Curriculum Overview

Bachelor of Physics Education

Faculty of Mathematics and Natural Science
Universitas Negeri Jakarta

2023

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A. Objectives of The Degree Programme

The Vision and Mission of Institution

Vision of Universitas Negeri Jakarta

- Becoming a Reputable University in the Asian Region

Mission of Universitas Negeri Jakarta

- Organizing the Tridharma of Higher Education that is Excellent and Useful for the Benefit of Humans

The Vision and Mission Objectives of Faculty

Vision of Faculty of Mathematics and Natural Science

- To become an excellent and competitive faculty in the field of Mathematics, Natural Sciences, Mathematics Education, and Natural Sciences Education at the ASIAN level based on faith and piety.

Mission of Faculty of Mathematics and Natural Science

- To produce graduates in the field of Mathematics and Natural Sciences education who are professional, able to utilize information and communication technology, have faith and piety, have entrepreneurial skills, according to stakeholder needs, and are able to compete at the ASEAN level.
- To produce quality scientific works based on research results in the field of Mathematics and Natural Sciences and Mathematics and Natural Sciences education in accordance with the development of science and technology.
- To produce works of community service in the field of Mathematics and Natural Sciences and Mathematics and Natural Sciences education that can be directly utilized by the community.
- To establish mutually beneficial cooperation with partner institutions both from within and from abroad, especially those related to the development of FMIPA UNJ.

The Vision of Bachelor of Physics Education

To become an excellent study programme in physics education enriched with advanced information technology media-based learning environment through collaboration with various institutions at the Asian level.

B. Program Educational Objectives (PEO)

The Qualification Profile (QP) of bachelor's degree in Physics Education Study Program and its specifications is presented in the table below.

No	Qualification Profile	Specifications
1	Professional Educators	a. Physics professional educators with proficiency in Physics educational concepts and pedagogy, with expertise in have excellent skill in utilizing ICT in instructional design, during teaching and learning, as well as in learning evaluation , both in formal and non-formal institutions. b. Capable of pursuing higher education in the field of Physics Education and Physics.
2	Physics Research Assistant	a. Capable to conduct collaborative physics education research by studying physics literature and observing physics instruction using quantitative or qualitative approaches to solve problems, and are able to communicate or report the findings in written or oral scientific articles to support professional development. b. Capable to manage Laboratories and Educational Institutions, performing resource management, and comprehensive implementation of physics laboratory and educational institution activities.
3	Practitioners	Capable of applying their expertise as a practitioner in the field of physics education and to collaborate in solving problems in society

The PEO was developed based on vision and mission in developing graduates who are qualified as mathematics educators and researche assistant. The programme provides opportunities for graduates to be able to:

1. Have excellent pedagogical knowledge, with cognitive, interpersonal, and intrapersonal competencies and capable to solve problems in physics teaching and learning and its applications by utilizing ICT.
2. Master theoretical and practical physics concepts as well as pedagogical concepts in the field of physics education.
3. Work as an educator who is professional, qualified, competitive, and innovative in science and physics teaching and learning through mastery of theoretical concepts and practical applications, capable to analyse, research, and involve learning models with ICT-based learning tools that appropriate for physics and science education.
4. Pursue a higher level of education in Indonesia or abroad to develop science, technology, and expertise in physics education and its applications.
5. Have scientific knowledge, skills, entrepreneurship, sportsmanship honesty, and integrity to develop themselves in society as edutechnopreneur practitioners.

6. Have expertise as a research assistant in Physics Education with article published in national or international journals.

C. Program Learning Outcomes (PLO)

The Bachelor of Physics Education Study Programme provides students with the opportunity to acquire the necessary skills and knowledge outlined in advance. To ensure this, the Program Learning Outcome (PLO) has been developed as part of the curriculum. The process of formulating these learning outcomes adheres to established standards, as guided by various entities such as the Higher Education and Profession Association, KKNI, Accreditation Berau, and Association Profession of Study Program. The academic board of the faculty has verified this procedure, which involves input from both internal and external stakeholders, including academic staff, university and faculty supporters, alumni, students, and experts. The PLOs are divided into two categories: social competences and specialist competences. The learning outcomes of bachelor's degree of Physics Education Study Programme classified into two areas is presented in Table 1.15.

