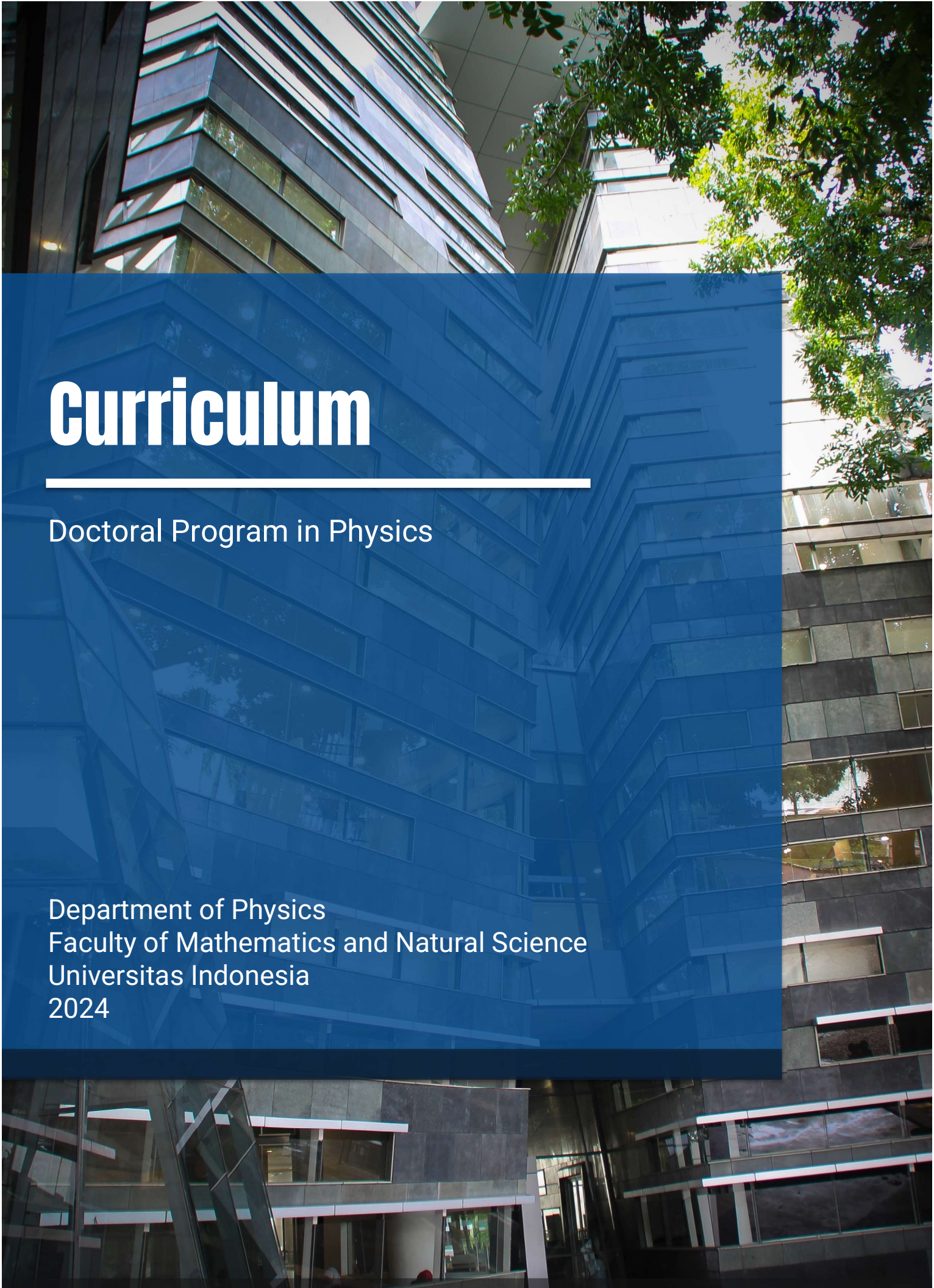


Curriculum

Doctoral Program in Physics

Department of Physics
Faculty of Mathematics and Natural Science
Universitas Indonesia
2024

Content

List of Figure

List of Table

1. Introduction

The Doctoral Program in Physics (DPPhy) at the Faculty of Mathematics and Natural Sciences UI always strives to keep up with the times by updating its curriculum. In 2024, 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 Doctoral Study Program was also making improvements and adjustments to its curriculum.

Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 53 of 2023 concerning Quality Assurance of Higher Education is the primary reference in changing the university curriculum towards the independent campus concept. A curriculum is a set of plans and arrangements regarding learning objectives, contents, materials, and methods used as guidelines for implementing learning activities to achieve higher education goals.

The construction of the curriculum of the Doctoral Program in Physics 2024 (Curriculum 2024) 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 and continuously improves based on the output evaluation results of learning activities comprehensively by applying a cycle of plan, do, check, and act.

The Doctoral Program in Physics curriculum consists of two programs: By Research and By Course. The Doctoral 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 required for a doctoral degree education is 88 credits within three academic years. A one-credit learning Module consists of 50 minutes per week 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 Doctoral 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, the UI Great Program is organized by the University of Indonesia. These programs allow students outside Indonesia to take a Doctoral 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 Doctoral Program in Physics evaluates its curriculum every four years by a study program curriculum team that the 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 2024 curriculum review is as follows

Prof. Dr. rer. nat. Terry Mart

Prof. Dr. techn. Djoko Triyono

Adhi Harmoko Saputro, Ph.D.

Ar Rohim, S.Si., M.Sc., Dr.

Djati Handoko, Ph.D.

Efta Yudiarsah, M.Si., Ph.D.

M. Syamsu Rosid, Dr.

Seno Aji, S.Si., M.Sc., Dr.

Yunus, Dipl.Geotherm.Tech, M.Sc., Dr.Eng.

2. Graduate Profile

2.1. Vision

The vision of the Doctoral Program in Physics 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 Doctoral 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. Improve 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 objectives of the Doctoral Program in Physics are

1. Producing internationally standardized doctoral graduates in physics and its applications to become intellectuals and cultured scientists, able to enter and/or create jobs, and develop themselves into professionals through comprehensive and accurate research
2. Producing superior, original scientific and creative works and works that become references in the development of science in the field of physics and its applications through the development and practice of science and technology with a scientific method approach

3. Producing original community service works through the application of physics and its applications to realize the development of science and technology based on physics in industry and society

2.4. Graduate Profile

Graduates with a Doctoral Degree in Physics who are able to think logically, critically, systematically, and creatively by contributing to producing original scientific and creative works in the national and international arena to build a professional career in fields related to physics and its applications.

