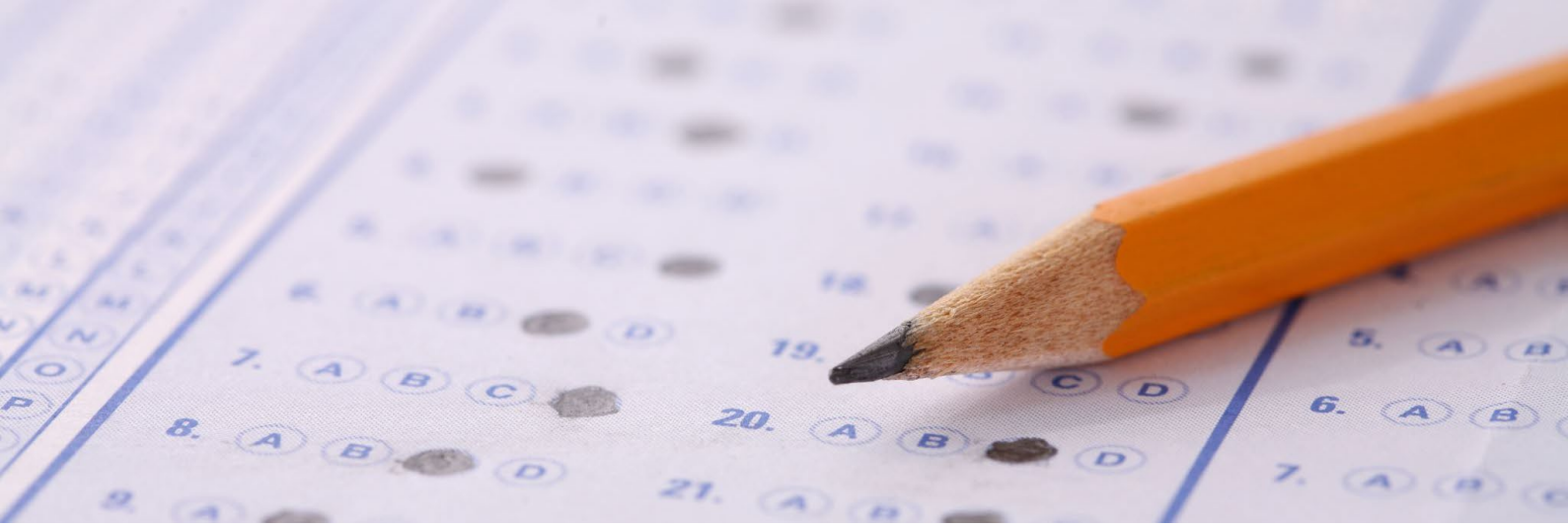
4.8. The Central Library (Crystal of Knowledge)

The Central Library of Universitas Indonesia is an integrated system allowing all individual faculties and disciplines to comprehensively access the learning resources service. This primary library is the fusion of all faculty's libraries that provides more than 1,500,000 collections and offers comprehensive collected work by considering uncountable hard and electronic research archives and documentation. It is one of the most extensive university libraries in Asia.

In addition, students can access electronic resources that include e-journals, databases, statistical data, images, and digital maps. The digital library online system also allows students to collect help by searching and downloading it via the website.

4.9. Banking

Many bank offices and ATMs (Automatic Teller Machines) are available on campus, such as BNI at the Central Library, Bank Mandiri at the Faculty of Economics, BRI at the Faculty of Psychology, and Bank Bukopin and BCA at the Engineering Center, Faculty of Engineering.



5. General Form

The list of general forms used to register and evaluate some related courses is as follows:

- SCPH802806 – By Course – Scientific Publication
- SCPH801004 – By Research – Scientific Publication 1
- SCPH801006 – By Research – Scientific Publication 2
- SCPH801007 – By Research and By Course – Thesis

The student fills out all forms online in Examiner Application System, which is accessed via https://univindonesia.sharepoint.com/sites/PhysicsUI/. Students need active "Universitas Indonesia Single Sign On" to enter the application.