Table 1.15 The PLO of Bachelor of Physics Education Study Programme

Area	Code	Programme Learning Outcome
Social Competences	PLO 1	Demonstrate a professional attitude in work based on religious values, human values and culture.
	PLO 2	Demonstrate an attitude of critical thinking, innovative, collaborative and communicative in solving problems in the field of physics education
Specialist Competencies	PLO 3	Able to comprehend concepts in classical and mod-ern physics.
	PLO 4	Involve mathematical, computational, and measurement protocols in order to solve the physics problem.
	PLO 5	capable to implement pedagogical content knowledge technology (TPACK) in advancing, implementing and evaluating physics learning.
	PLO 6	Capable to utilize fundamental principle and applied physics, identify problem, discover alternative solutions based on theory and research, construct-ed and implemented in physics education research.
	PLO 7	Capable of conducting education, management of physics laboratory, and practicum in accordance with the HSE (Health Safety and Environment) principle.

	PLO 8	Capable to enhancing another related competence with applied physics.

The relevance between PLO and PEO of the Physics Education Study Programme is described in the matrix Figure 1.11.

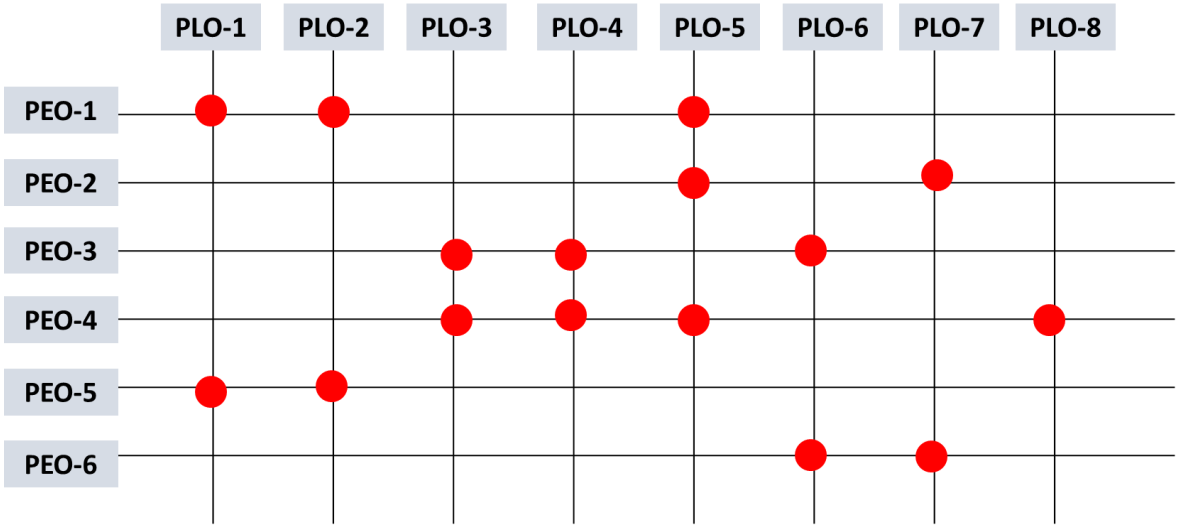

Figure 1.11 Matrix of Relationship between Programme Learning Outcomes (PLO) and Programme Educational Objective (PEO) of Physics Education Study Programme

The Subject-Specific Criteria (SSC) for Bachelor of Physics Education Study Pro-gramme graduates are stated in Table 1.16. https://fmipa.unj.ac.id/physicsedu-b/?page_id=18

Table 1.16 The SSC of Bachelor of Physics Education Study Programme

SSC (Subject-Specific Criteria)		
Spesialist Competences	SSC-1	They have sound knowledge of classical physics (mechanics, electrodynamics, thermodynamics, oscillations, waves and optics) and are familiar with the fundamentals of quantum, atomic and molecular, nuclear, elementary particle and solid state physics.
	SSC-2	They are familiar with important mathematical methods used in physics and can use these to solve physics problems.