2.5. Program Learning Outcomes (PLOs)

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

1. Able to analyze scientific problems and new cases in their field of work comprehensively and thoroughly in all aspects of physics knowledge and its applications (C4)
2. Able to synthesize physics knowledge and its applications with various experimental method approaches (experimental physics) or simulation methods (theoretical physics) to solve problems scientifically (C5)
3. Able to recommend solutions to new scientific and sustainable development problems relevant to physics and its applications collaboratively and comprehensively using interdisciplinary, multidisciplinary and/or transdisciplinary approaches (C5)
4. Able to integrate scientific methods and problem-solving strategies in any professional field (C4)
5. Able to evaluate the latest relevant international research to develop an advanced understanding of scientific progress in one field of physics (C6)
6. Able to develop solutions to problems through scientific research in one of the fields of Physics and Physics Applications by complying with guidelines, ethics, safety, and considering environmental impacts (C6)
7. Able to produce valuable original insights, methods, knowledge, and technology related to Physics and Physics Applications to contribute to industry and society (C6)
8. Able to manage research and development projects with high competence in communication and teamwork (C6)
9. Able to lead a research and development team to realize targets in accordance with the objectives, strategies, and tasks set (C4)
10. Able to compile research manuscript reports systematically and clearly in the form of dissertation books or international or national publications (C6)
11. Able to create innovative, tested, and original works as a result of research work in international or national academic forums (C6)

2.6. Learning Outcome Network

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

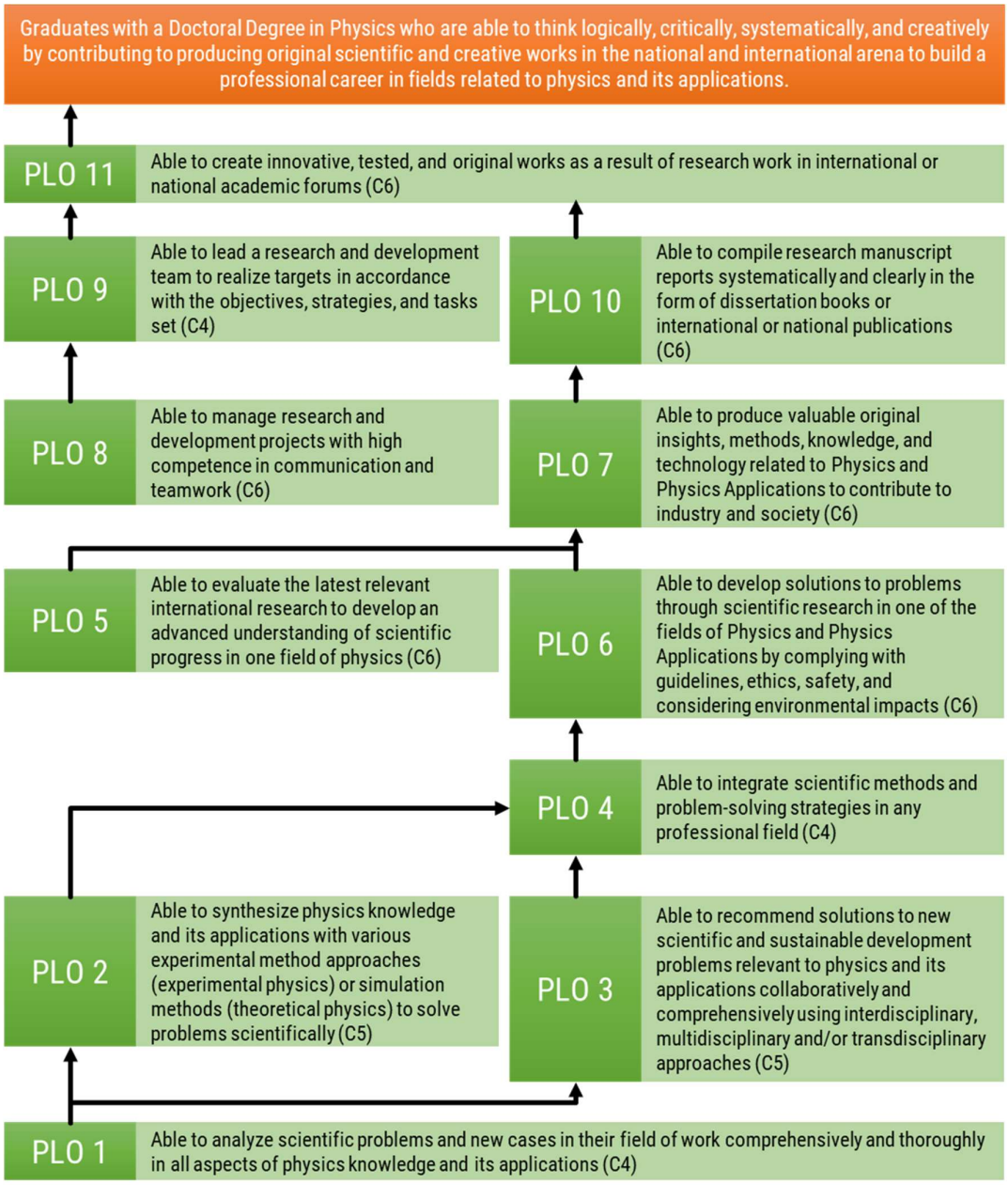
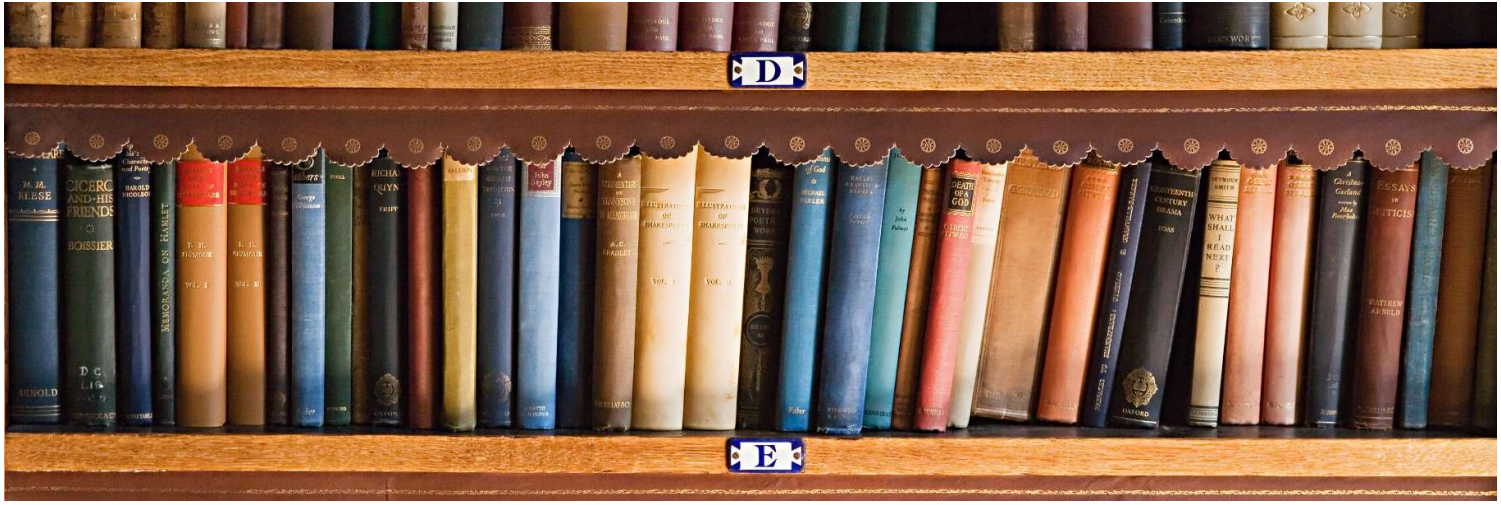


Figure 1. Main Program Learning Outcome Network



3. Structure and Curriculum Content

The Doctoral 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 Modules offered in a period, UI employs a credit unit system known as "SKS." One SKS is equivalent to a 45 hours in semester.