Universitas Indonesia
Fakultas Matematika dan Ilmu Pengetahuan Alam
Departemen Fisika

PUBLIKASI ILMIAH (SCPH802806 – 2 SKS)

Scientific Publications

A. Informasi Umum (*General Information*)

Nama Mahasiswa *Student's Name*	:	
NPM *Student's ID*	:	
Program Studi & Skema *Study Program & Track*	:	S2 Ilmu Fisika – Jalur Kuliah
Judul Tesis *Thesis title*	:	
Pembimbing *Supervisor*	:	1. 2.
Judul Artikel *Article Title*	:	
Nama Penulis *Author*	:	
Nama Jurnal/Prosiding *Journal/Proceeding's Name*	:	
Tautan Jurnal/Prosiding *Journal/Proceeding Link*	:	
Nama Penerbit *Publisher*	:	
Tautan Artikel *Article link*	:	
Indeks *International Index*	:	Q1 | Q2 | Q3 | Q4 | Web of Science | DOAJ | Other: ……
Indeks Sinta *Sinta National Index*	:	1 | 2 | 3 | 4 | 5

Universitas Indonesia
Fakultas Matematika dan Ilmu Pengetahuan Alam
Departemen Fisika

B. Penilaian (*Grading*)

No. (*No.*)	**Jenis Publikasi** (*Publication Type*)	**Status Publikasi**	**Bobot (A)**	**Jumlah (B)**	**Nilai Angka (A × B)**
1.	Prosiding Konferensi Internasional Terindeks Scopus atau Web of Science (*Scopus or Web of Science Indexed International Conference Proceedings*)	Diterima (*Accepted*)	8		
2.	Jurnal Internasional Terindeks (Minimal DOAJ) (*Indexed International Journal – Minimum* DOAJ)	Diterima (*Accepted*)	8		
3.	Jurnal Nasional Terakreditasi Sinta 1-2 (*Accredited National Journal: Sinta 1-2*)	Diterima (*Accepted*)	8		
4.	Jurnal Nasional Terakreditasi Sinta 3 (*Accredited National Journal: Sinta 3*)	Diterima (*Accepted*)	7		
5.	Jurnal Nasional Terakreditasi Sinta 4 (*Accredited National Journal: Sinta 4*)	Diterima (*Accepted*)	6		
6.	Jurnal Nasional Terakreditasi Sinta 5 (*Accredited National Journal: Sinta 5*)	Diterima (*Accepted*)	5		
7.	No. 1 – 6 (Max 1)	Under Reviewed	4		
Keterangan Nilai (*Grading Information*): ▪ > 8: A ▪ 7: A− ▪ 6: B+ ▪ 5: B ▪ 4: B−		**NILAI ANGKA TOTAL** (*Grading Summation*)			
		NILAI HURUF (*Grading in Word*)			

Depok, 20…..
Telah diverifikasi oleh:
Kaprodi

……..
NIP.

C. Lampiran (*Attachment*)

No	**Dokumen (*Document*)**	**Tersedia (*Available*)**
1.	Makalah/draft makalah (*Published or draft Article*)	
2.	Bukti status artikel (*Proof of article status*)	
3.	Bukti jurnal/prosiding terindeks (*Proof of indexed journal or proceeding*)	
4.	Bukti akreditasi jurnal/prosiding (*Proof of journal or prceeding accreditation*)	
5.	Sertifikat Presentasi Konferensi - khusus prosiding (*Conference Presentation Certificate*)	

Universitas Indonesia
Fakultas Matematika dan Ilmu Pengetahuan Alam
Departemen Fisika

PUBLIKASI ILMIAH 1 (SCPH801004 – 2 SKS)