	SSC-3	They have applied their knowledge to physics problems in an exemplary manner and studied some areas in greater depth, thereby acquiring a first basis for problem solving competence.
	SSC-4	They have a basic capacity to comprehend physics problems. This will in general however not yet facilitate a deeper understanding of current research areas.
	SSC-5	They are familiar with basic principles of experimentation, are able to use modern physics measurement methods, and are in a position to assess the significance of results correctly.
	SSC-6	They have generally also acquired an overview knowledge in selected other natural science subjects or technical disciplines.
Social Competences	SSC-7	They are able to apply their knowledge to different fields and act responsibly in their professional activity. They are moreover able to recognise new trends in their subject area and integrate the relevant methodology – if necessary after appropriate qualification – into their further work.
	SSC-8	They are able to continuously and independently extend and deepen the knowledge acquired in the Bachelor's degree programme. They are familiar with suitable learning strategies (lifelong learning) for this; they are in particular qualified for a consecutive Master's degree programme in principle.
	SSC-9	They are familiar with the basic elements of the relevant specialised English.
	SSC-10	They are able to solve a simple scientific problem and to present their results orally (talk/presentation) and in writing (demonstrated in a Bachelor's thesis).
	SSC-11	They know the rules of good scientific practice.

The relevance of PLO and SSC of the Physics Education Study Programme is presented in the matrix Figure 1.12.

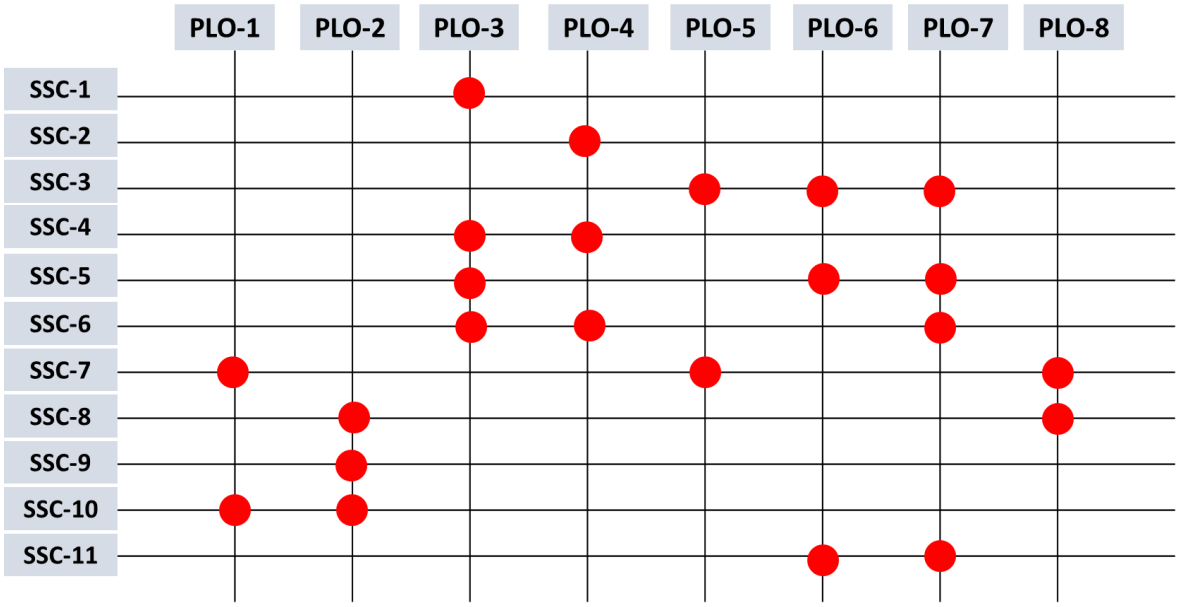

Figure 1.12 Matrix of Relationship between Programme Learning Outcomes (PLO) and Subject-Specific Criteria (SSC) of Physics Education Study Programme

D. Programme Structure

The curriculum structure of the Bachelor of Physics Education study program is designed in accordance with the Regulation of the President of the Republic of Indonesia (PPRI) No. 12 (2012) concerning Higher Education Standards Regulations (Permenristekdikti No. 44 (2015) and Permendikbud No. 3 (2020)) and the Indonesian National Qualifications Framework (KKNI), the National Standards of Higher Education, the Professional Associations of Study Programs, and the Consortiums in scientific fields. The designing of the curriculum also takes into account the orientation of future challenges and international accreditation as a reference. The courses in the Bachelor of Physics Education study programme consist of five groups, namely: University Courses, Study Program Compulsory Courses, Elective Courses, and MBKM (Freedom of Learning).