3.1. Curriculum Structure

The Doctoral Program in Physics is designed as a 3-year program (6 terms), obtaining 88 SKS. The Doctoral Program in Physics curriculum consists of two programs: By Research and By Course. Figure 2 shows the Doctoral Program in Physics by research, whereas Figure 3 shows the Doctoral Program in Physics by Course.

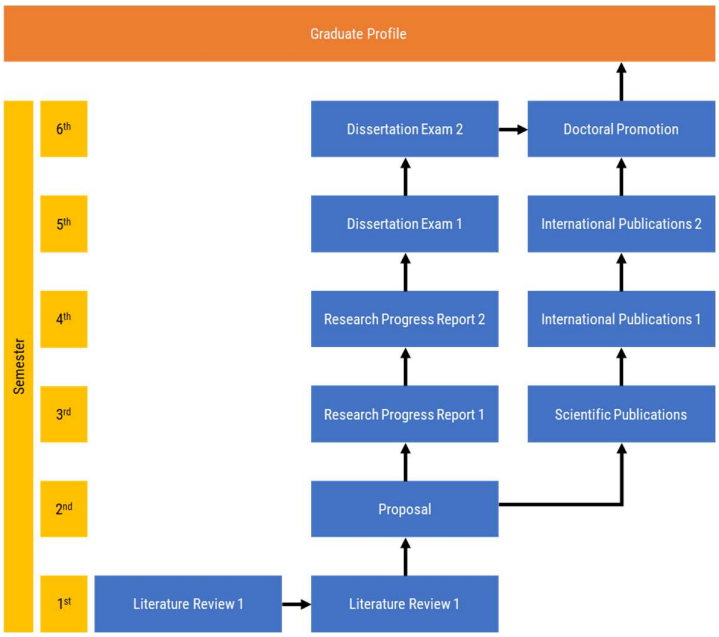


Figure 2. Curriculum Structure of Doctoral Program in Physics by Research

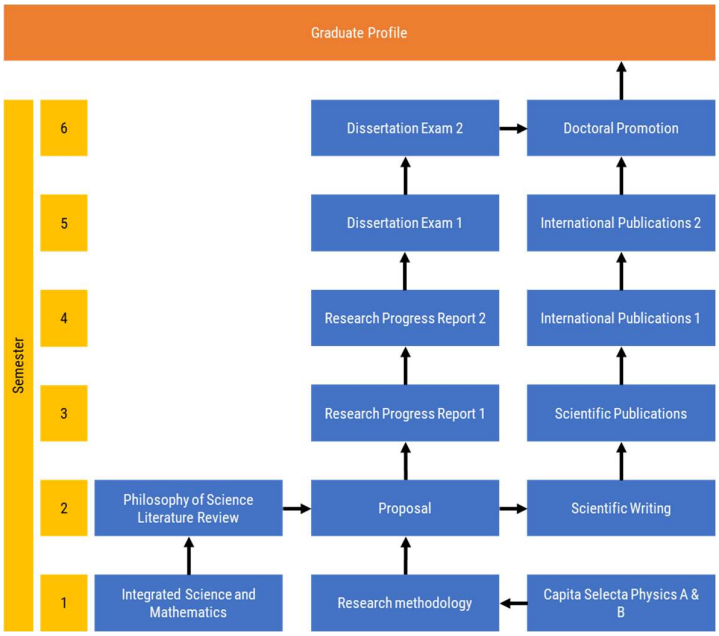


Figure 3. Curriculum Structure of Doctoral Program in Physics by Course

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 9.

Table 1. Matrix 0: KKNI Equivalent

KKNI	Description of KKNI (Level 9)	Graduate Profile / Competencies / Learning Outcomes / ELO	Bill
1.	Able to solve scientific, technological and/or artistic problems in their scientific field through an interdisciplinary, multidisciplinary, or transdisciplinary approach.	1. Able to analyze scientific problems and new cases in their field of work comprehensively and thoroughly in all aspects of physics knowledge and its applications (C4) 2. Able to synthesize physics knowledge and its applications with various experimental method approaches (experimental physics) or simulation methods (theoretical physics) to solve problems scientifically (C5) 3. Able to recommend solutions to new scientific and sustainable development problems relevant to physics and its applications collaboratively and comprehensively using interdisciplinary, multidisciplinary	Literature Review Proposal

KKNI	Description of KKNI (Level 9)	Graduate Profile / Competencies / Learning Outcomes / ELO	Bill
		and/or transdisciplinary approaches (C5) 4. Able to integrate scientific methods and problem-solving strategies in any professional field (C4)	
2.	Able to develop new knowledge, technology and/or art in his/her scientific field or professional practice through research to produce innovative, original, and tested work.	1. Able to evaluate the latest relevant international research to develop an advanced understanding of scientific progress in one field of physics (C6) 2. Able to develop solutions to problems through scientific research in one of the fields of Physics and Physics Applications by complying with guidelines, ethics, safety, and considering environmental impacts (C6) 3. Able to produce valuable original insights, methods, knowledge, and technology related to Physics and Physics Applications to contribute to industry and society (C6)	Literature Review Proposal Progress Report Scientific Publication
3.	Able to manage, lead, and develop research and development that is beneficial to science and the welfare of humanity, as well as gain national and international recognition.	1. Able to manage research and development projects with high competence in communication and teamwork (C6) 2. Able to lead a research and development team to realize targets in accordance with the objectives, strategies, and tasks set (C4) 3. Able to compile research manuscript reports systematically and clearly in the form of dissertation books or international or national publications (C6) 4. Able to create innovative, tested, and original works as a result of research work in international or national academic forums (C6)	Scientific Publication Disertation

Every graduate of the Doctoral 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 and 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 independent work in their field of expertise.
10. Internalize the spirit of independence, struggle, and entrepreneurship.