Scientific Publications 1

A. Informasi Umum (*General Information*)

Nama Mahasiswa *Student's Name*	:	
NPM *Student's ID*	:	
Program Studi & Skema *Study Program & Track*	:	S2 Ilmu Fisika – Jalur Riset
Judul Tesis *Thesis title*	:	
Pembimbing *Supervisor*	:	1. 2.
Judul Artikel *Article Title*	:	
Nama Penulis *Author*	:	
Nama Jurnal/Prosiding *Journal/Proceeding's Name*	:	
Tautan Jurnal/Prosiding *Journal/Proceeding Link*	:	
Nama Penerbit *Publisher*	:	
Tautan Artikel *Article link*	:	
Indeks *International Index*	:	Q1 | Q2 | Q3 | Q4 | Web of Science | DOAJ | Other: ……
Indeks Sinta *Sinta National Index*	:	1 | 2 | 3 | 4 | 5

Universitas Indonesia
Fakultas Matematika dan Ilmu Pengetahuan Alam
Departemen Fisika

B. Penilaian (*Grading*)

No. (*No.*)	**Jenis Publikasi** (*Publication Type*)	**Status Publikasi**	**Bobot (A)**	**Jumlah (B)**	**Nilai Angka (A × B)**
1.	Prosiding Konferensi Internasional Terindeks Scopus atau Web of Science (*Scopus or Web of Science Indexed International Conference Proceedings*)	Diterima (*Accepted*)	8		
2.	Jurnal Internasional Terindeks (Minimal DOAJ) (*Indexed International Journal – Minimum* DOAJ)	Diterima (*Accepted*)	8		
3.	Jurnal Nasional Terakreditasi Sinta 1-2 (*Accredited National Journal: Sinta 1-2*)	Diterima (*Accepted*)	8		
4.	Jurnal Nasional Terakreditasi Sinta 3 (*Accredited National Journal: Sinta 3*)	Diterima (*Accepted*)	7		
5.	Jurnal Nasional Terakreditasi Sinta 4 (*Accredited National Journal: Sinta 4*)	Diterima (*Accepted*)	6		
6.	Jurnal Nasional Terakreditasi Sinta 5 (*Accredited National Journal: Sinta 5*)	Diterima (*Accepted*)	5		
7.	No. 1 – 6 (Max 1)	Under Reviewed	4		
Keterangan Nilai (*Grading Information*): ▪ > 8: A ▪ 7: A− ▪ 6: B+ ▪ 5: B ▪ 4: B−		**NILAI ANGKA TOTAL** (*Grading Summation*)			
		NILAI HURUF (*Grading in Word*)			

Depok, 20…..
Telah diverifikasi oleh:
Kaprodi

……..
NIP.

C. Lampiran (*Attachment*)

No	**Dokumen (*Document*)**	**Tersedia (*Available*)**
1.	Makalah/draft makalah (*Published or draft Article*)	
2.	Bukti status artikel (*Proof of article status*)	
3.	Bukti jurnal/prosiding terindeks (*Proof of indexed journal or proceeding*)	
4.	Bukti akreditasi jurnal/prosiding (*Proof of journal or prceeding accreditation*)	
5.	Sertifikat Presentasi Konferensi - khusus prosiding (*Conference Presentation Certificate*)	

Universitas Indonesia
Fakultas Matematika dan Ilmu Pengetahuan Alam
Departemen Fisika

PUBLIKASI ILMIAH 2 (SCPH801006 – 2 SKS)

Scientific Publications 2

A. Informasi Umum (*General Information*)

Nama Mahasiswa *Student's Name*	:	
NPM *Student's ID*	:	
Program Studi & Skema *Study Program & Track*	:	S2 Ilmu Fisika – Jalur Riset
Judul Tesis *Thesis title*	:	
Pembimbing *Supervisor*	:	1. 2.
Judul Artikel *Article Title*	:	
Nama Penulis *Author*	:	
Nama Jurnal *Journal's Name*	:	
Tautan Jurnal *Journal Link*	:	
Nama Penerbit *Publisher*	:	
Tautan Artikel *Article link*	:	
Indeks *International Index*	:	Q1 | Q2 | Q3 | Q4 | Web of Science | DOAJ | Other: ……
Indeks Sinta *Sinta National Index*	:	1 | 2 | 3 | 4 | 5