The courses that must be completed during a minimum study period of 8 (eight) semesters and a maximum of 14 (fourteen) semesters with 145 credit hours or 217.5 ECTS. In the final year, students conduct research as final thesis. The curriculum structure of Bachelor of PhysicsEducation study program consists of 4 (four) groups of courses:

1. University Courses which are general courses for all students in Universitas Negeri Jakarta.
2. Faculty Courses feature specific courses for Faculty of Mathematics and Natural Science.
3. Study Program Courses feature consist of Compulsory Courses and Elective Courses.
4. Pedagogy Courses

Table 1. Groups of Subjects and Workload of Curriculum of Bachelor of PhysicsEducation Study Programme

No	Types of Courses	Total (In Credits)	Total (In ECTS)
1	General Courses (MKU) /University Courses	14	21
2	Faculty Course	1	1,5
3	Pedagogical Courses *)	7	10,5
4	Compulsory Courses	94	141
5	Elective Course	9	13,5
6	MBKM *)	20	30
Total		**145**	**217.5**

Physics Education combines the principles of physics and education, merging their distinct characteristics to generate a specialized body of knowledge within the field. Consequently, the curriculum of this study program adopts a multidisciplinary, interdisciplinary, and transdisciplinary approach that incorporates both physics and education, along with their relevant areas of expertise. The Bachelor of Physics Education study program encompasses three core subject matters (SM), which are outlined in the table below.

Table 2. Subject Matter (SM) of Mathematics Education Programme

Code	Subject Matter	Descriptions	Course
SM1	General Knowledge of Science, Personality, Social and Culture, Leadership, and Entrepreneurship	The scope of study material includes the study of religion, Pancasila, civic education, social sciences, culture, languages, scientific philosophy, leadership, and entrepreneurship.	1. Indonesia Language 2. Education Overview 3. Pancasila 4. Olympism 5. Civic Education 6. Religion 7. Logic and Reasoning 8. Entrepreneurship
SM2	Classical and Modern Physics, Electronics and Instrumentation	The scope of the study material in theory and practice as well as measurement rules includes material for classical physics studies (mechanics, thermodynamics, electrodynamics, oscillations, waves, and optics) and modern physics studies (modern, quantum, atomic and molecular, atomic nuclei, and solids), complemented by	1. Classical Mechanics 2. Modern Physics 3. Modern Physics Practicum 4. Electronics 5. Electronics Practicum 6. Wave 7. Electricity and Magnetism 8. Quantum Physics 9. Thermodynamics 10. Introduction to Solid State Physics 11. Introduction to Nuclear Physics 12. Earth and space physics 13. Environmental Physics

		electronics studies and instrumentation.	Education 14. Statistical physics 15. Solid matter physics 16. Quantum mechanics 17. Electromagnetic field theory 18. Digital electronics 19. Digital electronics Practicum 20. Sensor technology
SM3	Elementary Science, Mathematics, and Computing	The scope of study materials in theory and simulation as well as practice includes study materials for basic physics, general chemistry, general biology, mathematical theorems of calculus, mathematical physics and algorithms, programming, and computational physics.	1. Basic Physic I 2. Basic Physic Practicum I 3. Basic Physics II 4. Basic Physics Practicum II 5. General Chemistry 6. General Biology 7. Introduction to Information Technology 8. Calculus I 9. Calculus II 10. Mathematical Physics I 11. Mathematical Physics II 12. Big Data and Programming 13. Computational Physics 14. Computational Physics Practicum
SM4	Physics Education and Learning Skills	The scope of the study material includes theoretical and practical studies in the basic fields and educational skills and learning Physics by utilizing science and technology.	1. Student Development 2. Learning theory and learning 3. Foundation of education 4. Curriculum analysis 5. Development of Physics Learning Media 6. Teaching Materials Development 7. Teaching Experience 8. Teaching skills 9. ICT-based learning of Physics 10. English for Teaching
SM5	Research, Evaluation and Scientific Development	The scope of study material includes research methodology including reports and publications using science and technology based on evaluation techniques and scientific development related to physics education.	1. Learning assessment 2. Science learning strategy 3. Science learning design 4. Special topics in school physics 5. Laboratory management 6. Environmental Studies in Physics Learning 7. Research Method for Education 8. Statistics for Research 9. Undergraduate Pre-Thesis Seminar 10. Undergraduate Thesis

The curriculum structure is based on course classification to achieve Program Learning Outcomes (PLO) of each study program. The structure and description of the courses can be seen in the module. Each course has a CLO which is used to measure PLO achievement.