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

Table 2. General Skill Formation

No	Doctoral Degree Skills (SN DIKTI)	General Skills of Doctor 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 scientific journals or accepted in international journals.	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
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 concepts 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

No	Doctoral Degree Skills (SN DIKTI)	General Skills of Doctor of Physics Level
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 influential 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.	Able to apply the main rules of other disciplines (C3)
	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	Able to carry out various techniques and approaches to solve physical problems (P5)
		Able to evaluate data from experiments results (C5)

State Clump	Key Competencies	Supporting Competencies
	critically and systematically and draw conclusions	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 Doctoral Program in Physics.

Table 4. Matrix II: Learning Experience

No	Competence	Learning Experience	Scope	Media and Technology	Modules	Indicator	Assessment
1.	Able to analyze scientific problems and new cases in their field of work comprehensively and thoroughly in all aspects of physics knowledge and its applications (C4)	Able to apply logical, critical, systematic, and creative thinking in the field of science and technology that is in accordance with the field of physics competency (C3) Able to explore new scientific problems that are relevant to aspects of physics knowledge and its applications comprehensively and thoroughly (C4) Able to examine laws, theories, or physics formulas and their relevant applications to solve new scientific problems comprehensively and scientifically (C4) Able to analyze all aspects of the problems faced based on the	- Physics Concept - Scientific Literature - Critical Attitude	Computer LCD Internet	- Research Methodology - Literature Review - Scientific Writing - Selected Physics Chapters - Integration of Science and Mathematics - Philosophy of Science	Ability to think logically, critically, systematically, and creatively Ability to correlate scientific problems Ability to examine laws, theories, or physics formulas and their applications Ability to analyze all aspects of the problems faced	- Supervision Observation - Research Discussion - Paper - Final Exam - Class Discussion - Independent & Group Assignments - Final Project Presentation - Midterm & Final Exam

No	Competence	Learning Experience	Scope	Media and Technology	Modules	Indicator	Assessment
		concept of physics and its relevant applications (C4)					
2.	Able to synthesize physics knowledge and its applications with various experimental method approaches (experimental physics) or simulation methods (theoretical physics) to solve problems scientifically (C5)	Able to calculate physical quantities from laws or theories of physics that are relevant to scientific problems or work (C3) Able to apply methods and tools to help solve physics problems in the form of analytical, numerical, or experimental approaches in applying physics knowledge and its applications (C4) Able to maximize information technology in the context of implementing work using one of the computer-based applications (C5) Able to compare data, observations, or calculation results using theoretical, conceptual approaches or related	- Physics Concepts - Information Technology - Computer Programming - Scientific Literature	Computer LCD Internet	- Research Methodology - Literature Review - Scientific Writing - Capita Selecta in Physics	Ability to calculate physical quantities Ability to use analytical, numerical, or experimental methods Ability to use information technology to support work Ability to analyze comparative data, observations, or calculation results	- Supervision Observation - Research Discussion - Paper - Final Exam - Class Discussion - Independent & Group Assignments - Final Project Presentation - Midterm & Final Exam

No	Competence	Learning Experience	Scope	Media and Technology	Modules	Indicator	Assessment
		calculation methods (C5)					
3.	Able to recommend solutions to new scientific and sustainable development problems relevant to physics and its applications collaboratively and comprehensively using interdisciplinary, multidisciplinary and/or transdisciplinary approaches (C5)	Able to solve problems in the field of physics, its applications and new sustainable development collaboratively and comprehensively using an interdisciplinary or multidisciplinary approach (C4) Able to validate problem solutions based on scientific studies according to the field of physics competency in solving relevant problems in society or industry (C5) Able to compile recommendations for scientific problems and sustainable development based on the results of comprehensive studies involving various fields in the scope of mathematics and science (C6)	- Physics Concepts - Scientific Literature	Computer LCD Internet	- Literature Review - Scientific Writing - Capita Selecta in Physics - Integration of Science and Mathematics	Problem solutions are available using an interdisciplinary or multidisciplinary approach Ability to validate problem solutions based on scientific studies Ability to prepare comprehensive problem recommendations Ability to solve new problems analytically and/or numerically	- Supervision Observation - Research Discussion - Paper - Final Exam - Class Discussion - Independent & Group Assignments - Final Project Presentation - Midterm & Final Exam

No	Competence	Learning Experience	Scope	Media and Technology	Modules	Indicator	Assessment
		Able to solve new problems in the field of physics and its applications analytically and/or numerically using one of the computer-based applications (C6)					
4.	Able to integrate scientific methods and problem-solving strategies in any professional field (C4)	Able to adapt to the latest scientific developments by constantly learning new things that are relevant to any job or profession (C4) Able to implement the principle of sustainability in applying scientific methods and problem-solving strategies in any professional field (C3) Able to internalize the spirit of independence, struggle, and entrepreneurship based on academic values, norms, and ethics (C3) Able to increase the capacity of learning physics and its applications	- Scientific Mindset - Work Systematics	Face-to-face lectures, Demonstrations, LCD, ICT	- Research Methodology - Literature Review - Integration of Science and Mathematics - Philosophy of Science - Research Result Examination	Ability to adapt to the latest scientific developments Ability to implement the principle of sustainability in applying scientific methods Internalization of the spirit of independence, struggle, and entrepreneurship Increasing the capacity for independent and sustainable physics learning	- Supervision Observation - Research Discussion - Paper - Final Exam - Class Discussion - Independent & Group Assignments - Final Project Presentation - Midterm & Final Exam

No	Competence	Learning Experience	Scope	Media and Technology	Modules	Indicator	Assessment
		independently and sustainably (C6)					
5.	Able to evaluate the latest relevant international research to develop an advanced understanding of scientific progress in one field of physics (C6)	Able to summarize the latest literature relevant to scientific problems or research topics by sourcing from reputable international journals in sufficient quantities (C5) Able to analyze trends and developments in a research topic through expert discussions, current literature and other relevant reading sources (C4) Able to critique various current literature related to research topics and critique to find potential for development and renewal of science in one field of physics (C5)	- Scientific Literature - Utilization of IT	Face-to-face lectures, Demonstrations, LCD, ICT	- Literature Review - Proposal	Availability of presentation materials to present the latest literature relevant to scientific problems or research topics Availability of articles containing analysis of the latest literature studies related to related research topics Availability of articles containing potential for development and renewal of scientific knowledge	- Supervision Observation - Research Discussion - Paper - Final Exam
6.	Able to develop solutions to problems through scientific research in one of the fields of Physics and Physics Applications by complying with	Able to compile new ideas and concepts in the form of research proposals in accordance with scientific problems and topics to be resolved responsibly	- Scientific Methodology - Ethics & Guidelines - HSE	Face-to-face lectures, Demonstrations, LCD, ICT	- Proposal - Research Result Examination - Dissertation Examination	Availability of ideas, objectives, plans and research proposals in written and presentation form	- Supervision Observation - Research Discussion - Paper