B. Penilaian (*Grading*)

No. (*No.*)	**Jenis Publikasi** (*Publication Type*)	**Status Publikasi**	**Bobot (A)**	**Jumlah (B)**	**Nilai Angka (A × B)**
1.	Jurnal Internasional Terindeks Scopus - Min Q3 (*Scopus Indexed International Journal – Min Q3*)	Diterima (*Accepted*)	8		
2.	Jurnal Internasional Terindeks Web of Science (*Web of Science Indexed International Journal*)	Diterima (*Accepted*)	8		
3.	Jurnal Internasional Terindeks Scopus Q4 (Q4 *Scopus Indexed International Journal*)	Diterima (*Accepted*)	7		
4.	Jurnal Nasional Terakreditasi Sinta 1 (*Accredited National Journal: Sinta 1-2*)	Diterima (*Accepted*)	7		
5.	Jurnal Nasional Terakreditasi Sinta 2 (*Accredited National Journal: Sinta 3*)	Diterima (*Accepted*)	6		
6.	Jurnal Nasional Terakreditasi Sinta 3 (*Accredited National Journal: Sinta 4*)	Diterima (*Accepted*)	5		
7.	Jurnal Internasional Terindeks DOAJ (*DOAJ Indexed International Journal*)	Diterima (*Accepted*)	5		
8.	No. 1 – 7 (Max 1)	Under Reviewed	4		
Keterangan Nilai (*Grading Information*): ▪ > 8: A ▪ 7: A− ▪ 6: B+ ▪ 5: B ▪ 4: B−		**NILAI ANGKA TOTAL** (*Grading Summation*)			
		NILAI HURUF (*Grading in Word*)			

Depok, 20…..
Telah diverifikasi oleh:
Kaprodi

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NIP.

C. Lampiran (*Attachment*)

No	**Dokumen (*Document*)**	**Tersedia (*Available*)**
1.	Makalah/draft makalah (*Published or draft Article*)	
2.	Bukti status artikel (*Proof of article status*)	
3.	Bukti jurnal terindeks (*Proof of indexed journal*)	
4.	Bukti akreditasi jurnal (*Proof of journal accreditation*)	

Universitas Indonesia
Fakultas Matematika dan Ilmu Pengetahuan Alam
Departemen Fisika

TESIS (SCPH801007 – 8 SKS)

Thesis Examination

A. Informasi Umum (*General Information*)

Nama Mahasiswa *Student's Name*	:	
NPM *Student's ID*	:	
Program Studi & Skema *Study Program & Track*	:	S2 Ilmu Fisika: Jalur Kuliah | Jalur Riset
Judul Tesis *Thesis title*	:	
Pembimbing *Supervisor*	:	1. 2.
Judul Tesis *Thesis Title*	:	
Nama Penguji *Examiner*	:	1. 2. 3. 4.
Tanggal Sidang *Date*	:	
Waktu Sidang *Time*	:	
Lokasi *Place*	:	

Universitas Indonesia
Fakultas Matematika dan Ilmu Pengetahuan Alam
Departemen Fisika

B. Rekapitulasi Penilaian (*Fnal Grading*)

Pembimbing *Supervisor*	**Nilai** *Grade*	**Nilai Rerata**	**Angka Final**	**Huruf Final**
1.				
2.				
Penguji *Examiner*	**Nilai** *Grade*	**Nilai Rerata**		
1.				
2.				
3.				
4.				

Angka Final : (60% × Nilai Rerata Pembimbing) + (40% × Nilai Rerata Penguji)

Depok, 20…..
Ketua Sidang Tesis

……..
NIP.