Table 3. Curriculum structure mapping towards PLO of Mathematics Education Study Programme

Course Code	Course Name	CP	ECTS	PLO							
				1	2	3	4	5	6	7	8
Semester 1											
1	Basic Physics I	3	4.5			V					
2	Basic Physics Practicum I	1	1,5			V					
3	Calculus I	3	4.5				V				
4	General Chemistry	3	4.5			V					
5	Indonesian Language	2	3		V						
6	Education Overview	2	3	V							
7	Pancasila	2	3	V							
8	Introduction to Information Technology	2	3				V				
9	Olympism	1	1.5		V						
	Total CP	**19**	**27**								
Semester 2											
1	Basic Physics II	3	4.5			V					
2	Basic Physics Practicum II	1				V					
3	Calculus II	3	4.5				V				
4	General Biology	2	3			V					
5	Student Development	2	3					V			
6	Civic Education	2	3	V							
7	Religion	2	3	V							
8	Logic and Reasoning	2	3		V						
9	Science learning strategy	2	3					V			
	Total CP	**19**	**27**								
Semester 3											
1	Mathematical Physics I	4	6				V				
2	Electronics	4	6			V					

3	Electronics Practicum	1				V					
4	Classical Mechanics	4	6			V					
5	Modern Physics	3	4.5			V					
6	Modern Physics Practicum	1				V					
7	Big Data and Programing	2	3				V				
	Total CP	**19**	**27**								
Semester 4											
1	Mathematical Physics II	4	6				V				
2	Wave	4	6			V					
3	Electricity and Magnetism	4	6			V					
4	Computational Physics	3	4.5				V				
5	Computational Physics Practicum	1					V				
6	Foundation of education	3	4.5					V			
	Total CP	**19**	**27**								
Semester 5											
1	Quantum Physics	3	4.5				V				
2	Thermodynamics	3	4.5				V				
3	Introduction to Solid State Physics	3	4.5				V				
4	Learning assessment	2	3					V			
5	Curriculum analysis	2	3					V			
6	Development of Physics Learning Media	2	3					V			
7	Learning theory and learning	2	3					V			
8	Elective Course	2	3								
	Total CP	**19**	**27**								
Semester 6											
1	Research Method for Education	3	4.5						V		
2	Teaching skills	2	3					V			

3	Statistics for Research	3	4.5						V		
4	Introduction to Nuclear Physics	3	4.5			V					
5	English for Teaching	2	3	V							
6	Science learning design	2	3					V			
7	Teaching Materials Development	2	3					V			
8	Elective Course	2	3								
	Total CP	**19**	**28.5**								
Semester 7											
1	Teaching Experience	6						V	V	V	
2	Implementing Learning Media Development in Schools	4	6					V			V
3	Implementation of the development of teaching materials in schools	4	6					V			V
4	Implementation of instrument development in schools	4	6					V			V
5	Undergraduate Pre-Thesis Seminar	2					V		V	V	
	Total CP	**20**									
Semester 8											
1	Undergraduate Thesis	4		V	V	V	V	V	V	V	V
2	Elective Course	6	9								
	Total CP	**10**									
	TOTAL CREDITS	**145**									
Elective Courses											
1	Special topics in school physics	2	3					V			V

2	Laboratory management	2	3							V	V
3	ICT-based learning of Physics	2	3					V			V
4	Earth and space physics	2	3			V					V
5	Environmental Physics Education	2	3			V					V
6	Environmental Studies in Physics Learning	2	3					V			V
7	Entrepreneurship	2	3		V						V
8	Statistical physics	3	4.5			V					V
9	Solid matter physics	3	4.5			V					V
10	Quantum mechanics	3	4.5			V					V
11	Electromagnetic field theory	3	4.5			V					V
12	Digital electronics	3	4.5			V	V				V
13	Digital electronics Practicum	2				V	V				V
14	Sensor technology	2	3			V	V				V

Students of bachelor of Physics Education study program have opportunity to take obligatory andelective courses, besides Independent Learning Activities (Merdeka Belajar Kampus Merdeka).