No	Competence	Learning Experience	Scope	Media and Technology	Modules	Indicator	Assessment
	guidelines, ethics, safety, and considering environmental impacts (C6)	based on academic ethics (C6) Able to apply scientific methodology in conducting research by considering guidelines, ethics, safety, and environmental impacts (C4) Able to analyze data, observations, calculation results or simulations obtained through research supported by related theories (C4) Able to compile research results carefully related to the discussion of research results and answer research problems and objectives clearly (C6)			- Doctoral Promotion	Ability to conduct research with appropriate scientific methodology Availability of data analysis results, observations, calculation results or simulations in written and presentation form Ability to conclude research results carefully	- Final Exam- Supervision Observation - Research Discussion - Paper - Final Exam
7.	Able to produce valuable original insights, methods, knowledge, and technology related to Physics and Physics Applications to contribute to industry and society (C6)	Able to update knowledge of physics and its applications through research to contribute to solving problems in industry and society (C4) Able to deepen or expand the science of	- Originality of ideas and data - Plagiarism - Data Analysis	Face-to-face lectures, Demonstrations, LCD, ICT	- Scientific Publication - International Publication - Research Result Examination - Dissertation Examination	Contribute to solving problems in industry and society Ability to produce a model, method or theory development that	- Supervision Observation - Research Discussion - Paper - Final Exam

No	Competence	Learning Experience	Scope	Media and Technology	Modules	Indicator	Assessment
		physics or applied physics by producing an original, accurate, tested, and innovative model, method or theory development that is useful for industry and society (C6) Able to solve new scientific problems and sustainable development through an inter- or multidisciplinary approach characterized by the production of comprehensive valuable insights, methods, knowledge and technology (C6)			- Doctoral Promotion	is accurate, tested and innovative Ability to produce comprehensive valuable insights, methods, knowledge and technology	
8.	Able to manage research and development projects with high competence in communication and teamwork (C6)	Able to design the distribution of workload and time well for working independently or in a team (C6) Able to evaluate the relationship between colleagues in completing a research and development project (C5)	- Cooperation and Communication - Work and Time Effectiveness	Face-to-face lectures, Demonstrations, LCD, ICT	- Proposal - Research Result Examination - Dissertation Examination - Doctoral Promotion	Availability of a good workload and time distribution plan Ability to work with co-workers Research work is completed on time according to the plan made Ability to manage work networks	- Supervision Observation - Research Discussion - Paper - Final Exam

No	Competence	Learning Experience	Scope	Media and Technology	Modules	Indicator	Assessment
		Able to direct work effectively in research and development projects (C5) Able to manage networks with colleagues, peers within institutions and the wider physics research community (C5) Able to be accountable for the results of research and development project work (C5)				Ability to be accountable for work results	
9.	Able to lead a research and development team to realize targets in accordance with the objectives, strategies, and tasks set (C4)	Able to decide on the objectives, strategies, and tasks of each member of the research team to achieve the research target (C5) Able to monitor and evaluate the objectives, strategies, and tasks of each member of the research team in carrying out research periodically (C4) Able to resolve problems and technical constraints of each team	- Cooperation and Communication - Work and Time Effectiveness	Face-to-face lectures, Demonstrations, LCD, ICT	- Research Result Examination - Dissertation Examination	Ability to decide on the objectives, strategies, and tasks of each member of the research team Ability to monitor and evaluate the objectives, strategies, and tasks of each member of the research team Ability to resolve technical issues and constraints of	- Supervision Observation - Research Discussion - Paper - Final Exam

No	Competence	Learning Experience	Scope	Media and Technology	Modules	Indicator	Assessment
		member in carrying out research to complete the target according to the time set (C5)				each team member	
10.	Able to compile research manuscript reports systematically and clearly in the form of dissertation books or international or national publications (C6)	Able to elaborate data information, observations, or calculation results in detail using images, tables and graphs that support research results (C4) Able to clarify contributions to valuable insights and knowledge appropriately and comprehensively in the form of scientific writing (C5) Able to compile final assignment reports systematically in accordance with writing techniques determined by applicable guidelines at the university (C6) Able to compile scientific papers that can be published in international and/or	- Writing & Graphic Illustration - Report Systematics	Face-to-face lectures, Demonstrations, LCD, ICT	- Scientific Publication - International Publication - Dissertation Examination	Ability to convey information data, observations, or calculation results There is a contribution to insight and knowledge in the form of scientific writing Availability of final assignment reports in accordance with writing techniques Availability of scientific papers that can be published	- Supervision Observation - Research Discussion - Paper - Final Exam

No	Competence	Learning Experience	Scope	Media and Technology	Modules	Indicator	Assessment
		national publications (C6)					
11.	Able to create innovative, tested, and original works as a result of research work in international or national academic forums (C6)	Able to clarify the presentation of research plans and results systematically by using good sentence structure and language (C5) Able to compile innovative and tested works as the realization of ideas, results of thinking and scientific arguments that are useful for the academic community and the wider community (C6) Able to maintain arguments and opinions in presenting work and research results clearly, straightforwardly, precisely, and well/politely based on data evidence (C5)	- Presentation and Communication - Ethics of asking and arguing	Face-to-face lectures, Demonstrations, LCD, ICT	- Literature Review - Proposal - Publication - Dissertation Examination - Doctoral Promotion	Implementation of systematic presentation of research plans and results Availability of innovative work that has been tested and is useful for the academic community and the wider community Ability to argue clearly, straightforwardly, precisely and politely when defending the results of one's research	- Supervision Observation - Research Discussion - Paper - Final Exam

3.3. Curriculum Detail

Distribution of Modules in 6 Semesters

The modules listed in Table 5 are required to obtain a doctoral program in physics (DPPh) through research. Table 6 shows the Module list necessary for obtaining the Doctoral Program in Physics (DPPh) by course.

Table 5. The By-Research Modules Distribution

1st Semester		
Code	**Modules**	**Credit**
SCPH901001	Literature Review 1 (R)	5
SCPH901002	Literature Review 2 (R)	5
	Total	**10**

2nd Semester		
Code	**Modules**	**Credit**
SCPH901003	Research Proposal (R)	8
	Total	**8**

3rd Semester		
Code	**Modules**	**Credit**
SCPH901004	Research Progress 1 (R)	10
SCPH901005	Scientific Publication (R)	8
	Total	**18**

4th Semester		
Code	**Modules**	**Credit**
SCPH901006	Research Progress 2 (R)	10
SCPH901007	International Publication 1 (R)	8
	Total	**18**

5th Semester		
Code	**Modules**	**Credit**
SCPH901008	Dissertation Examination 1 (R)	8
SCPH901009	International Publication 2 (R)	10
	Total	**18**

6th Semester		
Code	**Modules**	**Credit**
SCPH901010	Dissertation Examination 2 (R)	12
SCPH901011	Doctoral Promotion (R)	4
	Total	**16**