C. Penilaian Pembimbing (*Invidual Supervisor Grading*)

No	**Aspek**	**Nilai**
1.	Sistematika dan Teknik Penulisan	
2.	Pendahuluan (Judul, Rumusan Masalah, Tujuan) dan Hipotesis Penelitian	
3.	Substansi	
4.	Metode dan Analisis Data	
5.	Penarikan Kesimpulan	
6.	Presentasi Hasil Penelitian	
7.	Diskusi Hasil Penelitian	
8.	Potensial Diseminasi	
9.	Proses Penyelesaian Tesis dan Sikap Ilmiah	
	Rata-rata Nilai	

D. Penilaian Penguji (*Invidual Examiner Grading*)

No	Aspek	Nilai
1.	Sistematika dan Teknik Penulisan	
2.	Pendahuluan (Judul, Rumusan Masalah, Tujuan) dan Hipotesis Penelitian	
3.	Substansi	
4.	Metode dan Analisis Data	
5.	Penarikan Kesimpulan	
6.	Presentasi Hasil Penelitian	
7.	Diskusi Hasil Penelitian	
8.	Potensial Diseminasi	
	Rata-rata Nilai	

E. Panduan Penilaian (*Grading Guidance*)

No	Aspek	Nilai		Kriteria
1.	Sistematika dan Teknik Penulisan	Tidak Memadai	<70	▪ **Tidak** mengandung sebagian besar aspek
		Kurang	70 - 74.9	▪ Penulisan (abstrak – referensi) **kurang sistematis** ▪ Pendahuluan kurang mengandung latar belakang ▪ Tinjauan pustaka, teori dan konsep **kurang relevan** dengan masalah penelitian, ▪ Metode penelitian **belum sesuai** tujuan penelitian ▪ Referensi **kurang** relevan dan **kurang** kredibel (sebagian bukan peer-reviewed atau situs web organisasi resmi) ▪ Penggunaan bahasa dan istilah formal dapat dimengerti, sesuai tata bahasa Indonesia (SPOK) tapi inkonsisten dan tidak terkait
		Cukup	75 - 79.9	▪ Penulisan (abstrak – referensi) sistematis **sesuai** pedoman penulisan ▪ Pendahuluan **mengandung** latar belakang ▪ Tinjauan pustaka, teori dan konsep **relevan** dengan masalah penelitian ▪ Metode penelitian **belum sesuai** tujuan penelitian ▪ Referensi **kurang** relevan dan **kurang** kredibel (sebagian bukan peer-reviewed atau situs web organisasi resmi) ▪ Penggunaan bahasa dan istilah formal **dapat dimengerti**, **sesuai** tata bahasa Indonesia (SPOK) dan konsisten
		Baik	80 - 84.9	▪ Penulisan (abstrak – referensi) sistematis **sesuai** pedoman penulisan ▪ Pendahuluan **mengandung** latar belakang ▪ Tinjauan pustaka, teori dan konsep **relevan** dengan masalah penelitian ▪ Metode penelitian **mendukung** tujuan penelitian ▪ Referensi **kurang** relevan namun **kredibel** (peer-reviewed atau situs web organisasi resmi) ▪ Penggunaan bahasa dan istilah formal **jelas** dan **sesuai** tata bahasa Indonesia (SPOK) dan konsisten