E. Structure and Module

The Bachelor of Physics Education study program is composed of a total of 145 credit hours (SKS) in terms of its structure and course modules. Within the study program, there are 94 credit hours (SKS) dedicated to compulsory courses, which focus on developing general and fundamental competences for a Bachelor of Physics Education. Additionally, 7 credit hours (SKS) are allocated to general pedagogy courses. Elective courses are offered to students, providing them with the opportunity to choose 9 credit hours (SKS) worth of courses based on their interests. Moreover, the study program includes 20 credit hours (SKS) for MBKM (Community Service Learning) and 14 credit hours (SKS) for general courses. The elective courses are categorized into three interest groups: Physics, Physics Education, and Physics Learning Media.

The curriculum structure of the Bachelor of Physics Education study program is designed as a four-year program. In the first year, students focus on gaining foundational knowledge in mathematics, natural science, general courses, and basic philosophy of education, which amounts to a total of 40 credit hours (SKS) of courses. The second year centers around pedagogy courses, along with mathematics, totaling 42 credit hours (SKS). During the third year, students delve into Physics and pedagogy of Physics, taking courses worth 39 credit hours (SKS). The final year of study

encompasses 24 credit hours (SKS) and encompasses the MBKM program, thesis preparation, and elective courses that support the thesis.

The curriculum structure of the Physics Education study program is developed in accordance with national and university regulations, aiming to integrate Physics content knowledge with pedagogy. Each course within the curriculum is specifically designed to contribute towards achieving the Program Learning Outcomes (PLOs). The table below illustrates the alignment between the PLOs and the courses offered in the curriculum.

Table 4. Curriculum structure mapping towards PLO of Mathematics Education Study Programme

Course Code	Course Name	CP	ECTS	PLO							
				1	2	3	4	5	6	7	8
Semester 1											
1	Basic Physics I	3	4.5			V					
2	Basic Physics Practicum I	1	1,5			V					
3	Calculus I	3	4.5				V				
4	General Chemistry	3	4.5			V					
5	Indonesian Language	2	3		V						
6	Education Overview	2	3	V							
7	Pancasila	2	3	V							
8	Introduction to Information Technology	2	3				V				
9	Olympism	1	1.5		V						
	Total CP	**19**	**27**								
Semester 2											
1	Basic Physics II	3	4.5			V					
2	Basic Physics Practicum II	1				V					
3	Calculus II	3	4.5				V				
4	General Biology	2	3			V					
5	Student Development	2	3					V			

6	Civic Education	2	3	V							
7	Religion	2	3	V							
8	Logic and Reasoning	2	3		V						
9	Science learning strategy	2	3					V			
	Total CP	**19**	**27**								
Semester 3											
1	Mathematical Physics I	4	6				V				
2	Electronics	4	6			V					
3	Electronics Practicum	1				V					
4	Classical Mechanics	4	6			V					
5	Modern Physics	3	4.5			V					
6	Modern Physics Practicum	1				V					
7	Big Data and Programing	2	3				V				
	Total CP	**19**	**27**								
Semester 4											
1	Mathematical Physics II	4	6				V				
2	Wave	4	6			V					
3	Electricity and Magnetism	4	6			V					
4	Computational Physics	3	4.5				V				
5	Computational Physics Practicum	1					V				
6	Foundation of education	3	4.5					V			
	Total CP	**19**	**27**								
Semester 5											
1	Quantum Physics	3	4.5				V				
2	Thermodynamics	3	4.5				V				
3	Introduction to Solid State Physics	3	4.5				V				