Table 6. The By-Course Modules Distribution

1st Semester		
Code	**Modules**	**Credit**
SCSC900001	Integrated of Science and Mathematics	4
SCPH902001	Research Methodology	2
SCPH902002	Capita Selecta in Physics A	4
SCPH902003	Capita Selecta in Physics B	4
	Total	**14**

2nd Semester		
Code	**Modules**	**Credit**
SCSC900002	Philosophy of Science	2
SCPH902004	Literature Review	2
SCPH902005	Scientific Writing	2
SCPH902006	Research Proposal	8
	Total	**14**

3rd Semester		
Code	**Modules**	**Credit**
SCPH902007	Research Progress 1	8
SCPH902008	Scientific Publication	6
	Total	**14**

4th Semester		
Code	**Modules**	**Credit**
SCPH902009	Research Progress 2	10
SCPH902010	International Publication 1	6
	Total	**16**

5th Semester		
Code	**Modules**	**Credit**
SCPH902011	Dissertation Examination 1	8
SCPH902012	International Publication 2	6
	Total	**14**

6th Semester		
Code	**Modules**	**Credit**
SCPH902013	Dissertation Examination 2	12
SCPH902014	Doctoral Promotion	4
	Total	**16**

3.4. Syllabus

Literature Review 1 (R)

Module Code	SCPH901001
Credits	5 Credits
Semester	1
Description	Literature Review 1 is a course that contains research preparation to strengthen basic scientific concepts that support research. Students must search for, read, and analyze the fundamental theories, physics concepts related to research, and other supporting research materials, then present the physics concepts and theories and have scientific discussions periodically. The main topics of this course are adjusted to the needs of the research theme and other supporting sciences.
Reference	1. Bryan Greetham (2021), How To Write Your Literature Review, Red Globe Press/Macmillan Education 2. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 3. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 4. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Literature Review 2 (R)

Module Code	SCPH901002
Credits	5 Credits
Semester	1
Description	Literature Review 2 is a course that contains presentation and discussion activities on research topics as initial preparation before conducting research. Students must search for, read, and analyze reputable journal scientific publications and prepare a literature review plan, starting with determining the title, problem, background, study method, and the literature review results. Students are asked to review at least 50 reputable scientific journals related to a particular research topic, criticize, explain current research, and get research opportunities. Students present the results of the literature review and have scientific discussions periodically. The main topics of this course include the breadth and depth of research topics, as well as mastery of material and scientific systematics. Scientific attitude in analyzing specific research topics with good scientific systematics.
Reference	1. C. George Thomas (2021), Research Methodology And Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Jay D. Gatrell, Gregory D. Bierly, Ryan R. Jensen, Rajiv R. Thakur (2020), Research Design and Proposal Writing in Spatial Science, Springer 4. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Research Proposal (R)

Module Code	SCPH901003
Credits	8 Credits
Semester	2
Description	The Research Proposal course prepares students for planning and writing research proposals. This course prepares essential steps in preparing a quality research plan, from formulating research questions, developing a theoretical framework, designing a research methodology, and planning data analysis. This course involves discussions, writing assignments, and possibly small projects that allow students to apply the concepts learned in practical situations. The goal is for students to have strong competencies in designing and writing good research proposals, which can be the basis for conducting further research during the education process.
Reference	1. C. George Thomas (2021), Research Methodology And Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Jay D. Gatrell, Gregory D. Bierly, Ryan R. Jensen, Rajiv R. Thakur (2020), Research Design and Proposal Writing in Spatial Science, Springer 4. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Research Progress 1 (R)

Module Code	SCPH901004
Credits	8 Credits
Semester	3
Description	The Research Results Examination course aims to determine and evaluate students' ability to present research findings clearly and cohesively, obtain constructive feedback, and practice communicating effectively. This course guides students in constructing a logical and orderly presentation structure, including the use of images, tables, and graphs to support data presentation. This course also encourages the development of strong oral communication skills, including the ability to speak clearly, explain complex concepts, and answer questions confidently. Student success is based on clear criteria for evaluating presentations and students' knowledge of their own research, as well as providing useful feedback for further development.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Scientific Publication (R)

Module Code	SCPH901005

Credits	10 Credits
Semester	3
Description	The Scientific Publication course prepares students to understand, evaluate, and produce quality scientific publications. This course guides students in choosing the type of publication, writing an abstract, introduction, methods, results, discussion, and bibliography, selecting an appropriate journal or conference, and knowing the principles of ethics in scientific publication, including copying and other academic fraud. In addition, students are also guided to learn how to evaluate the quality of scientific publications, both in terms of content and the reputation of the journal or conference. This course involves discussions, writing assignments, and analysis and criticism of existing scientific publications. The goal is to equip students with the skills and knowledge needed to succeed in the scientific publication process as writers and critical readers to grow in publishing their research results.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Research Progress 2 (R)

Module Code	SCPH901006
Credits	10 Credits
Semester	4
Description	The Research Results Examination course aims to determine and evaluate students' ability to present research findings clearly and cohesively, obtain constructive feedback, and practice communicating effectively. This course guides students in constructing a logical and orderly presentation structure, including using images, tables, and graphs to support data presentation. This course also encourages the development of strong oral communication skills, including the ability to speak clearly, explain complex concepts, and answer questions confidently. Student success is based on clear criteria for evaluating presentations and students' knowledge of their own research and providing useful feedback for further development.
Reference	1. C. George Thomas (2021), Research Methodology And Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

International Publication 1 (R)

Module Code	SCPH901007
Credits	8 Credits
Semester	4

Description	The International Publication course prepares students to understand, evaluate, and produce quality scientific publications. This course guides students in choosing the type of publication, writing an abstract, introduction, methods, results, discussion, and bibliography, choosing an appropriate journal for publication, knowing the principles of ethics in scientific publication, including copying and other academic fraud. In addition, students are also guided to learn about how to evaluate the quality of scientific publications, both in terms of content and the reputation of the journal or conference. This course involves discussions, writing assignments, and analysis and criticism of existing scientific publications. The goal is to equip students with the skills and knowledge needed to succeed in the scientific publication process, both as writers and critical readers to success in preparing a draft of a scientific journal that is the result of their own research.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Dissertation Examination 1 (R)

Module Code	SCPH901008
Credits	8 Credits
Semester	5
Description	Tehe Dissertation Defense course is the final stage in the doctoral program in which students are examined on their dissertation, which is the student's original contribution to knowledge in the field of physics and its applications. This course evaluates the student's ability to design, conduct, and present original and substantial scientific research. This course also provides guidance on the proper structure of a dissertation, including the required chapters such as introduction, literature review, research methodology, results, analysis, and conclusion. The course introduces the dissertation defense process, where students will present their research results to a panel of examiners and answer questions and provide clarification on the material presented. This course has clear evaluation criteria to assess the quality of the dissertation and the student's performance during the defense, as well as provide constructive feedback for further development.
Reference	4.