No	Aspek	Nilai		Kriteria
		Sangat Baik	85 - 100	▪ Penulisan (abstrak – referensi) sistematis **sesuai** pedoman penulisan ▪ Pendahuluan **mengandung** latar belakang ▪ Tinjauan pustaka, teori dan konsep **relevan** dengan masalah penelitian ▪ Metode penelitian **mendukung** tujuan penelitian ▪ Referensi **relevan** dan **kredibel** (peer-reviewed atau situs web organisasi resmi). ▪ Penggunaan bahasa dan istilah formal **sangat jelas** dan **sesuai** tata bahasa Indonesia (SPOK) dan konsisten.
2.	Pendahuluan (Judul, Rumusan Masalah, Tujuan) dan Hipotesis Penelitian	Tidak Memadai	<70	▪ **Tidak** ada keterkaitan satu sama lain
		Kurang	70 - 74.9	▪ Latar belakang **kurang jelas** memunculkan masalah ▪ Tujuan **belum menjawab** masalah (sintesis/ analisis/ karakterisasi/ evaluasi/ rekonstruksi/ model/ metode perhitungan) dengan hipotesa **kurang terkait** dengan masalah
		Cukup	75 - 79.9	▪ Latar belakang **kurang jelas** memunculkan masalah ▪ Tujuan **menjawab** sebagian masalah (sintesis/ analisis/ karakterisasi/ evaluasi/ rekonstruksi/ model/ metode perhitungan) dengan hipotesa **kurang terkait** dengan masalah
		Baik	80 - 84.9	▪ Latar belakang **jelas** memunculkan masalah ▪ Tujuan **menjawab** masalah (sintesis/ analisis/ karakterisasi/ evaluasi/ rekonstruksi/ model/ metode perhitungan) dengan hipotesa **kurang** terkait dengan masalah
		Sangat Baik	85 - 100	▪ Latar belakang **jelas** memunculkan masalah ▪ Tujuan **menjawab** masalah (sintesis/ analisis/ karakterisasi/ evaluasi/ rekonstruksi/ model/ metode perhitungan) dengan hipotesa **terkait** dengan masalah
3.	Substansi	Tidak Memadai	<70	▪ Isi **tidak** memiliki kebaruan ▪ Permasalahan dibahas secara **dangkal** ▪ Konsep ilmu terkait digunakan dengan **kurang tepat** dan **kurang komprehensif** ▪ Tujuan riset **tidak** tercapai
		Kurang	70 - 74.9	▪ Isi memiliki **sedikit** kebaruan ▪ Permasalahan dibahas secara **dangkal** ▪ Konsep ilmu terkait digunakan dengan **kurang tepat** dan **kurang komprehensif** ▪ Tujuan riset **tercapai sebagian**
		Cukup	75 - 79.9	▪ Isi **memiliki** kebaruan namun **kurang** memberi kontribusi bagi keilmuan ▪ Permasalahan yang dibahas **kurang dalam** ▪ Konsep ilmu terkait digunakan dengan **tepat** namun **kurang komprehensif** ▪ Tujuan riset **tercapai sebagian**
		Baik	80 - 84.9	▪ Isi **memiliki** kebaruan namun **kurang** memberi kontribusi bagi keilmuan ▪ Permasalahan yang dibahas **memiliki** kedalaman dan keluasan yang **cukup** ▪ Konsep ilmu terkait digunakan dengan **tepat** dan **komprehensif** ▪ Tujuan riset **tercapai**
		Sangat Baik	85 - 100	▪ Isi **memiliki** kebaruan dan **memberi** kontribusi bagi keilmuan