4	Learning assessment	2	3					V			
5	Curriculum analysis	2	3					V			
6	Development of Physics Learning Media	2	3					V			
7	Learning theory and learning	2	3					V			
8	Elective Course	2	3								
	Total CP	**19**	**27**								
Semester 6											
1	Research Method for Education	3	4.5						V		
2	Teaching skills	2	3					V			
3	Statistics for Research	3	4.5						V		
4	Introduction to Nuclear Physics	3	4.5			V					
5	English for Teaching	2	3	V							
6	Science learning design	2	3					V			
7	Teaching Materials Development	2	3					V			
8	Elective Course	2	3								
	Total CP	**19**	**28.5**								
Semester 7											
1	Teaching Experience	6						V	V	V	
2	Implementing Learning Media Development in Schools	4	6					V			V
3	Implementation of the development of teaching materials in schools	4	6					V			V
4	Implementation of instrument development in schools	4	6					V			V

5	Undergraduate Pre-Thesis Seminar	2					V		V	V	
	Total CP	**20**									
Semester 8											
1	Undergraduate Thesis	4		V	V	V	V	V	V	V	V
2	Elective Course	6	9								
	Total CP	**10**									
	TOTAL CREDITS	**145**									
Elective Courses											
1	Special topics in school physics	2	3					V			V
2	Laboratory management	2	3							V	V
3	ICT-based learning of Physics	2	3					V			V
4	Earth and space physics	2	3			V					V
5	Environmental Physics Education	2	3			V					V
6	Environmental Studies in Physics Learning	2	3					V			V
7	Entrepreneurship	2	3		V						V
8	Statistical physics	3	4.5			V					V
9	Solid matter physics	3	4.5			V					V
10	Quantum mechanics	3	4.5			V					V
11	Electromagnetic field theory	3	4.5			V					V
12	Digital electronics	3	4.5			V	V				V
13	Digital electronics Practicum	2				V	V				V
14	Sensor technology	2	3			V	V				V

Course mapping based on courses and PLO in Bachelor of Physics Education Study Programme is described in the following figure.

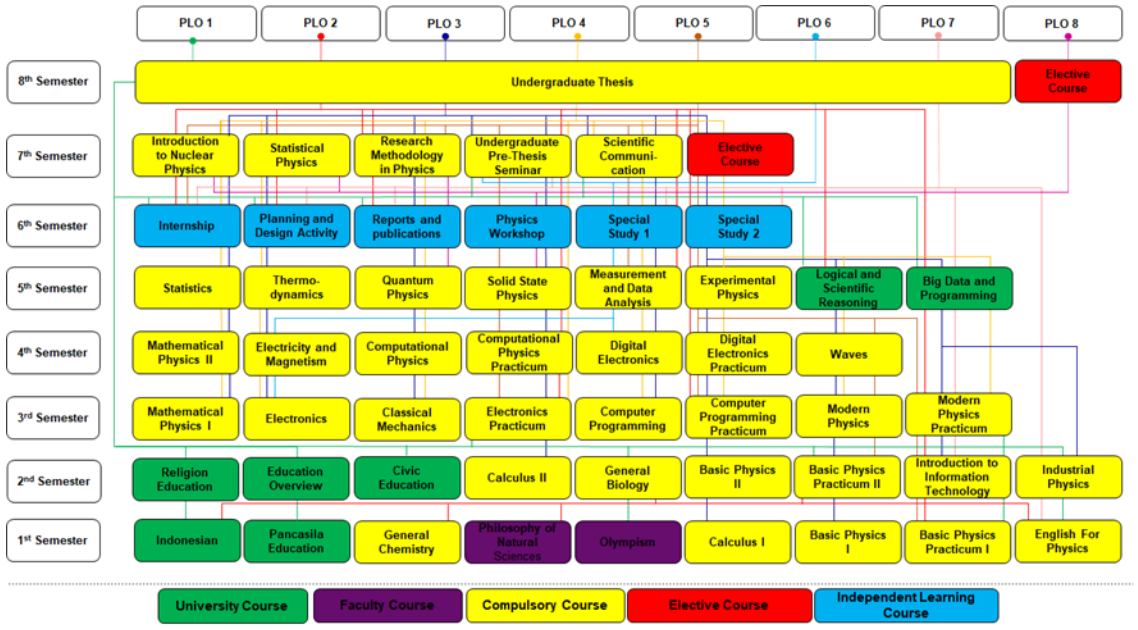

Figure 2. Course mapping based on Courses and PLO in Bachelor of Physics Education Study Programme