International Publication 2 (R)

Module Code	SCPH901009
Credits	10 Credits
Semester	5
Description	The International Publication course prepares students to understand, evaluate, and produce quality scientific publications. This course guides students in choosing the type of publication, writing an abstract, introduction, methods, results, discussion, and bibliography, choosing an appropriate journal or conference for publication, knowing the principles of ethics in scientific publication, including copying and other

	academic fraud. In addition, students are also guided to learn about how to evaluate the quality of scientific publications, both in terms of content and the reputation of the journal or conference. This course involves discussions, writing assignments, and analysis and criticism of existing scientific publications. The goal is to equip students with the skills and knowledge needed to succeed in the scientific publication process, both as writers and critical readers to success in publishing their own research results in quality scientific journals.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Dissertation Examination 2 (R)

Module Code	SCPH901010
Credits	12 Credits
Semester	6
Description	The Dissertation Defense Course is the final stage in the doctoral program where students are examined on their dissertation, which is the student's original contribution to knowledge in the field of physics and its applications. This course evaluates the student's ability to design, conduct, and present original and substantial scientific research. This course also provides guidance on the proper structure of a dissertation, including the required chapters such as introduction, literature review, research methodology, results, analysis, and conclusion. The course introduces the dissertation defense process, where students will present their research results to a panel of examiners and answer questions and provide clarification on the material presented. This course has clear evaluation criteria to assess the quality of the dissertation and the student's performance during the defense, as well as provide constructive feedback for further development. The defense examination of this course is conducted privately in front of the promoter team and the examiner team.
Reference	1. C. George Thomas (2021), Research Methodology And Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Doctoral Promotion (R)

Module Code	SCPH901011
Credits	4 Credits
Semester	6
Description	This Doctoral Promotion course is the final stage of the doctoral program where students complete their research and prepare their dissertation to be defended in front of a panel of examiners in public. This course develops strong oral presentation skills, both in preparing presentation materials and in presenting them confidently

	and clearly. The Doctoral Promotion Defense is conducted to complete and defend their dissertation, and obtain a doctoral degree.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Integrated of Science and Mathematics

Module Code	SCSC900001
Credits	4 Credits
Semester	1
Description	This course combines various disciplines of science and mathematics to provide a comprehensive understanding of solving a scientific problem. The course is a cross-border study that cannot be limited to one academic discipline. The focus is on explaining how to use mathematical and scientific principles to understand, analyze, and explain various scientific problems in a multi-disciplinary manner. This course aims to help students develop analytical, problem-solving, and critical thinking skills needed to address challenges in modern science. It also helps them understand the close relationship between mathematics and science, and the relevance of mathematics in understanding and research in various fields of science.
Reference	1. Scientific journal articles 2. Textbooks and monographs related to specific topics

Research Methodology

Module Code	SCPH902001
Credits	2 Credits
Semester	1
Description	The Research Methodology course aims to equip students with an understanding of research methods in Physics, the ability to design valid and relevant research, and the necessary data analysis skills. This course introduces basic concepts in research, including formulating research problems, developing hypotheses, and determining research objectives. This course also introduces data analysis techniques appropriate to the research method they choose, including statistical analysis, qualitative analysis, and more advanced data analysis techniques. The course guides students in designing a comprehensive research proposal, which includes the research background, objectives, methodology, and implementation schedule.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Patrick X. W. Zou, Xiaoxiao Xu (2023), Research Methodology and Strategy: Theory and Practice, Wiley-Blackwell 3. Shyama Prasad Mukherjee (2020), A Guide To Research Methodology: An Overview Of Research Problems, Tasks And Methods, Taylor & Francis Group

Capita Selecta Physics A

Module Code	SCPH902004
Credits	4 Credits
Semester	1
Description	Capita Selecta Physics A courses are advanced courses designed to provide a deeper understanding of specialized topics in physics. Students taking this course are assumed to have a solid understanding of the basic concepts in physics. The course may involve literature review and discussion of recent research, laboratory experiments, and simple research projects. The goal is to help students develop a deeper understanding of a specific area of physics and prepare them to begin research in one of the areas of physics.
Reference	1. Scientific journal articles 2. Textbooks and monographs related to specific topics

Capita Selecta Physics B

Module Code	SCPH902005
Credits	4 Credits
Semester	1
Description	Capita Selecta Physics B courses are advanced courses designed to provide a deeper understanding of specialized topics in physics. Students taking this course are assumed to have a solid understanding of the basic concepts in physics. The course may involve literature review and discussion of recent research, laboratory experiments, and simple research projects. The goal is to help students develop a deeper understanding of a specific area of physics and prepare them to begin research in one of the areas of physics.
Reference	1. Scientific journal articles 2. Textbooks and monographs related to specific topics

Philosophy of Science

Module Code	SCSC900002
Credits	2 Credits
Semester	1
Description	Philosophy of Science courses address fundamental concepts and questions about the nature, limits, and methodology of science. It is the study of the origins, development, and nature of human knowledge, and the ways in which we understand the world around us. It examines the history of philosophical thought about the nature of science, including concepts such as reality, truth, justification, reasoning, the scientific method, and the relationship between science and other beliefs such as religion or philosophy. The focus of the course may include analysis of classical and modern philosophical theories and their application to contemporary issues in science and society. In addition, the course often encourages students to think

	critically, evaluate arguments, and develop a deeper understanding of the nature and limits of human knowledge.
Reference	4.

Literature Review

Module Code	SCPH902002
Credits	2 Credits
Semester	1
Description	The Literature Review course provides an understanding of the latest developments in a particular field of study, the ability to evaluate relevant literature, and skills in synthesizing information from various sources. This course teaches students to analyze and evaluate sources of information, distinguish between credible and non-credible information, and assess the presence of bias in the literature. This course also teaches effective literature search techniques, including the use of academic databases, scientific journals, books, and other sources of information. The course teaches skills in analyzing and synthesizing relevant literature, identifying patterns, trends, and contributions of these works to the development of the field of study. This course aims to prepare students for dissertation research in searching, evaluating, and analyzing academic literature.
Reference	1. Bryan Greetham (2021), How To Write Your Literature Review, Red Globe Press/Macmillan Education 2. Lawrence A Machi; Brenda T McEvoy (2022), The literature review: six steps to success, Corwin Press 3. Bryan Greetham (2021), How To Write Your Literature Review, Macmillan Education 4. David J. Harris (2020), Literature Review And Research Design: A Guide To Effective Research Practice, Taylor Francis Group

Scientific Writing

Module Code	SCPH902003
Credits	2 Credits
Semester	1
Description	The Scientific Writing course equips students with the skills and knowledge needed to produce quality scientific writing. This course provides an understanding of the structure and style of scientific writing, the development of research skills, and the ability to construct a cohesive argument. The course helps students develop the ability to construct logical and cohesive arguments, and to present data and findings effectively. The course also provides students with the opportunity to practice writing and editing their own scientific papers, with feedback from lecturers and fellow students. This course focuses on preparing students to become skilled and trained scientific writers, and helps them understand the importance of effective scientific communication in the academic and professional world.
Reference	1. Bryan Greetham (2021), How To Write Your Literature Review, Red Globe Press/Macmillan Education