No	Aspek	Nilai		Kriteria
				▪ Permasalahan yang dibahas **memiliki** kedalaman dan keluasan yang tinggi ▪ Konsep ilmu terkait digunakan dengan **tepat** dan **komprehensif** ▪ Tujuan riset **tercapai**
4.	Metode dan Analisis Data	Tidak Memadai	<70	▪ Diskusi **kurang jelas** ▪ Data eksperimen, observasi, atau hasil perhitungan **sulit** dimengerti dan **kurang** mendukung topik penelitian serta **tidak original** ▪ Analisis data eksperimen, observasi, atau hasil perhitungan **tidak didukung** oleh teori atau metode perhitungan terkait ▪ **Tidak ada** komparasi data eksperimen, observasi, atau hasil perhitungan dengan hasil penelitian sebelumnya
		Kurang	70 - 74.9	▪ Diskusi mengandung hubungan **kurang jelas** diantara semua analisis data ▪ Komparasi data **kurang didukung** oleh teori terkait ▪ Informasi data eksperimen, observasi, atau hasil perhitungan **cukup** dimengerti (gambar, tabel, grafik cukup dimengerti) dan **cukup** mendukung topik penelitian serta original ▪ Analisis data eksperimen, observasi, atau hasil perhitungan **kurang** didukung oleh teori atau metode perhitungan terkait ▪ **Tidak ada** komparasi data eksperimen, observasi, atau hasil perhitungan dengan hasil penelitian sebelumnya
		Cukup	75 - 79.9	▪ Diskusi mengandung hubungan **cukup jelas** diantara semua analisis data ▪ Komparasi data eksperimen, observasi, atau hasil perhitungan **cukup** didukung oleh teori atau metode perhitungan terkait ▪ Informasi data eksperimen, observasi, atau hasil perhitungan **cukup** dimengerti (gambar, tabel, grafik cukup dimengerti) dan cukup mendukung topik penelitian serta original ▪ Analisis data eksperimen, observasi, atau hasil perhitungan **cukup** didukung oleh teori terkait ▪ Komparasi data **cukup** tersedia dengan hasil penelitian sebelumnya
		Baik	80 - 84.9	▪ Diskusi mengandung hubungan **sangat jelas** diantara semua analisis data ▪ Komparasi data eksperimen, observasi, atau hasil perhitungan **cukup** didukung oleh teori atau metode perhitungan terkait ▪ Informasi data eksperimen, observasi, atau hasil perhitungan **cukup** dimengerti (gambar, tabel, grafik cukup dimengerti) dan **cukup** mendukung topik penelitian serta original ▪ Analisis data eksperimen, observasi, atau hasil perhitungan lengkap **didukung** oleh teori terkait ▪ Komparasi data **tersedia** lengkap dengan hasil penelitian sebelumnya
		Sangat Baik	85 - 100	▪ Diskusi mengandung hubungan **sangat jelas** diantara semua analisis data ▪ Komparasi data eksperimen, observasi, atau hasil perhitungan **didukung** oleh teori atau metode perhitungan terkait

No	Aspek	Nilai		Kriteria
				▪ Informasi data eksperimen, observasi, atau hasil perhitungan yang **detail** (gambar, tabel, grafik mudah dimengerti) dan **sangat mendukung** topik penelitian serta original ▪ Analisis data eksperimen, observasi, atau hasil perhitungan lengkap **didukung** oleh teori terkait ▪ Komparasi data tersedia **lengkap** dengan hasil penelitian sebelumnya
5.	Penarikan Kesimpulan	Tidak Memadai	<70	▪ Kesimpulan tidak dibuat berdasarkan hasil penelitian dan pembahasan yang ada.
		Kurang	70 - 74.9	▪ Kecermatan dalam menyimpulkan hasil penelitian terkait pembahasan kurang mencukupi dan kurang menjawab masalah dan tujuan penelitian
		Cukup	75 - 79.9	▪ Kecermatan dalam menyimpulkan hasil penelitian terkait pembahasan mencukupi namun kurang menjawab masalah dan tujuan penelitian
		Baik	80 - 84.9	▪ Kecermatan dalam menyimpulkan hasil penelitian terkait pembahasan sudah baik namun kurang menjawab masalah dan tujuan penelitian.
		Sangat Baik	85 - 100	▪ Kecermatan dalam menyimpulkan hasil penelitian terkait pembahasan sangat baik dan menjawab masalah dan tujuan penelitian.
6.	Presentasi Hasil Penelitian	Tidak Memadai	<70	▪ Presentasi tidak terstruktur, ▪ Tidak fokus pada penelitian yang dilakukan, ▪ Persiapan bahan presentasi yang lemah.
		Kurang	70 - 74.9	▪ Presentasi kurang terstruktur, ▪ Menggunakan susunan kalimat dan bahasa kurang baik, ▪ Memiliki sikap kurang baik, ▪ Kurang fokus pada penelitian yang dilakukan, ▪ Persiapan bahan presentasi kurang baik.
		Cukup	75 - 79.9	▪ Presentasi cukup terstruktur, ▪ Menggunakan susunan kalimat dan bahasa cukup baik, ▪ Memiliki sikap cukup baik, ▪ Cukup fokus pada penelitian yang dilakukan, ▪ Persiapan bahan presentasi cukup baik.
		Baik	80 - 84.9	▪ Presentasi cukup terstruktur, ▪ Menggunakan susunan kalimat dan bahasa baik, ▪ Memiliki sikap baik, ▪ Cukup fokus pada penelitian yang dilakukan, ▪ Persiapan bahan presentasi cukup baik.
		Sangat Baik	85 - 100	▪ Presentasi sangat terstruktur, ▪ Menggunakan susunan kalimat dan bahasa baik, ▪ Memiliki sikap baik, ▪ Sangat fokus pada penelitian yang dilakukan, ▪ Persiapan bahan presentasi sangat baik.
7.	Diskusi Hasil Penelitian	Tidak Memadai	<70	▪ Tidak menjawab sebagian besar atau keseluruhan pertanyaan ▪ Tidak berargumentasi.
		Kurang	70 - 74.9	▪ Kurang dapat menjawab pertanyaan dengan jelas, lugas, tepat, baik/santun, ▪ Sedikit berargumentasi berdasarkan bukti data.
		Cukup	75 - 79.9	▪ Cukup dapat menjawab pertanyaan dengan jelas, lugas, tepat, baik/santun, ▪ Berargumentasi berdasarkan sebagian bukti data.
		Baik	80 - 84.9	▪ Dapat menjawab pertanyaan dengan jelas, lugas, tepat, baik/santun,