	2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Research Proposals

Module Code	SCPH902006
Credits	8 Credits
Semester	2
Description	The Proposal course prepares students in planning and writing research proposals. This course prepares important steps in preparing a quality research plan, starting from formulating research questions, developing a theoretical framework, designing a research methodology, to planning data analysis. This course involves discussions, writing assignments, and possibly small projects that allow students to apply the concepts learned in practical situations. The goal is for students to have strong competence in designing and writing good research proposals, which can be the basis for conducting further research during the education process.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Jay D. Gatrell, Gregory D. Bierly, Ryan R. Jensen, Rajiv R. Thakur (2020), Research Design and Proposal Writing in Spatial Science, Springer 4. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Research Progress 1

Module Code	SCPH902007
Credits	8 Credits
Semester	3
Description	The Research Results Examination course aims to determine and evaluate students' ability to present research findings clearly and cohesively, obtain constructive feedback, and practice communicating effectively. This course guides students in constructing a logical and orderly presentation structure, including the use of images, tables, and graphs to support data presentation. This course also encourages the development of strong oral communication skills, including the ability to speak clearly, explain complex concepts, and answer questions confidently. Student success is based on clear criteria for evaluating presentations and students' knowledge of their own research, as well as providing useful feedback for further development.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers

	3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Scientific Publications

Module Code	SCPH902008
Credits	6 Credits
Semester	3
Description	The Scientific Publication course prepares students to understand, evaluate, and produce quality scientific publications. This course guides students in choosing the type of publication, writing an abstract, introduction, methods, results, discussion, and bibliography, choosing an appropriate journal or conference for publication, knowing the principles of ethics in scientific publication, including copying and other academic fraud. In addition, students are also guided to learn about how to evaluate the quality of scientific publications, both in terms of content and the reputation of the journal or conference. This course involves discussions, writing assignments, and analysis and criticism of existing scientific publications. The goal is to equip students with the skills and knowledge needed to succeed in the scientific publication process, both as writers and critical readers to success in publishing their own research results.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Research Progress 2

Module Code	SCPH902009
Credits	10 Credits
Semester	4
Description	The Research Results Examination course aims to determine and evaluate students' ability to present research findings clearly and cohesively, obtain constructive feedback, and practice communicating effectively. This course guides students in constructing a logical and orderly presentation structure, including the use of images, tables, and graphs to support data presentation. This course also encourages the development of strong oral communication skills, including the ability to speak clearly, explain complex concepts, and answer questions confidently. Student success is based on clear criteria for evaluating presentations and students' knowledge of their own research, as well as providing useful feedback for further development.
Reference	1. C. George Thomas (2021), Research Methodology And Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

International Publication 1

Module Code	SCPH902010
Credits	6 Credits
Semester	4
Description	The International Publication course prepares students to understand, evaluate, and produce quality scientific publications. This course guides students in choosing the type of publication, writing an abstract, introduction, methods, results, discussion, and bibliography, choosing an appropriate journal or conference for publication, knowing the principles of ethics in scientific publication, including copying and other academic fraud. In addition, students are also guided to learn about how to evaluate the quality of scientific publications, both in terms of content and the reputation of the journal or conference. This course involves discussions, writing assignments, and analysis and criticism of existing scientific publications. The goal is to equip students with the skills and knowledge needed to succeed in the scientific publication process, both as writers and critical readers to success in preparing a draft of a scientific journal that is the result of their own research.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Dissertation Examination 1

Module Code	SCPH902011
Credits	8 Credits
Semester	5
Description	The Dissertation Defense course is the final stage in the doctoral program in which students are examined on their dissertation, which is the student's original contribution to knowledge in the field of physics and its applications. This course evaluates the student's ability to design, conduct, and present original and substantial scientific research. This course also provides guidance on the proper structure of a dissertation, including the required chapters such as introduction, literature review, research methodology, results, analysis, and conclusion. The course introduces the dissertation defense process, where students will present their research results to a panel of examiners and answer questions and provide clarification on the material presented. This course has clear evaluation criteria to assess the quality of the dissertation and the student's performance during the defense, as well as provide constructive feedback for further development.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

International Publications 2

Module Code	SCPH902012
Credits	6 Credits
Semester	5
Description	The International Publication course prepares students to understand, evaluate, and produce quality scientific publications. This course guides students in choosing the type of publication, writing an abstract, introduction, methods, results, discussion, and bibliography, choosing an appropriate journal or conference for publication, knowing the principles of ethics in scientific publication, including copying and other academic fraud. In addition, students are also guided to learn about how to evaluate the quality of scientific publications, both in terms of content and the reputation of the journal or conference. This course involves discussions, writing assignments, and analysis and criticism of existing scientific publications. The goal is to equip students with the skills and knowledge needed to succeed in the scientific publication process, both as writers and critical readers to success in publishing their own research results in quality scientific journals.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Dissertation Examination 2

Module Code	SCPH902013
Credits	12 Credits
Semester	6
Description	The Dissertation Defense course is the final stage in the doctoral program in which students are examined on their dissertation, which is the student's original contribution to knowledge in the field of physics and its applications. This course evaluates the student's ability to design, conduct, and present original and substantial scientific research. This course also provides guidance on the proper structure of a dissertation, including the required chapters such as introduction, literature review, research methodology, results, analysis, and conclusion. The course introduces the dissertation defense process, where students will present their research results to a panel of examiners and answer questions and provide clarification on the material presented. This course has clear evaluation criteria to assess the quality of the dissertation and the student's performance during the defense, as well as provide constructive feedback for further development.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE Press

Doctoral Promotion

Module Code	SCPH902014
Credits	4 Credits
Semester	6
Description	This Doctoral Promotion course is the final stage of the doctoral program where students complete their research and prepare their dissertation to be defended in front of a panel of examiners in public. This course develops strong oral presentation skills, both in preparing presentation materials and in presenting them confidently and clearly. The Doctoral Promotion Defense is conducted to complete and defend their dissertation, and obtain a doctoral degree.
Reference	1. C. George Thomas (2021), Research Methodology and Scientific Writing, Springer 2. Gábor L Lövei (2021), Writing and Publishing Scientific Papers: A Primer for the Non-English Speaker, Open Book Publishers 3. Robert E. Berger (2014), A Scientific Approach to Writing for Engineers and Scientists, Wiley-IEEE 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 7 shows a list of information and technology facilities for all students.

Table 7. 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. Examiner Application System

The student fills out all forms online in Examiner Application System, which is accessed in https://univindonesia.sharepoint.com/sites/PhysicsUI/. Students need active "Universitas Indonesia Single Sign On" to enter the application. Student should fill the form correctly to request an assessment (Scientific Publication) or to register their research supervisor in doctoral work.