No	Aspek	Nilai		Kriteria
				▪ Berargumentasi berdasarkan sebagian bukti data.
		Sangat Baik	85 - 100	▪ Dapat menjawab pertanyaan dengan jelas, lugas, tepat, sangat baik/santun, ▪ Berargumentasi berdasarkan bukti data.
8.	Potensial Diseminasi	Tidak Memadai	<70	▪ Tidak dapat didiseminasikan
		Kurang	70 - 74.9	▪ Paling mungkin didiseminasikan dalam forum yang tidak direview
		Cukup	75 - 79.9	▪ Dapat menghasilkan satu diseminasi yang direview
		Baik	80 - 84.9	▪ Dapat menghasilkan dua diseminasi yang direview
		Sangat Baik	85 - 100	▪ Dapat menghasilkan satu publikasi yang direview dan satu diseminasi yang direview
9.	Proses Penyelesaian Tesis dan Sikap Ilmiah	Tidak Memadai	<70	▪ Proses penyusunan proposal hingga skripsi tidak meningkatkan kualitas tugas akhir.
		Kurang	70 - 74.9	▪ Proses penyusunan proposal hingga skripsi kurang meningkatkan kualitas tugas akhir, ▪ Mengikuti sebagian petunjuk dosen pembimbing, ▪ Berkomunikasi kurang efektif, ▪ Kualitas revisi yang dilakukan kurang baik.
		Cukup	75 - 79.9	▪ Proses penyusunan proposal hingga skripsi cukup meningkatkan kualitas tugas akhir, ▪ Mengikuti sebagian petunjuk dosen pembimbing, ▪ Berkomunikasi cukup efektif, ▪ Kualitas revisi yang dilakukan cukup baik.
		Baik	80 - 84.9	▪ Proses penyusunan proposal hingga skripsi meningkatkan kualitas tugas akhir, ▪ Mengikuti petunjuk dosen pembimbing, ▪ Berkomunikasi efektif, ▪ Kualitas revisi yang dilakukan cukup baik.
		Sangat Baik	85 - 100	▪ Proses penyusunan proposal hingga skripsi sangat meningkatkan kualitas tugas akhir, ▪ Mengikuti petunjuk dosen pembimbing, ▪ Berkomunikasi efektif, ▪ Kualitas revisi yang dilakukan sangat baik.